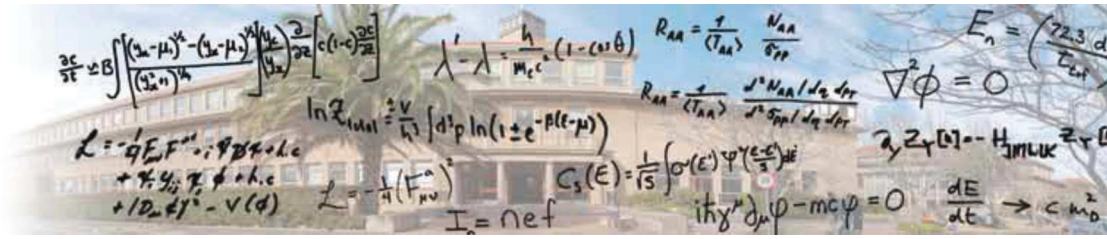
61st Annual Conference of the South African Institute of Physics

University of Cape Town

4 - 8 July 2016

DEPARTMENT OF
PHYSICS
UNIVERSITY OF CAPE TOWN



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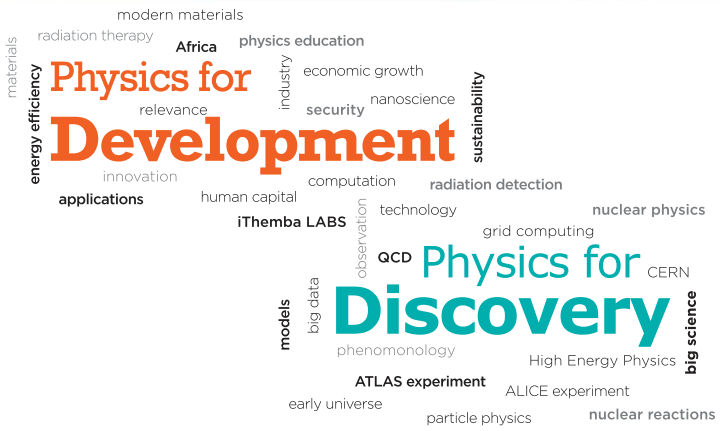
- Close ties with nearby iThemba LABS national facility for nuclear physics
- Innovative applied and industry-focused research
- Strong connections with the Department of Astronomy and the SKA project

A dynamic and beautiful location

- UCT Physics is located on the heritage site of UCT's upper campus
- Cape Town is a vibrant and beautiful city offering many lifestyle attractions



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General Information

Welcome to Cape Town and UCT.

Conference venue:
Kramer Law Building, middle campus, UCT.

Registration:
The registration desk is operated by UCT's Conference Management Centre and is located in the quad area on level 3 of the Kramer Building. It will be open between 08:00 and 17:00 on each day. The registration desk is the first port of call for all conference-related enquiries.

Name badges are to be worn at all times during the conference. Lost and found items are handled by the registration desk staff.

Accommodation at Baxter student residence:
Bedrooms will be available for occupancy from 14.00 on arrival day and all rooms must be vacated by 10.00 on departure day unless notification is received from or prior permission is given in writing by the conference management. Breakfast is served between 07:00 and 08:30, and dinner between 17:30 and 20:00. Lunch is served at the conference venue.

Wifi:
Eduroam should work fine. Delegates requiring alternative means to connect to the internet may collect their user names and passwords from the registration desk. Please use the following url to log on once you have received your log on details https://goo.gl/N1YfBJ. Delegates may add 3 devices to this username and password.

Opening cocktail function:
Monday 04 July, Kramer Law Building, 17:30.

Conference dinner:
Thursday 07 July, Jameson Hall, Upper Campus, 18:30. Please bring along your dinner ticket, which will be in your name badge pouch.

Emergency contact numbers:
Police: 10111
Ambulance: 10177
Cape Town International Airport: 021 937 1200

Language:
The official conference language is English.

Airport transfers and tours:
Marlyn at Kingdom Tours:
info@kingdomtt.co.za; +27 81 476 7159

Insurance:
The SAIP Conference and its representatives accepts no liability for any personal injury, loss or damage of property belonging to or additional expenses incurred by congress participants either during the conference or as result of delays, strikes or any other circumstances. Participants are requested to make their own arrangements with respect to health and travel insurance.

Security:
For those participants who have not previously visited South Africa, or Cape Town, and are concerned about personal safety, we wish to assure all visitors that Cape Town is like any other major city with areas with greater or reduced risk of crime. Common sense will ensure a trouble free and enjoyable congress and vacation.

The area around UCT and adjacent hotels is safe and well monitored at all times but we advise that you do not walk alone after dark in unpopulated streets. Ostentatious displays of wealth should be avoided at all times. During the conference, the information desk at the conference and your hotel's concierge will be able to assist you with information on places to visit and the appropriate means of transport.

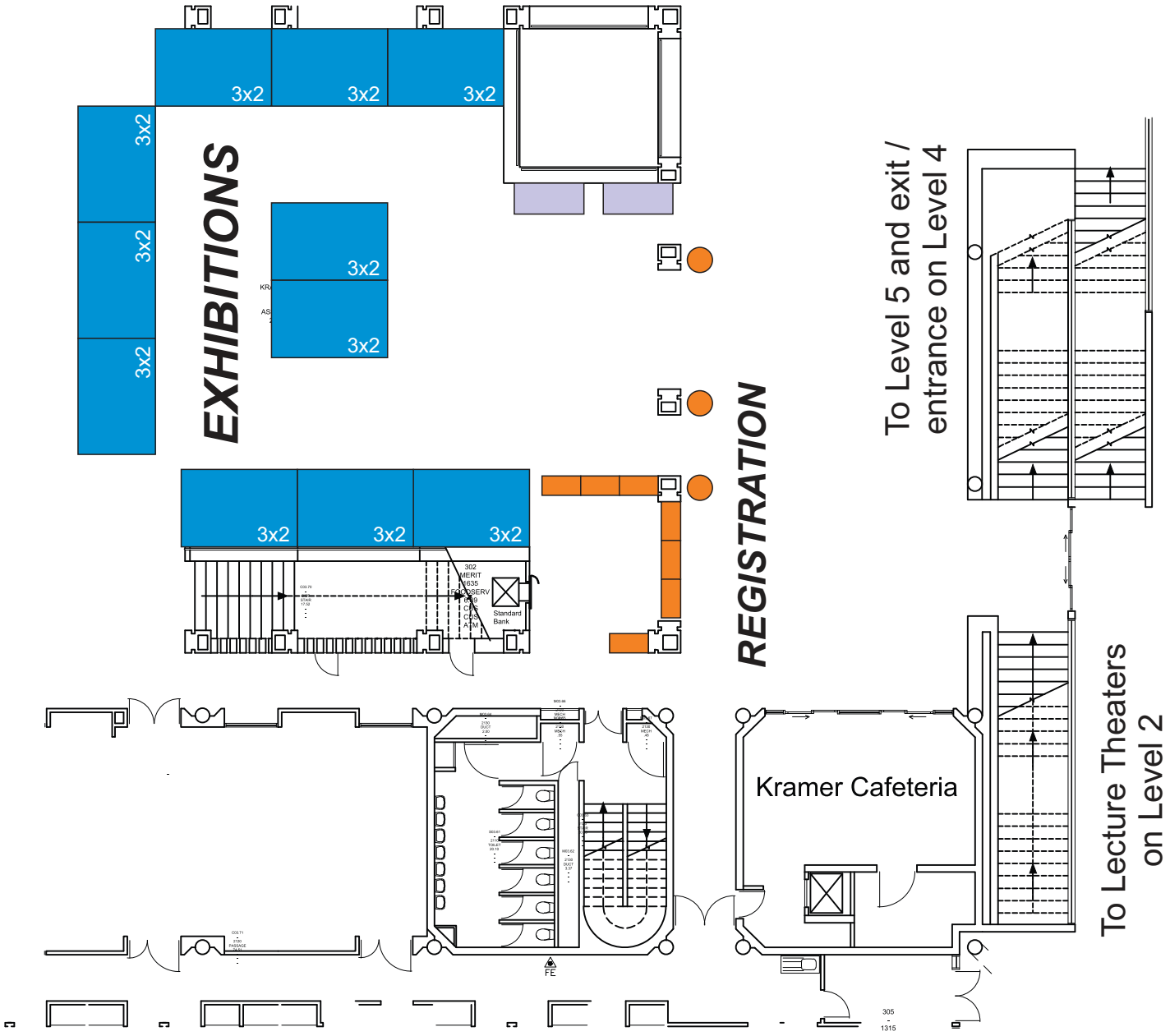
Weather:
Sunshine, rain, and overcast, wind: you'll experience it all during a good Capetonian winter. This is what the facts say: The average high temperature during winter is 17 degrees with a minimum temperature of 8 degrees in June, July and August. Rainfall in Cape Town is between 82 mm in August and 105 mm in June. Nevertheless all delegates will be supplied with a free umbrella!

Venue: Kramer Law Building

Conference Dinner: Jameson Hall

Floor plan and room allocation: Kramer Law

3rd floor layout



Division		Main Venue	Overflow (Date)
A: DPCMM		Kramer LT1	Kramer 4B (5, 8)
B: NPRP		Kramer LT3	Kramer 4A (5, 6, 7)
C: Photonics		Kramer 5C	-
D1: Astro		Kramer 5A	Kramer 4B (7)
D2: Space		Kramer 5B	-
E: Edu		Kramer 2B	-
F: Applied		Kramer LT2	Kramer 4B (6)
G: TCP		Kramer 2A	Kramer 4A (5)

DEPARTMENT OF PHYSICS
UNIVERSITY OF CAPE TOWN

PHYSICS BOWL 2016

THE PHYSICS QUIZ FOR FAST BUZZERS

61ST ANNUAL CONFERENCE OF THE SOUTH AFRICAN INSTITUTE OF PHYSICS (UCT, 4-8 JULY)

R8000 Cash Prize for the Winning Team

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Spirit Prize for the Team with the most Enthusiasm

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Date: Thursday, 7th July at 16:00

Theme: African Skies - Stories and Science

Rules:

- At most 1 team per university
- Teams must consist of 4 postgraduate students from the same university who are registered for the conference
- First 16 teams to apply guarantee themselves a spot in the physics bowl

To apply, send an email to **physicsbowl.uct@gmail.com** before **2nd July** with the names of the team members, team name and a team logo

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Guidelines

Guidelines for Speakers

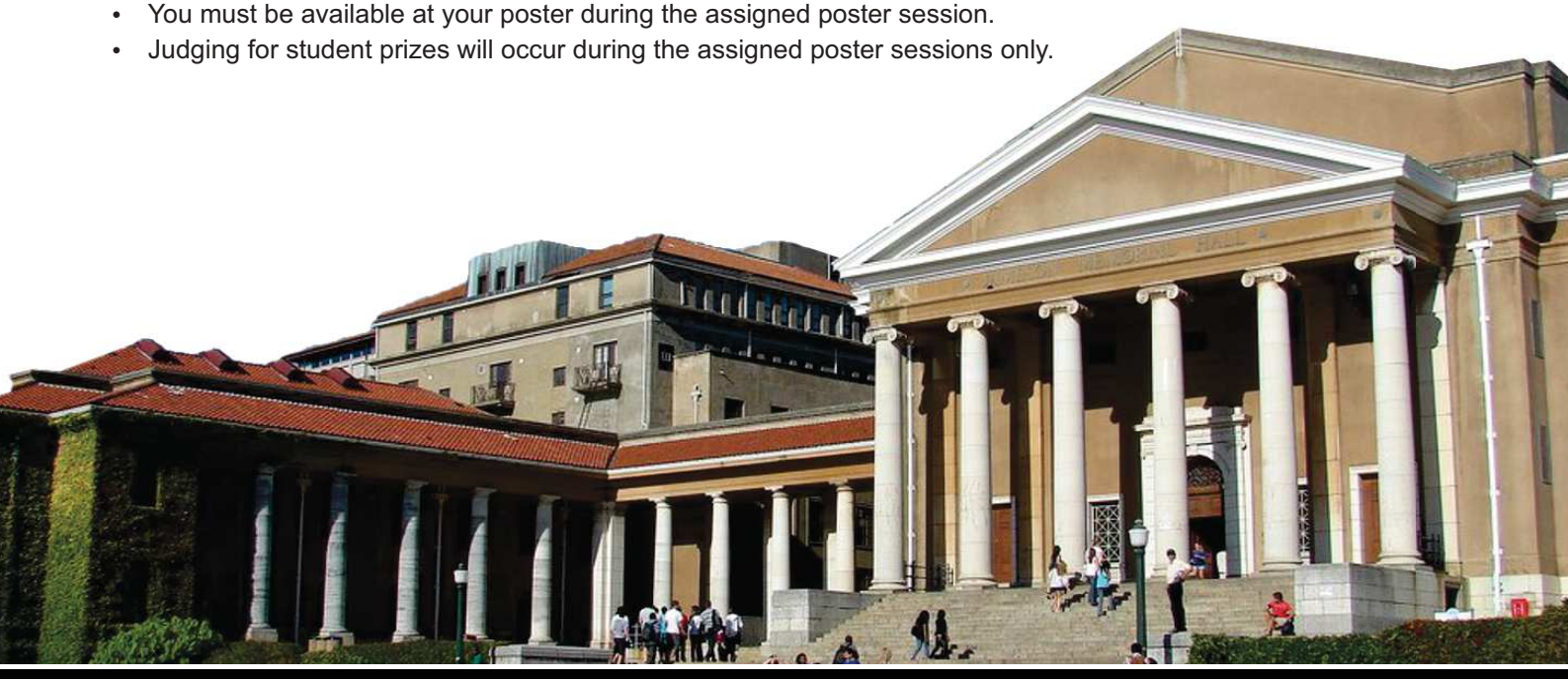
- Slots of length 20 minutes have been allocated for orals: 15 minutes for presentations and 5 minutes for questions.
- It is important to double check the date, time and venue for your presentation.
- Technicians will be available in each room to assist speakers on uploading their presentations. Please do this well before your session, such as the day before. Inform the technician if your presentation has sound or video clips.
- Be on time and report to the chair.
- Is your talk part of a group presentation? Are you a student competing for one of the prizes?
- You are not permitted to move your presentation to any other slot.
- Please respect the time-keeping of the chair.

Guidelines for Session Chairs

- Please keep to the scheduled times.
- Re-check the date, time and venue of your session.
- Please be on time, at least 5 minutes before your session starts.
- Consult with the session assistant in the venue (whether your presentations are on computer and how the microphone system works).
- Identify the speakers before your session starts.
- No alterations are to be made to the programme.
- Talks may not be moved earlier due to a speaker not showing up.
- Welcome delegates and speakers at the beginning of your session.
- Make the following announcements:
    - All cell phones are to be switched off.
    - The title and name of the speaker.
    - Whether it is a group presentation.
    - Whether the speaker is competing for an MSc or PhD prize.
- Allow questions according to time. Stay within the time slots. The last 5 minutes of each timeslot is for questions
- Thank all the speakers at the end of the session.
- Report problems to the session assistant.

Posters

- Posters should be displayed on the allocated board for the duration of the conference.
- Board assignments will be according to contribution number.
- If you present more than one poster, we'll try to place them on adjacent boards.
- You must be available at your poster during the assigned poster session.
- Judging for student prizes will occur during the assigned poster sessions only.



National Research Foundation | iThemba LABS Laboratory for Accelerator Based Sciences

CREATING OPPORTUNITIES

iThemba LABS is one of **seven** National Facilities administered by the National Research Foundation. The National Research Foundation (NRF) is an independent statutory body setup in accordance with the National Research Foundation Act. Its mandate is to support and promote research through funding, human resource development and the provision of necessary research facilities in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including indigenous knowledge, and thereby contribute to the improvement of the quality of life of all South Africans.

VISION

iThemba LABS aims to be the **leading** African organization for **research ,training** and **expertise** in accelerator-based science and technologies.

Research at iThemba LABS is undertaken in the fields of experimental **nuclear physics** (applied and fundamental) **materials research, radiation biophysics,** and the development of **particle accelerators.**

iThemba LABS **offers** postgraduate students **(Hons,MSc, PhD)** access to state-of-the-art **infrastructure** for data acquisition and data analysis, and **quality supervision.** Limited funding is available within the organization through a "Top-up-funding-scheme".

iThemba LABS is committed to address the skills shortage in the nuclear sector through its involvement in three **structured Master's programmes** (M'SONE, MANUS,MATSCI). These programmes are offered in partnership with the universities of **Johannesburg, Zululand** and the **Western Cape.**

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Andy Buffler (HoD Physics)
Patrick Woudt (HoD Astronomy)
Steve Peterson (Proceedings)
Sahal Yacoob (Proceedings)
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South African Institute of Physics:

Brian Masara (Executive Officer)
Roelf Botha (Online systems, programme book)
Juan Grey (Online systems, timetable)
Deena Naidoo

Abbreviations

CERN	- European Organization for Nuclear Research
CSIR	- Council for Scientific and Industrial Research
DUT	- Durban University of Technology
FHIT	- Fort Hare Institute of Technology
HartRAO	- Hartebeesthoek Radio Astronomy Observation
LRI	- Laser Research Institute
NECSA	- Nuclear Energy Corporation of South Africa
NITheP	- National Institute for Theoretical Physics
NLC	- National Laser Centre
NMISA	- National Metrology Institute of South Africa
NMMU	- Nelson Mandela Metropolitan University
NWU	- North West University
RU	- Rhodes University
SAAO	- South African Astronomical Observatory
SANSA	- South African National Space Agency
SKA	- Square kilometre Array
SU	- Stellenbosch University
TUT	- Tshwane University of Technology
UCT	- University of Cape Town
UFH	- University of the Free State
UJ	- University of Johannesburg
UKZN	- University of KwaZulu-Natal
UL	- University of Limpopo
UNISA	- University of South Africa
UniVen	- University of Venda
UP	- University of Pretoria
UWC	- University of Western Cape
UNIZULU	- University of Zululand
WiPiSA	- Women in Physics in South Africa
Wits	- University of the Witwatersrand
WSU	- Walter Sisulu University

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NRF National Research Foundation

Message from the President of the South African Institute of Physics

It is my pleasure to welcome you all to the 61st Annual Conference of the South African Institute of Physics jointly hosted by the Departments of Astronomy and Physics at the University of Cape Town. The conference takes place during the period 4-8 July 2016 in the City of Cape Town. The conference will be preceded by two Winter Schools running on Monday, 4th July 2016. The two Winter Schools this year are Our Evolving Universe: From the Smallest to the Largest Scales and The Biophysics of Cells and Molecules.

The SAIP annual conference is attended by a substantial number of delegates including physicists, scientists, and journalists from South Africa and abroad. It offers valuable opportunities for presenting research, sharing of key ideas and insights, networking, related workshops and activities for scientific discussion, professional development, critical reflection on innovative interventions aimed at the improvement of the quality of education as well as science advocacy.

As a major highlight, the 2016 SAIP Annual Conference will feature a Teacher Workshop as part of its activities. In a historic new development, this will be the first occasion where a significant teacher programme has been planned which will have joint sessions and its own parallel sessions in the SAIP Annual Conference programme. This is truly a landmark development and coincides with the SAIP having identified both basic training and undergraduate training as the most important areas of its current focus. The workshop scheduled for 4th – 6th July would be facilitated by renowned local and international presenters. Let me take this opportunity to welcome the educators to the physics family and to this conference. Please use this opportunity to engage with other teachers, students and senior physicists.

SAIP has embarked on a journey to augment its membership which will include categories for school learners and teachers. Together with marketing and outreach initiatives, this undertaking will enable SAIP to attract and nurture future generation of physicists and scientists.

I also extend a warm welcome to our students. You are the future voices of physics! Please make use of this opportunity to engage and network with other students and senior scholars. A special welcome to the invited guests and distinguished plenary speakers. Your presence is an embodiment of scientific solidarity and a special gift to students, teachers and researchers in many ways. I sincerely implore you to engage and share your scientific expertise with the students and emerging researchers.

I would like to express sincere gratitude to the UCT local organising team led by Prof Roger Fearick for putting appropriate systems in place to make the conference a tremendous success. In addition, I would like to wish the proceedings editorial team all the best as it embarks on an extremely important task of getting the conference proceedings published. The broader physics community is once again urged to play a key role during the manuscript review process to ensure timeous publication of conference proceedings. Sincere thanks are indeed extended to Mr Brian Masara, SAIP Executive Officer, and his team for their unwavering commitment towards sustainable development and management of SAIP flagship projects.

I would like to invite all SAIP members to our Annual General Meeting on Thursday 7 July 2016 as outlined in the conference programme. I am looking forward to a fruitful conference in the beautiful city.

Professor AZWINNDINI MURONGA
President: South African Institute of Physics

MSc in Data Science

The Science Faculty at UCT will offer an interdisciplinary degree in Data Science form 2017. Participating departments are Statistical Sciences, Computer Science, Astronomy, Physics, and the Computational Biology group (Health Sciences faculty).

The degree is aimed as students

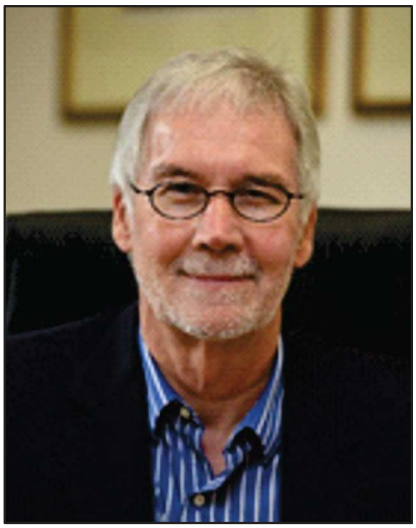
- who hold a good honours degree;
- who do not have advanced background in Statistics and Computer Science;
- who have been exposed to mathematics and computing during their undergraduate studies.

Students will learn the statistical and computing skills required to deal with Big Data from Astronomy, Physics, Medicine, and Commerce.

Structure: One year course work (90 credits) followed by a dissertation (90 credits)

Visit : http://www.stats.uct.ac.za/stats/study/postgrad/masters or e-mail celene.jansen-fielies@uct.ac.za.

Welcome from the DVC for Research



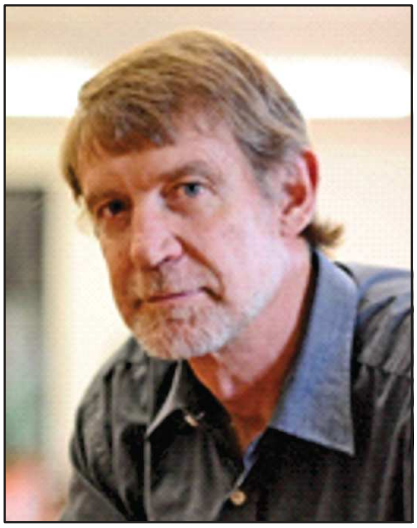
The University of Cape Town is delighted to welcome you to the Annual Meeting of the South African Institute of Physics. UCT's research strategy (2015-2025) places great emphasis on the transformative power of research. This of course commits us to research that has obvious and immediate application and social impact, particularly where it is pertinent to our continent, such as research towards eliminating poverty or eradicating malaria. However, we do not underestimate, and remain committed to, the power of fundamental research.

The work of physicist Alan Cormack demonstrates how important this is – his theoretical calculations tested on a hand-held calculator in the early 1960s generated little interest (he himself said, once his papers were published, that he was now 'leaving it to the engineers') until they were turned into a real application – the building of the first CT scanner in the early 1970s, a breakthrough in medicine that led to his winning a Nobel Prize in 1979.

Cormack is just one of the reasons we at UCT are proud of the legacy of our Department of Physics and Department of Astronomy, and why South Africans can hold their heads high in the international world of physics. But we cannot rest here. While a student, and later as a lecturer, Alan Cormack was mentored by RW James, then head of physics at UCT and now legendary for having nurtured two Nobel laureates (the other was Aaron Klug). This early act of extraordinary capacity building is something we, as South Africans, must strive to repeat. Our close involvement in some of the world's greatest challenges in physics, such as being explored at CERN and the SKA, give us an opportunity to generate the next generation of laureates. We look forward to see the SAIP continue to take up this challenge.

Professor DANIE VISSER
Deputy Vice Chancellor: Research and Internationalisation

Welcome from the Dean of Science



It is my great pleasure to welcome you to the fairest Cape and the University of Cape Town to attend the 61st Annual Conference of the South African Institute of Physics, jointly hosted by our Departments of Physics and Astronomy. The importance of physics in the modern era cannot be over-emphasised with the increasing recognition that many of the fundamental questions scientists are addressing today, across a range of disciplines, rely heavily on physics in one form or another.

Two such examples are CERN and the forth-coming SKA experiment, both of which have active involvement from our staff in the Departments of Physics and Astronomy, and the newly created inter-institutional Institute for Data Intensive Astrophysics (IDIA). The Faculty of Science at UCT has recently developed a research strategy where we plan to focus on 6 impact areas that draw on our geographic advantage. One of these areas links directly to one of the foci of this conference, viz. “the Southern Skies and the Evolving Universe”.

This same theme serves as the topic of one of the conference Winter Schools this year. Through hosting this conference we hope to bring together the high energy physics being explored at CERN with the radio astronomy of SKA path-finder MeerKAT experiment, with cross fertilisation into to the exciting sessions on Physics of Condensed Matter and Materials; Nuclear, Particle and Radiation Physics; Photonics and Physics Education.

I wish you all a memorable conference, some robust debates, and future interdisciplinary collaborations sealed over a glass of red wine.

Professor ANTON LE ROEX
Dean: Faculty of Science

Welcome from the HoD of Physics

The Department of Physics at UCT welcomes you to this year's conference of the South African Institute of Physics, organised together with our Astronomy neighbours at UCT. I hope that you will enjoy your week in Cape Town and that you won't need to use your conference umbrella too often. This year's conference features a number of innovations. One of these is the scaling-up to national level of our “fastest-finger-first” Physics Bowl general (physics) knowledge competition, which has been a departmental-level event for a number of years and this year invites teams from across the country. We have also partnered this year with the National Metrology Institute of South Africa to feature a metrology-themed day in the Applied Physics division.

These past years have been an exciting time of growth for UCT Physics. The Department of Physics now participates in two experiments at CERN, ATLAS and ALICE, and is home to a strong group of high energy physics theorists. The SA-CERN programme allows our staff faculty and postgraduate students participating in either theory or experiment to make frequent trips to CERN to conduct their research and collaborate with the large number of colleagues from around the world. The Square Kilometre Array radio astronomy project provides interesting opportunities to link radio astronomy, cosmology and particle physics, all of which constitute strong research programmes at UCT, and thus featured as the topic of this year's Winter School.

The Physics Department also supports research programs in experimental nuclear and materials physics. Our department benefits greatly from the facilities of iThemba LABS (national laboratory) which is located 30 km from UCT and where there is located a range of accelerator-based activities, mainly centred on the 200 MeV cyclotron which provides beams for fundamental, applied and medical research. One of our main interests is in the use of fast neutron beams for physics and applications, and the fast neutron facility at iThemba LABS is on the brink of being recognised as metrological standard.

The department also operates a positron emission particle tracking laboratory at iThemba LABS where medical PET scanners are used to study systems of flow, with particular interest in the minerals industries. Solid state physics research in the department is led by the Nanoelectronics Research Laboratory which features an 8 mK closed-loop liquid helium refrigerator (which is officially the coldest place in Africa), providing opportunities for fundamental nano-scale research and materials applications. The department also features research in physics education at university-level, which often supports the teaching programmes in the department.

A conference is always about its participants and I hope that we would have put in place the sort of environment that will maximise opportunities for positive interactions throughout the week.

Professor ANDY BUFFLER
Head of Department: Physics

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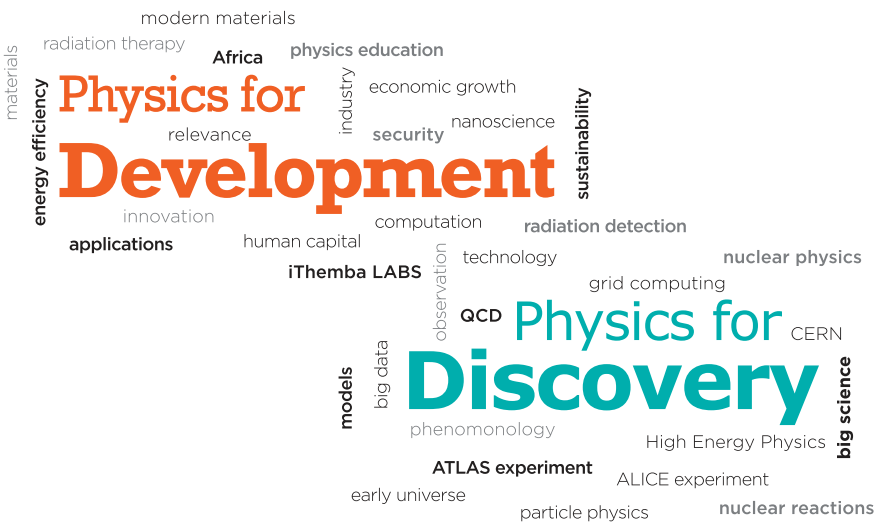

Welcome from the HoD of Astronomy

On behalf of UCT's Department of Astronomy, the co-host of the 61st South African Institute of Physics conference, it is my distinct pleasure to welcome the South African Physics community to the University of Cape Town.

This year is promising to be a great year for South African astronomy with the first array release of MeerKAT scheduled for July 2016. The commissioning of the first 16 MeerKAT antennas - one-quarter of the full MeerKAT array - marks the first stage of the mid-frequency component of the Square Kilometre Array, and ushers in a new era for South African astronomy.

The Department of Astronomy at UCT has a long history in astrophysics in South Africa. The department was established in 1972 and has, over the past 44 years, held a position at the international forefront of research in compact binary astrophysics and the study of large-scale structures in the Universe. The Department of Astronomy has close ties (and joint positions) with the South African Astronomical Observatory and the SKA South Africa project. In the SALT and MeerKAT era, the Department of Astronomy has grown substantially and our research focus has expanded to face the challenges of the phenomenal data rates in modern astrophysics, brought about by the SKA and the Large Synoptic Survey Telescope (LSST). In this regard, I would like to highlight the newly formed Inter-University Institute for Data-Intensive Astronomy (IDIA) - an exciting new partnership between the University of Cape Town, the University of the Western Cape, North-West University and the University of Pretoria. Our involvement in SKA science is best illustrated by four MeerKAT large legacy survey projects which are led by academics from UCT Astronomy.

This year's annual conference of the South African Institute of Physics is brought to you jointly by the Department of Physics and the Department of Astronomy at UCT. In the spirit of this joint organisation, we have put together an exciting winter school on “Our Evolving Universe: From the Smallest to the Largest Scales”, where CERN meets the SKA and the LSST. I am particularly delighted that we can welcome the Director of the LSST, Prof Steve Kahn, as one of our many distinguished visitors this week.

I would like to thank our Physics colleagues at UCT for their hard and relentless work in putting together a very exciting program, and highlight in particular the incredible work done by the chair of the organising committee, Roger Fearick, in collaboration with Ange Bukasa (UCT's Conference Management Centre) and the office of the SAIP.

SAIP2016 promises to be a fantastic week of science, celebrating the research highlights of the South African Physics community, and, as always, featuring the next generation of researchers. I wish everyone a most enjoyable and very successful conference.

Professor PATRICK WOUDT
Head of Department: Astronomy

DEPARTMENT OF ASTRONOMY

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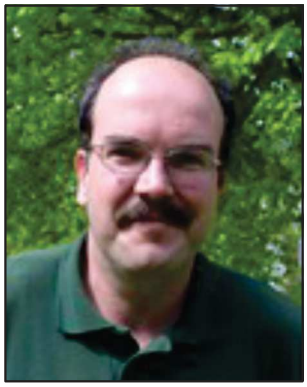
Invited Plenary Speakers



Prof. Dr. Kai Zuber
Technische Universität
Dresden, Germany

BIOGRAPHY:

- 1990 Diploma degree at University of Heidelberg working on the solar neutrino experiment GALLEX
- 1992 PhD degree at University of Heidelberg working on the Heidelberg-Moscow double beta decay experiment
- 1993-1996 Postdoc at University of Heidelberg working in the H1 experiment at HERA (DESY)
- 1996-2002 Postdoc at University of Dortmund working on the NOMAD and HARP experiment at CERN
- 2002-2005 Heisenberg Fellowship of the German Research Society (DFG) performed at Oxford University working on SNO and HARP
- 2005-2008 Senior lecturer/reader at University of Sussex working on SNO and COBRA
- Since June 2008 : Head of the Nuclear Physics Department at TU Dresden working on COBRA, GERDA, SNO+, Borexino, COMET

BOOKS:

H.V. Klapdor-Kleingrothaus, K.Zuber: Particle Astrophysics (in german, english, russian) 1997
K. Zuber: Neutrino physics, IOP Publ. 2004

ABSTRACT

PLENARY : NEUTRINOS - THE X-FILES OF PARTICLE PHYSICS
Tuesday 05 July 2016 (9:00 to 10:00)

ABSTRACT
The neutrino is a very special candidate of all fundamental particles as it barely interacts with matter and is very hard to detect. Over the last decades experimental methods were developed which allows to detect neutrinos on a level that physical properties can be studied in detail. After some historical introduction the talk will focus on the status of direct neutrino mass searches and neutrino oscillations, whose observation proved that neutrinos have a non-vanishing rest mass.

These results were awarded with the Nobel price in Physics 2015. A brief view on geo- and astrophysical neutrinos will be given.

Prof. Pauline Gagnon
CERN

BIOGRAPHY:

Pauline Gagnon was born in Chicoutimi in Quebec, Canada in 1955. After teaching physics for a few years in local colleges, she moved to California, where, she first studied at San Francisco State University then completed a PhD in particle physics at University of California in Santa Cruz in 1993.

She then started her research activities at CERN, the European Laboratory for Particle Physics located near Geneva, with Carleton University then became Senior Research Scientist at Indiana University until she retired in 2016. Within the ATLAS Collaboration, she searched for dark matter in the decays of the Higgs boson and for hypothetical dark photons.

From 2011 until 2014, she worked within the CERN Communication group, writing blogs for the Quantum Diaries and answering questions from numerous media worldwide. Explaining particle physics in simple and accessible terms has become her trademark. Since 2013, she has given more than sixty presentations to large audiences in seven countries. She wrote a popular science book on particle physics: Who Cares about Particle Physics: Making Sense of the Higgs boson, the LHC and CERN in the hope to reach even larger audiences since particle physics is too much fun to leave it only to physicists!

ABSTRACT

PLENARY : WOMEN AND DIVERSITY IN PHYSICS
Tuesday 05 July 2016 (12:10 to 13:10)

ABSTRACT
Why is there so little diversity in physics? I will examine the situation at CERN, the European Laboratory for Particle Physics as well as use data from a large international study. While CERN is becoming a truly international laboratory where people of 102 nationalities conduct research, 80% of its scientists are still white males.

I examine why this is so by reviewing many contributing factors and suggest easily applicable measures that could greatly improve the situation. These measures would make the field more welcoming to all people and benefit all scientists, regardless of their gender, race, sexual orientation, physical ability or religion. Science can greatly benefit from more diversity since it translates into increased creativity potential, the key ingredient to scientific progress.

Dr. Wynand Louw
Research, International and Infrastructure Development, NMISA

BIOGRAPHY:
Wynand Louw has been involved in accurate measurement since 1986 when he started his post - graduate studies in Solid State Physics at the University of the (then) Orange Free State. After obtaining his PhD from UFS working at the Council for Scientific and Industrial Research on orthodontal implant surfaces for better osseointegration into bone and being involved in projects on nuclear technologies, petrochemicals, ultra-hard materials, photovoltaics, fuel cells and aerospace materials, he became the manager of the Surface and Structure Analytical Surfaces (SSAS) of CSIR. In 1998 SSAS was moved to the CSIR National Metrology Laboratory. In 2000 he became the manager of metrology in chemistry, in 2002 the general manager of CSIR NML and in 2006 when the NML was established as the NMISA, was appointed by the parliament of South Africa as the Acting CEO of the NMISA. In 2011 with the appointment of a CEO he became the Director of Metrology and later Research, International and Infrastructure Development, the position he holds today.
Wynand was instrumental in the establishment of the Intra-Africa Metrology System (AFRIMETS) with 44 member countries and was the inaugural chair from 2007 to 2011. He represented NMISA at the Consultative Committee for Amount of Substance (CCQM) of the International Committee for Weights and Measures (CIPM) from 1999 to 2012 where he was a founder member of the Surface Analysis Working Group. He is a member of the Joint Committee for Regional Metrology Organisations and the BIPM and was the Chair of the Cooperation on International Traceability in Analytical Chemistry (CITAC) from 2008 to 2011. In 2013 he became the first South African (and African) scientist to be elected to the CIPM by the General Conference on Weights and Measures. In 2014 he was elected as the President of the Consultative Committee for Ionising Radiation, thus coordinating scientific activities in ionising radiation worldwide. In this capacity he is also a guest attendee of the Consultative Committee for Units, the CCU.

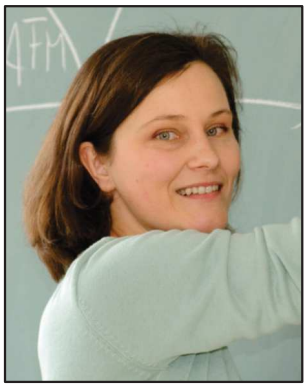
PLENARY : THE SI REDEFINED: COUNTING ATOMS, SINGLE-ELECTRON TUNNELLING AND OPTICAL ATOMIC CLOCKS

Wednesday 06 July 2016 (8:40 to 9:40)

ABSTRACT

ABSTRACT
The International System of Units is undergoing a redefinition where fundamental constants are to serve as the defining reference values for all seven base units and for all derived units in the future. In 2018, the kilogram, ampere, mole and kelvin will be redefined with the others to follow. This opened exciting new research and application opportunities for metrologists: counting atoms for the kilogram and mole, single-electron tunnelling for the ampere, dielectric constant gas thermometry for the kelvin, etc.

What research have been conducted, are in progress or are planned internationally and in South Africa for the redefinition, the realisation of the units and its implementation? Find out what the Watt balance, Avogadro, Frequency Comb and Quantum Hall projects at the NMISA entail and how the traceability chain will be shortened for Africa.



Prof. Silke Bühler-Paschen
Vienna University of Technology, Vienna

BIOGRAPHY:
Silke Bühler-Paschen is an experimental condensed matter physicist, working on strongly correlated electron systems and thermoelectrics. She graduated in physics from Graz University of Technology in 1992, with an external diploma work at the Paul Scherrer Institute in Switzerland. After her PhD studies at École Polytechnique Fédérale de Lausanne, Switzerland and a postdoctoral stay at ETH Zurich she moved to Germany, where she joined the Max Planck Institute for Chemical Physics of Solids in Dresden, first as scientific collaborator and then as associate professor.

After a visiting professorship at the Nagoya University in Japan she was appointed full professor at the Vienna University of Technology in Austria where she has served for eight years as Head of the Institute for Solid State Physics. She received a C3 professorship from the Excellence Program of the Max Planck Society for the Advancement of Outstanding Female Scientist in 2003 and an ERC Advanced Grant from the European Research Council in 2008. She is APS fellow and leader of various national and international research projects. Her team is active in materials synthesis and characterization, using a large pool of different physical property measurements under multiple extreme conditions spanning, for instance, seven orders of magnitude in temperature. Topics of current interest include quantum criticality, heavy fermion systems, Kondo insulators, and thermoelectric clathrates. She has a broad international collaboration network of experimentalists and theorists.

PLENARY : NEW TRENDS IN STRONGLY CORRELATED MATERIALS

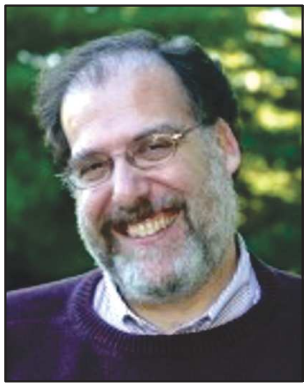
Wednesday 06 July 2016 (12:10 to 13:10)

ABSTRACT

ABSTRACT
Strongly correlated particles do not move independently of each other because their interaction energy is of the same order of magnitude as their kinetic energy. How can we detect and quantify correlations in condensed matter systems and what are their effects?

In my presentation I will highlight several cases where correlations have particularly drastic consequences: quantum critical materials where at the brink of electron localization superconductivity emerges, topological Kondo insulators where correlations might lead to the stabilization of massless Dirac fermions, and new thermoelectrics where the heat flow is suppressed by strong correlations among phonons. I will also discuss the formidable challenges that correlated materials put to experimentalists and theorists, and the potential rewards for all of us.

Invited Plenary Speakers



Prof. Steven M. Kahn
Stanford University,
California, USA

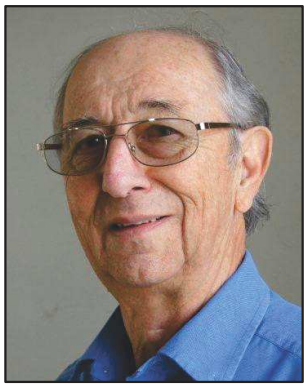
BIOGRAPHY:
Professor Kahn is the Director of the Large Synoptic Survey Telescope (LSST), a large-aperture wide-field telescope now under development to survey half the sky every few nights. As Director he oversees all aspects of the project construction, as well as the interactions with both federal funding agencies, and with the external scientific community. LSST will detect over three billion galaxies, providing detailed measurements of their red shifts, shapes, and properties. Through a technique called weak gravitational lensing, these data can be used to map out the structure of dark matter in the universe, and how that structure has evolved with cosmic time. The results will provide very sensitive constraints on the nature of dark matter and dark energy. LSST also provides crucial data on the structure of the outer regions of the Milky Way, makes a census of moving objects in the solar system, and discovers transient phenomena in the universe on a wide range of timescales.
Kahn did his undergraduate work at Columbia College and graduated summa cum laude in 1975. He received his Ph.D. in physics from UC Berkeley in 1980.He was a post-doctoral research fellow at the Harvard-Smithsonian Center for Astrophysics in 1980-82. Kahn has previously served as the Associate Laboratory Director of SLAC National Accelerator Laboratory. He has also been the Chair of the Physics Department at Stanford and Columbia Universities, and the Director, Deputy Director, or Associate Director of major interdisciplinary research laboratories at three universities; the Kavli Institute for Particle Astrophysics and Cosmology at Stanford, the Columbia Astrophysics Laboratory at Columbia, and the Space Sciences Laboratory at Berkeley. He has made significant contributions to X-ray astronomy, specifically with respect to high resolution X-ray spectroscopy of cosmic sources. He was the US Principal Investigator for the development of the Reflection Grating Spectrometer, which is currently flying on the European Space Agency's XMM-Newton Observatory. Kahn is a Fellow of the American Physical Society, the American Association for the Advancement of Science, and the American Academy of Arts and Sciences.

ABSTRACT

PLENARY : PROBING THE MYSTERY OF DARK ENERGY WITH BILLIONS OF GALAXIES

Thursday 07 July 2016 (8:40 to 9:40)

ABSTRACT
The discovery in the late 90's that the universal expansion is accelerating, rather than decelerating, has had a profound effect on modern physics. One possible explanation for that phenomenon is that the entire vacuum of space is filled with a mysterious energy field with negative pressure, the so-called 'dark energy'. However, the value of the implied energy density is nearly 120 orders of magnitude smaller than what would be naively expected from quantum field theories. So this remains one of the most pressing problems in physics. The only clear means we have of probing this problem experimentally is to make increasingly precise measurements of the expansion history of the universe itself. In recent years, a variety of distinct methods have been developed for that purpose, all of which involve measuring subtle statistical properties of the distribution and characteristics of large numbers of galaxies.
I will describe these techniques, and introduce the Large Synoptic Survey Telescope (LSST), which is currently under construction. LSST is a large-aperture, wide-field ground-based telescope designed to make an imaging survey of the entire southern hemisphere every few nights. Over ten years of operations, LSST will acquire roughly 1,000 distinct images of every part of the southern sky. Nearly 20 billion galaxies will be detected, yielding a very rich sample for cosmological investigations that will provide extremely tight constraints on the nature of dark energy.



Prof. Manfred Hellberg
University of KwaZulu-Natal

BIOGRAPHY:
Manfred Hellberg is an Emeritus Professor at UKZN. After his BSc (Hons) at UCT (1959), his PhD in theoretical plasma physics from Cambridge University (1965) centred on one of the first computer simulation studies, using facilities at Culham, the UKAEA fusion research laboratory. Following a Culham Research Associateship he joined the University of Natal (Durban), from which he formally retired in 2003, after spells as HoD, Dean and Pro Vice-Chancellor. He has spent sabbatical leaves in Princeton, Garching, Stockholm, Austin, Ghent, Bochum, and Sydney. After his initial computer modelling, he switched to fusion-related diffusion studies, before shifting his interests to waves in plasmas.

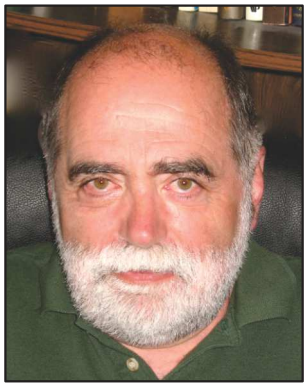
In the 1990's he embarked on two research themes: kinetic theory of the effects of excess superthermal particles on waves in space-related plasmas, and multi-fluid modelling of nonlinear electrostatic structures (solitons and double layers) in multi-component plasmas. Since retirement he has actively continued his research in these two areas, as well as teaching a NASSP module. Hellberg is a Fellow of the UK Institute of Physics, the SAIP and the Royal Society of SA, member of ASSAf and a Humboldt Research Fellow. He was on the IUPAP International Plasma Physics Commission (1987-96; Secretary 1993-6) and on numerous international conference committees, convened the DST-NRF-SAIP International Panel, "Shaping the Future of Physics in SA", in 2004 and headed the DST Astronomy Desk in 2010-11. He served as President of SAIP and on Advisory Boards of the National Astronomical Facilities and the National Laser Centre. Hellberg was awarded the SAIP De Beers Gold Medal in 2014.

ABSTRACT

PLENARY : FIRE, FLARES AND FUSION: SOME WANDERINGS IN PLASMALAND

Thursday 07 July 2016 (12:10 to 13:10)

ABSTRACT
A plasma is a quasineutral ionized gas whose dynamical behaviour is materially affected by the charged nature of its constituent elements. The so-called fourth state of matter is ubiquitous in the natural universe, although it does not occur commonly on Earth at room temperature. In the first part of the talk we shall give a historical overview of the study of plasmas, both natural and artificially produced. Early fundamental scientific investigations were linked to industrial applications. Plasma studies also developed in the context of trying to understand near-Earth space phenomena. Finally, large-scale developments occurred with the dream of obtaining power from nuclear fusion. In this overview of plasmas, we shall introduce some of the many types of waves that plasmas can support. In the second part of the talk we shall deal with two aspects of waves related to space plasma physics. In space, velocity distributions are commonly nonthermal in nature, with strong non-Maxwellian tails, and we shall thus consider effects of excess superthermal particles on wave behaviour. Finally, we shall describe some recently-found properties of nonlinear phenomena, such as acoustica-type electrostatic solitary waves (double layers, solitons and supersolitons) in plasmas.



Dr. Larry D. McLerran
Brookhaven National Laboratory, New York

BIOGRAPHY:
Larry McLerran received BS (1971) and PhD (1975) degrees from the University of Washington. He was a postdoctoral fellow at MIT (1975-1978), and SLAC (1978-1980), an Assistant and Associate Professor at the University of Washington (1980-1984), a member of the permanent scientific staff at Fermilab (1984-1988), and a Professor at University of Minnesota, (1984-1999), where he was the first director of the William Fine Theoretical Physics Institute (1989-1992). In 1999, he became a Senior Scientist at BNL. He has been Group Leader for Nuclear Theory and for RIKEN-BNL Center. He will soon become the Director of the Institute for Nuclear Theory at the University of Washington in Seattle. His awards include the Alfred Sloan Fellowship, Alexander Humboldt Prize which supported stays at Frankfurt University, Hans Jensen Prize at University of Heidelberg, Honorary PhD, the Liu Lian Shou Professorship at Central China Normal University in Wuhan, the Feshbach Prize for Theoretical Nuclear Physics of the American Physical Society and a PhD Honoris Causa from the Jagellonian University in Krakow, Poland. He was involved in early studies of the Quark Gluon Plasma developing perturbative and Monte Carlo methods. He and collaborators recently argued the existence of high baryon density Quarkyonic Matter.

He computed the rate of baryon number violation in electroweak theory. He did pioneering work on the properties of ultrarelativistic nuclear collisions, estimating achievable energy densities. He and collaborators argued that a high gluon density Color Glass Condensate (CGC) controls the initial stages of nuclear collisions. After the collision, the CGC forms a highly coherent ensemble of colored fields called the Glasma. The Glasma eventually evolves into a thermalized Quark Gluon Plasma. He and collaborators argued that anomalous configurations of the matter produced in heavy ion collisions can generate a Chiral Magnetic Effect. In 2005, he and Miklos Gyulassy that a Quark Gluon Plasma had been made at RHIC from the initial CGC of the nuclei.

PLENARY : STRONGLY INTERACTING MATTER AT HIGH ENERGY DENSITY

Friday 08 July 2016 (8:40 to 9:40)

ABSTRACT

ABSTRACT
I describe various forms of strongly interacting matter at extremely high energy densities. The Quark Gluon Plasma is the ultimate material at very high temperature and baryon number density. It is composed of deconfined quarks and gluons and the quarks have small masses. One may learn about confinement of quarks and the origin of mass from its study. At high baryon number density and low temperature, there is possibly an intermediate form of matter called Quarkyonic. In such matter, the Fermi sea is made of deconfined quarks, but at the Fermi surface, quarks are confined in mesons and baryons.

At much higher baryon densities, matter becomes a superconducting Quark Gluon Plasma. The matter which is responsible for high energy interactions of strongly interacting nuclei and hadrons is composed of a very high phase space density of gluons. This matter is described by stochastic classical gluon fields and is called the Color Glass Condensate. High energy nuclei may be thought of as sheets of Color Glass Condensate. In their collision, yet another new form of matter is made, the Glasma, that evolves into a thermalized Quark Gluon Plasma.

Prof. Peter Butler
University of Liverpool, United Kingdom

BIOGRAPHY:
Peter Butler is a Professor of Physics at the University of Liverpool. He was educated at King's College London and the University of Liverpool. As a recipient of a SRC/NATO Fellowship and as a staff member at M.I.T. he worked at the Lawrence Berkeley Laboratory during 1974-1977 before returning to Liverpool in 1978. He held a SRC Advanced Fellowship during 1978-83 and became a Lecturer in the department of Physics in 1983.

He was a Visiting Scientist at the Joint Institute for Nuclear Research (Oak Ridge National Laboratory) in 1985 and 1990 and was Visiting Scientist and Experienced Marie Curie Fellow at the University of Jyväskylä in 1994, 1995 and 1999-2000. He was head of the ISOLDE group at CERN 2002-2005, and has been strongly involved in the HIE-ISOLDE, EURISOL and TSR (Test Storage Ring) projects.

He has also been active in developing instrumentation for nuclear spectroscopy, in particular conversion-electron spectroscopy, and has applied these to the studies of the shapes of heavy and superheavy nuclei. He is an expert on the properties of reflection-asymmetric or "pear-shaped" nuclei, having written three review articles on this topic. In 2012 he received the Institute of Physics Rutherford Medal and Prize for his contributions to the field of experimental nuclear physics.

PLENARY : STUDIES OF THE SHAPES OF HEAVY PEAR-SHAPED NUCLEI AT ISOLDE

Friday 08 July 2016 (12:10 to 13:10)

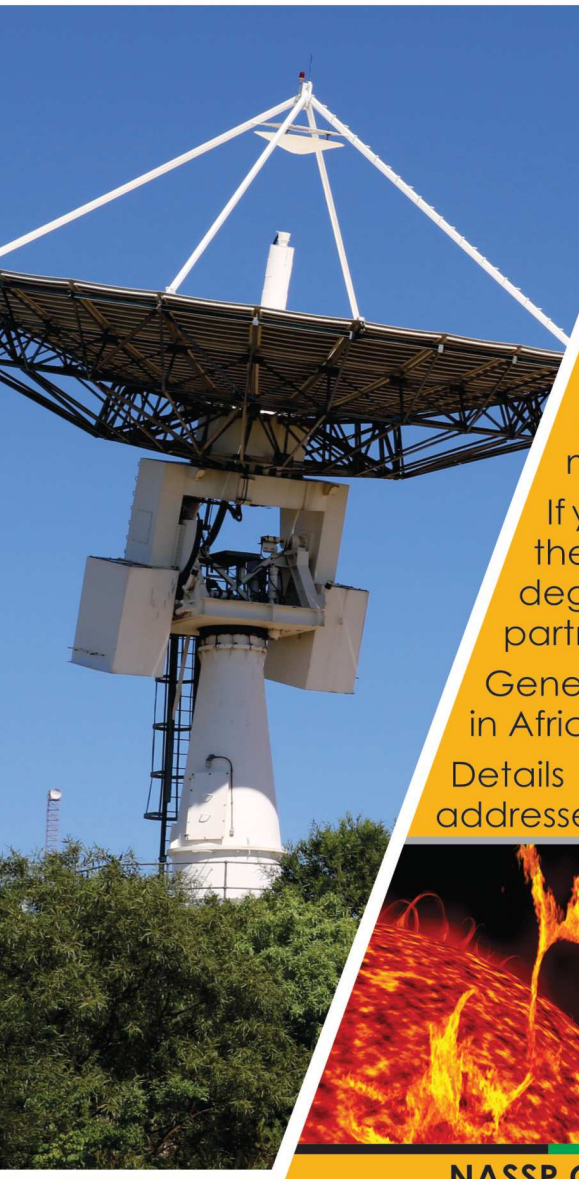
ABSTRACT

ABSTRACT
For certain combinations of protons and neutrons it is expected that the shape of atomic nuclei can undergo octupole deformation, which would give rise to reflection asymmetry or a "pear shape". In this talk I will review the historic evidence for reflection asymmetry in nuclei, and describe how recent experiments carried out at ISOLDE, CERN have found new examples of pear-shaped nuclei.

I will discuss how the new measurements are constraining nuclear theory and how they can help test extensions of the Standard Model. I will also discuss future prospects for measuring nuclear shapes using accelerated beams of radioactive ions.

Experiments are being planned that will exploit heavy-ion beams from the new HIE-ISOLDE facility at CERN. Eventually these beams will be injected into a storage ring (TSR); the emerging cooled beams will allow direct measurements of two-body reactions with unprecedented precision.

SOUTH AFRICAN NATIONAL ASTROPHYSICS AND SPACE SCIENCE PROGRAMME



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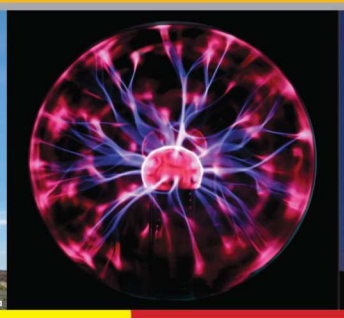

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Silver Medallist Lectures

Dr. Angela Dudley
CSIR National Laser Centre, South Africa

BIOGRAPHY:
After receiving her MSc in Physics from the University of KwaZulu-Natal, Angela joined the CSIR National Laser Centre (NLC) on a PhD studentship in 2008. Her PhD research realised two novel measurement techniques for optical fields.

She received her PhD in June 2012 from the University of KwaZulu-Natal and subsequently commenced a Postdoctoral Fellowship within the Mathematical Optics group at the NLC. Her research has resulted in 22 peer-reviewed journal articles and 25 international conference proceedings. She has been awarded two SPIE scholarships and the 2012 CSIR Excellence Award for 'Outstanding Performance by a PhD Student'.

In 2015 she was the recipient of the South African Institute of Physics (SAIP) Silver Jubilee medal. She has been invited to spend time in overseas laboratories such as the University of Glasgow, North Carolina State University and the City College of New York. Currently, she is a senior researcher at the NLC and holds a visiting lecturer position at the University of the Witwatersrand.

She is also serving her second 6-year term on the Optical Society of America's (OSA) Membership and Education Services (MES) council.

SILVER MEDALLIST LECTURE : MANIPULATING STRUCTURED LIGHT

Tuesday 05 July 2016 (11:30 to 12:10)

ABSTRACT

ABSTRACT
An overview of the research done within the CSIR's National Laser Centre and the University of the Witwatersrand's Structured Light group will be presented. Our main focus will be on implementing digital holograms for the creation and detection of the spatial modes of light - the various patterns of light. We make use of modal decomposition theory to determine the numerous properties of light, from the modal content of laser beams to decoding the information stored in optical fields carrying orbital angular momentum.

Although the modal decomposition of light has been known for a long time, applied mostly to pattern recognition, we illustrate how this technique can be implemented with the use of liquid-crystal displays. We demonstrate the versatility of these techniques to characterize both structured and vector fields with static and propagating optical fields. Finally, we show a holographic technique to realise a communication link using a densely packed spatial mode set where we experimentally multiplex and demultiplex over 100 spatial modes.

Dr. Shazrene Mohamed
SA Astronomical Observatory, South Africa

BIOGRAPHY:
Dr. Shazrene Mohamed is a computational astrophysicist working at the South African Astronomical Observatory (SAAO). She completed her undergraduate studies in Astronomy, Astrophysics and Mathematics at Harvard University and obtained her PhD in Astrophysics from Oxford University. After two years as an Argelander Fellow in Bonn, Germany, she moved to Cape Town where she is currently an NRF Research Career Advancement (RCA) fellow.

She is a Rhodes Scholar, a NRF P-rated researcher and recipient of the South African Institute of Physics (SAIP) Silver Jubilee Medal. Her research primarily focuses on supercomputer simulations of evolved stars to investigate how they interact with their surroundings and with each other, particularly, how mass is transferred from one star to another.

These systems are important as they are thought to be the progenitors of novae and supernovae explosions.

SILVER MEDALLIST LECTURE : 3D MODELS OF STELLAR WIND INTERACTIONS

Friday 08 July 2016 (11:10 to 11:50)

ABSTRACT

ABSTRACT
Evolved stars, e.g., Wolf-Rayet stars and red (super)giants, lose copious amounts of mass and momentum through powerful, dense stellar winds. The interaction of these outflows with their surroundings results in highly structured and complex circumstellar environments, often featuring knots, arcs, shells and spirals. Recent improvements in computational power and techniques have led to the development of detailed, multi-dimensional simulations that have given new insight into the origin of these structures, and better understanding of the physical mechanisms driving their formation.

In this talk, I review one of the main mechanisms that shapes the outflows of evolved stars: interaction with a companion. I will discuss both wind-wind interactions where the companion also ejects a stellar outflow, and mass-transfer interactions where the companion has a weak or insignicant outflow. I will also highlight the broader implications of these stellar wind interactions for other phenomena, e.g, for planetary nebulae, symbiotic and X-ray binaries, novae and supernovae.


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SAIP Divisions and Meetings

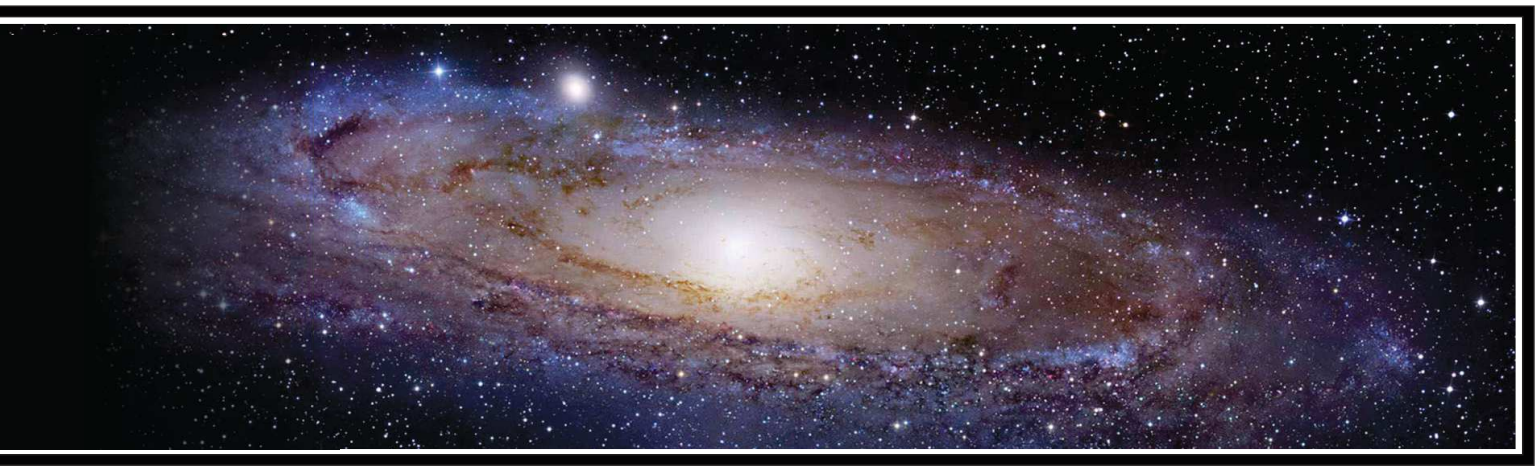
DIVISION	PERSON	E-MAIL	MEETING
Nuclear, Particle and Radiation Physics	Dr. Simon Mullins	nuclear@saip.org.za	Tuesday 5 July @ 14:40
Astrophysics and Space Science	Dr. Chris Engelbrecht (Astro) Dr. John Bosco Habarulema (Space)	astro@saip.org.za space@saip.org.za	Tuesday 5 July @ 15:00
Photonics	Prof. Erich Rohwer	photonics@saip.org.za	Wednesday 6 July @ 15:00
Theoretical and Computational Physics	Prof. Kristian Müller-Nedebock	theoretical@saip.org.za	Wednesday 6 July @ 14:40
Division for Physics of Condensed Matter and Materials	Prof. Japie Engelbrecht	dcmpm@saip.org.za	Wednesday 6 July @ 15:00
Physics Education	Dr. Sam Ramaila	education@saip.org.za	Thursday 7 July @ 12:10
Applied Physics Forum	Prof. Ernest van Dyk	applied@saip.org.za	Thursday 7 July @ 11:30

Meeting list

MEETING	DATE & TIME
Council Meeting	Monday 4 July @ 09:00 - 16:30
Council Meeting with HoDs & Heads of National facilities	Tuesday 5 July @ 18:00 to 20:00
Council Meeting with Divisions & Forums	Wednesday 6 July @ 18:00 - 20:00
SAIP Departmental Reps Meeting (Physics Marketing & Outreach HUB&SPOKE Reps)	To be advised
Annual General Meeting (LT1)	Thursday 7 July @ 14:00 - 15:30

Non Specialists Lectures

TRACK	PRESENTER	CONTB.	TITLE	TIMESLOT
TCP	Prof. TOUCHETTE, Hugo	159	Nonequilibrium processes and their fluctuations	Tuesday 5 July @ 11:10
DCMPM	Dr. GIBBON, Timothy	525	Optical Fibre Communication: Silica Information Super-Highways	Wednesday 6 July @ 09:40
Astro	Prof. BISHOP, Nigel	149	The gravitational wave event GW150914	Wednesday 6 July @ 14:00
Photonics	Dr. UYS, Herman	495	Trapped ions for new frontiers in precision measurement	Thursday 7 July @ 11:30
Applied	Dr. NAIDOO, Darryl	527	Photonics Prototyping Facility	Friday 8 July @ 11:10



Winter Schools (Monday 4 July 2016)

Registration on Monday 4 July: Kramer building, 08:00 - 09:00

From the Smallest to the Largest Scales: Our Evolving Universe (Kramer LT2)

TIME	TOPIC / TITLE	PRESENTER
09:00 - 09:25	Coffee fueling, Welcome & Logistics	**Dr. Tom Jarrett** (Univ of Cape Town)
09:25 - 09:30	Opening Remarks	**Dr. Rob Adam** (Director, SKA-SA)
09:30 - 10:15	The State of the Universe	**Dr. Steven Kahn** (Stanford Univ)
10:15 - 11:00	Particle physics -- a window into the early universe	**Dr. Heribert Weigert** (Univ. Cape Town)
11:00 - 11:20	Refreshment break	
11:20 - 12:05	The Exploration of the Early Universe with the Large Hadron Collider	**Dr. Helen Hayward** (University of Liverpool)
12:05 - 12:20	Brief talks by UCT Physics PhD students	**Various**
12:30 - 13:30	Lunch Talk : Exploring the early universe with the SKA	**Dr Obinna Umeh** (Univ. Western Cape)
13:30 - 14:15	The Stormy Cosmos: Life and Times of a Waning Universe	**Dr. Michelle Cluver** (Univ. Western Cape)
14:15 - 15:00	Studies of Galaxy Evolution with MeerKAT	**Dr. Brad Frank** (SKA-SA ; Univ. Cape Town)
15:00 - 15:25	Brief talks by UCT Astro PhD students	**Mr. Moses Mogotsi** (Dr. Bishop Mongwane)
15:25 - 16:00	Panel Discussion	**Participants**

The Biophysics of Cells and Macromolecules Programme (Kramer LT3)

TIME	TOPIC / TITLE	PRESENTER
09:00 - 10:00	Biological photovoltaic building blocks for solar energy harvesting	**Raoul Frese** (VU University Amsterdam)
10:00 - 10:30	The cytoskeleton and membrane: thermal and mechanical properties I	**Kristian Müller-Nedebock** (SU)
10:30 - 11:00	**TEA**	
11:00 - 11:30	The cytoskeleton and membrane: thermal and mechanical properties II	**Kristian Müller-Nedebock** (SU)
11:30 - 12:15	Single-molecule spectroscopy: Beyond the ensemble average	**Tjaart Krüger** (UP)
12:15 - 13:00	Higher order structures and noise filtering in biological signal cascades	**Musa Mhlanga** (UCT)
13:00 - 14:00	**LUNCH**	
14:00 - 14:40	Structure and Affinity of Protein Complexes in Infectious Diseases	**Wolf-Dieter Schubert** (UP)
14:40 - 15:20	Studying large (>400 kDa) macromolecular complexes	**Jeremy Woodward** (UCT)
15:20 - 16:00	An experimental physicist's view of enzyme reaction mechanisms	**Trevor Sewell** (UCT)
16:00 - 17:00	**TEA**	

Registration on Monday 4 July: Kramer building, 16:00 - 18:00

Teachers' Workshop, Monday 4 July (Kramer 2B)

TIME	SUNDAY 4 JULY	TUESDAY 5 JULY	WEDNESDAY 6 JULY
09:00 - 09:15	Welcome tea & coffee		
09:15 - 09:30	Opening address		
09:30 - 10:00	Keynote Address Dark Matter Pauline Gagnon		
10:00 - 10:30			
10:30 - 11:00	TEA		
11:00 - 11:30	Rhett Allain - Workshop Computational Physics		
11:30 - 12:00			
12:00 - 12:30			
12:30 - 13:00			
13:00 - 14:00	LUNCH		
14:00 - 15:00	Rhett Allain - Workshop Computational Physics	**Case Rijsdijk** South African Physics Olympiad	**Dale Taylor** **Eugenia Etkina** Investigative Science Learning Environment (ISLE)
15:00 - 16:00		**Douglas Clerk** Problem Solving	
16:00 - 16:30	TEA		
16:30 - 18:30	**David Wolfe -** **Stories of women in physics**	**Newton's Laws** Case Rijsdijk	
18:30	DINNER		

Opening Cocktail Function

Monday 4 July - Kramer Building quad

17:30 Arrival

18:00 Welcome by UCT hosts: Roger Fearick, Andy Buffler, Patrick Woudt

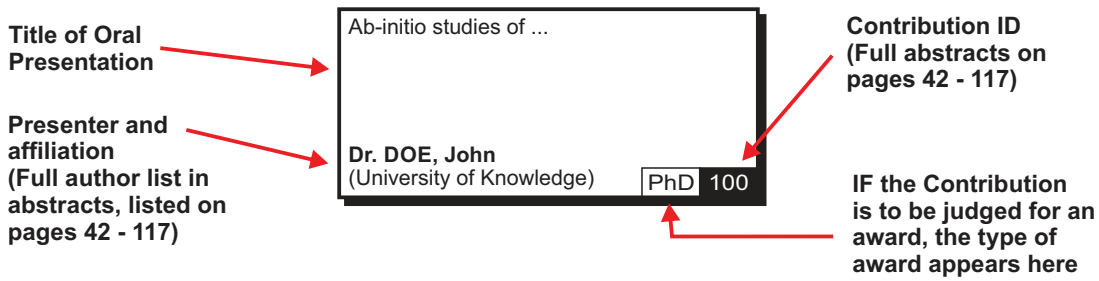
18:05 Remarks by UCT DVC Research: Danie Visser

18:10 Remarks by the SAIP President: Azwinndini Muronga

18:15 Opening of conference by DST Chief Director for Basic Sciences & Infrastructure: Danny Adams

Registration desk will be open daily between
08:00 - 17:00,
Tuesday 5 July - Friday 8 July

Timetable Legend



TUESDAY 5 JULY 2016

08:30 - 09:00	**Welcome Address**				
09:00 - 10:00	**PLENARY (LT1): NEUTRINOS THE X-FILES OF PARTICLE PHYSICS (p 14)** **PROF. KAI ZUBER** (Technische Universitat Dresden, Germany)				
TRACK	**Division for Physics of Condensed Matter and Materials (1): LT1**	**Division for Physics of Condensed Matter and Materials (2): 4B**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Theoretical and Computational Physics (1) 4A**	**Theoretical and Computational Physics (1) 2A**
Theme Chair	**PhD Orals for Award DR. MALILI MATSHABA**	**MSc Orals for Awards PROF. CHAUKE, HASANI**	**- DR. KAR, DEEPAK**	**TDB**	**PROF. NEDEBOCK, K**
10:00 - 10:20	Modelling temperature dependence of continuous wave optically stimulated luminescence from anion deficient corundum doped with carbon **Mr. Nyirenda, Angel** (Rhodes University) PhD 106	Structural and optical studies of cobalt and indium simultaneously doped zinc oxide nanopowders prepared using high energy ball milling technique **Ms. Manamela, Mahlatse** (University of Limpopo) MSc 91	Jet measurements in LHC **Ms. Roy, Debarati** (Wits) - 134	Are we gauging the pressure correctly? **Mr. Jackson, Greg** (UCT) MSc 111	Yang-Lee and Fisher zeros in a model of adsorbing self-avoiding walks **Prof. Janse v Rensburg, Esaias J** (Mathematics & Statistics, York University, Toronto, Ontario) - 229
10:20 - 10:40	Beyond Lithium-Ion Batteries: A Computational Study on Advanced Lithium – Sulphur Battery **Mr. Masedi, Cliffton** (CSIR/ UL) PhD 109	CZTS solar cell: CZT precursor layer deposition by electron beam evaporation and electroplating **Mr. Fourie, Antonie** (UFS) MSc 121	Jet substructure techniques for identifying boosted bosons in ATLAS **Ms. Moodley, Chane Simone** (Wits) Hons 172	Quantum Corrections to the Kink-Antikink Potential **Mr. Lee, Zander** (Stellenbosch University) MSc 41	Modelling the unbinding of membranes tethered randomly to a network substrate **Mr. Gumede, Sthembiso** (Stellenbosch University) PhD 199
10:40 - 11:10	**Tea & Coffee Break**				
TRACK	**Division for Physics of Condensed Matter and Materials (1) - LT1**	**Division for Physics of Condensed Matter and Materials (2) - 4B**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Nuclear, Particle and Radiation Physics (2) 4A**	**Theoretical and Computational Physics (1) 2A**
Theme Chair	**PhD Orals for Award DR. DIALE, MMANTSAE**	**MSc Orals for Awards DR. MEYER, WALTER**	**DR. BARK, ROB**	**PROF. CONNELL, SIMON**	**PROF. NEDEBOCK, K**
11:10 - 11:30	Evaluation of sputtering-induced surface roughness of poly-crystalline Ni/Cu multilayers thin films with AES and ToF-SIMS depth profiling **Mr. Yan, XinLiang** (UFS) PhD 124	Gas sensing applications of Cobalt and Indium double-doped ZnO nanoparticles prepared by sol-gel method **Mr. Maswanganye, Mpho** (Universtity of Limpopo) MSc 136	Spectroscopy of the low-lying excitation region in ^{9}B **Dr. Daniel José, Marín-Lámbarri** (University of the Western Cape / iThemba LABS) - 95	Wilson Lines and Color-Neutral Operators in the Color Glass Condensate **Mrs. Zeilinger, Judith** (University of Cape Town) PhD 113	Parallel computing solutions to the Balitsky-Kovchegov equation **Mrs. Hillebrand-Viljoen, Charlotte** (UCT) MSc 352
11:30 - 11:50	Ultrafast Excited state dynamics of a direct hetroarylation derived bithiophene-isoindigo copolymer and application in inverted ITO free solar cells. **Mrs. Tegegne, Newayemedhin** (Stellenbosch University) PhD 127	Investigation of the isochronal annealing profiles of the E centres in n-type silicon **Mr. Barnard, Abraham** (University of Pretoria) MSc 500	Coulomb excitation reorientation effect of the first 2^{+} state at 4.439 MeV in ^{12}C **Dr. Mukhi, Kumar Raju** (University of the Western Cape) - 424	Proton induced radiation damage to the fluorescence capability of plastic scintillators for the Tile Calorimeter of ATLAS **Ms. Jivan, Harshna** (Wits) MSc 260	Quantum Boltzmann evolution of the Quark-Gluon Plasma **Mr. Grunow, William** (University of Cape Town) MSc 145
11:50 - 12:10	Synthesis of ZrC coatings in a vertical-wall CVD system **Ms. Biira, Saphina** (University of Pretoria) PhD 182	Deep Level Transient Spectroscopy of GaSb/GaAs Quantum Dots **Ms. VENTER, Danielle** (NMMU) MSc 264	Searching for exotic shapes in silicon-28 **Dr. Adsley, Philip** (Stellenbosch University and iThemba LABS) - 194	Crystals Orientation Measurements of the iThemba LABS Segmented Clover Detector **Ms. Mthembu, Sinegugu Happiness** (iThemba LABS) Hons 419	Engineer inflation in realistic string compactifications **Mr. Pontiggia, Luca** (Wits) PhD 442
12:10 - 13:10	**PLENARY (LT1): PLENARY: WOMEN AND DIVERSITY IN PHYSICS (p 14)** **Prof. GAGNON, Pauline**				
13:10 - 14:00	**Lunch Break**				
TRACK	**Division for Physics of Condensed Matter and Materials (1) - LT1**	**Division for Physics of Condensed Matter and Materials (2) - 4B**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Theoretical and Computational Physics (1) 4A**	**Theoretical and Computational Physics (1) 2A**
Theme Chair	**PhD Orals for Award PROF. DEJENE, FRANCIS**	**MSc Orals for Awards PROF. VENTER, ANDRÉ**	**PROF. MULLINS, SIMON**	**PROF. NEDEBOCK, K**	**PROF. DE MELLO KOCH, R**
14:00 - 14:20	Interactions of xanthates and dithiophosphate on (110) nickel-rich pentlandite ($Fe^{4}Ni^{5}S^{8}$) mineral surface **Mr. Mkhonto, Peace** (University of Limpopo) PhD 268	Atomistic simulations studies on the structural change in Li_xTiO_2 (x: 2.82, 3.76, 6, 57) at high temp's for energy storage in Lithium-ion Battery Applications **Ms. RIKHOTSO, B.N** (University of Limpopo) MSc 240	Determining the spectroscopic quadrupole moment Q_s of the first 2^{+} state in $^{9}_{4}$ Ar **Mr. Mokgolobotho, Makabata Jeremia** (UWC) MSc 355	Lattice thermal conductivity properties of three binary type- I Sn clathrates from Density Functional Theory **Mr. Egbele, Peter** (Wits) PhD 457	Non-reversal Open Quantum Walks **Mr. Goolam hossen, Hazmatally** (UKZN) PhD 335
14:20 - 14:40	Colloidal InSe nanostructures: effect of morphology on their chemical sensitivity to methanol and formaldehyde fumes **Ms. Airo, Mildred** (Wits) PhD 247	Understanding proton induced radiation damage in plastic scintillators using electron paramagnetic resonance and DFT modelling **Mr. PELWAN, Chad** (Wits) MSc 209	Searching for the low-energy enhancement in ^{91}Zr **Mr. Zikhali, Bonginkosi Richard** (University of Zululand) MSc 92	First Principle Investigation of Structural, Thermodynamic, Electronic and Elastic Properties of Ru-Cr-Z Ternary Alloys **Mr. Mnisi, Bhila** (UNISA) MSc 386	Digital simulation of many-body non-Markovian dynamics **Sweke, Ryan** (Ukzn) PhD 323
14:40 - 15:00	Combustion synthesis and characterization of Eu3+ doped Ba5(PO4)3OH phosphorsanol and formaldehyde fumes **Ms. Mokoena, Puseletso Pricilla** (UFS) PhD 329	The Thermolysis of zinc acylthiourea complexes to form metal chalcogenides **Ms. LETHOBANE, Manthako** (Wits) MSc 195	**Division Meeting:** NPRP	Electronic structure and bandgap of gamma-Al_2O_3:Ce compound using LDA+U exchange potential **Ms. Mulwa, Winfred Mueni** (UFS) PhD 177	Quantum channel tomography with classical light **Mr. Ndagano, Bienvenu** (Wits) MSc 147
15:00 - 15:20	Structural and optical properties of Holmium doped a-$Fe^{2}O^{3}$ nanoparticles **Ms. Mathevula, Langutani** (University of South Africa) PhD 338	The photocatalytic degradation study of Rhodamine B using zinc oxide as an alternative catalyst to titanium dioxide **Mr. Nkabinde, Siyabonga** (Wits) MSc 309		Computational study of TiO_2 polymorphs as an anode material for energy storage devices **Mr. Gandamipfa, Mulatedzi** (University of Limpopo) PhD 189	Beyond ½-BPS: Symmetry Generators in *su(2)* and *su(3)* **Ms. Tribelhorn, Laila** MSc 288
15:20 - 15:40	The SCC-DFTBstudy of H_2O interaction with TiO_2 supported Pd catalyst **Ms. Chuma, Moyahabo Hellen** (University of Limpopo) PhD 397	Boundary Current Response in $Ba_{0.34}K_{0.64}Fe_2As_2$ Single Crystals Probed by Non-Resonant Microwave Absorption. **Ms. Ramashitja, Tshiwela Caroline** (University of South Africa) MSc 353	**Dr. Mullins, Simon** (iThemba LABS)	Determining resonance parameter from experimental cross-sections of Coulomb scattering **Mr. Vaandrager, Paul** (University of Pretoria) PhD 68	
15:40 - 16:10	**Tea and Coffee Break**				
16:10 - 18:00	**POSTER SESSION 1: DPCMM (A), NPRP (B), Edu (E)** **CONVENERS: Prof. Engelbrecht, Japie; Dr. Mullins, Simon; Dr. Ramaila, Sam**				

Welcome Address

PLENARY (LT1): NEUTRINOS THE X-FILES OF PARTICLE PHYSICS

PROF. KAI ZUBER (Technische Universitat Dresden, Germany)

Physics Education 2B	Photonics 5C	Astrophysics (1) 5A	Space Science 5B	Applied Physics (1) LT2
- **DR. ALBERS, CLAUDIA**	**Laser development** **DR. STRAUSS, HENCHARL**	**Cosmology & Large-Scale Structure** **VAN SOELEN, BRIAN**	**Plasma Physics** **DR. HABARULEMA, JOHN BOSCO**	- **PROF. VAN DYK, ERNEST**
Probing students perceptions of first year physics labs: a focus on learning and enjoyment aspects **Ms. TLOWANA, Munene** (Student) - 375	Development of a large mode area (LMA), high-power, thulium-doped fibre laser **Mr. MORRIS, Daniel** (Council for Scientific and Industrial Research) MSc 292	A Multi-frequency analysis of dark matter annihilation interpretations of recent anti-particle and gamma-ray excesses in cosmic structures **Mr. BECK, Geoff** (Wits) PhD 2	Nonlinear dust-acoustic waves in the nighttime polar mesosphere **Dr. MAHARAJ, Shimul** (SANSA Space Science / University of the Western Cape) - 97	Power Budget Analysis of Passive Components along an Optical Fibre Link of a Frequency Dissemination System within the MeerKAT Telescope Array **Mr. WASSIN, Shukree** (NMMU) PhD 376
Physical models: A crucial link between reality and mathematical models **Dr. LEMMER, Miriam** (North-West University) - 129	Simulaser, a graphical laser simulator based on Matlab Simulink **Mr. JACOBS, Cobus** (CSIR National Laser Centre) - 516	Anti-Newtonian cosmological solutions in fourth-order gravity **Dr. ABEBE, Amare** (North-West University) - 60	A small-amplitude study of solitons near supercritical points **Dr. OLIVIER, Carel** (SANSA) - 244	Effect of 1.712 GHz RF-Clock Signal Distribution on 10 Gbps 1550.89 nm VCSEL Based Transmission over Single Optical Fibre for Square Kilometre Telescope Array **Mr. ISOE, George** (Nelson Mandela Metropolitan University) - 245

Tea & Coffee Break

Physics Education 2B	Photonics 5C	Astrophysics (1) 5A	Space Science 5B	Applied Physics (1) LT2
DR. LEMMER, MIRIAM	- **PROF. FORBES, ANDREW**	**PhD Awards: General** **PROF. WOUDT, PATRICK**	**Plasmas & low latitude ionosphere** **DR. HABARULEMA, JOHN**	- **DR. FERRER, PHIL**
Understanding of vector addition and subtraction by first year university students: graphical versus algebraic methods **Dr. CARLESCHI, Emanuela** (University of Johannesburg) - 6	The interaction of high power cw laser beams with weakly absorbing optical elements **Mr. RAMOKOLO, Rocky** (CSIR, National Laser Centre) - 421	Probing accretion in magnetic Cataclysmic Variables through fast photometry **Mr. BREYTENBACH, Hannes** (University of Cape Town) PhD 491	Characterization of a Direct Current Discharge Based Microthruster **Mr. WRIGHT, William** (Wits) PhD 249	Free-space Optical Communications through Turbulence **Mr. COX, Mitchell** (Wits) PhD 176
Postgraduate Studies: Influences that make students to choose their respective research fields **Dr. SONDEZI, Buyi** (University of Johannesburg) - 252	**SILVER MEDALLIST LECTURE:** Manipulating Structured Light **Dr. DUDLEY, Angela** (CSIR National Laser Centre) - 544	Kozai-Lidov mechanism in LS I +61 303? **Mr. MONAGENG, Itumeleng** (SAAO / UCT) PhD 269	Confirmation of low latitude electrodynamics in driving poleward waves **Dr. HABARULEMA, John Bosco** (South African National Space Agency) - 196	Laser Effect on the RF Signal Stability for Clock Signal Distribution over Optical Fibre **Ms. DLAMINI, Phumla** (Nelson Mandela Metropolitan University) MSc 276
Comparison of two models of problem solving in Physics: a study of secondary school students in Adamawa state, Nigeria **Mr. ABUBAKAR, Ishiyaku Mbela** (College) PhD 318		Studying the Star formation - Neutral gas relation in WHISP Galaxies **Ms. NALUMINSA, Elizabeth** (University of Cape Town) PhD 427	Plasma Drift Modeling: Multivariate Analysis **Mr. DUBAZANE, Makhosonke** (SANSA Space Science) PhD 98	Ambient noise tomography (Passive Seismic) to image the Cape-Karoo transition near Jansenville, Eastern Cape **Mr. BEZUIDENHOUT, Lucian** (Nelson Mandela Metropolitan University) PhD 384

PLENARY (LT1): PLENARY: WOMEN AND DIVERSITY IN PHYSICS

Prof. GAGNON, Pauline

Lunch Break

Physics Education 2B	Photonics 5C	Astrophysics (1) 5A	Space Science 5B	Applied Physics (1) LT2
Teachers Workshop **DR. HENNING, COLLEEN**	**Ultrafast photonics** **DR. NEETHLING, PIETER**	**Cosmology and Galaxies** **PROF. FEAST, MICHAEL**	**Low & mid-latitude ionosphere** **DR. SHIMUL, MAHARAJ**	- **PROF. WINKLER, HARTMUT**
The Need for a Physics Olympiad **Mr. Rijsdijk, Case** (ASSA) - 7	Ultrafast mapping of structural changes in organic radical salts **Mr. Smit, A. Bart** (Stellenbosch University) PhD 296	Simulations of systematic effects for 21-cm observations **Mrs. Nunhokee, Chuneeta Devi** (Rhodes University) PhD 282	Quiet time enhancements over African latitudes **Ms. Orford, Nicola** (SANSA) PhD 99	The relationship between solar irradiance and cloud cover in Durban. **Mr. Ganya, Elison** (UKZN) MSc 58
Problem Solving **Mr. Clerk, Douglas** (Wits) - 551	Supercontinuum Generation in Highly Birefringent Photonic Crystal Fibers **Mr. Jena, James** (National University of Science and Technology) MSc 158 PIRANA, an all optical time-domain ptychographic pulse characterisation method **Mr. Spangenberg, Dirk-Mathys** (University of Stellenbosch) - 394	Survey of Southern Local Group Dwarf Galaxies **Ms. Namumba, Brenda** (University of Cape Town) PhD 304 Galaxy Dynamics and Star Formation in the Inner Regions of SINGG Galaxies **Mr. Mogotsi, Moses** (University of Cape Town) PhD 404	Using Particle Image Velocimetry (PIV) to determine velocities of TIDs over South Africa **Mr. Mahlangu, Fiso** (South African National Space Agency) MSc 520 A comparison of measured TEC data with the IRI2011 and NeQuick 2 model results over the transition regions from low to mid-latitudes **Dr. Sibanda, Patrick** (University of Zambia) - 526	Study of the performance of a Cadmium Telluride photovoltaic system **Ms. Dobreva, Petja** (NMMU) - 271 Application of Ag nanocubes for efficiency enhancement in organic photovoltaic (OPV) devices **Mr. Kotane, Lesias** (Wits) - 435
Newton's Laws **Mr. Rijsdijk, Case** (SAAO) - 552	Supercontinuum characterisation and compression **Mr. Viljoen, Ruan** (Stellenbosch University) MSc 401 Investigating the optical properties of ANDi-PCFs for nonlinear imaging application **Mr. Dwapanyin, George Okyere** (Stellenbosch University) PhD 513	**Division Meeting:** Astrophysics and Space Science **Dr. Engelbrecht, Christian** (University of Johannesburg) **Dr. Habarulema, John Bosco** (South African National Space Agency)		Synthesis and characterization of Titanium dioxide nanotubes using electrochemical anodization system for solar cell application **Mr. Lupiwana, Mpheleki** (University of Fort Hare) MSc 131 Characterisation of the optical thermometry properties of a phosphor material **Mr. Erasmus, Lucas** (UFS) MSc 307

Tea and Coffee Break

POSTER SESSION 1: DPCMM (A), NPRP (B), Edu (E)

CONVENERS: Prof. Engelbrecht, Japie; Dr. Mullins, Simon; Dr. Ramaila, Sam

08:40 - 09:40	**PLENARY (LT1): THE SI REDEFINED: COUNTING ATOMS, SINGLE-ELECTRON TUNNELLING & OPTICAL ATOMIC CLOCKS (p15) DR. WYNAND LOUW** (NMISA)				
TRACK	**Division for Physics of Condensed Matter and Materials (1) - LT1**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Nuclear, Particle and Radiation Physics (2) 4A**	**Theoretical and Computational Physics (1) 2A**	**Photonics 5C**
Theme Chair	- **PROF. ENGELBRECHT, JAPIE**	- **PROF. JOHN SHARPEY-SCHAFER**	- **PROF. BRUCE MELLADO**	- **DR. NNDITSHEDZENI, E M**	- **DR. CHRISTINE STEENKAMP**
09:40 - 10:00	**NON-SPECIALIST LECTURE** Optical Fibre Communication: Silica Information Super-Highways	Coupling of single proton configurations to collective core excitations in ^{162}Yb: the nucleus ^{161}Tm **Ms. Sandile Jongile** (University Of Zululand / University of the Western Cape) MSc 170	Thermal Model and Tsallis distribution for Large Hadron Collider **Dr. WORKU, DAWIT** (CPUT) - 28	How Cool is the Gluon Plasma? **Mr. GIOVANNONI, Dino** (Rhodes University) PhD 234	A Tunable Vacuum Ultraviolet Light Source and High Intensity Saturation of the Nonlinear Medium **Dr. Charles Rigby** (Stellenbosch University) - 233
10:00 - 10:20	**Dr. Timothy Gibbon** (NMMU) - 525	Coupling of single neutron and proton configurations to collective core excitations in ^{162}Yb **Mr. Linda Mdletshe,** (University of Zululand) MSc 470	Thermal Model Description of Collisions of Small Systems **Prof. CLEYMANS, Jean** (Univ. of Cape Town) - 267	Short Path Length Energy Loss in the Quark Gluon Plasma **Ms. KOLBE, Isobel** (University of Pretoria) PhD 257	Excitation spectroscopy with vibration selective detection for self-absorption free rovibronic spectra of CO **Mr. Andre de Bruyn** (Stellenbosch University) MSc 239
10:20 - 10:40	Characterization of inclusions and defects in natural zirconia **Prof. Mike Lee** (Nelson Mandela Metropolitan University) - 107	Coupling of single neutron configurations to collective core excitations in $^{162}{}_{70}$Yb , the nucleus $^{163}{}_{70}$Yb. **Mr. Makuhane Sithole** (UWC) **Mr. Linda Mdletshe** (UZ) **Mr. Jongile Sandile** (UZ) MSc 210	NLO Rutherford Scattering and Energy Loss in a QGP **Mr. IBRAHIM, Abdullah** (Univ. of Cape Town) MSc 328	Probing quark gluon plasma in pA collisions **Mr. ADAMIAK, Daniel** (UCT) MSc 411	Integrated optical tweezer and fluorescence microscope. **Ms. Anneke Erasmus** (Stellenbosch University) MSc 512
10:40 - 11:10	**Tea & Coffee Break**				
TRACK	**Division for Physics of Condensed Matter and Materials (1) - LT1**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Nuclear, Particle and Radiation Physics (2) 4A**	**Theoretical and Computational Physics (1) 2A**	**Photonics 5C**
Theme Chair	**PhD Orals for Awards PROF. MIKE LEE**	- **DR. PETE JONES**	- **PROF. SIMON CONNELL**	- **MR. GEORGE MANYALI**	**BIO PHOTONICS DR. GURTHWIN BOSMAN**
11:10 - 11:30	Characterization of elastic constants and electronic property of diamond-like carbon films **Mr. Wilfred Mbiombi** (Wits) PhD 398	Production of ion beams with ECR ion sources and the pre-acceleration with injector cyclotrons at iThemba LABS **Dr. Joele Mira** (iThemba LABS) - 345	The search for new bosons with the ATLAS detector at the LHC **Prof. Bruce Mellado** (Wits) - 468	QCD thermodynamics in finite volume **Husam Mohamed** (UCT) MSc 139	The efficiency of Hypericin used in Photodynamic Therapy Treatment with low intensity laser irradiation to induce the cell death of human breast cancer cells (MCF7). **Ms. Kiro Ndivito** (UJ) MSc 362
11:30 - 11:50	Optical and electronic properties of silicon nanowires fabricated by Metal Assisted Chemical Ecthing **Mr. Sfiso Khanyile** (Author) PhD 432	Experimental study of inner shell ionization in an Ecris plasma **Mr. Muneer Sakildien** (iThemba LABS) PhD 349	The production of multiple leptons due to heavy bosons at the Large Hadron Collider **Mr. Abdualazem Fadol** (Wits) MSc 198	BPS Geometries **Mr. Lwazi NKUMANE** (Wits) PhD 165	Photobiomodulation of Isolated Lung Cancer Stem cells **Ms. Anine CROUS** (Student at University of Johannesburg) MSc 415
11:50 - 12:10	Tuning the Energetic Driving Force of P3HT-ZnO hetero-structures for Enhanced Electron Transfer in Organic PV solar cells **Mr. Guy Leba Kabongo** (Université Pédagogique Nationale) PhD 478	Change in the Angular Momentum Distribution due to Nuclear Plasma Interactions **Mr. Thembalethu Nogwanya** (University of the Western Cape) **Dr. Mathis Wiedeking** (ithemba labs) MSc 93	Search for a heavy scalar decaying into the Higgs boson and missing energy with the ATLAS detector **Mr. Chad Pelwan** (Wits) MSc 208	Evolution of Yukawa couplings in 5 dimensions for an SU(3) gauge group **Mr. Mohammed Omer Khojali** (Wits) PhD 16	Exciton dynamics of individual plant light-harvesting complexes as revealed by fluorescence lifetime and intensity shifts. **Mr. Joshua Botha** (University of Pretoria) MSc 225
12:10 - 13:10	**PLENARY (LT1): NEW TRENDS IN STRONGLY CORRELATED MATERIALS (p 15)** **Prof. BÜHLER-PASCHEN, Silke** (Institute of Solid State Physics, Vienna University of Technology)				
13:10 - 14:00	**Lunch Break**				
TRACK	**Division for Physics of Condensed Matter and Materials (1) - LT1**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Nuclear, Particle and Radiation Physics (2) 4A**	**Theoretical and Computational Physics (1) 2A**	**Photonics 5C**
Theme Chair	- **PROF. COMRIE, CRAIG**	- **DR. PAPKA, PAUL**	- **DR. TOM DIETEL**	**PROF. KRISTIAN MÜLLER-NEDEBOCK**	- **PROF. ERICH ROHWER**
14:00 - 14:20	Modelling of Pyrite (FeS_2) surfaces and adsorption of dithiophosphate (DTP) onto pyrite surface **Mr. Masilu Godfrey Mulaudzi** (University of Limpopo) PhD 502	Upgrades to the iThemba LABS quasi mono-energetic neutron beam facility **Dr. Frederick David Smit** (iThemba LABS) - 333	Measurements of W-boson production in p-Pb collisions with ALICE at the LHC **Mr. Kgotlaesele Johnson Senosi** (University of Cape) - 464	Strings with Finite Endpoint Mass	Development of a free space, LED illuminated Spectral Domain Optical Coherence Tomography setup **Mr. SULIALI, Nyasha** (NUST) MSc 146
14:20 - 14:40	A study into the rate of photo-bleaching undergone by radiation damaged plastic scintillators **Ms. Harshna Jivan** (Wits) MSc 395	Radiation Shielding Calculation using FLUKA transport code for Radioactive-ion Beams Facility at iThemba LABS **Mr. Nkanyiso R. MANTENGU** (University of Zululand / iThemba LABS) MSc 467	Setup and Operation of a Readout Chamber of the ALICE Transition Radiation Detector **Ms. Raynette van Tonder** (UCT) Hons 22	**Dr. William HOROWITZ** (UCT) - 341	Experimental characterization of a metamaterial optical polarizer in the quantum regime **Mr. URIRI, Solomon A.** (UKZN) PhD 440
14:40 - 15:00	Investigation of Luminescence Properties of Dy3+ Doped different Alkaline based White-light emitting Phosphors **Dr. Balakrishna Avula** (UFS) PhD 47	Measurements of gamma-ray production cross sections of proton beam at energies of 80-125 MeV with calcium target. **Mr. Ayanda Kunyana** (University of Zululand) MSc 311	Heavy quark production at forward rapidity with ALICE at the LHC **Ms. Nomvelo Dindikazi** (University of Zululand) MSc 446	**Division Meeting:** TCP	Single-photon probing of plasmonic waveguides **Mr. FRANCIS, Jason** (UKZN) - 443
15:00 - 15:20	**Division Meeting:** DPCMM	Measuring prompt gamma cross-section data for Carbon target using AFRODITE clover detectors **Ms. Vijitha Ramanathan** (UCT) PhD 324	ALICE MUON software upgrade for RUN3 **Sean Murray** (CHPC / UCT) PhD 456		Division Meeting: Photonics
15:20 - 15:40	**Prof. Japie Engelbrecht**	Cross Section Measurements for Neutron Induced Reactions on Bi Target using Quasi Mono-Energetic Neutron Beams of 90 and 140 MeV **Ms. Thobeka Lamula** (University of Zululand) MSc 381	Neutral meson and direct photon measurement with ALICE **Andile Whitehead** (UCT) - 465	**Prof. Kristian Müller-Nedebock**	**Prof. Erich Rohwer**
	Tea & Coffee Break				
	POSTER SESSION 2: Photonics (C), Astro (D1), Space (D2), Applied (F), TCP (G) **CONVENERS: Prof. Rohwer, E; Dr. Engelbrecht, C; Dr. Habarulema, J; Prof. van Dyk, E; Prof. Müller-Nedebock, K**				

PLENARY (LT1): THE SI REDEFINED: COUNTING ATOMS, SINGLE-ELECTRON TUNNELLING & OPTICAL ATOMIC CLOCKS (p 15)
DR. WYNAND LOUW (NMISA)

Physics Education 2B	Astrophysics (1) 5A	Space Science 5B	Applied Physics (1) 4B	Applied Physics (2) LT2
- **PROF. DEENA NAIDOO**	**Computational Methods** **DR. SHAZRENE MOHAMED**	**High latitude studies** **PROF. MICHAEL KOSCH**	- **DR. FREDERIK VORSTER**	**Metrology Session 1** **PROF. ANDY BUFFLER**
The development of learners' views on the nature of science in a science enrichment programme **Mr. Vonani Michael Baloyi** (University of Pretoria) PhD 137	Orthonormal vector polynomials in a general pupil **Dr. Cosmas Mafusire** (University of Pretoria) - 326	Investigation of the number of time ground-backscatter occurs for all the beams and range gates using the SuperDARN SANAE HF radar data **Dr. Zolile Mtumela** (SANSA) - 192	Fast neutron radiography observation of water absorption through porous media **Mr. Graham DANIELS** (Necsa) PhD 77	The re-definition of the of mass **Dr. Aletta KARSTEN** (NMISA) - 290
Using Design Based Research to improve teaching, testing and learning **Mr. Derek Fish** (Unizul Science Centre) PhD 155	Streams out of a Cloud **Dr. Nathan Deg** (UCT) - 71	Ionospheric Disturbances During Geomagnetic Storm at SANAE **Mr. Alicreance Hiyadutuje** (South African National Space Agency and Rhodes University) MSc 123	Residual stress measurements in leached polycrystalline diamond using X-ray diffraction and Raman spectroscopy techniques **Mr. Maxwell vhareta** (DST/NRF, Wits) PhD 412	Towards a new standard for electrical current in South Africa **Prof. Mark BLUMENTHAL** (University of Cape Town) - 541
Physics of noise and its impediment to the health of mine workers **Mr. Amour Dorick Kombo Tsoumbou** (University of Johannesburg) MTech 213	Graph theory and pulsar astronomy tie the knot: the use of labeled graph kernels in exploring the pulsar P-Pdot diagram **Mrs. Maritz Elizabeth** (UFS) PhD 82	The mystery of black auroras **Ms. Amor Nel** (SANSA) - 122	Optimising GPU Integration into the ATLAS Trigger **Mr. Marc Sacks** (Wits) MSc 317	Single-photon, single-pixel camera **Mr. Gareth BERRY** (Wits) - 374

Tea & Coffee Break

Physics Education 2B	Astrophysics (1) 5A	Space Science 5B	Applied Physics (1) 4B	Applied Physics (2) LT2
- **MR. CLERK, DOUGLAS**	**Computational Methods - 5A** **PROF. MEINTJIES, P**	**Heliospheric Physics** **DR. DU TOIT STRAUSS**	**Applied - 4B** **DR. ALAN MATTHEWS**	**Metrology Session 2** **DR. WYNAND LOUW**
The pedagogical orientation of 4th year BEd students in teaching physics **Dr. Sam ramaila** (University of Johannesburg) - 61	Probing the role of mergers in galaxy evolution with HI profile asymmetries **Ms. Jamie Bok** (UCT) MSc 438	Long-term cosmic-ray modulation model: A simplified ab initio approach **Mr. MOLOTO, KATLEGO** (NWU) PhD 399	ADC trigger board for the PROMETEO test-bench of the ATLAS Tile Calorimeter **Mr. SPOOR, Matthew** (WITS) MSc 247	Performance characterisation for Positron Emission Particle Tracking at "PEPT Cape Town" **Prof. Andy BUFFLER** (University of Cape Town) - 539
Optical interference with digital holograms **Mr. David Gossman** (Wits) Hons 506	Modelling Radiative Line Transfer in Maser Environments **Ms. Ruby Van Rooyen** (SKASA) PhD 19	Solar energetic particles and their transport to Earth **Dr. STRAUSS, Du Toit** (NWU) - 86	Facile synthesis of mesoporous $NiCo(OH)_2$/CNT composite for high performance energy storage application **Ms. UGBO, Faith** (UP) PhD 340	Considerations when interpolating discrete measurements of continuous functions: applications to particle tracking in physical systems **Dr. Thomas LEADBEATER** (University of Cape Town) - 540
Seeing is believing? **Mr. Derek Fish** (Unizul Science Centre) - 169	3D Radiation-Hydro Models of the Circumstellar Environments of Evolved stars **Mr. Elias AYDI** (University of Cape Town) PhD 459	Analyses of heliospheric magnetic field data as input for ab initio modulation models **Prof. Renier Burger** (NWU) - 361	Evaluation of the Technical Feasibility and Economic Viability of Solar Heated underground fixed dome household size digesters suitable for Vhembe district of SA **Mrs. MANDADA, Sharon Ntuwiseni** (University of Venda) MSc 489	Measurement of ^{238}U fission cross sections using quasi-monoenergetic neutrons with energies from 35 MeV to 100 MeV **Mr. Dieter GEDULD** (University of Cape Town) - 524

PLENARY (LT1): NEW TRENDS IN STRONGLY CORRELATED MATERIALS (p 15)
Prof. BÜHLER-PASCHEN, Silke (Institute of Solid State Physics, Vienna University of Technology)

Lunch Break

Physics Education 2B	Astrophysics (1) 5A	Space Science 5B	Applied Physics (1) 4B	Applied Physics (2) LT2
Teachers' Workshop session **Dr. SAM RAMAILA**	**Gravity and High-Energy** **PROF P. WHITELOCK**	**Helio and Thermospheric** **DR. CILLIERS, Dr. OGUNJOBI**	- **DR. IGLE GLEDHILL**	**Metrology Session 3** **DR. ALETTA KARSTEN**
Dale Taylor **Dr. TAYLOR, Dale** (UCT) - 554	NON-SPECIALIST LECTURE: The gravitational wave event GW150914 **Prof. Nigel BISHOP** (Rhodes University) - 149	Cosmic ray ground level enhancments: Power of pulse shape **Dr. OGUNJOBI, Olakunle** (North-West University) - 94	ESKOM, Irradiance and Sunny Skies - the physics of solar irradiance in South African conditions **Prof. WINKLER, Hartmut** (University of Johannesburg) - 367	Primary liquid scintillation radioactivity measurement capabilities of NMISA **Mr. VAN ROOY, Milton** (Stellenbosch University) - 542
Investigative Science Learning Environment (ISLE)	Irrotational-fluid cosmologies in fourth-order gravity **Ms. Maye ELMARDI** (UCT) PhD 202	The total solar modulation of low energy electrons in the heliosphere **Dr. NNDANGANENI, Rendani** (SANSA) - 75	Solar power prediction model using quantum machine learning algorithm **Mr. SENEKANE, Makhamisa** (UKZN) - 354	Secondary standard instrumentation used at NMISA for radioactivity measurement **Mrs. LUBBE, Joline** (NMISA) - 543
	The Shear-Free Perfect Fluid Conjecture in General Relativity: Progress **Mr. Muzikayise SIKHONDE** (UCT) PhD 368	TEC modelling over the African sector during geomagnetic storms **Mr. UWAMAHORO, Jean Claude** (SANSA, RU) PhD 64	Effect of Solar tracking on a PV system operating in the CSIR (South Africa) **Dr. RORO, Kittessa** (CSIR) - 186	Comparison of low frequency accelerometer measurement results obtained from three different laboratories **Mr. TYALIMPI, Vumile** (NMISA) - 511
	Constraining Lorentz Invariance violation using directional correlations of Gamma-Ray Bursts with IceCube cosmic neutrinos **Dr. REETANJALI MOHARANA** (University of Johannesburg) - 284	Analysis of ionospheric response to great geomagnetic storms during solar cycle 23 **Mrs. MATAMBA, Tshimangadzo M** (SANSA Space Science) - 65	The study of organic photovoltaics with Illumination intensity **Dr. RANGANATHAN, Kamalakannan** (Wits) - 410	Accurate Volume Measurements of Irregular Objects at NMISA **Mr. NDLOVU, Bongani** (NMISA) - 130
Prof. ETKINA, Eugenia (Unizul Science Centre) - 553		Thermospheric neutral density observations by radar **Prof. KOSCH, Michael** (SANSA) - 183	Electrical design of and reticulation to solar energy triggered microwave single mode system for sandstones processing: A feasibility study **Mr. MARWALA, Tshilidzi** (University of Johannesburg) - 505	

Tea & Coffee Break

POSTER SESSION 2: Photonics (C), Astro (D1), Space (D2), Applied (F), TCP (G)
CONVENERS: Prof. Rohwer, E; Dr. Engelbrecht, C; Dr. Habarulema, J; Prof. van Dyk, E; Prof. Müller-Nedebock, K

THURSDAY 7 JULY 2016

08:40 - 09:40	**PLENARY (LT1): PROBING THE MYSTERY OF DARK ENERGY WITH BILLIONS OF GALAXIES (p 16)** **Prof. Steven M. KAHN (Stanford University, California)**				
TRACK	**Division for Physics of Condensed Matter and Materials (1) LT1**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Nuclear, Particle and Radiation Physics (2) 4A**	**Theoretical and Computational Physics (1) 2A**	**Photonics 5C**
Theme Chair	**MSc Orals for Award DR. RICHARD HARRIS**	**- PROF MURONGA**	**- DR. RICKY SMIT**	**- Prof. MURONGA**	**Beams DR. MCLARAN, MELANIE**
09:40 - 10:00	Room temperature CH4 gas sensor based on Au loaded ZnO nanorods: The effect of Au loading concentration on sensing properties. **Ms. SHINGANGE, Katekani** (CSIR and UFS) MSc 400	Modelling of Radiological Risks from Gold Mine Tailings in Gauteng Province, South Africa **Mr. KAMUNDA, Caspah** (NWU) PhD 4	CHPC WLCG Tier2 status, plans and user analysis **MURRAY, Sean** (CHPC/UCT) - 417	2HDM and the LHC **Mr. MOSOMANE, Chuene** (Wits) MSc 35	Hyper-entanglement for secure communication **Mr. NAPE, Isaac** (Wits) MSc 120
10:00 - 10:20	Effect of Hydrochloric Acid on the Structure, Defect States and Gas Sensing Properties of TiO_2 Nanotubes by Hydrothermal Method **Mrs. TSHABALALA, Zamaswazi** (CSIR and UFS) MSc 405	Chemical contamination and radiological risk assessment of Richards Bay waters **Mr. MASOK, Felix Bitrus** (UJ) PhD 160	The search for crystal undulator radiation **Dr. HENNING, Colleen** (St John's College) - 173	Quasinormal modes for a spin-3/2 field in the Reissner-Nordstrom black hole background **Mr. NGCOBO, Xolane** (Wits) MSc 103	Quantum transport with vector beams **Mr. NDAGANO, Bienvenu** (Wits) MSc 148
10:20 - 10:40	Sol-gel Synthesis and Characterization studies of Er^{3+} doped TiO_2 nanoparticles **Mr. TALANE, Tsholo** (UNISA) MSc 492	Modelling and measurements of cosmic-ray related muon-fluxes in the Huguenot Tunnel near Paarl **Mr. DAWAM, Robert Rangmou** (SU) PhD 463	CODE-RADE - Community Infrastructure for the Delivery of Physics Applications **MURRAY, Sean** (CHPC/UCT) - 413	Generalized Geometry and Hopf Twists **Mr. DLAMINI, Hector** (UP) MSc 126	A beam quality measure for vector beams **Ms. SROOR, Hend** (Wits) PhD 214
10:40 - 11:10	**Tea & Coffee Break**				
TRACK	**Division for Physics of Condensed Matter and Materials (1) LT1**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Nuclear, Particle and Radiation Physics (2) 4A**	**Theoretical and Computational Physics (1) 2A**	**Photonics 5C**
Theme Chair	**PhD for Award PROF. SWART, HENDRIK**	**- DR. KAR, DEEPAK**	**- DR. MULLINS, SIMON**	**- DR. HOROWITZ, WILLIAM**	**Ion Trapping DR. DUDLEY, ANGELA**
11:10 - 11:30	Formation of a Thin Film of AB compound Layer at a Low Irradiation Temperature under the Influence of Radiation Induced Interstitial **Mr. AKINTUNDE, Samuel** (University of Pretoria) PhD 100	The Analysis of Zh in association with missing transverse momentum using the CxAOD Framework with the ATLAS detector **Mr. MTHEMBU, Skhathisomusa** (Wits) MSc 342	Test for traditional vibrational wisdom in 110,112Cd by two proton stripping **Mr. MAQABUKA, Bongani** (iThemba LABS / UWC) PhD 59	Exact Magnon Dynamics **Prof. DE MELLO KOCH, Robert** (Wits) - 230	Towards quantum feedback measurements with trapped Yb+ ions **Dr. KHANYILE, Ncamiso** (Stellenbosch University) - 481
11:30 - 11:50	Copper nitride nanoparticles for use in optoelectronic devices **Ms. SITHOLE, Rudo** **(Wits)** PhD 514	Constraints on new hypothetical particles in the Higgs sector using LHC Run 1 and 2 data **Mr. VON BUDDENBROCK, Stefan** (Wits) MSc 331	Nuclear structure studies relevant to double beta decay of 136Xe **REBEIRO, Bernadette** (UWC) PhD 223	Anomalous Dimensions of Heavy Operators from Magnon Energies **Mr. HASINA TAHIRIDIMBISOA, Nirina Maurice** (Wits) PhD 166	NON-SPECIALIST LECTURE: Trapped ions for new frontiers in precision measurement
11:50 - 12:10		Phase-II Upgrade of the ATLAS Inner Detector **Mr. HAMITY, Guillermo** PhD 115	Resonances in odd-odd 182Ta **Mr. BRITS, Christiaan** (SU) MSc 67	Interacting Double Coset Magnons **Mr. MAHU, Augustine Larweh** (Wits) PhD 167	**Dr. UYS, Hermann** (CSIR / SU) - 495
12:10 - 13:10	**PLENARY (LT1): FIRE, FLARES AND FUSION: SOME WANDERINGS IN PLASMALAND (p 16)** **Prof. Manfred HELLBERG (UKZN)**				
13:10 - 14:00	**Lunch Break**				
14:00 - 15:30	**ANNUAL GENERAL MEETING (LT1)**				
15:30 - 16:00	**Tea & Coffee Break**				
16:00 - 17:30	**PHYSICS BOWL (LT1)**				

PLENARY (LT1): PROBING THE MYSTERY OF DARK ENERGY WITH BILLIONS OF GALAXIES (p 16)
Prof. Steven M. KAHN (Stanford University, California)

Physics Education 2B	Astrophysics (1) 5A	Astrophysics (2) 4B	Space Science 5B	Applied Physics (1) LT2
EDU - 2B **MR. RIJSDIJK, CASE**	**PhD Awards - General** **DR. ABEBE, AMARE**	**Survey data mining; Globular Clusters** **DR. ODENDAAL, ALIDA**	**Space Geodesy** **DR. NNDANGANENI, RENDANI**	**-** **DR. WAMWANGI, DANIEL**
An overview of the University of the Western Cape Physics Department Physics for teachers' program **Dr. HERBERT, Mark** (UWC) - 431	Modeling the JVLA primary beam using characteristic basis function **Mr. IHEANETU, Kelachukwu** (Rhodes University) PhD 105	Correlation study of multi-wavelength transient emission of selected CRTS cataclysmic variables **Ms. SZEGEDI, Helene** (UFS) MSc 55	Near-Earth Object Avoidance Mitigation: Profiting One Rock at a Time **Dr. MACLEOD, Gordon** (HartRAO) - 287	Solar water geysers - a South African perspective **Dr. FERRER, Phil** (Wits) - 237
Teaching students problem solving with the 'light bulb effect' cognitive diagrammatic representation **Dr. ALBERS, Claudia** (WITS) - 133	Direction Dependent Calibration for the KAT-7 radio data **Mr. KASSAYE, Ermias** (Rhodes University) PhD 246	Getting WISE on Star Formation **Ms. AUGUST, Tamlyn** (University of Cape Town) MSc 162	Development of an integrated model and system to enable optimal efficiency of the HartRAO LLR system **Dr. BOTHA, Roelf** (HartRAO) PhD 125	Hydrogen Fuel Cell Studies Using Neutron Radiography **Mr. DE BEER, Frikkie** (Necsa) - 232
Meeting the World's Needs for 21st Century Science Instruction – a synthesis of research and best practice **Mr. HORSZOWSKI, Peter** (PERT INDUSTRIALS) - 522	Rethinking IIR filters as part of real-time pulsar astronomy **Mr. JACQUES, Maritz** (UFS) PhD 50	Investigating gamma-ray fluxes from globular clusters **Ms. NDIYAVALA, HAMBELELENI** (NWU) MSc 144	Tube assembly experiments for optimal temperature sensor placement on the HartRAO Lunar Laser Ranger telescope **Mr. TSELA, Philemon** (University of Pretoria) PhD 517	Physics behind the life cycle and life cycle analysis of artisanal clay brick making **Mr. TSHIYOYO, Madjer Monatshiebe** (University of Johannesburg) - 509

Tea & Coffee Break

Physics Education 2B	Astrophysics (1) 5A	Astrophysics (2) 4B	Space Science 5B	Applied Physics (1) LT2
- **DR. RAMAILA, SAM**	**Compact Binaries** **DR. MCBRIDE, VANESSA**	**OAD: Virtual Observatory** **DR. BUCKLEY, DAVID**	**Open session and recent results** **Dr. MTUMELA, ZOLILE**	**-** **PROF. DERRY, TREVOR**
Student understanding of vectors **Mr. JOHN, Ignatius** (CPUT) **Mr. KUDINHA, Martin** (CPUT) - 201	The long-term evolution of the helium nova V445 Puppis **Prof. WOUDT, Patrick** (University of Cape Town) - 62	Astronomy for a Better World! **Mr. GOVENDER, Kevindran** - 546	Beam-driven slow and fast electron-acoustic solitons in three-electron temperature space plasmas **Mr. MBULI, Lifa Nicholas** (SANSA / UWC) PhD 81	Simple models for cytoskeleton **Prof. MÜLLER-NEDEBOCK, Kristian** (University of Stellenbosch) - 193
Is the Abstract/Concrete Distinction a Useful Tool in Physics Education Research? **Mr. SOUTHEY, Philip** **Mr. SOUTHEY, Philip (UCT)** PhD 227	Characterising new Be/X-ray binaries in the Large Magellanic Cloud **Ms. VAN JAARSVELD, Johanna** (University of Cape Town) PhD 310	The Virtual Observatory Tools and its benefits **Dr. EL BOUCHEFRY, Khadija** (HartRAO) - 51	AfriSprite campaign 2015/16 **Mr. NNADIH, Stanislaus** (SpaceLab) MSc 21	Division Meeting: Applied
Student difficulties with DC circuits: misconceptions or sense-making? **Mr. JOHN, Ignatius** (CPUT) - 200	Magnetic Cataclysmic Variables in the Catalina Real-time Transient Survey **Ms. MOTSOALEDI, Mokhine** (SAAO) PhD 434		Automated Scheduling for a robotic astronomical telescope **Mr. MAARTENS, Deneys** (SALT) MSc 18	**Prof van Dyk, Ernest** - 535
Division Meeting: EDU **Dr. Sam Ramaila**	**PLENARY (LT1): FIRE, FLARES AND FUSION: SOME WANDERINGS IN PLASMALAND (p 16)** **Prof. Manfred HELLBERG (UKZN)**			

Lunch Break

ANNUAL GENERAL MEETING (LT1)

Tea & Coffee Break

PHYSICS BOWL (LT1)

Conference dinner

Thursday 7 July - Jameson Hall

18:30 Arrival
Measurement challenge at tables

19:00 Welcome by Master of Ceremonies:
Andy Buffler
Further welcome by the President of the SAIP:
Azwinndini Muronga
Starter is served
Bootleggers Blues Band

20:00 Awarding of student prizes
Awarding of Honorary Membership of the SAIP
Awarding of SA Physics Olympiad 2015 Gold Medal
Main course is served
Bootleggers Blues Band

21:30 - 23:39 Vote of thanks by SAIP2016 Chair, Roger Fearick, and hand-over of SAIP mace to SAIP2017
Dessert is served
DJ Rene and DJ Sobsfor

09:00 - 10:00	**PLENARY (LT1): STRONGLY INTERACTING MATTER AT HIGH ENERGY DENSITY (p 17)** Dr. Larry MCLERRAN (Brookhaven National Laboratory, New York)				
TRACK	**Division for Physics of Condensed Matter and Materials (1) - LT1**	**Division for Physics of Condensed Matter and Materials (2) - 4B**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Theoretical and Computational Physics (1) 2A**	**Photonics 5C**
Theme Chair	General Orals DR. CHIRWA, MAX	General Orals DR. OMOTOSO, EZEKIEL	- DR. LEADBEATER, THOMAS	- DR. HOROWITZ, WILLIAM	- PROF. ROHWER, ERICH
09:40 - 10:00	Exceptionally Crystalline TiO2 Mesocrystals with Enhanced Light Harvesting Characteristics for solar energy conversion **Dr. HEGAZY, Aiat** (Nat. Research Centre) 34	Effect of Annealing Temperature on Optical and Electrical Properties of ZnO Thin Films Synthesized by Sol-Gel Method **Mr. TRILOK KUMAR PATHAK** (Gurukula Kangri Univ) 37	BAGEL: the HPGe clovers array at K600 spectrometer **Dr. PELLEGRI, Luna** (Wits and iThemba) 29	NON-SPECIALIST LECTURE: Nonequilibrium processes and their fluctuations	Modelling of a 2 micron cladding-pumped cw Tm-doped silica fibre laser **Dr. WU, Lorinda** (CSIR-NLC) 451
10:00 - 10:20	Structural and luminescence properties of sol-gel derived BaMg2Al6Si9O30: Eu2+ nanophosphors **Dr. KUMAR, Ashwini** (UFS) 39	Thermal effects on the plasmonic properties of Ag embedded glass based metamaterials **Dr. KUMAR, Promod** (UFS) 42	Fine structure of the Isovector Giant Dipole Resonance of neutron-rich calcium isotopes using the (p,p′) reaction at zero-degrees **Dr. USMAN, Iyabo** (Wits) 369	**Prof. TOUCHETTE, Hugo** (NITheP) 159	Development of high-power and high-energy solid-state lasers and amplifiers **Dr. STRAUSS, Hencharl** (CSIR NLC) 387
10:20 - 10:40	NIR quantum-cutting OF Pr3+ and Yb3+ Codoped Fluoride crystal **Dr. YAGOUB, Mubarak** (UFS) 45		Observation of K-splitting in the Isoscalar Giant Quadrupole Resonance within the neodymium isotope chain using high energy-resolution inelastic proton scattering **Prof. CARTER, John** (Wits) 388	Dynamics and thermodynamics of open quantum Brownian motion **Dr. SINAYSKIY, Ilya** (NITheP and UKZN) 339	14 W Mid-Infrared Optical Parametric Oscillator based on Zinc Germanium Phosphate **Dr. KOEN, Wayne** (CSIR NLC) 285
10:40 - 11:10	**Tea & Coffee Break**				
TRACK	**Division for Physics of Condensed Matter and Materials (1) - LT1**	**Division for Physics of Condensed Matter and Materials (2) - 4B**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Theoretical and Computational Physics (1) 2A**	**Photonics 5C**
Theme Chair	General Orals PROF. NAIDOO, SR	General Orals DR. PROMOD THAKUR	- DR. BUCHER, TD	- DR. MALUTA, NE	- PROF. ROHWER, ERICH
11:10 - 11:30	Spectroscopic investigation of Tm3+ containing Lithium borate glasses **Dr. RAMTEKE, Durgaprasad** (UFS) 72	Dynamics of several ultra-cold particles in a double-well potential **Dr. SOWINSKI, Tomasz** (Institute of Physics of the Polish Academy of Sciences) 112	Search for chirality in 192Tl **Dr. NDAYISHIMYE, Joram** (iThemba LABS) 344	Computational study of TIO2 Brookite (1 0 0) surface doped with Ruthenium for application in dye sensitised solar cells **Dr. MALUTA, Nnditshedzeni Eric** (Univ. of Venda) 321	Holographic toolkit for optical communication beyond orbital angular momentum **Dr. ROSALES-GUZMAN, Carmelo** (Wits) 178
11:30 - 11:50	Ferromagnetism in magnetic 4f-systems **Dr. NOLTING, Volkmar** (VUT) 132	Internal quantum efficiency and energy transfer processes in Ce3+ co-doped ZrO2: Eu3+ nanorod **Dr. AHEMEN, Iorkyaa** (UFS) 187	Identification of chiral pairs in multiple chiral bands associated with the same nucleon configuration **Dr. SHIRINDA, OBED** (iThemba LABS, US) 356	Modeling of the Debye Temperature, Melting Entropy and Enthalpy of Nanomaterials **Dr. SINGH, Madan** (Nat. Univ. of Lesotho) 1	Orthonormal polynomials for centred non-uniform rotationally symmetric pupils **Dr. MAFUSIRE, Cosmas** (UP) 327
11:50 - 12:10	Effect of calcination on structural and magnetic properties of nickel chromite **Dr. MOHANTY, Pankaj** (UJ) 206	Effect of thermal annealing on the electrical characteristics of Au/Ni Schottky contacts on high doped n-type 4H-SiC **Dr. OMOTOSO, Ezekiel** (University of Pretoria) 235	The design and simulation of a new experimental set up for measuring short nuclear level lifetimes **Mr. SINGH, Bhivek** (UWC) 370	Reduction of noise in CSDG MOSFET with HfO2 **Prof. SRIVASTAVA, VIRANJAY M.** (UKZN) 277	
12:10 - 13:10	**PLENARY (LT1): STUDIES OF THE SHAPES OF HEAVY PEAR-SHAPED NUCLEI AT ISOLDE (p 17)** Prof. Peter BUTLER (University of Liverpool)				
13:10 - 14:00	**Lunch Break**				
TRACK	**Division for Physics of Condensed Matter and Materials (1) - LT1**	**Division for Physics of Condensed Matter and Materials (2) - 4B**	**Nuclear, Particle and Radiation Physics (1) LT3**	**Theoretical and Computational Physics (1) 2A**	**Astrophysics (1) 5A**
Theme Chair	General Orals DR. NOLTING, VOLKMAR	General PROF. SWART, HENDRIK	- PROF. MURONGA, A	- PROF. NEDEBOCK, K	Galaxies and GRBs DR. FRANK BRADLEY
14:00 - 14:20	Simonkolleite nano-platelets: Synthesis and temperature effect on hydrogen gas sensing properties **Dr. SITHOLE, Joseph** (UNISA) - 279	RBS-Channelling analysis into the effect of thermal annealing on GeSn strained layers **Prof. COMRIE, Craig** (UCT & iThemba LABS) - 74	First Run 2 Soft QCD Results from ATLAS **KAR, Deepak** (Wits) - 163	The hierarchal decision making algorithm as an analytical tool for a natural understanding physical systems **Mr. AGWA-EJON, JOHN FRANCIS** (UJ) - 416	Galaxy stacking strategies for MeerKAT **Dr. ELSON, Ed** (UCT and SAAO) - 315
14:20 - 14:40	Ion beam modification of diamond to DLC: A SBS, Raman and HRTEM study **Prof. NAIDOO, Shunmugam Ramsamy** (Wits) - 379	Theory for diffusivity measurements when the temperature is ramped linearly **Prof. THERON, Chris** (University of Pretoria) - 119	Ads:CFT predictions for momentum correlations of bbbar pairs in heavy ion collisions **Mr. HAMBROCK, Robert** (UCT) - 515	The energy density as a function of spacetime for a light quark jet in AdS/CFT **Dr. MORAD, Razieh** (UCT) - 306	Identifying new narrow-line Seyfert 1 galaxies and white dwarfs from the second ROSAT all-sky survey catalogue **Dr. ODENDAAL, Alida** (UFS) - 180
14:40 - 15:00	Electrical characterisation of defects induced in GaN by electron beam exposure **Mr. NGOEPE, Phuti** (UP) - 452	Computational modelling of sulphides mineral (FeS_2) **Dr. LETSOALO, Thabo** (University of Limpopo) - 373	The search for the Dark Vector Boson via the Higgs Portal **Prof. CONNELL, Simon** (UJ) - 104	Radial Flow in Non-Extensive Thermodynamics and Study of Particle Spectra at LHC in the Limit of Small $q-1$ **Dr. BHATTACHARYYA, Trambak** (UCT) - 66	Observing Gamma-Ray Bursts with the H.E.S.S. experiment **Dr. GARRIGOUX, Tania** (NWU) - 385
15:00 - 15:20	Sustained pairing frees dipolar traits and the circular current's own magnetic dipolar nature **Dr. CHIRWA, Max** (WSU) - 455		Implementation of the pre-amplifier response function for the iThemba LABS segmented clover detector **Dr. BUCHER, Thifhelimbilu D** (iThemba LABS) - 372	Phenomenology of additional scalar bosons at the LHC **Dr. KUMAR, Mukesh** (Wits) - 449	
15:20 - 15:40	Search for dilute magnetism in 3*d* doped III-Nitrides - Results from Mössbauer Spectroscopy **Dr. MASENDA, Hilary** (Wits) - 476		Tracking Electrons Produced by Compton Scatter within a Prompt Gamma Imaging Device **Dr. PETERSON, Stephen** (UCT) - 157	Next to leading order electron-quark interaction **Dr. KEMP, Garreth** (UJ) - 302	
	Tea & Coffee Break				

PLENARY (LT1): STRONGLY INTERACTING MATTER AT HIGH ENERGY DENSITY (p 17)
Dr. Larry MCLERRAN (Brookhaven National Laboratory, New York)

Physics Education 2B	Astrophysics (1) 5A	Space Science 5B	Applied Physics (1) LT2
- DR. TAYLOR, DALE	HE Astrophysics and Quasars DR. BUCKLEY, DAVID		- DR. KHANYILE, NCAMISO
Analysis of Electric Circuits using MATLAB and Simulink **Mr. ERO, Felix** (Lead City University) - 445	A comparative timing and spectral analysis of Suzaku X-ray data of the nova-like variable system AE Aquarii **Dr. VAN HEERDEN, Hendrik Jacobus** (UFS) - 141		Activated carbon derived from tree bark biomass for high performance electrochemical capacitors **Dr. MOMODU, Damilola** (UP) - 298
Tests that promote physics learning **Dr. HERBERT, Mark** (University of the Western Cape) - 430	The contribution of photons from the circumstellar disc to gamma-gamma absorption in PSR B1259-63 **Dr. VAN SOELEN, Brian** (UFS) - 392		Measurements of Atmospheric Carbon Dioxide in South Africa **Mr. MUDAU, Azwitamisi** (Nat. Resources and the Environment) - 402
	Low mass supermassive blackholes of quasars and the low frequency radio luminosity correlation **Mr. MGUDA, Zolile** (UCT) - 453		Dose perturbation effects of unilateral Ti prosthesis in the dosimetry of 6 MV photon beam **Dr. ADE, Nicholas** (UFS) - 20

Tea & Coffee Break

Physics Education 2B	Astrophysics (1) 5A	Space Science 5B	Applied Physics (1) LT2
- DR. ALBERS, CLAUDIA	Pulsars, Galaxies DR. JOSEPH, TANA	DR. HABARULEMA, JOHN BOSCO	- PROF. VAN DYK, ERNEST
Teaching problem-solving by means of shoestring experiments **Prof. NAIDOO, Deena** (Wits) - 138	Spatially-Dependent Modelling of Pulsar Wind Nebulae **Mr. VAN RENSBURG, Carlo** (North-West University) - 255	SILVER MEDALLIST LECTURE: 3D Models of Stellar Wind **Dr. MOHAMED, Shazrene** (SAAO) - 357	NON-SPECIALIST LECTURE: Photonics Prototyping Facility **Dr. NAIDOO, Darryl** (CSIR) - 527
Operating the New Naval Hill Planetarium - An innovative and entrepreneurial approach **Prof. HOFFMAN, Matthiam** - 487	Discovery of the First White Dwarf Pulsar **Dr. BUCKLEY, David** (SAAO) - 250		
The metacurriculum of first year physics service courses **Dr. TAYLOR, Dale** (UCT) - 521	Investigating the hot gas in active Brightest Cluster Galaxies **Mrs. RATSIMBAZAFY, ANDO** (North-West University) - 36	Solar Total Irradiance Behaviour during Cycle 23-24 **Dr. KOTZE, Pieter** (SANSA) - 11	Effect of atmospheric turbulence on entangled photon field generated by partially coherent pump beam **Dr. JOSHI, Stuti** (UKZN) - 272

PLENARY (LT1): STUDIES OF THE SHAPES OF HEAVY PEAR-SHAPED NUCLEI AT ISOLDE (p 17)
Prof. Peter BUTLER (University of Liverpool)

Lunch Break

Physics Education 2B	Astrophysics (1) 5A	Applied Physics (1) LT2
- MR. SOUTHEY, PHILIP	See page 30	- DR. GIBBON, TIMOTHY
Faculty-Student Interaction - The Informal Revolution **Mr. SCHWARTZ, Marthnis Johannes** (UniZulu) - 224		Heterogeneous powders ID by means of fracture mechanics **Dr. VIGLIATURO, Ruggero** (UKZN) - 319
A new approach to teaching graphs to first year science students **Mr. TSIPA, AJ** (UniZulu) - 380		Efficiency measurement system for thermoelectric devices **Dr. MARIOLA, Marco** (UKZN) - 266
Fluid Dynamics as a precursor to a "Griffiths level" Electrodynamics course **Dr. TUPPER, Gary** (UCT) - 482		Spark Plasma Sintering of 2507 duplex stainless steel **Dr. SULE, Richard** (Wits) - 422
I taught them everything, but they still couldn't get it right **Mr. MOLEFE, Paul** (UJ) - 273		Physical stability of ionic liquid polymers for the recovery of Se and Te from metallurgical aqueous solutions **Ms. MOGOMETSI, Mpho** (UJ) - 448
Multiple Choice Question Responses: Right or Wrong? **Dr. MASENDA, Hilary** (Wits) - 477		Preparation and characterization of nanoporous carbon from expanded graphite for high energy density supercapacitor in aqueous electrolyte **Dr. BARZEGAR, Farshad** (UP) - 12

	Physics Education 2B
15:40 - 16:00	Termites in our tests? The role of stigmergy in our examination system **Mr. CLERK, Douglas** (Wits) - 135
16:00 - 16:20	Using Wolfram Mathematica to Analyze and Visualize experimental data **Mr. DEMPERS, Clemens** (Blue Stallion Technologies) - 582

Tea & Coffee Break

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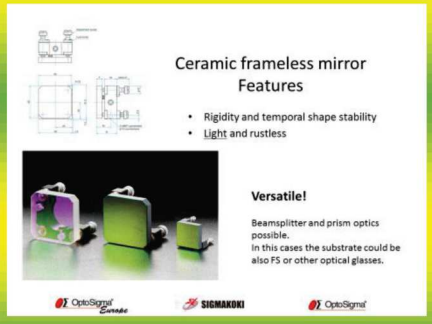

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Poster Sessions 1 & 2

POSTER SESSION 1 Tuesday 05 July 2016

Poster Session (1): Physics of Condensed Matter and Materials; Nuclear, Particle and Radiation Physics; Physics Education (16:10-18:00)

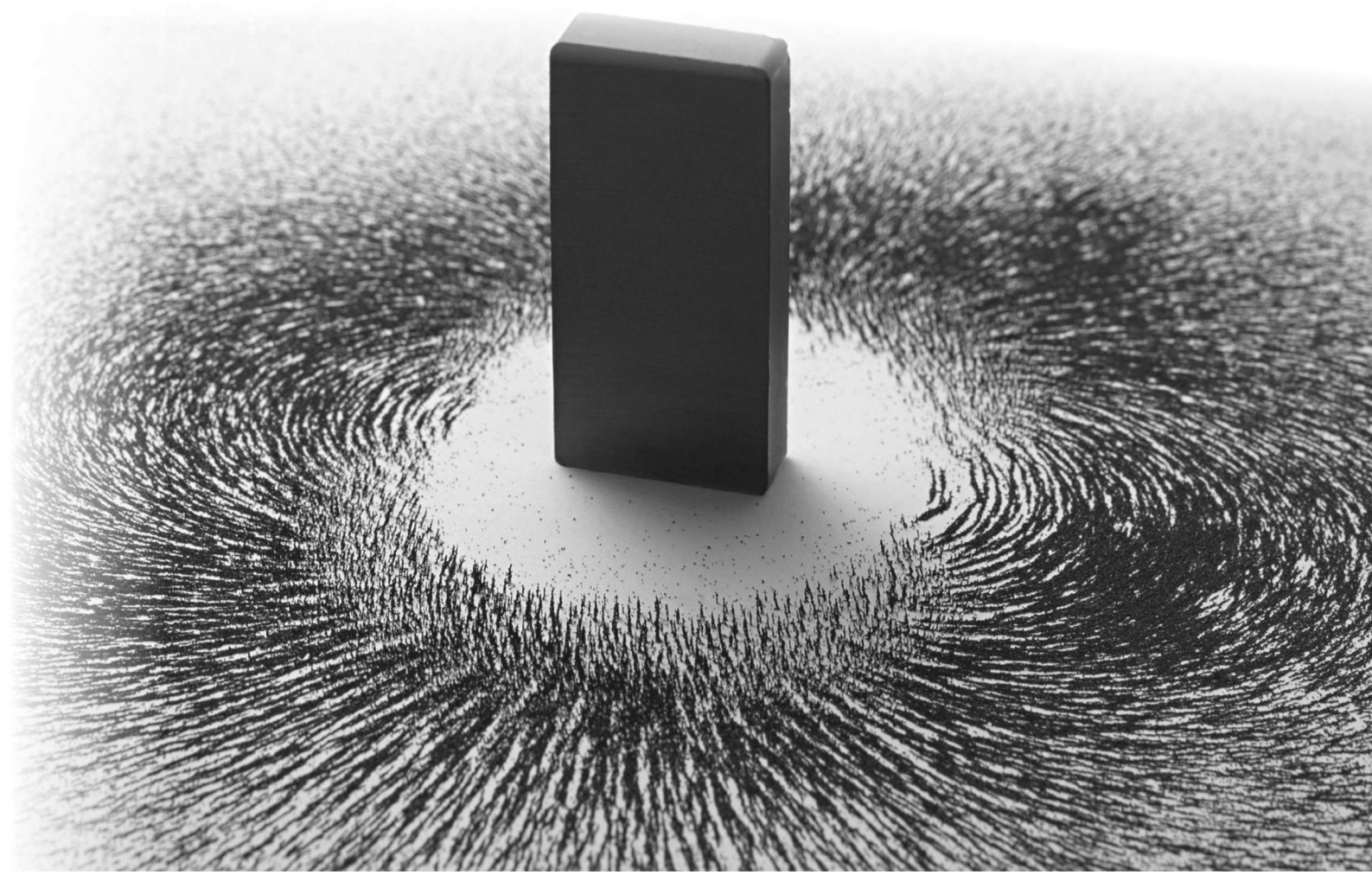
- Chair : Prof. Engelbrecht, Japie; Dr. Mullin, Simon; Dr. Ramaila, Sam

Board	Presenter	Title *[For Award]*
A.003	ENGELBRECHT, Japie	Problems with the calculation of the refractive index of $In_xGa_{1-x}As$
A.009	IGUMBOR, Emmanuel	Ab– initio study of transition metals impurities and stability of complexes in Ge. *[For award:* PhD*]*
A.023	MOTLOUNG, Setumo Victor	The effects of Cd2+ concentration on the structure, optical and luminescence properties of MgAl2O4:x% Cd2+ nanophosphor prepared by sol-gel method
A.033	LEE, Edward	Synthesize and characterisation of optical properties of a down-converting Y_2O_3 phosphor co-doped with Bi^{3+} and Yb^{3+}. *[For award:* MSc*]*
A.040	CARLESCHI, Emanuela	$Ce_{1-x}La_xCu_4Al$ as a case study for the investigation of Ce 4*f* wave function evolution from a coherent to a local Kondo effect
A.046	PHAAHLA, Tshegofatso Michael	Effect of pressure on the nanostructured of TiO2 during recrystallisation *[For award:* MSc*]*
A.049	MALATJI, kemeridge Tumelo	Phase Stability Study of Nickel Doped Spinel $LiMn_2O_4$ Using Cluster Expansion Method
A.056	KOAO, Lehlohonolo	Effect of annealing temperature on LiMn2O4 nanostructures prepared by chemical bath method
A.057	BEDYAL, Ankush Kumar	Thermoluminescence investigation of Sm^{3+} activated $NaSrBO_3$ phosphors for gamma dosimetry. *[For award:* PhD*]*
A.069	YIHUNIE, Moges Tsega DEJENE, F. Birhanu	Blue-yellow luminescence of Eu-doped CaSnO3 nanopowders synthesized by the sol-gel autocombustion process
A.073	TSUEN, Jessica	van Hove singularities in $Sr_3Ru_2O_7$ *[For award:* Hons*]*
A.076	MASHAMAITE, Mordecai	First-principle study of $Ti_{50-x}Pt_{50}Zr_x$ High temperature shape memory alloys *[For award:* MSc*]*
A.080	HASABELDAIM, Emad	Structure and luminescence of sol-gel spin coated ZnO films *[For award:* MSc*]*
A.085	VAN NIEKERK, Chani	Precise visualisation of dispersive low-energy features in ARPES spectra *[For award:*Hons *]*
A.096	MATSHABA, Malili	Molecular dynamics studies of Lithium intercalation into amorphous structure of Titanium dioxide (TiO_2) nanoparticle
A.100	AKINTUNDE, Samuel	Formation of a Thin Film of AB compound Layer at a Low Irradiation Temperature under the Influence of Radiation Induced Interstitial. *[For award:* PhD*]*
A.101	DEBELO, Nebiyu	Pulsed laser deposited KY3F10:Ho3+ phosphor thin films *[For award:* PhD*]*
A.142	MAENETJA, Khomotso	Density Functional Theory study of stability of rutile MnO_2, VO_2 and TiO_2 *[For award:* PhD*]*
A.143	MASENYA, Mamogo	Density functional theory study of PtS surfaces *[For award:* MSc*]*
A.156	TSHWANE, David Magolego	Computer simulation studies of spinel $LiMn_2O_4$ surfaces
A.174	JILI, Thulani	Pick-off annihilation of delocalized positronium in BaF2 at elevated temperatures
A.188	AHEMEN, Iorkyaa	Effect of Eu3+ ion concentration on phase transition, site symmetry and quantum efficiency of ZrO2 nanocrystal rods
A.191	MUDAU, patience	Magnetic properties of Cr +2.9 at.% Al thin films *[For award:* MSc*]*

A.195	LETHOBANE, Manthako	The Thermolysis of zinc acylthiourea complexes to form metal chalcogenides *[For award:* MSc*]*
A.203	SONDEZI, Buyi	Development of Metal-flux based Crystal-growth Facility
A.207	MOHANTY, PANKAJ	Role of swift heavy ion irradiation on structural and magnetic properties of $Ti_{0.95}Co_{0.05}O_{2-\delta}$ epitaxial thin films
A.209	PELWAN, Chad	Understanding proton induced radiation damage in plastic scintillators using electron paramagnetic resonance and DFT modelling *[For award:* MSc*]*
A.222	JAKATA, Kudakwashe	Surface Brillouin scattering studies of VC thin films deposited on SiC
A.240	RIKHOTSO, B.N	Atomistic simulations studies on the structural change in Li_xTiO_2 (x: 2.82, 3.76, 6, 57) at high temperatures for energy storage in Lithium-ion Battery Applications. *[For award:* MSc*]*
A.253	TCHOULA TCHOKONTE, Moise Bertin	Magnetic and Kondo behaviour in Ce8Pd24(Al1-xSnx)
A.258	BASHIR, Aiman	Interplay of antiferromagnetic and Kondo effect in $Ce_8Pd_{24}Al$ *[For award:* PhD*]*
A.259	LEDWABA, Raesibe Sylvia	Characterization of Complex Spinel $LiMn_2O_4$ Nanosheet Simulated via Armorphization and Recrystalization Technique *[For award:* PhD*]*
A.264	VENTER, Danielle	Deep Level Transient Spectroscopy of GaSb/GaAs Quantum Dots *[For award:* MSc*]*
A.291	KAMENI BOUMENOU, Christian	Measurement of the surface potential of AlGaAs/GaAs heterostructures using Kelvin Probe Force Microscopy *[For award:* MSc*]*
A.293	MBULE, Pontsho Sylvia	Sol-gel synthesis of $Zn_2SiO_4:Mn^{2+}$ phosphors and the effect of rare-earth ions co-doping on their photoluminescence
A.294	PHALA, Michael Feredi	Preparation of organically modified Vermiculite and calculation of intercalation energies of polymers into both unmodified and organically modified Vermiculite
A.295	MEHLAPE, Mofuti	Molecular dynamics simulations of the interactions between water molecules and sulphide nanoparticles
A.303	MAYIMELE, Meehleketo Advice	High energy electron irradiation influence on the Schottky barrier hieght and the Richardson constant on Pd/ZnO Schottky barrier diodes *[For award:* PhD*]*
A.305	MOKOEAN, Jimmy	Optimisation of spin-coating parameters for fabrication of thin film polyaniline-based nuclear radiation sensors
A.312	MOKOENA, Mpho S	Down-conversion process in Dy3+, Yb3+ co-doped TiO2 nanophosphor powder *[For award:* MSc*]*
A.314	NDALA, Zakhele	The Bottom-up synthesis and characterization of molybdenum dichalcogenide nanomaterials for applications in supercapacitors *[For award:* MSc*]*
A.322	DANGA, Helga Tariro	Thermal stability of titanium Schottky contacts and defects introduced in epitaxial p-Si *[For award:* PhD*]*
A.325	MASOGA, Phala	Structural prediction of β-MnO2 nanoclusters using global search techniques *[For award:* PhD*]*
A.332	DEJENE, Francis	Effects of precursor concentration on morphological, structure and optical properties of TiO2 synthesised via sol-gel method
A.337	TSHABALALA, Kamohelo George	Effect of annealing temperature on the structure, morphology and optical properties of Sm^{3+} doped lanthanum phosphovanadate
A.347	KIPROTICH, Sharon	Effect of refluxing growth time on structural, optical and luminescence properties of zinc telluride Quantum dots *[For award:* MSc*]*
A.351	OSMAN, Nadir	Effect of different synthesis methods on structure, morphology and magnetic properties of CoFe2O4 nanoparticles
A.365	MKHONTO, CHRESTINAH	High temperature and phase transformation studies of Pt_3Al compounds *[For award:* MSc*]*
A.382	UNGULA, Jatani	Effects of doping ratio on structural, luminescence and transmittance properties of Ga–Doped ZnO nanoparticles by precipitation reflux method *[For award:* PhD*]*

A.389	MWANKEMWA, Benard Saamwel	Influence of Hexamethylenetetramine on the Low Temperature Chemical Bath Deposited ZnO Nanorods *[For award:* PhD*]*
A.393	MALEBATI, Magoja Martinus	Beneficial effects of Cobalt on ZrNb alloy using density functional theory and virtual crystal approximation. *[For award:* MSc*]*
A.396	SHINGANGE, Katekani	Microwave-assisted method derived ZnO nanostructures with various morphologies: Effect of pH on PL, magnetic and sensing properties. *[For award:* MSc*]*
A.407	HARRIS, Richard	Simulating Iron Oxide Nanoparticle Oscillations in different Electric Fields.
A.414	TSHABALALA, Zamaswazi	The Effect of Annealing Temperature on the Sensitivity and Selectivity of TiO_2 base Gas Sensors *[For award:* MSc*]*
A.433	MBONGO, Mduduzi	Iron (III) Oxide Nanostructured Thin Films Based Selective Solar Absorber for Concentrating Solar Power Application *[For award:* PhD*]*
A.437	MOLEFE, Fokotsa	Spectroscopic investigation of charge and energy transfer in P3HT/GO nanocomposites *[For award:* PhD*]*
A.447	SHUMBULA, Ndivhuwo	Synthesis and characterization of gold nanoparticles and their functionalization using dodecanethiol *[For award:* MSc*]*
A.450	BALOYI, Kenneth KIRUI, Joseph JHAMBA, Lordwell	Characterisation of the optical properties of silver nanoparticles (Ag NPs) for use in the enhancement of the performance of an organic photovoltaic (OPV) device. *[For award:*Hons *]*
A.469	CHONCO, Nelisiwe	Growth and characterization of RuO_2 thin films nanostructures
A.472	MOTLOUNG, Selepe Joel	Enhanced photoluminescence emission from Dy^{3+} and Tb^{3+} activated lanthanum phosphovanadate
A.485	TAGHIZADEH, Fatemeh	Identification of a third stable state associated with E3 center in GaAs. *[For award:* PhD*]*
A.486	OSTVAR, Kian	Application of uniaxial stress with Laplace DLTS as a structure sensitive characterization technique. *[For award:* MSc*]*
A.488	MEYER, Walter	Growth and characterisation of an AlGaAs double barrier resonant tunnelling diode for use in a fast analogue to digital converter.
A.510	THERON, Chris	Commissioning of a Molecular Beam Epitaxy (MBE) system for III-V semiconductor growth
A.514	SITHOLE, Rudo	Copper nitride nanoparticles for use in optoelectronic devices *[For award:* PhD*]*
B.014	JURBANDAM, Linina	Evaluation of Fission Energy Deposition in the SAFARI-I Nuclear Reactor *[For award:*Hons *]*
B.063	SOWAZI, Khanyisa	Investigating the Gamma-Ray Strength Function in 74Ge using the Ratio Method *[For award:* MSc*]*
B.118	MCCONNELL, Lucas	Estimation of non-prompt fake muon background in scattering of two massive vector bosons (VBS), $W W \rightarrow W W$.
B.161	MUKWEVHO, ndinannyi justice	Measurement of the first $^{+}$ state in $^{9}B^{*}$ *[For award:* MSc*]*
B.164	MAVELA, Lihleli	Determination of spectroscopic quadrupole moment of the first excited state in 32S. *[For award:* MSc*]*
B.179	AKAKPO, Elijah	Disentangling second-order effects in Coulomb Excitation Theory: (Reorientation and Nuclear Polarizability Effects) *[For award:* MSc*]*
B.190	MDHLULI, Joyful	Neutron irradiation and damage assessment of plastic scintillators of the TILECAL section of the ATLAS detector. *[For award:* MSc*]*
B.212	THUSINI, Xolisile	Estimation of the fake rate background in same sign $W^{+mn}W^{+mn}$ production at the LHC with ATLAS Detector *[For award:* MSc*]*
B.226	MABIKA, Phumzile Zandile	The --> branch in ^{19}Ne β -decay *[For award:* MSc*]*
B.278	NEVELING, Retief	Particle and gamma decay studies: an update on the K600

B.286	EASTON, Jayson	Optimizing the 90 degree scattering setup for determining the coordinates of the interaction points inside the iThemba LABS segmented clover detector. *[For award:* PhD*]*
B.301	ABRAHAMS, Kenzo	Zig zag of quadrupole shapes in sd-shell *[For award:* PhD*]*
B.364	ELHAG, Elmughera	Novel method to make a calibrated thoron source *[For award:* PhD*]*
B.403	KHUMALO, Nontobeko	The Spectroscopy of ^{162}Hf at Low and High Spins *[For award:* PhD*]*
B.418	BOTHA, Nolan	Fine structure of the Isoscalar Giant Monopole Resonance in ^{208}Pb, ^{90}Zr, ^{58}Ni and ^{40}Ca using medium energy Alpha-particle Scattering at Zero Degree
B.426	DINOKO, Tshepo	Orientation of the Ge Crystals of the iThemba LABS Segmented Clover Detector
B.480	LORRAINE, Tebogo	Feasibility Study of Electron Source Production at iThemba LABS *[For award:* HONS*]*
B.496	NONCOLELA, Sive	Crystal orientation of the iThemba LABS segmented clover detector *[For award:* PhD*]*
B.497	KAMIL, mohamed	spectroscopy of proton unbound states in 32Cl for nuclear structure and astrophysical studies. *[For award:* MSc*]*
E.030	RAMAILA, Sam	University physics students' perceptions of teaching methods
E.031	RAMAILA, Sam	Self-efficacy beliefs of physical science teachers
E.032	RAMAILA, Sam	University science students' self-efficacy – A case of physics learning
E.466	ANTOINE F., Mulaba-Bafubiandi	Physics of the artisanal mining of sandstones in a rural community
E.501	LEEUW, Lerothodi	Astronomy for Teachers Update: Teaching the Strand Planet Earth and Beyond in Primary School Natural Science



POSTER SESSION 2 Wednesday 06 July 2016

Poster Session (2): Photonics; Astrophysics; Space Science; Applied Physics; Theoretical and Computational Physics - (16:10-18:00)

- Chair: Prof. Rohwer, Erich; Dr. Engelbrecht, Christian; Dr. Habarulema, John Bosco; Prof. van Dyk, Ernest; Prof. Müller-Nedebock, Kristian

Board	Presenter	Title *[For Award]*
C.005	IDISI, David Omoefe	Creation and detection of vector Bessel beams using digital axicons *[For award:* MSc*]*
C.038	WYNGAARD, Adrian	Measurements of the hyperfine and weak field Zeeman spectra of Rb 85 and Rb 87 *[For award:* MEng*]*
C.052	PATEL, Meena	Nonlinear optical processes and saturated absorption spectroscopy in two and multi-level atoms: a theoretical and numerical study *[For award:* MEng*]*
C.083	JAMES, Stubb	The design of a cost effective high precision time measurement unit for use in a Hanbury-Brown Twiss interferometer
C.102	SEPHTON, Bereneice	Characterization of a Q-Plate in terms of Hyper-Geometric Gaussian modes *[For award:* MSc*]*
C.175	COX, Mitchell	Generating Arbitrary Optical Vector Beams *[For award:* PhD*]*
C.184	SINGH, Asmita	Applying the technique of Ultrafast Pump-Probe spectroscopy on the main plant light-harvesting complex of spinach leaves *[For award:* MSc*]*
C.251	MADLALA, Bigboy	Low cost passively Q-switched laser *[For award:* MSc*]*
C.263	MREDLANA, Prince	The Wigner distribution function in modal characterisation *[For award:* MSc*]*
C.283	LUGONGOLO, Masixole	The effect of low level laser therapy on both HIV infected and uninfected TZM-bl cells *[For award:* PhD*]*
C.371	BERRY, Gareth	Classical light simulations of quantum measurements *[For award:* MSc*]*
C.383	GAILELE, Lucas	Free-space data transfer using the spatial modes of light *[For award:* MSc*]*
C.441	NGCOBO, Sandile	Digitally transforming high-order mode to a high brightness beam
C.454	NDEBEKA, Wilfrid	Determination of thin silicon sample thicknesses using linear and nonlinear optical methods *[For award:* PhD*]*
C.461	BELL, Teboho	Digital laser mode amplification using ND: YAG amplifier *[For award:* PhD*]*
C.474	VILJOEN, Ruan ERASMUS, Anneke DWAPANYIN, George	Development of non-linear microscopy infrastructure *[For award:* MSc*]*
C.479	MATJELO, Naleli	RF Generation for Ion Trapping Experiments *[For award:* PhD*]*
D1.015	WINKLER, Hartmut	Analysis of the rich optical iron-line spectrum of the x-ray variable I Zw 1 AGN 1H0707-495
D1.053	EL BOUCHEFRY, Khadija	Outreach and Education with the Virtual Observatory
D1.154	NYAMAI, Miriam Mumbua	Multi-wavelength variability and optical identification of a selection of supersoft X-ray sources *[For award:* MSc*]*
D1.204	FRANK, Bradley	Gas Accretion and Triggering in NGC 3998
D1.275	VAN DER WESTHUIZEN, Izak	Emission modelling of numerical hydrodynamical simulations with application to Active Galactic Nuclei jets *[For award:* MSc*]*
D1.280	HAILEMARIAM, Mekuanint Kifle	New Calibration Sources for Very Long Baseline Interferometry at 1.6 GHz *[For award:* MSc*]*
D1.320	HEALY, Julia	Finding the needle in Galaxy Evolution: HI Stacking *[For award:* MSc*]*

D1.334	SORGHO, Amidou	Observing 5 MHONGOOSE galaxies with the KAT-7
D1.358	MARAIS, Johannes Petrus	Long-term monitoring of TeV Blazars with the Watcher Robotic Telescope *[For award:* MSc*]*
D1.366	KLUTSE, Diana	Studying the thermal history of the intergalactic medium with the redshifted 21-cm line
D1.391	BEZUIDENHOUT, Tiaan	Calibration of a statistical method used to constrain pulsar geometries via light curve modelling *[For award:* Hons*]*
D1.406	MOHARANA, REETANJALI	Ultrahigh-energy neutrino events in current and future neutrino telescopes from nearby Gamma-Ray Bursts *[For award:* PhD*]*
D1.423	BUTTON, Charissa MRWETYANA, Nosicelo	Follow up studies on delta Schuti star: HD 75656
D1.484	DJIEDEU, Nicodeme	Nature of forces acting on the terrestrial globe
D1.490	DIRIRSA, Feraol F.	Isotropic energy and luminosity correlations with spectral peak energy for five long GRBs *[For award:* PhD*]*
D1.503	LEEUW, Lerothodi	The Sub-millimeter Continuum Emission of Selected Nearby Active Galaxies
D1.507	LEEUW, Lerothodi	Optical Spectra of Herschel Gravitational Lenses and their Astrophysical Implications
D2.010	DE VILLIERS, Jean	Geomagnetic derivation of current strengths and electric fields of three current systems in the ionosphere and magnetosphere.
D2.216	ANSARI, Ahsan	Computerised Ionospheric Tomography (CIT) for supportive GNSS-derived ionospheric applications *[For award:* Hons*]*
D2.217	AVERY, Megan	SQUID Magnetometer Filter Design and Data Analysis *[For award:* Hons*]*
D2.218	AZZOPARDI, Nick	Ionospheric Scintillation Proxies derived from geodetic GPS receiver data *[For award:* Hons*]*
D2.219	LUCKEY, Clare	HF Propagation Systems for African communications *[For award:* Hons*]*
D2.220	MCCAUGHNA, Andrew	Calculation of air density through measurements of falling spheres *[For award:* Hons*]*
D2.221	VARGO, Eric	Ionospheric Irregularities studies using GPS and radio astronomy interferometers *[For award:* Hons*]*
D2.265	CILLIERS, Pierre	Surface Impedance Derived from the South African Magnetotelluric Network for the estimation of geomagnetically induced currents in the South African Power network
D2.363	VERMEULEN, Annelie	Ionospheric characterisation of the South Atlantic Magnetic Anomaly using a ship-based dual-frequency GISTM receiver *[For award:* MSc*]*
D2.436	SNELL, Holly	Modelling and testing the effects of space radiation on space borne electronic components *[For award:* MSc*]*
F.008	NETHWADZI, LUTENDO CHRISTOPHER	Modelling the Linke Turbidity for solar irradiance in South Africa *[For award:* MSc*]*
F.013	MUNTHALI, Kinnock Vundawaka	Structural and electrical properties of ruthenium thin films on 6H-SiC annealed in the air
F.024	ALAWAD, Bilal	Growing zirconium carbide (ZrC) layers by CVD using ZrCl4 mixed with CH4,Ar and H2 *[For award:* PhD*]*
F.044	KHALEED, Abubakar	The effect of activated carbon on the CO sensing performance of NiO *[For award:* PhD*]*
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F.070	KHALEED, Abubakar	Facile hydrothermal synthesis of $Ni(OH)_2$-graphene foam composite for supercapacitor application *[For award:* PhD*]*
F.078	CHIMOWA, George	Improving gas sensing properties of multi-walled carbon nanotubes by vanadium oxide encapsulation

F.079	MELAPI, Aviwe	Characterization and implications of Soot generated from Pinewood gasification *[For award:* MSc*]*
F.084	OVEREN, Ochuko Kelvin	Characterization and Thermal Load Impact of Reflective Coatings on a Low Cost House in Alice, South Africa *[For award:* PhD*]*
F.088	NANA, YONGOUA	Dynamic Model to Evaluate the Performance of Residential Air Source Heat Pumps in South Africa *[For award:* MSc*]*
F.089	BANTAN MAFOR, GLORY	Performance evaluation of a domestic split-type air conditioner in South Africa, a case study of ALICE *[For award:* MSc*]*
F.110	MADIMA, Ntakadzeni	Synthesis of nanostructured molybdenum disulfide (MoS2) for photodegradation of organic dyes from aqueous solution *[For award:* MSc*]*
F.114	OBILEKE, KECHRIST	The design and performance monitoring of fabricated Biogas Digester using plastic *[For award:* PhD*]*
F.117	OTIENO, Francis	Effect of annealing of P3HT:PCBM blend in the performance of organic solar cell devices *[For award:* MSc*]*
F.128	USMAN, Ibrahim B.	Metal Oxide N-doped CNTs decorated Gas sensors *[For award:* PhD*]*
F.150	MALINDISA, RAMOKONE CHRISTINA	Tin oxides nanostructures: Synthesis, characterization and their photocatalytic application. *[For award:* MSc*]*
F.151	CONNELL, Simon	Using Geant4 to create 3D maps of dosage received within a MinPET diamond sorting facility
F.153	CONNELL, Simon	A genetic algorithm approach to enhancing the performance of a PET detector array
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F.181	NTOZAKHE, Luyolo	Effect of carbon doping on the structural, optical and electronic properties of zinc oxide nanoparticles synthesized by pneumatic spray pyrolysis technique. *[For award:* MSc*]*
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F.241	BOIYO, Duncan	Characterization and Compensation of Fibre Link Dispersion in a 10 Gb/s Flexible Network *[For award:* PhD*]*
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F.254	NAIDOO, Kreason Aaron RAMOHOEBA, Nonky	Africhino Quasi-Computer *[For award:* Hons*]*
F.256	NWOKOLO, Nwabunwanne	DESIGN, MANUFACTURE AND PERFORMANCE EVALUATION OF A WASTE HEAT RECOVERY UNIT IN A GASIFICATION PLANT *[For award:* PhD*]*
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F.330	NICLETTE, Eloko	Materiallurgy of macadamia nut shell explained using its physical properties
F.336	DIX-PEEK, Ross	Qualitative comparison of advanced characterisation techniques of Photovoltaic cells *[For award:* MSc*]*
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F.350	MEGNE-TIEGUM-, Adeline	Physics of clayey soils to explain their geophagic, traditional pottery making and paints applications
F.390	MAMPHWELI, SAMPSON	A review on the benefits of Biogas Technology from the Renewable Energy, Environment and Agronomy perspectives
F.428	HERBERT, Mark	A comparison of neutron energy distributions unfolding codes used with a NE213 detector

F.460	KURIA, Jonah	Surface Brillouin Scattering studies of Transition metal nitrides thin films deposited by RF Magnetron Sputtering *[For award:* PhD*]*
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F.494	NEKHUBVI, vhutshilo 1st mountaineer TINARWO, DAVID	Second stage distribution of biogas to an area of application after the first stage distribution has reached the zero pressure as displayed on the gauge *[For award:* PhD*]*
F.499	OSAYEMWENRE, Gilbert	Photo-thermal degradation analysis of single junction amorphous silcion solar module EVA encapsulation
F.504	CONNELL, Simon	Novel PET detector with high throughput electronics for Mineral-PET
F.508	CHINAKA, Eric	MCNPX based Radiation Shielding Analysis for the Mineral-PET Kimberlite Sorting Facility
G.043	MANYALI, George S.	Enhanced properties of thermoelectric materials for technological applications
G.087	STRAUSS, Du Toit	Stochastic differential equations as a powerful numerical tool
G.140	JULE, Leta	Computational Model of solid-state lithium ion batteries *[For award:* PhD*]*
G.171	ANDRIAMBELAZA, Noeliarinala Felana	First-principles studies of transition metal defects in a molybdenum disulfide (MoS_2) monolayer *[For award:* PhD*]*
G.231	KIRAN, Zubia	Dust heating by Alfvén waves using non-Maxwellian distribution function
G.242	TSOBGNI NYAWO, Pelerine	Driven non-equilibrium systems modeled with Markov processes *[For award:* PhD*]*
G.248	SEKGA, COMFORT MAFU, Mhlambululi	Multiparty Quantum State Sharing of an arbitrary unknown three particle state with GHZ state measurements
G.261	MOGLIACCI, Sylvain	Analytical Results for the Tsallis Thermodynamic Variables in a Hot and Dense System
G.281	RAVAL, Haresh	suitability of quadratic gauge for non-perturbative QCD *[For award:* PhD*]*
G.289	SEKGA, Comfort MAFU, Mhlambululi	Quantum state sharing of an arbitrary three particle state using Einstein-Podolsky-Rosen pairs and GHZ state measurements
G.308	AMOUZOUVI, Kossi	Density Functional Theory on a Lattice: Self-consistence Hartree plus Exchange Approximation. *[For award:* PhD*]*
G.343	DESPOTULI, Alexandr ANDREEVA, Alexandra	Theory of fast ion transport on nanoscale and computer exploration
G.346	SALAGARAM, Trisha	Visualizing higher order Brillouin zones with applications
G.360	ELS, Paul	Open Quantum System approach to spontaneous formation of prebiotic molecules in interstellar space. *[For award:* MSc*]*
G.377	RUGUT, Elkana	An ab initio density functional theory study of structural, electronic, magnetic and optical properties of Niobium diphosphide (NbP2) *[For award:* MSc*]*
G.483	MOSUANG, Thuto	Structural and dynamical properties of oxygen and cerium vacancies in cerium dioxide

BOOK OF ABSTRACTS:
Oral Contributions

1 - Modeling of the Debye Temperature, Melting Entropy and Enthalpy of Nanomaterials

Theoretical and Computational Physics (1) - Friday 08 July 2016 11:30
Primary author: *SINGH, Madan (National University of Lesotho)*
Co-author: *TLALI, Spirit (National University of Lesotho)*

Free surface atoms experience a different state than do atoms in the bulk of material. As a consequence, the energy associated with these atoms will be different from the atoms of the bulk. The excess energy associated with the surface atom is called the free surface energy. In bulk materials, such free energy is neglected because it is associated with only few layers of atoms near the surface and the ratio of the volume occupied by the surface atoms and the total volume of the material is extremely small. However for the nanomaterials, the surface to volume ratio is significant. Based on this theory, we report a theoretical model, free of adjustable parameters, the shape and size dependent Debye temperature, Melting entropy and Enthalpy of Au, Ag and In nanomaterials. In this report, we adopt the top down approach using classical thermodynamics by considering Lindemann's criterion to study the size and shape effect. The results obtained are compared with the available experimental data. A good agreement between the model prediction and the experimental data support the theory developed.

2 - A Multi-frequency analysis of dark matter annihilation interpretations of recent anti-particle and gamma-ray excesses in cosmic structures.

Astrophysics (1) - Tuesday 05 July 2016 10:00 *[For award: PhD]*
Primary authors: *BECK, Geoff (University of Witwatersrand); COLAFRANCESCO, Sergio (University of the Witwatersrand)*

Annihilation of the supersymmetric neutralino dark matter has consequences across the frequency spectrum, from radio to gamma-rays. Using the sensitivity projections for the Square Kilometre Array (SKA), Cherenkov Telescope Array (CTA) and ASTRO-H Satellite, we determine the detection prospects for neutralino models compatible with FERMI observations of the galactic centre as well as those consistent with the AMS-2/Pamela anti-proton excess. We also examine the consequences of recent gamma-ray excesses observed in the Reticulum 2 dwarf galaxy which throw a dark matter interpretation of the excess into doubt. We demonstrate that both the SKA and ASTRO-H have great potential to probe the radio/X-ray emissions from neutralino annihilation, identifying spectral characteristics containing information about the neutralino mass and annihilation channel. Thus, multi-frequency observation with the next generation of experiments will allow for unprecedented sensitivity to the neutralino parameter space as well as offsetting the individual weaknesses of each observation mode.

4 - Modelling of Radiological Risks from Gold Mine Tailings in Gauteng Province, South Africa

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 09:40 *[For award: PhD]*
Primary author: *KAMUNDA, Caspah (North West University (Mafikeng))*
Co-authors: *MATHUTHU, Manny (North West University (Mafikeng)); MADHUKU, Morgan (iThemba LABS)*

Mining is one of the major causes of elevation of Naturally Occurring Radionuclide Materials (NORMs) concentrations on the earth's surface. The aim of this study was to evaluate the human risk associated with exposure to NORMs in soils from mine tailings around a gold mine. A broad energy germanium detector was used to measure activity concentrations of these NORMs in 56 soil samples from 5 mine tailings. RESidual RADioactivity (RESRAD) OFFSITE modeling program (version 3.1) was then used to estimate the radiation doses and the cancer morbidity risk for a hypothetical resident scenario. The average activity concentrations in Bq.kg-1 for Uranium-238 (238U), Thorium-232 (232Th), and Potassium-40 (40K) were found to be 785.3±13.7, 43.9±1.0 and 427.0±13.1, respectively. According to RESRAD prediction, the maximum Total Effective Dose Equivalent (TEDE) during 1,000 years was found to be 0.0315 mSv/yr at year 28, while the maximum total excess cancer morbidity risk for all the pathways was 5.76 × 10-5 at year 20. South Africa considers the individual cancer risk limit for members of the public to be 5 x 10-6. This means that total excess cancer morbidity risk was higher than the acceptable limit rendering gold mine tailings unsafe.

6 - Understanding of vector addition and subtraction by first year university students: graphical versus algebraic methods

Physics Education - Tuesday 05 July 2016 11:10
Primary author: *CARLESCHI, Emanuela (Department of Physics, University of Johannesburg)*

Vectors constitute a fundamental building block for any introductory physics course at university level. Vector concepts are used in topics such as motion, forces, linear and angular momentum, and torque, and therefore need to be properly mastered by students. The understanding of vector addition and subtraction by first year university students was investigated for both the arrow representation and the algebraic notation (using unit vectors **i** and **j**) in a generic mathematical context. In particular, students enrolled in the first semester module *General Physics for Earth Sciences* at the University of Johannesburg were given a series of tests dealing with vectors in one- and two-dimensions. Questions in these tests were structured in such a way as to probe students' capabilities in manipulation of vectors for different relative orientations (with aligned and/or opposing *x*- and *y*-components) for both graphical and algebraic methods. Students' performance shows that difficulties are mostly found in the use of the graphical representation. The average performance in the *i-j*format was excellent. In some of these questions the average score was higher by 60% with respect to the score in the arrow-format-type questions. Some of the trends include scores being comparatively higher for vectors in 1D than in 2D, as well as for the addition than the subtraction of vectors. For subtraction of vectors in one-dimension, the score was definitively worse when the vector to be subtracted points in the negative direction. Interestingly, there is no such trend for vectors in 2D. Having positive or negative *x*- and *y*-components does influence the solution path in the subtraction of 2D vectors. Post-test interviews were carried out in order to understand the lack of understanding and the misconceptions leading to mistakes, which will also be reported.

7 - The Need for a Physics Olympiad

Physics Education - Tuesday 05 July 2016 14:00
Primary author: *RIJSDIJK, Case (ASSA/SAIP)*

South Africa, like every other country around the world, has a huge, latent talent, much of it in the rural areas, that needs to be indentified, nurtured and monitored. But South Africa has unique challenges, and some of these will be highlighted, as will several ways of addressing these. Past successes and methods will be discussed and the final goal stated.

11 - Solar Total Irradiance Behaviour during Cycle 23-24

Space Science - Thursday 07 July 2016 11:10
Primary author: *KOTZE, Pieter (SANSA)*

Solar total (integrated over all wavelengths) irradiance measurements by the VIRGO experiment on the SOHO satellite have been analysed during cycle 23-24, covering the period 1996 till 2014. The most recent minimum of solar activity was deeper and longer than any previous period as evidenced by various indicators of solar activity (e.g. sunspots, geomagnetic indices) as well as total solar irradiance (TSI). Solar activity levels during solar maximum are considerably different from those during the declining or minimum phases of a solar cycle. Daily mean TSI measurements are used to identify how several harmonics of the 27-day recurrent period change during cycle 23-24, applying a 95% confidence level. Spectral analysis using Lomb-Scargle and Morlet wavelet techniques of TSI data showed that during the solar maximum of cycle 23 the 27-day recurrence period is dominating, while during the anomalously low minimum of cycle 23-24 the 13.5 and 9.0-day periods corresponding to the 2nd and 3rd harmonics of the synodic solar rotation period, are prominent above the 95% confidence level. An investigation of the power spectra showed that the spectra fit a power law with different scaling exponents at solar maximum (2001) and solar minimum (2008), highlighting the self-affine properties of the TSI time series. It will also be shown, using Pearson correlations, that the detection of different recurrence intervals can be traced to an unusual combination of the sectorial spherical harmonic structure in the solar magnetic field and the tilting of the solar dipole field. It is therefore reasonable to conclude that the recent minimum 23-24 was characterised by the solar dynamo obtaining a state of unusual asymmetry.

12 - Preparation and characterization of nanoporous carbon from expanded graphite for high energy density supercapacitor in aqueous electrolyte

Applied Physics (1) - Friday 08 July 2016 15:20
Primary author: *BARZEGAR, Farshad (University of Pretoria)*
Co-authors: *BELLO, Abdulhakeem (Department of Physics University of Pretoria); MOMODU, Damilola (UNIVERSITY OF PRETORIA); MADITO, Moshawe (Student); DANGBEGNON, Kouadio Julien (University of Pretoria); MANYALA, Ncholu (University of Pretoria)*

In this work, we present the synthesis of low cost carbon nanosheets derived from expanded graphite dispersed in Polyvinylpyrrolidone, subsequently activated in KOH and finally carbonized in Ar atmosphere. Interconnected sheet-like structure with low concentration of oxygen (9.0 at.%) and a specific surface area of 457 m2 g-1 was obtained. The electrochemical characterization of the carbon material as supercapacitor electrode in a 2-electrode configuration shows high specific capacitance of 337 F g-1 at a current density of 0.5 A g-1 as well as high energy density of 37.9 Wh kg-1 at a power density of 450 W kg-1.This electrical double layer capacitor electrode also exhibits excellent stability after floating test for 120 h in 6 M KOH aqueous electrolyte. These results suggest that this activated expanded graphite (AEG) material has great potential for high-performance electrode in energy storage applications.

ORAL ABSTRACTS

16 - Evolution of Yukawa couplings in 5 dimensions for an SU(3) gauge group

Theoretical and Computational Physics (1) - Wednesday 06 July 2016 11:50 *[For award: PhD]*
Primary author: *KHOJALI, Mohammed Omer (Wits University)*
Co-author: *CORNELL, Alan (NITheP)*

We test, in a simplified 5-dimensional model with SU(3) gauge symmetry, the evolution equations of the Yukawa couplings of a model containing bulk fields, gauge fields and one pair of fermions. The evolution equations of the Yukawa couplings are derived for the one-loop renormalisation group equations, where we assume that the fermion doublet and two singlets are located at fixed points of the extra-dimension which is compactified on an S^{1}/Z_{2} orbifold.

18 - Automated Scheduling for a robotic astronomical telescope

Space Science - Thursday 07 July 2016 11:50 *[For award: MSc]*
Primary author: *MAARTENS, Deneys (SALT)*
Co-authors: *MARTINEZ, Peter (UCT); VAN ROOYEN, Ruby (SKA)*

The Alan Cousins Automatic Photometric Telescope (APT) is a 0.75-m automatic photoelectric telescope commissioned in mid-2000. The sole science driver for the APT is photometry, used mainly for the long-term monitoring of variable stars. In addition, there is the potential for target-of-opportunity observations such as gamma ray bursts and solar eclipse observations.Ultimately the APT is expected to be fully robotic. Some advance toward this goal has been made. The next phase is the implementation of an automated scheduler that will generate a pool of valid observations for each night of observation. The aim of this project is to implement such an automated scheduling strategy for the APT.Scheduling related to science instruments is typically complex, since often the problem contains many interacting complex constraints and requires making preliminary scheduling choices that impact other choices later. Furthermore, sets of constraints are dependent on the particular scientific project being conducted, while new types of constraints may be added as the fundamental problem changes.Given these complex, often inseparably connected constraints, astronomy scheduling requires long-term planning as well as short-term optimisation. While one aspect of scheduling is to focus on optimising resource utilization, another aspect is the ability to recover from periods of bad observational conditions and other disruptions in the observing schedule.This leads us to consider a three-stage approach: Planning, scheduling, and observing. Planning and scheduling are distinctly different activities. Planning not only concerns setting up an observation plan for a telescope and/or instrument, but also relates to planning by the observatory on scheduling the observations to achieve some objective. Scheduling requires planning information to assess temporal assignment of observations to best achieve an execution plan. Observing has to deal with the dynamic conditions during execution of an observation through best-choice selection among possible options, based on available observation plans.

19 - Modelling Radiative Line Transfer in Maser Environments

Astrophysics (1) - Wednesday 06 July 2016 11:30 *[For award: PhD]*
Primary author: *VAN ROOYEN, Ruby (SKASA)*
Co-author: *VAN DER WALT, Johan (North West University)*

An astrophysical maser is a naturally occurring source of stimulated spectral line emission. To generate maser radiation, a molecular population inversion is required. This non-equilibrium inversion can be created by various pumping mechanisms, most typically infrared radiation and collisions. Spectral line emission from masers is stimulated (or seeded) and monochromatic, meaning the emitted photons have the same frequency and direction as the original photon, resulting in great amplification.In order to understand the pumping mechanisms and physical characteristics of masers, suitable models for the molecular excitation and radiative transfer must be developed.Complete solutions involve a multi-level system and requires a simultaneous solution for the level populations well as the transfer of radiation in all the lines that couple them. However, the escape probability method is an approximation that can be used to decouple the equations, thus enabling analysis in terms of level populations independent of radiative transfer.From a mathematical point of view, this decoupling allows the solution to be expressed as a matrix of coefficients acting on a vector of populations. In this form, the level populations can be obtained by a number of standard numerical methods, with the only prerequisite for a successful solution being a reasonable initial guess.The "masers" package was developed in Python and solves the matrix equation using molecular data and parameters describing the physical environment. It extends existing radiative transfer software by providing a reasonably fast, stable algorithm that deals with the solution method's inherent sensitivity to oscillations and multiple valid outcomes; allows different maser geometries for calculation; includes the contribution of interacting background radiation fields, as well as other sources of opacity such as line overlap.

20 - Dose perturbation effects of unilateral Ti prosthesis in the dosimetry of 6 MV photon beam

Applied Physics (1) - Friday 08 July 2016 10:20
Primary author: *ADE, Nicholas (Medical Physics Department, University of the Free State, Bloemfontein)*
Co-author: *DU PLESSIS, Freek (Medical Physics Department, University of the Free State, Bloemfontein)*

During irradiation of malignancies in the hip region with external megavoltage photon beams, the presence of metallic prostheses could partially shield the beam at the target and alter the dose distribution. This may cause a dramatic difference in treatment outcome. This study investigates the magnitude of 6 MV photon beam dose perturbations caused by unilateral titanium prosthesis and were measured with Gafchromic EBT2 film in a pelvic phantom made out of nylon slices. Dose perturbations were measured and compared using dose maps and beam profiles for a range of field sizes between 3×3 and 10×10 cm^2. The magnitude of these perturbations were quantified as dose correction factors, DCFs which is defined as the ratio of the dose influenced by the prosthesis and the unaltered beam. A DCF of unity marks the margin between dose enhancement (where DCF > 1.0) and dose reduction (where DCF < 1.0). DCFs above unity were observed on the proximal (beam entry) side of the prosthesis while DCFs below unity occurred in the distal region (behind the prosthesis). For the studied field sizes maximum DCFs ranged between 1.251±0.003 and 1.283±0.019. Minimum DCFs ranged between 0.746±0.010 and 0.810±0.014. The DCFs on the proximal side of the prosthesis drop off rapidly with distance from the proximal prosthesis-nylon interface. The results of the study indicate that at the nylon-prosthesis interface, about 25% of dose enhancement is due to electron backscatter from the prosthesis and at least 19% of dose reduction behind the prosthesis is due to photon attenuation.

21 - AfriSprite campaign 2015/16

Space Science - Thursday 07 July 2016 11:30 *[For award: MSc]*
Primary author: *NNADIH, Stanislaus (SpaceLab, Electrical Engineering Department)*
Co-authors: *MARTINEZ, Peter (UCT); KOSCH, Michael (SANSA)*

Sprites are the electrical discharge that occurs over an active thunderstorm in the mesosphere. Recent studies suggest that sprite initiation could affect the chemistry of the middle atmosphere or interfere with long-range distance communication through the lower ionosphere. Sprite research has been actively conducted in all other continents excluding Africa, which has been termed a “dark continent” due to the infrastructural limitation to contribute to this study. This paper describes the effort made by the South African National Space Agency to conduct middle atmospheric research in Africa, which led to the observation of approximately 100 sprites over southern Africa during the summer of 2015/16. This study also shows that sprites over southern Africa have the same morphology as those observed elsewhere and in most cases they occur in clusters. The methodology used for this campaign can be applied to the study of the Transient Luminous Events in other parts of Africa. Future plans are presented

22 - Setup and Operation of a Readout Chamber of the ALICE Transition Radiation Detector

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 14:20 *[For award: Hons]*
Primary author: *VAN TONDER, Raynette (University of Cape Town)*
Co-authors: *DIETEL, Tom (University of Cape Town); FINLAY, Chris (University of Cape Town)*

ALICE is CERN’s only experiment dedicated to heavy-ion collisions. The Transition Radiation Detector(TRD) of ALICE is used mainly to distinguish between electrons and pions, by achieving a rejection factor of 100 for background particles with momenta above 1 GeV/c. Additionally, the TRD is a fast tracker and can be used as a trigger for electrons and jets with high transverse momenta, which is useful when studying rare particles. The TRD consists of 540 readout chambers that are put together in 18 supermodules, arranged azimuthally around the Time Projection Chamber. Each readout chamber consists of a radiator, a gas detector with a 3 cm drift region and a multiwire proportional chamber, and readout electronics mounted on the back panel of the chamber. A readout chamber of the TRD was installed in the Physics Department at the University of Cape Town and will be utilised in a laboratory practical for senior students. In this presentation we will discuss the setup of the detector as well as its operation. We will describe the necessary infrastructure: the Data Acquisition(DAQ) system, high and low voltage power supplies, etc. Finally, we will show first performance measurements of the Readout Chamber, based on first recorded data.

28 - Thermal Model and Tsallis distribution for Large Hadron Collider

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 09:40
Primary author: *WORKU, DAWIT (Cape Peninsula University of Technology)*
Co-author: *CLEYMANS, Jean (University of Cape Town)*

The hadron resonance gas model and its extension to include the Hagedorn spectrum is discussed. The Hagedorn temperature, TH is determined from the number of hadronic resonances including all mesons and baryons. This leads to the result TH = 174 ± 11 MeV consistent with the critical and the chemical freeze-out temperatures at zero chemical potential. We apply this result to calculate the speed of sound and other thermodynamic quantities in the resonance hadron gas model for a wide range of baryon chemical potentials using the chemical freeze-out curve. We compare some of our results to those obtained previously papers. Furthermore, a discussion is presented of results with identified particles at the Large Hadron Collider. Possible deviations from the standard statistical distributions are investigated by considering in detail results obtained using the Tsallis distribution. Theoretical issues are clarified concerning the thermodynamic consistency of the Tsallis distribution in the particular case of relativistic high energy quantum distributions. An improved form is proposed for describing the transverse momentum distribution and fits are presented together with estimates of the parameter q and the temperature T.

29 - BAGEL: the HPGe clovers array at K600 spectrometer

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 09:40
Primary author: PELLEGRI, Luna *(University of Witwatersrand and iThemba LABs)*
Co-authors: *ADSLEY, Philip (University of Stellenbosch/iThemba LABS); PESUDO, Vicente (UWC); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); STEYN, Deoin (iThemba LABS); SMIT, Frederick David (iThemba LABS); BRUMMER, Johann (Stellenbosch University); CARTER, John (University of the Witwatersrand); LI, Kevin (Stellenbosch University, iThemba Labs); MARIN-LAMBARRI, Daniel (UWC); NEVELING, Retief (iThemba LABS); PAPKA, Paul (Stellenbosch University)*

The 8 HPGe clover detectors of the AFRODITE array will be coupled to the K600 spectrometer at iThemba LABs to allow coincident measurements of the γ-decay of nuclei excited in inelastic hadron scattering at 50–200 MeV incident energies. Compared to previous experiments, where NaI detectors have been used, the energy resolution of the γ-detection will be improved by more than one order of magnitude in the energy region of interest. The coincident measurement of the γ-decay in inelastic hadron scattering experiments is very useful for the separation of nearby excitations, the assignment of multipolarities, the determination of branching ratios and to study the isospin character of excitations. Preparations for such particle-γ coincidence measurements started as far back as 2012. In December 2012 a successful test measurement of the (α,α'γ) reaction on 24Mg at 160 MeV was performed using two HPGe Clover detectors from the AFRODITE array. The results demonstrated that HPGe detectors can be used nearby the target chamber in coincidence with the K600 spectrometer to separate the excitations of interest and to determine branching ratios. A particular physics case that can be study with this experimental set-up is the Pygmy Dipole Resonance (PDR). This resonance can be interpreted as the vibration of the excess neutrons against the core. Studies of the PDR are currently almost exclusively focused on spherical nuclei. Only a few measurements on the PDR have been performed in deformed nuclei so far. These measurements showed the presence of a double-hump structure of the PDR in these deformed nuclei similar to the one observed in the GDR. To investigate in more detail what is the contribution of the deformation to this excitation mode, an (α,α'γ) experiment aimed at the study of the PDR character in the deformed 154Sm nucleus via inelastic scattering of 120-MeV α particles.

34 - Exceptionally Crystalline TiO2 Mesocrystals with Enhanced Light Harvesting Characteristics for solar energy conversion

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 09:40 *[For award: N/A]*
Primary author: HEGAZY, Aiat *(National Research Centre)*
Co-authors: *ALLAM, Nageh (The American University in Cairo); ELSAYED, Ahmed (The American University in Cairo)*

Titanium dioxide (TiO2) is one of the most abundant compounds in our planet. It is cheap, non-toxic, highly chemically and thermally stable semiconductor material. Titanium dioxide nanoparticles (TiO2-NPs) show high visible light transparency combined with high UV light absorption. However, altering the particle size and crystalline structure of TiO2-NPs influences the absorption range, adsorption of dye molecules and electron transfer rate at the surface. Unfortunately, TiO2-NPs suffer high electron/hole recombination rates. Therefore, an ordered superstructure consisting of nanoparticles on the scale of nanometers to several micrometers is proposed; titanium dioxide mesocrystals (TiO2-MCs). In this work, we represent a new and facile way to fabricate TiO2-MCs with spherical structure by sol-gel method. We were able to fabricate spherical TiO2-NCs with narrow size distribution by controlling the hydrolysis conditions. The effect of air annealing on the morphology, size shrinkage, and phase transition of the nanoparticles was studied by scanning electron microscopy, X-ray diffraction, and Raman spectroscopy. Also, the fabricated TiO2-MCs showed exceptional photoactivity compared to their degussa p-25 nanoparticles counterparts upon their use in dye-sensitized solar cells and water splitting cells.

35 - 2HDM and the LHC

Theoretical and Computational Physics (1) - Thursday 07 July 2016 09:40 *[For award: MSc]*
Primary author: MOSOMANE, Chuene *(University of Witwatersrand)*
Co-authors: *CORNELL, Alan (University of Witwatersrand); KAR, Deepak (University of Witwatersrand)*

The discovery of a 125 GeV Higgs particle at the Large Hadron Collider in 2012 which has properties as expected in the Standard Model (SM) was a major milestone for particle physics. More recently the ATLAS experiment has reported several excesses in the search for di-Higgs boson resonances and other Higgs-related channels. These excesses can be explained by a heavy scalar with a mass in the range 275-285 GeV, together with a scalar dark matter candidate with a mass around 55-60 GeV. The SM Higgs boson can be realised within the Inert Doublet Model (IDM)- a version of the two-Higgs doublet Model (2HDM) with an unbroken parity symmetry under which one of the SU(2) doublets is the SM Higgs doublet with one SM Higgs boson, and the second SU(2) doublet transforms non-trivially and has no vacuum expectation value and doesn't interact with fermions. In this proceedings, we shall review the 2HDM together with the IDM from the starting point of the SM, in particular how elementary particles gain mass through the Higgs mechanism. As the 2HDM is a theory which goes beyond the SM, it has a richer particle spectrum. The most general potential of a 2HDM is Lorentz invariant and renormalizable containing 14 free parameters, with the most general Yukawa Lagrangian giving rise to flavour changing neutral currents which are strongly constrained by experiment. We shall also discuss CP-violation which may arise in the scalar potential.

36 - Investigating the hot gas in active Brightest Cluster Galaxies

Astrophysics (1) - Friday 08 July 2016 11:50
Primary author: RATSIMBAZAFY, ANDO *(North-West University)*
Co-author: *LOUBSER, Ilani (North-West University)*

We investigate a crucial phase in the cooling-feedback cycle in the unusual star forming Brightest Cluster Galaxies (BCGs) by looking at the optical emission line properties of the reheated gas that ultimately causes the cycle to repeat. We investigate the source(s) of ionisation of the hot, optical line emitting gas in BCGs. No single dominant ionisation mechanism can reproduce the observed emission lines, and it is possible that a mixture of the heating mechanism(s) applies to the nebula(e). To identify the dominant ionisation processes, excitation sources, morphology and kinematics of the hot gas, more line ratios over the entire optical wavelength range is necessary. For this purpose, the spatially-resolved spectra over the entire optical wavelength range for eight nearby, active BCGs in X-ray luminous groups and clusters have been obtained with SALT. The sample was chosen to have Halpha detections, strong indication of star formation activity and existing data from X-ray regime available. The fundamental gas properties such as electron density, gas temperature, metallicity and several abundances were derived using the spectral features in the long wavelength coverage. The present optical sample will be combined with the other multi-wavelength data to form a complete view of the different phases (hot and cold gas and young stars) and how they interact in the processes of star formation and feedback detected in central galaxies in cooling flow systems, as well as the influence of the surrounding intracluster medium (ICM). The preliminary results will be presented, which includes the complexity and spatial variation of the ionisation mechanisms in the nuclei, as well as the large variety of hot gas properties in BCGs.

37 - Effect of Annealing Temperature on Optical and Electrical Properties of ZnO Thin Films Synthesized by Sol-Gel Method

Division for Physics of Condensed Matter and Materials (2) - Friday 08 July 2016 09:40
Primary author: TRILOK KUMAR PATHAK, Trilok *(Gurukula Kangri University, Haaridwar, India)*
Co-authors: *KROON, Ted (University of the Free State); SWART, Hendrik (University of the Free State); PROMOD THAKUR, Promod (Department of Physics , University of The Free State, Bloemfontein,South Africa,9300)*

Zinc oxide (ZnO) is a multifunctional material having unique physical properties as well as chemical and photo stability. Its large bandgap of 3.27 eV and exciton binding energy of 60 meV at room temperature give it great importance in the field of optoelectronic devices and solar cell applications. Despite several approaches adopted for making ZnO thin films, various parameters affecting these materials still need to be investigated. Therefore, it is essential to evaluate optimum conditions for fabrication of highly oriented and transparent ZnO thin films. ZnO thin films were synthesized on ITO coated glass substrates by the sol-gel process using spin coating at 2500 rpm for 30 s. The precursor sol was prepared by mixing 2-methoxyethanol and zinc acetate dehydrate and using mono-ethanolamine as stabilizer. After annealing at temperatures of 350 °C, 450 °C and 550 °C, structural, optical and electrical studies were carried out. X-ray diffraction patterns show the crystalline nature of the ZnO thin films while the (002) peak reveals their hexagonal wurtzite structure. Scanning electron microscopy results revealed that the grain size decreases as the annealing temperature increases. Optical transmittance of the thin films was about 80% obtained in the range 400-800 nm using a UV-VIS spectrophotometer. The optical bandgap varies from 3.26 to 3.28 eV as calculated using Tauc's plot method. The band to band emission peak was observed at 384 nm and luminescence intensity increases with increasing annealing temperature. The current-voltage characteristics of ZnO films show ohmic behaviour and the resistivity decreases with increasing annealing temperature. These highly transparent and conducting ZnO thin films can be used in solar cells and optoelectronics devices.

39 - Structural and luminescence properties of sol-gel derived BaMg2Al6Si9O30: Eu2+nanophosphors

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 10:00
Primary author: KUMAR, Ashwini *(University of the Free State)*
Co-author: *TERBLANS, JJ (Koos) (UFS)*

Single phased Eu2+activated BaMg2Al6Si9O30 phosphors were synthesized by modified sol-gel combustion technique. The phase purity, particle sizes and luminescence properties of the prepared phosphors have been investigated systematically by using powder X-ray diffraction (XRD), transmission electron microscopy (TEM), and the photoluminescence (PL) techniques.In addition, the effects of annealing temperature and Eu2+ doping concentration on the PL intensities were also investigated. In order to understand the structure property relationship better, Rietveld refinement analysis has been performed for the BaMg2Al6Si9O30:Eu2+ phosphor.The phosphor showed only one blue emission band peaking at 494 nm under 325 nm near UV excitation, corresponding to the 4f65d1–4f7 transition of the Eu2+ ion. The results show that the phosphor has the highest emission intensity at 1 mol % of Eu2+ which should be considered as the quenching concentration. The XRD pattern of the as-obtained BaMg2Al6Si9O30 powder was perfectly indexed to hexagonal crystalline phase with lattice constants of a = 10.129 Å, b = 10.129 Å and c = 14.340 Å (JCPDS No.01-83-740). No peaks of any other phases or impurities were observed from the XRD patterns, indicating that the BaMg2Al6Si9O30 crystalline phase with high purity could be obtained using the present synthesis route. The average crystallite size obtained using Scherrer's equation was around 70 nm which was later confirmed by TEM. The concentration quenching mechanism due to dipole–dipole interaction has been studied and the critical energy-transfer distance was calculated to be ~5.8 Å. The band gap of the synthesized phosphors was calculated from diffuse reflectance spectra using the Kubelka–Munk function. The PL characteristics of the prepared phosphor showed the excitation matched well with the solid state lighting excitation sources and emission in the blue region of the spectrum indicating that Eu2+activated BaMg2Al6Si9O30 nanophosphors may be applicable for solid state lighting with stable physical as well as chemical properties.

ORAL ABSTRACTS

41 - Quantum Corrections to the Kink-Antikink Potential

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 10:20 *[For award: MSc]*
Primary author: *LEE, Zander (Stellenbosch University)*
Co-author: *WEIGEL, Herbert (Physics Department Stellenbosch University)*

In field theory vacuum polarization effects may significantly alter classical predictions for non-perturbative configurations. This is particularly the case when comparing the vacuum polarization energy (VPE) of different topological sectors that represent different particle numbers. For this reason we calculate the VPE of the kink-antikink interaction in models with one time and one space dimension. We compute the VPE from the spectral method. This approach makes heavy use of scattering data for fluctuations around the non-perturbative background configuration. In a first step we compare our numerical results for the (anti)kink background in the ϕ^4 and sine-Gordon models to analytical results from the literature. In the next step the VPE is computed for backgrounds that have a kink and antikink at a certain separation. Since each calculation is done at a fixed separation, we must exclude quantum fluctuations from modes which correspond to the variation of this separation. This enforces an orthogonality constraint in the symmetric channel. Ultimately, the first order quantum correction to the kink-antikink potential is extracted from the calculation of the VPE.

42 - Thermal effects on the plasmonic properties of Ag embedded glass based metamaterials

Division for Physics of Condensed Matter and Materials (2) - Friday 08 July 2016 10:00
Primary author: *KUMAR, Promod (University of the Free State)*
Co-authors: *PRAKASH, JAI (University of the Free State, Bloemfontein); TRILOK KUMAR PATHAK, Trilok (Gurukula Kangri University, Haaridwar, India)*

Plasmon resonance in noble metals such as Ag, Cu and Au at the nanoscale is technologically important for various applications as it opens up a new horizon at the nanoscale. Silver embedded in a soda-lime glass matrix was synthesized by the ion-exchange (Ag+ - Na+) method followed by thermal annealing in an air atmosphere. The effects of annealing temperature and time on the plasmonic response and optical activity of the silver in soda-lime glass have been investigated using Ultra violet-visible absorption spectroscopy and photoluminescence. The surface plasmon resonance (SPR) at a hybrid metal–dielectric interface for silver was shown to be influenced by the presence of Ag+ ions and the increased particle size of the Ag nanoparticles as a function of post annealing temperature. This study revealed that the SPR and the luminescence properties were strongly dependent on the glass matrix, which could not be achieved in all types of glass slides. During annealing the Ag+ is reduced to Ag0 atoms and subsequently forms silver nanoparticles in the oxidizing atmosphere. The particle sizes calculated from Mie theory were in excellent agreement with the size measured from Field Emission Gun Transmission Electron Microscope (FEGTEM). The nano-sized Ag nanoclusters on the glass matrix may be suitable for the future prospective for potential applications in optical data storage devices.

45 - NIR quantum-cutting OF Pr3+ and Yb3+ Codoped Fluoride crystal

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 10:20
Primary author: *YAGOUB, Mubarak (University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); COETSEE, Elizabeth (University of the Free State)*

A possible quantum cutting process between the Pr3+ and Yb3+ ions in CaF2 was investigated to increase solar cell efficiencies. There are certain phosphor materials that can transform the energy of one absorbed high energy photon into two (or more) emitted low energy photons. This process is known as quantum-cutting (down-conversion) with a quantum efficiency of more than 100 %. The down-conversion materials based fluorides have stood out among other candidates because of their low phonon energy (which reduces the non-radiative electronic relaxation processes). The Pr3+-Yb3+ down-conversion couple in CaF2 materials was synthesised by the co-precipitation method. X-ray diffraction patterns indicate that the samples crystalized completely into the pure face-centred cubic structure (space group: Fm3m). Energy transfer occurred subsequently from Pr3+ to Yb3+ followed by an intense NIR (~ 1000 nm) emission spectral range. The energy transfer process is indicated by the decrease in the Pr3+ related photoluminescence (PL) and lifetime results with increasing Yb3+ concentration. The energy transfer is completed at a high concentration but the Yb3+ emission intensity decreased as a result of concentration quenching. Keywords: Quantum-cutting, energy transfer, fluoride material, Pr3+-Yb3+ couple.References:1. B. M. van der Ende, L. Aartsa and A. Meijerink, “Lanthanide ions as spectral converters for solar cells”. Phys. Chem. Chem. Phys. 2009, 11, 11081-11095.2. X. Huang, S. Han W. Huang, X. Liu, “Enhancing solar cell efficiency: the search for luminescent materials as spectral converters”. Chem. Soc. Rev. 2013, 42, 173-201.

47 - Investigation of Luminescence Properties of Dy3+ Doped different Alkaline based White-light emitting Phosphors

Division for Physics of Condensed Matter and Materials (1) - Wednesday 06 July 2016 14:40 *[For award: PhD]*
Primary author: *AVULA, Balakrishna (University of The Free State)*
Co-authors: *KUMAR, Vinod (Centre for Energy Studies, Indian Institute of Technology Delhi, New Delhi-110016, India); SHARMA, ASHWINI (UNIVERSITY OF THE FREE STATE); NTWAEABORWA, O. Martin (University of The Free State)*

Dy3+ doped different alkaline based sodium-phosphate (NaMPO4, where M= Mg, Ca, Sr and Ba) phosphors were prepared by solution combustion method. The prepared phosphors were characterized by powder X-ray diffraction, field emission scanning electron microscope (FE-SEM), fluorescent spectrophotometry and UV–vis spectroscopy. The XRD and FE-SEM results confirm that the samples contain mixed phases of crystals. The band gap of the phosphors was calculated from diffuse reflectance spectra data using the Kubelka–Munk function. The excitation spectra of the phosphors showed a broad band extending from 250 to 500 nm, which are characteristics of near ultraviolet (NUV) excitation wavelength for light emitting diode (LED). Upon near-UV excitation, the phosphor emits intense blue and yellow with a weak red band emissions, which originate from 4F9/2→6H15/2, 6H13/2, 6H11/2 transitions of Dy3+ ion. Different results on the luminescence features of Dy3+:NaMPO4 will be discussed on the basis of crystal structure. The effect of the Dy3+ concentration on the luminescence properties of NaMPO4:Dy3+ phosphors will also be discussed. The calculated CIE coordinates were found to be lying in the white region of the horse shoe plot of color gamut. All the results imply that the Dy3+:NaMPO4 phosphors could be used as a NUV excited white LEDs.

50 - Rethinking IIR filters as part of real-time pulsar astronomy

Astrophysics (1) - Thursday 07 July 2016 10:20 *[For award: PhD]*
Primary authors: *JACQUES, Maritz (UFS); PIOTR, Osuch (UP)*
Co-authors: *TINUS, Stander (UP); PIETER, Meintjes (UFS)*

The interstellar medium between the observer and a pulsar under investigation can be modeled as a cold plasma which alters the characteristics of electromagnetic radiation emitted by a pulsar event. Dispersion and scattering effects, which primarily contribute to the altered electromagnetic characteristics, ultimately influence our ability to detect pulsar events. In this paper we propose, for the first time, an infinite impulse response filter to correct for the aforementioned effects in real-time. Computational improvements over existing finite impulse response solutions are demonstrated using an FPGA implementation. A new possibility of trading elastic storage space for reduced computational complexity is further presented.

51 - The Virtual Observatory Tools and its benefits

Astrophysics (2) - Thursday 07 July 2016 11:30
Primary author: *EL BOUCHEFRY, Khadija (HartRAO)*

The Virtual Observatory (VO) is an international astronomical community-based initiative. It aims to allow users to interrogate multiple data centres and services in a seamless and transparent way, to best utilise astronomical data. The main goal of the VO is to enable new science by making the huge amount of data presently on-hand easily accessible to astronomers. The VO initiative is a global collaboration of the world’s astronomical communities under the International Virtual Observatory Alliance (IVOA). It is a collection of tools for accessing and visualizing multi-wavelength data that collectively provide a scientific environment, rather than a physical observatory. In this talk I will focus on the Visual Observatory tools such as Topcat, Aladin, VO-Splat.., and their uses to query astronomical catalogues, cross correlate catalogues to find objects at different wave bands , to visualise astronomical images, and to display spectral energy distributions obtained from different photometric data sets.

54 - Beam-driven slow and fast electron-acoustic instabilities in three-electron temperature space plasmas

Space Science - Friday 08 July 2016 10:00 *[For award: PhD]*
Primary author: *MBULI, Lifa Nicholas (SANSA/University of the Western Cape(UWC))*
Co-authors: *BHARUTHRAM, Ramesh (University of the Western Cape(UWC)); MAHARAJ, Shimul (SANSA/University of the Western Cape(UWC))*

Using kinetic and fluid theory, instabilities associated with slow and fast electron-acoustic waves are investigated in a plasma model composed of cool, warm and hot electrons and cool ions. The warm electrons are considered to be drifting parallel to an external ambient magnetic field. The dependence of the instabilities on plasma parameters such as beam speed, number density and temperature of the constituent plasma species will be studied. A detailed investigation of associated nonlinear structures such as solitons and double layers of arbitrary amplitudes will be conducted in afollow-up paper.

55 - Correlation study of multi-wavelength transient emission of selected CRTS cataclysmic variables

Astrophysics (2) - Thursday 07 July 2016 09:40 *[For award: MSc]*
Primary author: *SZEGEDI, Helene (University of the Free State)*
Co-authors: *ODENDAAL, Alida (University of the Free State); MEINTJES, Pieter (University of the Free State)*

The Catalina Real Time Survey (CRTS) is aimed at mapping the sky for near-Earth objects like asteroids, and provides a detailed survey that includes extremely faint sources up to 20 magnitudes. The CRTS is an incredibly rich source of data, as a large number of these sources may not be included in earlier catalogues that did not go as deep in magnitude. A sample of cataclysmic variable systems, showing high levels of transient emission, have been identified in the CRTS. It involved the identification of rapidly varying transient sources that have the potential to be selected for intensive multi-wavelength follow-up studies. These follow-up studies will be aimed at better understanding the possible magnetohydrodynamic processes driving thermal and non-thermal transient phenomena in several disc-fed and disc-less cataclysmic variable sources. Further optical observations will include photometric observations with the UFS/Boyden 1.5-m telescope at the Boyden observatory, and spectroscopic observations with the SAAO 1.9-m telescope, located at the South African Astronomical Observatory (SAAO).

58 - The relationship between solar irradiance and cloud cover in Durban.

Applied Physics (1) - Tuesday 05 July 2016 14:00 *[For award: MSc]*
Primary author: *GANYA, Elison (UKZN)*
Co-authors: *MATTHEWS, Alan (UKZN); VENKATARAMAN, Sivakumar (UKZN)*

A Total Sky Imager (TSI) and three solar radiometers were used to study the relationship between solar irradiance and cloud cover in Durban. The instruments are located at the Howard College campus of the University of KwaZulu-Natal. The TSI takes all-sky photographs at 1 minute intervals, and these images are processed to produce cloud fraction (CF) as a measure of cloud cover. The radiometers include a pyrheliometer to measure direct beam irradiance (direct normal irradiance, DNI), a shaded pyranometer to measure diffuse irradiance on the horizontal plane (diffuse horizontal irradiance, DHI) and an unshaded pyranometer to measure total (global) irradiance on the horizontal plane (global horizontal irradiance, GHI). We present results on the relationship between the radiometric and cloud fraction measurements.

59 - Test for traditional vibrational wisdom in 110,112Cd by two proton stripping

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 11:10 *[For award: PhD]*
Primary author: *MAQABUKA, Bongani (iThemba LABS/University of the Western Cape)*
Co-authors: *JONES, Pete (iThemba LABS); SHARPEY-SCHAFER, John (University of Western Cape); PAPKA, Paul (University of Stellenbosch)*

The cadmium nuclei have traditionally been regarded as best examples of spherical vibrational nuclei. However, advances in nuclear spectroscopy have begun to detail the properties of these nuclei at the two and three vibrational phonon levels, casting doubts on the vibrational assumptions. In particular the properties of the excited 0n+ (i.e. for n ≥ 2) levels are key to vibrational models. Excited 0+ states can arise in nuclei in association with the nucleon pairing degrees of freedom, and in model spaces with collective shape degrees of freedom.Historically, the Cd isotopes, especially 110,112Cd [J. Kern et al., Nucl. Phys. A593, 21 (1995)] have been favoured examples of near-harmonic quadrupole vibrational behaviour, with a two-phonon triplet of levels having I■ = 0+, 2+ and 4+ at approximately twice the energy of the one-phonon 21+ state. A further quintuplet of three-phonon levels with I■ = 0+, 2+, 3+, 4+ and 6+ is then expected close to three times the energy of the one-phonon state. This simple picture is complicated in cadmium isotopes by the presence of low-lying intruder states (caused by elevation of two protons across the Z = 50 shell gap). Extensive investigations of 110,112,114Cd [P. E. Garrett et al., Phys. Rev. C 75, 054310 (2007) & P. E. Garrett et al., Phys. Rev. C 78, 044307 (2008)] have revealed that these nuclei, far from being “textbook” cases of near-harmonic spherical vibrators, show serious disagreement with expected multi-phonon patterns of low energy excitation.Details of the population of the excited 0n+ levels have been investigated at high resolution using 108,110Pd(3He, n-gamma)110,112Cd the two proton stripping direct reactions at 25 MeV. The experimental technique involves operating AFRODITE in-coincidence with a wall containing 12 large plastic scintillators to detect the fast neutrons from the direct reaction.

60 - Anti-Newtonian cosmological solutions in fourth-order gravity

Astrophysics (1) - Tuesday 05 July 2016 10:20
Primary author: *ABEBE, Amare (North-West University)*

A class of perfect-fluid "anti-Newtonian" cosmological solutions in higher-order gravity will be discussed. In particular, we present the integrability conditions of such gravity models using the covariant consistency analysis formalism. We show that, unlike in General Relativity, these anti-Newtonian solutions exist subject to the solution of an integrability condition equation we derive, and that they are not silent cosmological models. We also present the set of evolution equations governing the linear perturbations of matter, expansion and Ricci scalar for this class of models.

61 - The pedagogical orientation of 4th year BEd students in teaching physics

Physics Education - Wednesday 06 July 2016 11:10
Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-author: *RAMNARAIN, Umesh (University of Johannesburg)*

This study investigated the pedagogical orientations of 4th year BEd students at a South African university using the Pedagogy of Science Teaching Test (POSTT) consisting of teaching scenario-based items. Effective science teaching requires integration of various types of knowledge which include knowledge of content, pedagogies, science teaching methods, inquiry, and application of these types of knowledge to teaching specific topics to specific groups of learners. Any formal assessment of teachers’ science pedagogical orientations should ideally reflect various types of knowledge and their application to teaching specific topics. Teaching practices cover a wide spectrum of pedagogical orientations ranging from didactic exposition to open inquiry learning. For our purposes we considered four main orientations in the form of Didactic Direct, Active Direct, Guided Inquiry, and Open Inquiry. Analysis of data revealed that students straddle between active direct and guided inquiry orientations in the teaching of physics.

62 - The long-term evolution of the helium nova V445 Puppis

Astrophysics (1) - Thursday 07 July 2016 11:10
Primary author: *WOUDT, Patrick (Department of Astronomy, University of Cape Town)*
Co-authors: *STEEGHS, Danny (University of Warwick); MACFARLANE, Sally (Radboud University Nijmegen)*

Nova Puppis 2000 (V445 Pup) is the first - and so far only - helium nova detected in the Milky Way. From high angular resolution imaging and spatially-resolved kinematics we derived an expansion parallax of V445 Pup indicating a distance of 8.2 kpc. Here we report on two epochs of integral field unit spectroscopy of the helium nova V445 Pup using the 6.5-m Magellan-I telescope and the IMACS spectrograph. From observations taken one year apart, approximately 5 and 6 years after the nova explosion, we are able to resolve the kinematic signatures of the bipolar shell and isolate the spectra of the fast moving knots at the polar extremes of the ejecta. The latter are dominated by emission lines of oxygen, with no trace of the helium lines seen in the bulk of the ejecta. The fast moving knots are seen in two epochs of HST narrow band [OIII] imaging in 2013 and 2015. We discuss the implications of the unusual abundances and kinematics of this rare nova explosion.

64 - TEC modelling over the African sector during geomagnetic storms

Space Science - Wednesday 06 July 2016 14:40 *[For award: PhD]*
Primary author: *UWAMAHORO, Jean Claude (SANSA Space Science, Rhodes University)*
Co-author: *HABARULEMA, John Bosco (SANSA Space Science, Rhodes University)*

Using available TEC data derived from GPS stations within the entire African sector, a regional empirical model for TEC predictions was developed based on the Empirical Orthogonal Functions (EOF). The regional TEC data was first decomposed in terms of EOF base functions and associated coefficientsand a system of coordinates that changes with location was adopted: local time and modified dip latitude, to allow the base functions to change from location to location. Thereafter, the EOF coefficients were estimated in terms of the global indices F10.7p, Ap, Dst and AE in order to take into account the solar and geomagnetic activities. The model validation will be done by comparing the reconstructed and observed TEC.

65 - Analysis of ionospheric response to great geomagnetic storms during solar cycle 23

Space Science - Wednesday 06 July 2016 15:00
Primary author: *MATAMBA, Tshimangadzo Merline (SANSA Space Science)*
Co-author: *HABARULEMA, John Bosco (South African National Space Agency)*

Using Total Electron Content (TEC) and critical frequency of F2 layer (foF2) over Southern and Northern Hemisphere mid-latitude stations, ionospheric response to great geomagnetic storms will be presented. Four great geomagnetic storm periods were identified using the storm criterion of Dst ≤ – 350 nT namely, 29 March - 02 April 2001, 27 - 31 October 2003, 18 - 23 November 2003 and 06 - 11 November 2004 during solar cycle 23. Analysis has shown that ionospheric dynamics during these storm conditions could be due to a number of dynamic and electrodynamics processes in both Hemispheres. In some instances the ionosphere responds differently to the same storm condition in both Hemispheres. Physical mechanisms related to (but not limited to) composition changes and electricfields will be discussed.

ORAL ABSTRACTS

66 - Radial Flow in Non-Extensive Thermodynamics and Study of Particle Spectra at LHC in the Limit of Small $q-1$

Theoretical and Computational Physics (1) - Friday 08 July 2016 14:40
Primary author: BHATTACHARYYA, Trambak *(University of Cape Town)*
Co-authors: *CLEYMANS, Jean (University of Cape Town); SAHOO, Raghunath (Department of Physics, School of Basic Science, Indian Institute of Technology Indore, MP 452017, India); KHUNTIA, Arvind (Department of Physics, School of Basic Science, Indian Institute of Technology Indore); PAREEK, Pooja (Department of Physics, School of Basic Science, Indian Institute of Technology Indore,)*

We expand the Tsallis distribution in a Taylor series of powers of ($q-1$), where q is the Tsallis parameter, assuming q is very close to 1. This helps in studying the degree of deviation of transverse momentum spectra and other thermodynamic quantities from a thermalized Boltzmann distribution. After checking thermodynamic consistency, we provide analytical results for the Tsallis distribution in the presence of collective flow up to the first order of q-1. The formulae are compared with the experimental data.

67 - Resonances in odd-odd 182Ta

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 11:50 *[For award: MSc]*
Primary author: BRITS, Christiaan *(University of Stellenbosch)*
Co-authors: *KHESWA, Bonginkosi (iThemba LABS); TVETEN, G.M. (University of Oslo); ZEISER, F.B. (University of Oslo); BELLO GARROTTE, F.L. (University of Oslo); BLEUEL, Darren (Lawrence Berkeley National Laboratory); GIACOPPO, F (University of Oslo); GUTTORMSEN, M. (University of Oslo); GORGEN, A. (University of Oslo); HADYNSKA-KLEK, K. (University of Oslo); HAGEN, T.W. (University of Oslo); INGEBERG, V.W. (University of Oslo); KLINTEFJORD, M. (University of Oslo); LARSEN, A.C. (University of Oslo); NYHUS, H.T. (University of Oslo); PAPKA, P. (iThemba LABS/ University of Stellenbosch); RENSTROM, T. (University of Oslo); ROSE, S. (University of Oslo); SAHIN, E. (University of Oslo); SIEM, S. (University of Oslo)*

Relatively small resonances on the low-energy tail of the giant electric dipole resonance such as the scissors or pygmy resonances can have significant impact on reaction rates. These rates are important input for modelling processes that take place in astrophysical environments and nuclear reactors. Recent results from the University of Oslo indicate the existence of a significant enhancement in the photon strength function for nuclei in the actinide region due to the scissors resonance [1]. Further, the M1 strength distribution of scissors resonances in rare earth nuclei has been studied extensively over the years [2]. In order to investigate the extent and persistence of the scissor resonance in other mass regions, an experiment was performed utilizing the NaI(Tl) gamma-ray detector array (CACTUS) and silicon particle telescopes (SiRi) at the cyclotron laboratory at the University of Oslo. Particle-gamma coincidences from the 181Ta(d,p)182Ta reaction were used to measure the nuclear level density and photon strength function of the well-deformed 182Ta system, to investigate the existence of resonances below the neutron separation energy. In this talk I will present and discuss the results of this investigation and place our findings in the context of previous work. [1] M. Guttormsen et al. Phys. Rev. Lett. 109, 162503 (2012).[2] P. von-Neumann-Cosel, K. Heyde, and A. Richter, Rev. Mod. Phys., 82, 2365,(2010).This work is based on the research supported in part by the National Research Foundation of South Africa Grant Number 92600.

68 - Determining resonance parameter from experimental cross-sections of Coulomb scattering.

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 15:20 *[For award: PhD]*
Primary author: VAANDRAGER, Paul *(University of Pretoria)*

Scattering data is fitted with a new parametrization of the multi-channel Scattering matrix (S-matrix) to determine the resonance parameters (resonance energy and resonance width) of scattering problems involving Coulomb interactions. The S-matrix is written in terms of the corresponding “in” and “out” Jost matrices which are expanded in the Taylor series of the collision energy, E, around an appropriately chosen energy, E0. This is achieved by writing the Jost matrices in a semi-analytic form where all the factors responsible for the multi-valuedness of the Jost matrices and branching of theRiemann surface of the energy are factorised explicitly. The remaining unknown factors in the Jost matrices are analytic and single-valued functions of the variable E and are defined on a simple energy plane. The expansion is done for these analytic functions and the expansion coefficients are used as the fitting parameters. The method is tested on both a single-channel and a two-channel model, using sets of artificially generated data points with typical error bars and a typical random noise in the positions of the points.

71 - Streams out of a Cloud

Astrophysics (1) - Wednesday 06 July 2016 10:00
Primary author: DEG, Nathan *(UCT)*

Stellar streams provide powerful constraints on the shape and structure of the Milky Way's dark matter halo. In this talk I will present a new particle cloud based algorithm for modelling stellar streams. The particle cloud method is computationally efficient while providing a good approximation to actual details of tidal stripping. I will demonstrate the algorithm's success in a number of test cases.

72 - Spectroscopic investigation of Tm3+ containing Lithium borate glasses

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 11:10
Primary author: RAMTEKE, Durgaprasad *(Department of Physics, University of the Free State)*
Co-authors: *DUTTA, Somrita (University of the Free State); SWART, Hendrik (University of the Free State)*

Rare earth (RE) oxides are currently used for a variety of optical applications due to their interesting 4f and 5d orbital properties. Tm2O3 RE oxide is very useful in biomedical applications such as tissue welding and ablation. Excitation at around 800 nm of materials doped with Tm2O3 generates emission bands near 1460 and 1860 nm. This feature allows it to be utilized for numerous applications. The broad emission around 1460 nm is useful for the development of an optical amplifier for uses in fiber-optic communication. By using the 1860 nm emission of Tm3+ it is possible to build a mid –infrared laser. Glass hosts can be utilized to attain both these properties. Among the available potential hosts, the lithium borate glasses are very interesting due to their easy formability, wide range of composition and good rare earth solubility. In the present study we investigated the spectroscopic properties of Tm3+ containing lithium borate glasses as a function of Tm3+ concentration. The physical properties were analyzed by using the density and molar volume of the glasses. The Judd-Ofelt theory were used to analyze the experimental data. The main focus of the present study was to study the effect of ion concentration on the two emission bands with peaks at 1460 nm (3F4 level) and 1860 nm (3H4 level).

74 - RBS-Channelling analysis into the effect of thermal annealing on GeSn strained layers

Division for Physics of Condensed Matter and Materials (1) - Thursday 07 July 2016 11:10
Primary author: COMRIE, Craig *(University of Cape Town & iThemba LABS)*
Co-authors: *MTSHALI, Christopher (iThemba LABS); SECHOGELA, Phillip (iThemba LABS); VANTOMME, Andre (KU Leuven, Belgium)*

Alloying Ge with Sn improves carrier mobility and can also transform the material from an indirect bandgap into a direct bandgap semiconductor. Unfortunately α-Sn is only stable at temperatures <13°C and this, coupled with the large mismatch between Sn and Ge, results in an upper limit of Sn in Ge of around 1%. It is possible to produce alloys with the higher Sn concentrations but these alloys are metastable and can relax on thermal annealing. Rutherford Backscattering Spectrometry and channelling have been employed to investigate the effect of thermal annealing on epitaxial GeSn (6.5% Sn) strained layers grown on Ge-buffered Si(100) wafers, with channelling along the [110] axis being used to investigate the strain residing in the layers upon thermal annealing. Annealing at temperatures below 400°C for 20 minutes had no noticeable effect on the strain in the epitaxial layers. Once the temperature was raised above 400°C however, relaxation of the layer sets in and the GeSn layer has essentially completely relaxed following a 20 minute anneal at 650°C. The results are in good agreement with similar investigations conducted using X-ray diffraction. The advantage of the RBS/Channelling approach however, is its ability to provide compositional information as a function of depth. One is therefore able to monitor the effect of the thermal anneal on the Ge and Sn distribution throughout the layer, and also to extract information about their lattice location. The results obtained show that that when the initial relaxation sets in both the Ge and the Sn are still situated in substitutional sites, and it is only around 600°C after substantial relaxation has taken place that the Sn is ejected from the lattice sites and diffuses to the surface of the sample.

75 - The total solar modulation of low energy electrons in the heliosphere

Space Science - Wednesday 06 July 2016 14:20
Primary author: NNDANGANENI, Rendani *(South African Nation Space Agency)*
Co-author: *POTGIETER, Marius (North-West university)*

Modeling and the subsequent understanding of the processes responsible for the solar modulation of Jovian and galactic electrons require that a source function for Jovian electrons and a heliopause spectrum (HPS) for galactic electron as an input spectrum be specified at the heliopause (assumed to be the solar modulation boundary). Using a comprehensive three-dimensional numerical model based on solving Parker’s transport equation, both a new Jovian source function and HPS are used to compute the total modulation of electrons over an energy range from 1 MeV to 50 GeV. The modulation of low energy electrons is a particular handy tool to construct a suitable diffusion tensor to assure compatibility between model computations and observations from different spacecraft and balloon flights relevant to electrons in the heliosphere. The choice of a Jovian electron source function, a HPS and the choice of diffusion coefficients (DCs) influence the total modulation that occurs between the Earth and the heliospheric boundary. Observationally, the galactic electron intensity below ~50 MeV is not known at Earth because of the dominance of the Jovian electrons at these energies in the inner heliosphere. With the HPS established, a prediction is made of what the galactic electron intensity at these low energies could be at the Earth, as a part of a long missing piece of the modulation puzzle. Key words: Cosmic rays; Heliosphere; Solar modulation; Jovian electrons; Galactic electrons

77 - Fast neutron radiography observation of water absorption through porous media

Applied Physics (1) - Wednesday 06 July 2016 09:40 *[For award: PhD]*
Primary author: *DANIELS, Graham (Necsa)*
Co-authors: *BUFFLER, Andy (University of Cape Town); DANGENDORF, Volker (Physikalisch-Technische Bundesanstalt); TITTELMEIER, Kai (Physikalisch-Technische Bundesanstalt)*

Water concentration in porous media is an important aspect toward inferring the structural integrity of the building framework. A need exists to determine the water content of samples in order to infer the structural integrity of the time. A developmental approach was conducted at the PTB cyclotron making use of a 6.6 MeV fast neutron beam and fast neutron radiography system to follow the uptake of water through porous media. The observed benefit of fast neutrons as compared to the thermal neutron complement, is the ability to evaluate thicker samples. From the resulting images, the volume of water absorbed as well as the rate of absorption can be inferred, which will be presented here.

81 - Beam-driven slow and fast electron-acoustic solitons in three-electron temperature space plasmas

Space Science - Friday 08 July 2016 09:40 *[For award: PhD]*
Primary author: *MBULI, Lifa Nicholas (SANSA/University of the Western Cape(UWC))*
Co-authors: *MAHARAJ, Shimul (SANSA/University of the Western Cape(UWC)); BHARUTHRAM, Ramesh (University of the Western Cape(UWC))*

This study on nonlinear potential structures follows from our study of linear instabilities associated with the slow and fast electron-acoustic waves in a model with stationary cool electrons, warm electrons (drifting parallel to an external ambient magnetic field), stationary hot electrons and stationary ions. All species are treated as adiabatic fluids. The Sagdeev pseudo-potential approach is used to investigate nonlinear structures of arbitrary amplitudes. The soliton existence regions are found to be limited by the numberdensities of the plasma constituents or by the occurrence of double layers. The study will focus predominantly on the effects of the magnitude of beam speed (of the warm electrons) on the existence regions of solitons.

82 - Graph theory and pulsar astronomy tie the knot: the use of labeled graph kernels in exploring the pulsar P-Pdot diagram

Astrophysics (1) - Wednesday 06 July 2016 10:20 *[For award: PhD]*
Primary author: *ELIZABETH, Maritz (UFS)*
Co-author: *MEINTJES, Pieter (University of the Free State)*

In this paper we explore the dependency of pulsar population structures (seen in P-Pdot diagrams) on the measurable characteristics of pulsars. We implement graph kernels for this investigation and it forms part of structure mining which is a domain of learning on structured data objects in machine learning. Among others, we implement one of the most powerful graph kernels that is based on random walks, and has been successfully applied to data mining projects in the field of astronomy. With instruments such as the SKA coming online in the near future, the quest continues to search for relationships between the different pulsar populations.

86 - Solar energetic particles and their transport to Earth

Space Science - Wednesday 06 July 2016 11:30
Primary author: *STRAUSS, Du Toit (Centre for Space Research, North-West University)*
Co-author: *OGUNJOBI, Olakunle (NWU)*

Solar energetic particles (SEPs) are highly relativistic, non-thermal particles, accelerated in/near the solar corona during transient solar events. The acceleration processes include acceleration via magnetic reconnection during solar flares and via diffusive shock acceleration during coronal mass ejections. After being accelerated, the SEPs propagate towards Earth and may pose a radiation hazard. We investigate the transport of these ionized SEPs, from the Sun to the Earth, in the turbulent heliospheric plasma. After discussion the relevant transport processes, we show simulations of SEP transport and compare these, at least in a qualitative fashion, to recent spacecraft observations.

91 - Structural and optical studies of cobalt and indium simultaneously doped zinc oxide nanopowders prepared using high energy ball milling technique

Division for Physics of Condensed Matter and Materials (2) - Tuesday 05 July 2016 10:00 *[For award: MSc]*
Primary author: *MANAMELA, Mahlatse (University of Limpopo)*
Co-authors: *MOSUANG, Thuto (University of Limpopo); MWAKIKUNGA, Bonex (CSIR National Laser Centre)*

Samples of undoped ZnO, Co and In single doped and Co-In co-doped ZnO nanoparticles were prepared using the high energy ball milling method. X-ray diffraction (XRD), ultraviolet-visible spectroscopy (UV-Vis) and photoluminscence (PL) spectroscopy were employed to characterise the prepared samples. The peaks obtained from the XRD patterns indicated that the samples prepared were of hexagonal ZnO nanoparticles. Additional peaks were reflected within the doped samples belonging to Co+2 and In+3 ions. These peaks indicated that Co+2 and In+3 ions preferred the interstitial site in the hexagonal ZnO structure. The lattice parameters were not significantly affected by the dopant concentration of either Co or In. The average grain sizes of the nanoparticles were found to be reduced when In and Co were incorporated into the ZnO nanoparticles structure. The band gap energies were calculated using the UV-Vis. It was found that the doped ZnO nanoparticles had smaller band gap energy compared to the undoped ZnO nanoparticles. In the PL studies, excitation wavelength of 350 nm was used and various defects related emissions were observed for the doped and undoped ZnO nanoparticles.

92 - Searching for the low-energy enhancement in ^{91}Zr

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 14:20 *[For award: MSc]*
Primary author: *ZIKHALI, Bonginkosi Richard (University of Zululand)*
Co-authors: *WIEDEKING, Mathis (iThemba Labs); KHESWA, Vincent (University of Oslo); NTSHANGASE, Sifiso (University of Zululand); GARROTE, F.L. Bello (University of Oslo, Oslo, Norway); GUTTORMSEN, Magne (University of Oslo, Oslo, Norway)*

Theγ -ray strength function (γ SF) is defined as a measure of the average reduced decay probability of a nucleus. This concept is useful at high excitation energies where the spacing between the levels is small and gives information on degrees of freedom and underlying nuclear dynamics. Evidence of the low-energy enhancement in the γ SF for energies less than 4 MeV has been discovered in several fp-shell nuclei, e.g. see Ref.[1]. Recently, a strong enhancement of M1 transitions in ^{90}Zr has been predicted for γ-ray energies below 2 MeV in shell model calculations [2]. In this work we explore the existence of the low-energy enhancement in neighboring ^{91}Zr. The experiment ^{90}Zr(d,p)^{91}Zr was conducted at the Oslo Cyclotron Laboratory (OCL). The SiRi (silicon telescope) array was used to detect charged ejectiles from the reaction. The CACTUS NaI(Tl) array was utilized to detect rays that were in coincidence with charged particles. The nuclear level density and γ SF were extracted with the Oslo method [3]. These quantities were used to calculate (n, γ) cross sections with the Talys reaction codes. In this presentation the results will be discussed.[1] M. Guttormsen, et al., Phys. Rev. C 71, 044307 (2005).[2] R. Schwengner, et al., Phys. Rev. Lett.111, 232504 (2013).[3] A. Schiller, et al., Nucl. Instrum. Meth. Phys. Res. A 447, 498 (2000).This work is based on the research supported in part by the National Research Foundation of South Africa.

93 - Change in the Angular Momentum Distribution due to Nuclear Plasma Interactions

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 11:50 *[For award: MSc]*
Primary authors: *NOGWANYA, Thembalethu (University of the Western Cape); WIEDEKING, Mathis (iThemba Laboratory for Accelerator-Based Sciences, Cape Town, 7131)*
Co-authors: *HOLLIDAY, Holliday (Lawrence Livermore National Laboratory, Livermore, CA 94550, USA); LUNDGREN, J. (University of California, Berkeley, CA 94720, USA); MOODY, K. (Lawrence Livermore National Laboratory, Livermore, CA 94550, USA); ORCE, J.N. (University of the Western Cape, Cape Town); BLEUEL, D.L. (Lawrence Livermore National Laboratory, Livermore, CA 94550, USA); BERNSTEIN, L.A. (Lawrence Livermore National Laboratory, Livermore, CA 94550, USA); BRICKNER, N.M. (University of California, Berkeley, CA 94720, USA); BROWN, J.A. (University of California, Berkeley, CA 94720, USA); DAUB, B.H. (Lawrence Livermore National Laboratory, Livermore, CA 94550, USA); GOLDBLUM, B.L. (Lawrence Livermore National Laboratory, Livermore, CA 94550, USA &University; of California, Berkeley, CA 94720, USA)*

Electron-mediated nuclear plasma interactions (NPIs), such as Nuclear Excitation by Electron Capture (NEEC) or Transition (NEET), can have significant impact on nuclear cross sections in High Energy Density Plasmas (HEDPs). These HEDP environments are found in National Ignition Facility's shots and in the cosmos where nucleosynthesis takes place. Attempts have failed so far in measuring the NEEC process [1, 2], while NEET has recently been observed experimentally [3, 4]. Further, NPIs have not been observed due to the narrowness of nuclear transitions ($\Gamma \leq 1\mu$ eV) . The NPIs will occur on highly excited nuclear states in the quasi-continuum which is populated in nuclear reactions prior to their decay by spontaneous $\gamma\gamma$-ray emission. Direct observation of NPIs are hindered by the lack of a clear signature of the effect in HEDP environments. Hence, a new signature [5] for NPIs on highly excited nuclei will be tested by investigating isomeric to ground state feeding from the quasi-continuum region. An experiment was performed using the reactions 197Au(13C,12C)198Au and 197Au(13C,12C 2n)196Au at Lawrence Berkeley National Laboratory in inverse kinematics with a 197Au beam of 8.5 MeV/u energy. Several measurements were performed with different target configurations. The activated foils were counted at the low-background counting facility of Lawrence Livermore National Laboratory. In this talk I will present theoretical concepts, experimental details and preliminary results.Reference[1] Y. Izawa and C. Yamanaka , Phys. Lett. B 88 , 59 (1979)[2] P. Morel et al., Nucl. Phys. A 746, 608c (2004)[3] S. Kishimoto et al., Phys. Lett. 85 , 1831 (2000)[4] T. Carreyre et al., Phys. Rev. C 62 024311 (2000)[5] D. L. Bleuel et al., Plasma and Fusion Research (in publication)

ORAL ABSTRACTS

94 - Cosmic ray ground level enhancments: Power of pulse shape

Space Science - Wednesday 06 July 2016 14:00
Primary author: OGUNJOBI, Olakunle *(Centre for Space Research, North-West University)*
Co-author: *STRAUSS, Du Toit (Centre for Space Research, North-West University)*

Ground level enhancements (GLEs) of the cosmic-ray intensity have been observed 71 times since over seven decades. GLEs are due to sudden increases of solar energetic particles associated with large eruptive episodes. GLEs have been, controversially, divided into two distinct categories, gradual (classical) and impulsive events. Some recent findings argued that some GLEs are too impulsive to be accelerated in the eruptive episodes. Here we investigated this hypothesis by studying time profiles of ten GLEs, which were observed with excellent data coverage of associated solar eruptions. Preliminary results support that the shape of the profile is apowerful indicator of propagation conditions between Sun and Earth. The average continuous range from gradual to impulsive will be presented

95 - Spectroscopy of the low-lying excitation region in ^{9}B

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 11:10
Primary author: DANIEL JOSÉ, Marín-Lámbarri *(University of the Western Cape/ iThemba LABS)*

The structure of A=9 nuclei are relevant in nuclear astrophysics. The measurement of the low-lying excited states in Boron-9 nucleus through the ^{9}Be(^{3}He,t)^{9}B reaction, with the K600 spectrometer in conjunction with a segmented silicon detector array will be performed at iThemba LABS facility. Of particular interest is the conclusive observation and characterisation of the first 1/2^{+} state in Boron-9. By accurately measuring the excitation energy of this state, we aim to obtain the Coulomb Energy Difference (CED) between isobaric analog 1/2^{+} states in the Boron-9 and Beryllium-9 mirror pair to address discrepancies that currently exist between theoretical models in describing these nuclei.

97 - Nonlinear dust-acoustic waves in the nighttime polar mesosphere

Space Science - Tuesday 05 July 2016 10:00
Primary author: MAHARAJ, Shimul *(SANSA Space Science/University of the Western Cape)*
Co-authors: *BHARUTHRAM, Ramesh (University of the Western Cape); MURALIKRISHNA, Polinaya (Instituto Nacional de Pesquisas Espaciais); SINGH, Satya Vir (Indian Institute of Geomagnetism/University of the Western Cape); LAKHINA, Gurbax Singh (Indian Institute of Geomagnetism/University of the Western Cape)*

Large amplitude nonlinear potential structures are investigated for a four-component plasma model which is closely aligned with the plasma composition in the nighttime polar mesosphere (~80-90 km altitude)[1]. Nano-sized dust grains (with radii exceeding 2 nm) become positively charged when immersed in a three-component plasma composed of electrons, positive ions and negative ions provided that the negative ions are sufficiently heavy and abundant. This is because the mechanism by which the nano-sized grains become charged is through the capture of currents as secondary electron emission and photo-electron emission processes do not play a role. The existence of large amplitude nonlinear soliton and double layer structures is investigated for broad regions in parameter space. The model will be varied by retaining the inertia of the heavy ion species and these will be treated as dust whereas the electrons and the ionic components which are very much lighter than the dust will be assumed to be isothermal species which are Boltzmann distributed. The study will establish how the polarity of the nano-sized dust grains influences the polarity of the supported solitons.[1] Observations of positively charged nanoparticles in the nighttime polar mesosphere, M. Rapp, J. Hedin, I. Strelnikova, M. Friederich, J. Gumbel, and F.~J. Lübken, Geophys. Res. Letters. 32, L23821, doi:10.1029/2005GL024676 (2005).

98 - Plasma Drift Modeling: Multivariate Analysis

Space Science - Tuesday 05 July 2016 11:50 *[For award: PhD]*
Primary author: DUBAZANE, Makhosonke *(SANSA Space Science)*
Co-author: *HABARULEMA, John Bosco (SANSA Space Science)*

Quantitative estimate of equatorial plasma drift is required since it is a main transport mechanism causing plasma density fluctuations at low and equatorial latitudes. In practice, this has an impact on radio communication and navigation systems. It has been established that taking difference of horizontal magnetic field ΔH between ground-based magnetometers stationed 6 – 9 -degrees off the magnetic equator provides realistic measure of daytime plasma drift velocities. Although drivers of this phenomenon/process could be associated with horizontal neutral wind; its direct measurements are lacking and models estimating it could be unreliable. In this work, daytime magnetic field-inferred equatorial plasma drift is modelled using multivariate analysis. Seasonal, diurnal and ionospheric disturbances are also considered through various modeling inputs as drivers. In contrast to traditional least squares technique, the analysis techniques avoid multicollinearity and uses variable selection methods. The model shows appreciable correlation of the modeling inputs with the plasma drift. Since solar zenith angle is included in the model formulation, plasma drift at other low –latitudinal regions could be estimated. Since daytime equatorial plasma drift is independent of altitude in the range of 150- 180 km, the modelled plasma drift could be verified by satellite data at low-latitudes.

99 - Quiet time enhancements over African latitudes

Space Science - Tuesday 05 July 2016 14:00 *[For award: PhD]*
Primary author: ORFORD, Nicola *(SANSA)*
Co-author: *KATAMZI, Zama Thobeka (South African National Space Agency)*

F2 layer disturbances not related to geomagnetic activity are known as quiet time enhancements (QTEs). The phenomenon of QTEs has not yet been studied over African latitudes. Wetherefore explore the occurrence of QTEs over Africa in order to expand our knowledge on the behaviour of the ionosphere over this region. Several GPS stations in the middle to equatorial latitudes, during the solar minimum (2009) and near solar maximum (2013), are used. This data was examined for possible trends in variation with solar cycle, season and latitude as well as time of commencement of enhancements. Over the southern mid-latitude region of Africa we have observed that the QTEs are more likely to commence during the night in both solar minimum and maximum, however a slightly larger portion of daytime commencements during solar minimum than during solar maximum were observed. The total number of enhancements for the solar minimum period appears greater than during solar maximum. A seasonal trend is seen with the maximum number of enhancements occurring in summer during solar minimum and in winter during solar maximum. We explore further whether these trends are mirrored or different at low latitude/equatorial African regions.

103 - Quasinormal modes for a spin-3/2 field in the Reissner-Nordstrom black hole background

Theoretical and Computational Physics (1) - Thursday 07 July 2016 10:00 *[For award: MSc]*
Primary author: NGCOBO, Xolane *(University of the Witwatersrand)*
Co-author: *CORNELL, Alan (University of the Witwatersrand)*

We will present a quasi-normal modes (QNMs) calculation for a scalar (spin-0) field in a Schwarzschild black hole background and comment on how this could be generalised to QNMs for a Weyl field, as well as fields in a Reisnner-Nordstrom black hole background. These are the first steps towards calculating the QNMs for the spin-3/2 field in a Reissner-Nordstrom black hole background, which is the ultimate aim of my current research project. We shall make use of the works of Sai Iyer and Clifford M. Will, where in a 1987 paper they applied the Wentzel-Kramers-Brilloin (WKB) approximation method to computing the QNMs for black holes perturbed by fields. The WKB approach has been frequently used to approximate QNMs to high orders of approximation. We shall work to sixth order for the systems described above.

104 - The search for the Dark Vector Boson via the Higgs Portal

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 14:40
Primary author: CONNELL, Simon *(University of Johannesburg)*

The Standard Model (SM) is known to be incomplete. The introduction of a Dark Sector via an additional $U(1)_D$ gauge symmetry added to the SM Lagrangian provides a mechanism to introduce much needed new physics without perturbing the already excellent agreement between the SM theoretical description and the Electroweak Precision Observables (EWPO) experimental constraints. The model has a dark vector boson Z_d which can mix with the hypercharge gauge boson with the coupling ε. This opens the Hypercharge Portal which can mediate the fluctuation of a Z to a Z_d, or the decay of the Z_d to SM leptons. If a dark Higgs singlet s also exists, this then breaks the $U(1)_D$, opening the Higgs portal and also allowing for Higgs mass mixing between the SM and dark sectors, described by the Higgs mass mixing parameter, k. Including dark fermionic fields in the Lagrangian allows for long-lived cold Dark Matter candidates. The various connections between the Dark and SM sectors allow descriptions of many key astro-physical phenomena. The Model is therefore a fascinating candidate for new physics beyond the SM. It becomes crucial to search for experimental signatures of this model. This contribution discusses a search for the dark force boson Z_d using its production via the Higgs Portal and its decay back to SM leptons: $H \rightarrow h_d \rightarrow Z_d Z_d \rightarrow 4l$. The results from ATLAS Run 1 and the further development of the search for Run 2 are presented.

105 - Modeling the JVLA primary beam using characteristic basis function

Astrophysics (1) - Thursday 07 July 2016 09:40 *[For award: PhD]*
Primary author: IHEANETU, Kelachukwu *(Rhodes University)*

Accurate modeling of the antenna primary beam response (also known as the antenna radiation pattern) is important in many wireless applications, but is particularly crucial for the next generation of radio telescopes, since they offer unprecedented levels of sensitivity, at which even the most subtle instrumental effects become important. Electromagnetic and optical simulations can only provide a first-order model; real-life primary beam patterns differ from this due to various subtle effects such as (a priori unknown) mechanical deformation, etc. Ideally, a parameterized model is required, so that these effects can be calibrated for in a closed-loop manner. Instances of actual patterns can be measured through a process known as holography, but this is subject to noise, radio frequency interference, and other measurement effects. We present a set of holography measurements for a subset of dishes of the Karl G. Jansky Very Large Array telescope (JVLA US), and discuss the problem of using these measurements to derive parameterized models of the primary beam. We show that the beams exhibit complicated frequency behaviour due to standing waves (resonance) in the optics, particularly in the polarization terms. We discuss the potential application of a technique called characteristic basis function patterns (CBFPs) to these data, which offers the possibility of deriving a parameterized model that can accommodate subtle variations in the beam pattern.

106 - Modelling temperature dependence of continuous wave optically stimulated luminescence from anion deficient corundum doped with carbon

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 10:00 *[For award: PhD]*
Primary author: NYIRENDA, Angel *(Rhodes University)*
Co-author: *CHITHAMBO, Makaiko (Rhodes University)*

We present a model that accounts for the temperature dependence of the continuous wave optically stimulated luminescence (CW-OSL) signal obtained from anion deficient corundum doped with carbon. The model has been derived from the experimental behaviour of the CW-OSL signal exhibited for the measurement temperatures between 30 degrees Celcius and 300 degrees Celcius. The model consists of a set of coupled differential equations that has been solved numerically using Mathematica, a commercially available computer software. Simulations, based on the solutions to the differential equations, have been carried out and the results compared with the experimentally observed behaviour. The experimental results and the simulation results are in good agreement, an indication that the model depicts the underlying F-centre related luminescence processes quite well.

107 - Characterization of inclusions and defects in natural zirconia

Division for Physics of Condensed Matter and Materials (1) - Wednesday 06 July 2016 10:20
Primary author: LEE, Mike *(Centre for HRTEM, Nelson Mandela Metropolitan University, Port Elizabeth)*
Co-authors: *O'CONNELL, Jacques (Centre for HRTEM, Nelson Mandela Metropolitan University, Port Elizabeth); JANSE VAN VUUREN, Arno (Centre for HRTEM, Nelson Mandela Metropolitan University, Port Elizabeth); GOOSEN, William (Centre for HRTEM, Nelson Mandela Metropolitan University, Port Elizabeth)*

Minerals such as zircon ($ZrSiO_4$) and baddeleyite (natural zirconia, ZrO_2) are considered to be ideal materials for the geothermal and geochronology characterization of mineral deposits. For geochronology applications these two minerals are considered to be stable and undergo little or no physical or chemical alteration (closed systems) before or after the geological emplacement process. However, natural zirconia is a mineral which undergoes a martensitic phase transformation from cubic (2750°C) through tetragonal to monoclinic at about 1100°C. The material undergoes a volume change (5%) and strain energy (~8%) during the tetragonal-monoclinic transformation which would be expected to have major influence on the material during the geological emplacement process. It is therefore important to apply a detailed microstructural analysis for natural zirconia which could possibly provide information on the nature of primary and secondary mineral inclusions as well as secondary physical alteration mechanisms for the material.Baddeleyite (zirconia) xenocrysts from the Phalaborwa complex (South Africa), which has a geological age of 2060 ±1 Ma, were used in this work to determine the nature of inclusions and defects in the material using a number of microanalytical techniques. These techniques include scanning (SEM) and transmission electron (TEM) microscopy supported by energy dispersive spectroscopy (EDS) and electron backscattered diffraction (EBSD). Microanalysis results have shown the presence of monoclinic {001} and {011} twin bands in the material which could be a result of transformation or deformation processes. Secondary mineral inclusions observed in cracks (due to transformation stress) formed in the single crystalline material during emplacement will be shown to be related to the original mineral content of the magma. Lastly, a detailed report on the observation of extended defects such as loops and platelets will be reported. It will therefore be concluded that severe physical alteration for baddeleyite does in fact take place.

109 - Beyond Lithium-Ion Batteries: A Computational Study on Advanced Lithium – Sulphur Battery

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 10:20 *[For award: PhD]*
Primary author: MASEDI, CLIFFTON *(CSIR/ UL)*
Co-authors: *NGOEPE, PHUTI (UL); SITHOLE, HAPPY (CSIR/CHPC)*

Rechargeable lithium–sulphur (Li–S) batteries hold great potential for high-performance energy storage systems because they have a high theoretical specific energy, low cost, and are eco-friendly.We show the stability of Li_2S formed in Lithium- Sulphur batteries and investigate structural, electronic and mechanical properties using density functional theory within the generalized gradient approximation. Atomistic simulations was employed to successfully generate interatomic potential models. The lattice parameters were well reproduced and agree with the available experimental data. The heats of formation predicts that the structure Li_2S is generally stable. The elastic constants suggest that the structure is mechanically stable which is in great agreement with calculated phonon dispersion curve. Phonon dispersion curve shows that the structure is stable with absence of vibrations in the negative frequency and it is in good agreement with experiment work (neutron scattering experiments) and elastics properties which are all positive. The Buckingham interatomic potentials describing the interactions between lithium and sulphur were successfully generated and validated since they produced same melting temperature as experimental studies.

111 - Are we gauging the pressure correctly?

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 10:00 *[For award: MSc]*
Primary authors: JACKSON, Greg *(UCT); PESHIER, André (UCT)*

Thermodynamic properties of the quark-gluon plasma have been the subject of extensive numerical and analytical work over the past decades. Monte Carlo lattice calculations have made great progress; in particular for the pure SU(3) gluon plasma, which serves as a benchmark for theoretical descriptions of full QCD. Nonetheless, 'artifacts' of this coarse-grained approach lead to uncertainties near the (phase) transition at T_c~260 MeV, which are closely related to the divergences encountered in perturbation theory in the continuum limit. The latter must first be regularised and then renormalised, which we propose to do by comparing to the QCD trace anomaly. Fixing the analytic results at a semi-pertubative temperature, we find the bulk properties tend towards the free limit more gradually than has been presented in recent lattice findings. This discrepancy is actually crucial to understand because it emerges from a well-defined limit, in which both treatments can do 'precision physics'.

112 - Dynamics of several ultra-cold particles in a double-well potential

Division for Physics of Condensed Matter and Materials (2) - Friday 08 July 2016 11:10
Primary author: SOWINSKI, Tomasz *(Institute of Physics of the Polish Academy of Sciences)*

In nowadays experiments in ultra-cold physics it is possible to study dynamical properties of a few quantum particles confined in nontrivial potentials. Typically these experiments are described on theoretical level with simplified models based on mean-field description or Hubbard-like models with limited number of modes. In my talk I will present two examples showing that in the case of strongly interacting particles these approaches may lead to completely incorrect predictions.1. In the case of two ultra-cold BOSONS confined in a one-dimensional double-well potential we compare the exact dynamics governed by a full two-body Hamiltonian with the dynamics obtained in a two-mode model approximation. We show that for sufficiently large interactions the two-mode model breaks down and higher single-particle states have to be taken into account to describe the dynamical properties of the system correctly. The fundamental difference between the exact and two-mode descriptions emerges when inter-particle correlations are considered. For example, the evolution of the probability that both bosons are found in opposite wells of the potential crucially depends on couplings to higher orbitals of an external potential [1].2. In the case of a few ultra-cold FERMIONS confined in a double-well potential we show that the dynamics, which is governed by single-particle tunnelings for vanishing interactions, is completely different for strong interactions. Depending on the details of the configuration, for sufficiently strong interactions (repulsions or attractions) the particle flow through the barrier can be accelerated or slowed down. This effect cannot be explained with the single-particle picture. It is clarified with a direct inspection of the spectrum of the few-body Hamiltonian [2].[1] J. Dobrzyniecki, T. Sowinski: EPJ D (in press).[2] T. Sowinski, M. Gajda, K. Rzazewski: Europhys. Lett. 113, 56003 (2016).

113 - Wilson Lines and Color-Neutral Operators in the Color Glass Condensate

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 11:10 *[For award: PhD]*
Primary author: ZEILINGER, Judith *(University of Cape Town)*

In modern collider experiments such as the LHC or DESY, QCD reaction channels dominate the particle production. In the high energy limit, the number of gluons produced through these channels is so large, that these gluons dominate the initial conditions of heavy ion collisions and influence subsequent transitions of the produced hot dense matter into a Quark Gluon Plasma. These gluon dominated configurations are called the color glass condensate (CGC). The JIMWLK equation is a renormalization group equation that describes the energy evolution of observables in the CGC. In a collider experiment in the above described regime, the following stages occur: Due to confinement, a *color-neutral* configuration of partons, hereafter referred to as a *singlet*, scatters off a target eikonally; that is, each parton at a position x picks up a Wilson line U_x. The resulting color-rotated parton will then recombine into a color-neutral state, as is necessary by confinement. Since Wilson lines U_x are elements of the group $SU(N_c)$, the interaction is governed by principles of group theory. I present a way of classifying all singlet states of an algebra of m quarks and n anti-quarks, where each gluon is mathematically equivalent to a dipole consisting of a quark and an anti-quark. I begin by considering all singlets of $SU(N_c)$ over the algebra of m quarks and m anti-quarks, and then show that these give rise to the remaining (N_c-dependent) singlets of the algebra of m quarks and n anti-quarks via the Leibniz identity. I then discuss coincidence limits of the Wilson lines, giving interesting physical insights.

115 - Phase-II Upgrade of the ATLAS Inner Detector

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 11:50 *[For award: PhD]*
Primary author: HAMITY, Guillermo *(Honours Physics Student)*

The Large Hadron Collider (LHC) at CERN is expected to deliver an integrated luminosity of approximately 300 invfb by the end of it's third run in 2023. At this point, the LHC will undergo a major shut-down to upgrade the delivered instantaneous luminosity by a factor of five. During this upgrade period the ATLAS detector will prepare for the unprecedented luminosity by upgrading it's detector systems. In order to deal with the high pile-up, the Inner Detector (ID) will be replaced by an ID composed entirely of pixels and silicon strip detectors. In this talk the major upgrade plans will be outlined, with an emphasis on the proposed design of the ID silicon modules.

119 - Theory for diffusivity measurements when the temperature is ramped linearly

Division for Physics of Condensed Matter and Materials (1) - Thursday 07 July 2016 11:30
Primary author: *MALHERBE, Johan (University of Pretoria)*
Co-authors: *THERON, Chris (University of Pretoria); ODUTEMOWO, opeyemi (university of pretoria); NJOROGE, eric (university of pretoria); HLATSHWAYO, Thulani (University of Pretoria)*

Nearly all measurements to determine diffusion coefficients in solids are performed using either isochronal or isothermal measurements. Usually the diffusion coefficient, at a particular temperature, depends primarily on the microstructure of the substrate, with the type of impurity (i.e. the diffusion species) being of secondary order. When a phase change occurs in the substrate material or when a chemical reaction occurs between the diffusion species and the substrate, the diffusion mechanism usually undergoes a discrete change with a corresponding change in the diffusion coefficient as a function of temperature. Consequently, it is often highly desirable to perform in situ diffusion measurements during the heating cycle. This paper derives the necessary equations for such diffusivity measurements for the case where the temperature is ramped linearly.

120 - Hyper-entanglement for secure communication

Photonics - Thursday 07 July 2016 09:40 *[For award: MSc]*
Primary author: *NAPE, Isaac (Structured Light Lab, School of Physics, University of Witwatersrand)*
Co-authors: *MCLAREN, Melanie (University of the Witwatersrand); FORBES, Andrew (CSIR)*

Entangled photons can be generated using spontaneous parametric down conversion to create two photons that are correlated in space. These photons can be tailored to exhibit entanglement either in their polarisation or spatial modes which are their independent degrees of freedom (DOF). However, hyper-entangled states can be generated by coupling the DOFs and exploiting their non-separable property that is observable under the classical and quantal regime. We demonstrate the first transport of hyper entangled photons through optical fibers in a classical and quantum setup by manipulating the dynamic and geometric phase of light. A method of engineering hyper-entangled photon states is mathematically proposed to exploit the classical properties of the DOFs of light to induce the hyper-entangled states. We then implement this in a setup that measures and quantifies the entanglement as a result of using optical fibers as the carrier of the hyper-entangled photons. This finds application in quantum information systems such as quantum key distribution protocols that can ensure secure communication between two parties. They are provided with an extended DOF that allows them to establish a securely encrypted communication system using two different measuring bases in addition to higher bandwidth that is supplemented by the use of optical fibers.

121 - CZTS solar cell: CZT precursor layer deposition by electron beam evaporation and electroplating

Division for Physics of Condensed Matter and Materials (2) - Tuesday 05 July 2016 10:20 *[For award: MSc]*
Primary author: *FOURIE, Antonie (University of the Free State)*
Co-authors: *TERBLANS, JJ (Koos) (UFS); SWART, Hendrik (University of the Free State)*

A sufficiently efficient Copper zinc tin sulfide (CZTS) solar cell will allow for solar cells to be built using low environmental impact materials and processes in a relatively simple way, at a more affordable cost. The photo absorber layer of a CZTS solar cell is the naturally p-type semiconductor $Cu_{text5}2ZnSnS_{text5}4$, sometimes referred to by the name of the naturally occurring mineral called kesterite. The substrate has been grown by evaporating a thin layer of Mo onto glass, the glass provides support for the subsequent layers, and the Mo acts as the bottom contact of the photovoltaic cell. The first step in producing the required CZTS crystal structure was the deposition of Cu, Sn and Zn in a 2:1:1 ratio. Software, apparatus and methods were developed to grow the CZTS crystal layer using electroplating. For initial characterisation, the Cu-Zn-Sn precursor layer was deposited using electron beam evaporation. To create an optimal bottom contact with Mo, Cu was deposited onto the Mo followed by Sn and then the Zn. Zn was deposited at the end to minimise the loss of Sn during annealing.. Sulfurisation of the precursor layer completed the $Cu_{text5}2ZnSnS_{text5}4$ structure. This was done by annealing the structure in a sulfur containing atmosphere. Characterisation of the thin layers (Cu-Sn-Zn) and the CZTS layer was done by Auger Electron Spectroscopy (AES), X-ray Diffraction (XRD) and Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS), before and after the annealing process.

122 - The mystery of black auroras

Space Science - Wednesday 06 July 2016 10:20
Primary author: *NEL, Amore (SANSA)*
Co-authors: *KOSCH, Michael (SANSA); GUSTAVSSON, Bjorn (University of Tromsø); YAMAZAKI, Yosuke (Lancaster University)*

Black auroras are recognized as spatially well-defined regions within quasi-uniform diffuse auroral background where the optical emission is significantly reduced. This phenomenon remains a mystery, as the underlying mechanism is still unknown.Multi-wavelength optical data will be combined with incoherent scatter radar data to determine the characteristic energy of the precipitating particles both inside and outside black auroras. EISCAT is the world's most sophisticated incoherent scatter radar system. The radars observe electron density, ion and electron temperature, and ion velocity. From these parameters, a wide range of geophysical phenomena can be studied in the ionosphere.Black aurora events are analysed using two cameras simultaneously with different optical filters for the first time. 427.8/844.6 nm corresponds to higher/lower energy precipitating electrons. The ratio of these wavelengths gives the characteristic precipitating electron energy. Images of the wavelength ratio, corresponding to electron energy, will be shown from inside and outside the black auroras. Data from the EISCAT radar site in Tromsø, Norway, is presented.

123 - Ionospheric Disturbances During Geomagnetic Storm at SANAE

Space Science - Wednesday 06 July 2016 10:00 *[For award: MSc]*
Primary author: *HIYADUTUJE, Alicreance (South African National Space Agency and Rhodes University)*
Co-authors: *KATAMZI, Zama (South African National Space Agency and Rhodes University); STEPHENSON, Judy (University of KwaZulu Natal)*

It has been reported by many studies that the ionosphere responds differently to different geomagnetic storms depending on their magnitude and time of occurrence.During geomagnetic storms the polar plasma dynamics can influence the middle and low latitude ionosphere via travelling ionospheric disturbances (TIDs).TIDs are a wave-like electron density disturbances caused by atmospheric gravity waves propagating in the ionosphere.The aim of this study is to investigate the ionospheric responses to the storm of 15th July 2012 using total electron content (TEC) and scintillationsmeasurements derived from Global Positioning System (GPS) receiver as well as superDARN relative power at SANAE station and superDARN convection map. TEC results show that this storm had positive storm effect on the ionosphere (i.e. increase in TEC), which commenced in the main phase of the storm and lasted for approximately 8 hours.Both TEC and superDARN power measurements show presence of a TID with period of 39 minutes and amplitude of ~ 0.6 TECU between 12:00 and 16:00 UT.SuperDARN convection map indicates that this TID was caused by instabilities moving at around 200 m/s brought by the heat gradient in the plasmaaround 9:40 magnetic local time (MLT).

124 - Evaluation of sputtering-induced surface roughness of polycrystalline Ni/Cu multilayers thin films with AES and ToF-SIMS depth profiling

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 11:10 *[For award: PhD]*
Primary author: *YAN, XinLiang (University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); WANG, Jiang Yong (Shantou University, China); TERBLANS, JJ (Koos) (UFS)*

Auger Electron Spectroscopy (AES) and Time-of-Flight Secondary-Ion Mass Spectrometry (ToF-SIMS) in combination with ion beam sputtering are frequently used for performing composition-depth profiling of thin films. During the sputter depth profiling of polycrystalline metal thin films, sputtering-induced surface roughness is the main source of the degradation of the depth resolution. Ni/Cu polycrystalline multi-layered structures were deposited on a SiO2 substrate by means of electron beam evaporation in a high vacuum. The true concentration-depth profiles of Ni/Cu multi-layered specimens were determined utilising the Mixing-Roughness-Information depth (MRI) model by fitting measured data (concentration-depth profiles) obtained by AES and ToF-SIMS depth profiling. The MRI model used for calculation of the true concentration-depth profiles accounts for the broadening upon experimental depth profiling owing to the effects of atomic mixing, surface roughness and the information depth of the Auger electrons (for AES depth profiling) or secondary ions (for SIMS depth profiling). The depth-dependent depth resolution and ion sputter-induced surface roughness upon depth profiling of the as-deposited sample were quantitatively evaluated.

125 - Development of an integrated model and system to enable optimal efficiency of the HartRAO LLR system

Space Science - Thursday 07 July 2016 10:00 *[For award: PhD]*
Primary author: *NDLOVU, Sphumelele (HartRAO)*
Co-authors: *COMBRINCK, Ludwig (HartRAO); CHETTY, Naven (UKZN - Discipline of Physics); BOTHA, Roelf (HartRAO); AKOMBELWA, Mulemwa (UKZN - School of Engineering)*

The Lunar Laser Ranger (LLR) system under development at Hartebeesthoek Radio Astronomy Observatory (HartRAO) in South Africa is being built to accurately measure the Earth-Moon distance (at 1 cm level) through the use of short laser pulses, a single photon detection system, an accurate timing system and other sophisticated components. This LLR system is unique in Africa and the entire Southern Hemisphere, and utilizes a 1 m diameter optical telescope, which was donated to the project by the Observatoire de la Côte d'Azur of France. In this work, we discuss the development of an integrated model that will be utilized to obtain optimal efficiency of the HartRAO-LLR system. The model calculates the expected number of returned photons by considering a number of parameters which affects the laser beam pulses as they traverse the atmosphere from the LLR telescope to the Moon and back to the telescope. This is achieved by modelling the effects of thermal and density fluctuations of the atmosphere on the apparent Earth - Moon range, atmospheric extinction, laser beam characteristics, optical path efficiencies and other factors on the number of returned photons. These factors affect the estimated (predicted by software) and actual (measured) number of returned photons for the HartRAO-LLR station. The estimated average signal return rate of the HartRAO LLR ranges between 0 to 12 photons per second, which is in agreement with the available data from five globally distributed LLR stations. Our estimated signal returns are strongly affected by two-way atmospheric extinction (atmospheric and cirrus cloud transmissions), variations in the laser beam incident angle on the retroreflectors located on the Moon as well as the varying Earth - Moon range. Modelling the returned number of photons and comparing these to the actual number received will lead to an understanding of the effects of numerous variables on the total laser path efficiency.

126 - Generalized Geometry and Hopf Twists

Theoretical and Computational Physics (1) - Thursday 07 July 2016 10:20 *[For award: MSc]*
Primary author: *DLAMINI, Hector (University of Pretoria)*

The Leigh-Strassler theories are marginal deformations of the N=4 SYM theory preserving N=1 Supersymmetry. As such they admit a Hopf algebra structure which is a quantum group deformation of the SU(3) structure of the R-symmetry of N=4 SYM. In this presentation we discuss how we reproduced the beta-deformed theory, a subset of the Leigh-Strassler theories, from the Hopf twist approach and how we investigated the twist manifests itself on the gravity dual by defining a star product between chiral superfields of the beta-deformed field theory. The treatment on the gravity side was done in the Generalized Geometry framework. This star product was then used to deform the pure spinors of six-dimensional flat space and from the deformed spinors we obtain an N=2 solution of Supergravity. The Lunin-Maldacena background dual to the beta-deformed theory was recovered when a stack of D3-branes was introduced in this N=2 solution. Alongside the beta-deformed theory we considered a unitarily equivalent theory, which we refer to as a w-deformed theory. In this approach the role of the twist is transparent from the field theory to the gravity dual, making it useful in constructing backgrounds dual to the full Leigh-Strassler family of theories.

127 - Ultrafast Excited state dynamics of a direct hetroarylation derived bithiophene-isoindigo copolymer and application in inverted ITO free solar cells.

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 11:30 *[For award: PhD]*
Primary author: *TEGEGNE, Newayemedhin (Stellenbosch University)*
Co-authors: *SCHWOERER, Heinrich (Stellenbosch University); MAMMO, Wendimagegn (Addis Abab University); ABDISSA, Zelalem (Addis Ababa univesity); ANDERSSON,, Mats R. (Chalmers University of Technology)*

A low band gap copolymer (Eg= 1.6.eV) with bithiophene as a donor and isoindigo as an acceptor units was designed and synthesized by direct heteroarylation method. Absorbance of the polymers spans from 300nm to 780nm with a deeper HOMO level of -5.42eV and LUMO level of -3.72eV. It exhibits absorption coefficient (ε) as high as 96 L /g cm in solution at its maxima. Steady state spectroscopy measurements showed solvent polarity independent absorption but the emission spectra was red shift with increasing solvent polarity. Femtosecond-transient absorption measurement in solution showed the presence of intramolecular charge transfer state (ICT) in the relaxation of the polymer in monodisperse system. The intersystem conversion to generate the ICT state was as fast as 2ps. Inverted ITO free solar cells were prepared in bulk heterojunction with PCBM71 and moderate efficiency of 1.02% with high open circuit voltage of 0.81V was obtained.

129 - Physical models: A crucial link between reality and mathematical models

Physics Education - Tuesday 05 July 2016 10:20
Primary author: *LEMMER, Miriam (North-West University (Potchefstroom))*
Co-author: *GUNSTONE, Richard (Monash University, Australia)*

Physics describes real-life phenomena with the aid of models; mathematical modelling is a prime goal of physicists. All models, even abstract mathematical models, are embedded in real life experiences and Physics students should learn to look at the world through this lens and to handle modelling cycles with ease. Major processes of a modelling cycle are mathematical modelling of a physical system followed by mathematical processing of which the outcome is interpreted and validated in the physical system. In this paper it is argued that crucial attention should be paid during physics instruction to understanding of physical models (that incorporate physical systems) as an initial phase in the modelling process. Physical models involve simplifications of real life situations and the assumptions, features and limitations of physical systems; conceptual understanding of physics concepts, relations, basic principles, laws and theories and the ability to translate between various representations thereof as well as application of scientific causal, proportional and analogical reasoning. Research-based problems that students encounter when physics tuition commences with mathematical models or when these are directly built into real life situations without sufficient attention to physical models are discussed. Teaching strategies to circumvent these problems are proposed. These include experimental work using inquiry learning principles and ICT, refinement of daily-life and laboratory experiences to generalize relations and principles that form a coherent explanatory framework as well as attention to the nature and epistemology of science. Students' understanding and appreciation of physical models further requires consideration of socio-cultural aspects, such as their background knowledge, world views and ways of doing, thinking and reasoning. All the above-mentioned features of physical models should progressively be introduced in the teaching of physics to aid students' comprehension of what physics is all about, it's nature, methods, principles and reasoning and their becoming physicists themselves.

130 - Accurate Volume Measurements of Irregular Objects at NMISA

Applied Physics (2) - Wednesday 06 July 2016 10:00
Primary author: *NDLOVU, Bongani (NMISA)*
Co-author: *MAUTJANA, Thomas (NMISA)*

Accurate volume determination of irregular objects can be complex because there are no standard formulas to be applied. One technique to apply is the water displacement method which is not very accurate. The other is using Archimedes' principle where the buoyant force exerted by a fluid on the submerged object is equated to the weight of the object. By measuring the mass of the object and knowing the fluid density, the volume of the object can be determined. At NMISA, hydrostatic weighing which is based on Archimedes' principle is applied in the FC-40 fluid to determine the volume of the mass pieces from 1 g to 1 kg. Volumes of the OIML-shaped stainless steel and spherical weights have been measured using the automated volume comparator (VC1005). The results for volumes of some of the mass pieces such as the OIML-shaped 50 g weights were measured to within an accuracy of 99.996% with measurement uncertainties of ± 0.0005 cm3. These measurements lead to the determination and confirmation of densities of the materials which is critical for high accuracy mass measurements. This paper will present results found for various mass pieces which were used to determine densities of their material.

131 - Synthesis and characterization of Titanium dioxide nanotubes using electrochemical anodization system for solar cell application.

Applied Physics (1) - Tuesday 05 July 2016 15:00 *[For award: MSc]*
Primary author: *LUPIWANA, Mpheleki (1Fort Hare Institute of Technology (FHIT), University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa. 2Chemistry department, University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa.)*
Co-authors: *RAYMOND, Taziwa (1Fort Hare Institute of Technology (FHIT), University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa. 2Chemistry department, University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa.); MEYER, Edson (1Fort Hare Institute of Technology (FHIT), University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa.); KATWIRE, David (2Chemistry department, University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa.)*

The study reveals the synthesis and characterization of Titanium dioxide nanotubes (NTs) using electrochemical anodization. Titanium dioxide NTs were fabricated using ethylene glycol containing ammonium fluoride at different anodization periods (1 hr, 2 hrs, 3 hrs, 4 hrs, 5 hrs, 6 hrs, 8 hrs, 10 hrs and 12 hrs) at a constant voltage of 10 V. The fabricated Titanium dioxide nanotubes were characterised by SEM, XRD, RS and HRTEM. SEM analysis has shown that the fabricated nanotubes have different morphologies that vary with anodization time. XRD analysis revealed that the fabricated nanotubes are polycrystalline consisting of Brookite and Anatase phases. The X-ray diffraction (XRD) patterns of Titanium dioxide nanotubes were in good agreement with the standard x-ray diffraction of the (ASTM) data of Anatase and Brookite phases of Titanium dioxide. The dominant peaks at two-theta degree of 38.7 ° and 77.6 ° which represent the Miller indices of (004) and (031) planes, respectively correspond to the crystalline structure of the pure Anatase phase of Titanium dioxide. Then the other peaks characteristic located at 35.3°, 40.3°, 53.2°, 63.1°, 70.8°, 76.3° and 77.5° two-theta degree, representing the hkl Miller index (002), (202), (222), (610), (413), (204), and (133), respectively, correspond to pure Brookite phase of Titania. RS analyses have revealed that the fabricated Titanium dioxide NTs Anatase with peaks at 154, 199, 406 and 614 per cm, can be seen in the range of 100 to 700 per cm Furthermore structural properties were evaluated by HRTEM. Optical and electronic properties were evaluated by UV-Vis and 4 point probe (I-V characterization) .

132 - Ferromagnetism in magnetic 4f-systems

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 11:30
Primary author: *NOLTING, Volkmar (Vaal University of Technology)*

In magnetic 4f-systems electronic and magnetic properties are carried by two different electron groups. These materials are ferromagnetic semiconductors and insulators and have become important recently due to their applications in spintronics. For their realistic theoretical description the sf-model is used that contains the electron-magnon interaction in the form of an intraatomic exchange coupling between the itinerant conduction and the localized 4f-electrons. The sf-model is solved exactly in the zero bandwidth limit; it turns out that finite band occupations n reduce the saturation magnetization so that m(T=0, n &neq; 0) < S. Furthermore, the Curie temperature T_C depends on the band occupation n which is experimentally modeled by doping with suitable impurities. The theoretical calculations are shown to reasonably agree with experimental results.

133 - Teaching students problem solving with the 'light bulb effect' cognitive diagrammatic representation

Physics Education - Thursday 07 July 2016 10:00
Primary author: ALBERS, Claudia *(WITS university)*
Co-authors: *CLERK, Douglas (School of Physics, University of the Witwatersrand); NAIDOO, Deena (School of Physics, University of the Witwatersrand)*

A diagrammatical representation of the cognitive processes required for solving Physics problems is used to teach students in Physics I Major at the University of the Witwatersrand, about problem solving by empowering them metacognitively, with the aid of a cognitive process diagrammatic representation called 'the light bulb effect'. After a teaching session on 'the light bulb effect' students answer a questionnaire with a problem that is new to them, and then are invited to reflect on their cognitive processes by describing those processes in their own words and drawing a 'light bulb effect' diagram that represents their cognitive processes. The analysis of responses shows that the majority of students find it easy to describe their cognitive processes after the session and also that students find the session beneficial.

134 - Jet measurements in LHC

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 10:00
Primary author: ROY, Debarati *(Postdoc at Wits)*

Jets are collimated bunch of hadrons, originating from quarks and gluons produced in proton-proton collisions at the Large Hadron Collider (LHC). LHC is a jet factory and jets are the most direct manifestations of perturbative and non-perturbative aspects to probe QCD in a hadron collider experiment. Several features of jet production such as inclusive jet cross section, dijet/multijet cross section, jet cross section ratios, as well as jet properties, such as angular (de)correlation between jets, and jet observables, such as jet charge, jet mass have been measured in LHC. These measurements are not only important for precision tests of QCD, but also in developing MC models in the new energy regime ever reached by any particle collider. Jet study is crucial both for hadronically decaying new resonances as well as in many new physics searches jets play as the most dominating background.

135 - Termites in our tests? The role of stigmergy in our examination system

Physics Education - Friday 08 July 2016 15:40
Primary author: CLERK, Douglas *(School of Physics, University of the Witwatersrand)*
Co-authors: *NAIDOO, Deena (School of Physics, University of the Witwatersrand); ALBERS, Claudia (WITS university)*

This study is inspired by perceived shortcomings in the 'problem-solving' abilities of undergraduate physics students. A detailed analysis of student performance in examinations in relation to the type of question being answered for a first year physics course for engineering students has been undertaken. The data collected show that firstly, there is empirical evidence in support of these perceptions. Secondly, evidence has also emerged that there is a favoured question-type that can explicitly be taught and relatively easily mastered, and which typically makes up a sufficiently large fraction of an examination that students can pass without having to demonstrate any real problem-solving ability. What students need to demonstrate instead is a well-developed ability to expedite routine operations of various levels of complexity – which by definition does not amount to problem-solving. It is possible that this bias has become established stigmergically via a feedback process sometimes called 'backwash' to which candidates, examiners and instructors have all been party. Candidates learn what kind of questions to expect, examiners learn what kind of questions candidates can be expected to answer, and instructors learn what kind of questions need to be taught, by traces left in the system's environment. The third outcome of the study has been the emergence of a taxonomy of question types typically set in physics examinations.

136 - Gas sensing applications of Cobalt and Indium double-doped ZnO nanoparticles prepared by sol-gel method

Division for Physics of Condensed Matter and Materials (2) - Tuesday 05 July 2016 11:10 *[For award: MSc]*
Primary author: MASWANGANYE, Mpho *(Universtity of Limpopo)*
Co-authors: *MOSUANG, Thuto (University of Limpopo); MWAKIKUNGA, Bonex (CSIR National Laser Centre); RAMMUTLA, Erasmus Koena (University of Limpopo)*

The undoped and doped ZnO nanoparticles were synthesised using sol-gel method. XRD and PL were used to study the structural and optical properties of the synthesised samples. The gas sensing applications of the undoped and doped ZnO nanoparticles were performed on the Carbon monoxide (CO) gas. The structural studies showed that the synthesised samples were of ZnO wurtzite structure and indium and cobalt were successfully doped into the ZnO structure. In the optical studies the energy band gap of the doped ZnO nanoparticles were found to be smaller as compared to the undoped ZnO nanoparticles. In the gas sensing applications, the response of the doped ZnO nanoparticles were found to be higher than the response of the undoped ZnO nanoparticles. Doping with indium and cobalt was found to reduce the response\ recovery time of the ZnO nanoparticles.

137 - The development of learners' views on the nature of science in a science enrichment programme

Physics Education - Wednesday 06 July 2016 09:40 *[For award: PhD]*
Primary author: BALOYI, Vonani Michael *(University of Pretoria)*
Co-authors: *MEYER, W.E. (University of Pretoria); GAIGHER, E (University of Pretoria)*

This paper presents results of the study conducted with a group of 82 Grade 10 applicants to a science enrichment programme at the University of Pretoria. The Views on the Nature of Science (VNOS-Form C) questionnaire composed of eleven open-ended questions was used in examining learners' views on seven aspects of the nature of science. The initial study investigated the influence of students' social background on their views of nature of science (NOS). We discuss the results obtained and investigate the correlations between the learners' performance on the test and parents' level of education, school performance, and marks in school subjects, home language, and culture. Findings showed no significant difference in the test scores between genders. The strongest influence on the scores was found to be the educational background of the parents. Also, learners with English as a home language performed better. A follow up study was performed on the same group of learners two years later. This group included learners that had attended the science enrichment course (the experimental group) as well as the learners that had not done so (the control group). The second study provided the opportunity to investigate the effect of attending the science enrichment on the learners' views on the NOS. The follow-up study showed that both groups had a more informed view on the nature of science. There was a small difference in the scores obtained between the students that attended the science enrichment programme and those that did not. This is in agreement with results obtained by Abd-El-Khalick & Akerson (2005), Akerson, Abd-El-Khalick, and Lederman (2000) and Khishfe & Abd-El-Khalick (2002) who found that learners' scores on VNOS were not significantly influenced if the NOS was not explicitly taught.

138 - Teaching problem-solving by means of shoestring experiments

Physics Education - Friday 08 July 2016 11:10
Primary author: *CLERK, Douglas (School of Physics, University of the Witwatersrand)*
Co-authors: NAIDOO, Deena *(School of Physics, University of the Witwatersrand); ALBERS, Claudia (WITS university)*

Traditional "recipe-based" practical exercises may have a high degree of outcome predictability, but, because they absolve the student of a great deal of thinking, such exercises have a low degree of value as learning experiences. Practical exercises could instead become problem solving activities, where the student must devise a method as well as generate an answer to a question. The student is given prior warning only of the broad outcome of the task. A common objection to this sort of exercises is that realistically, it can only be performed by students after the relevant 'theory' has been covered. This can present a difficulty for service courses where prohibitively large groups of students would have to perform the same practical exercise simultaneously. In addition, economic and logistic obstacles such as the cost of purchasing large quantities of laboratory equipment, and problems of storage can be seen as prohibitive. In this paper, two exercises are presented that are potentially good learning experiences and can easily be performed by first year Physics students without detailed procedural instructions as problem solving activities compared to traditional 'cookbook' practical exercises. Furthermore, the apparatus for these exercises is cheap to acquire and relatively easy to store, hence the objection mentioned above becomes invalid.

139 - QCD thermodynamics in finite volume

Theoretical and Computational Physics (1) - Wednesday 06 July 2016 11:10 *[For award: MSc]*
Primary author: MOHAMED, Husam *(UCT)*

Thermodynamic bulk properties (pressure, energy and entropy densities) of strongly interacting matter are usually discussed in the infinite-volume limit. We here re-derive these quantities in finite regions of space, in different geometries, in order to quantify finite-size effects. This study is motivated by the fact that, in heavy-ion experiments, the evolution of the produced quark-gluon plasma is often described by hydrodynamic models, which compute the evolution of these bulk properties in discretized space(time) cells.

141 - A comparative timing and spectral analysis of *Suzaku* X-ray data of the nova-like variable system AE Aquarii.

Astrophysics (1) - Friday 08 July 2016 09:40
Primary author: *VAN HEERDEN, Hendrik Jacobus (University of the Free State)*
Co-author: *MEINTJES, Pieter (University of the Free State)*

The nova-like variable system AE Aquarii shows strong emission in the X-ray regime. Previous studies using data from *Ginga, ASCA, XMM-Newton, Suzaku, Chandra* and *Swift* was used to characterise the soft and hard X-ray components. The soft component was found to be multi-thermal in nature whereas the hard component could possibly be non-thermal in nature. Additional timing analysis of predominantly the soft X-ray data was used to update the white dwarf (WD) spin ephemeris, with discrepancies however still reported between different ephemerides determined at different epochs and data sets. A comparative timing and spectral analysis of the available Suzaku data will be considered. A phase based timing analysis will be considered, with the results used in conjunction with results from previous studies to compare the current most accurate and excepted ephemerides for the WD as calculated by Mauche (2006) and de Jager et al (1994) to update and confirm the WD ephemeris. A very accurate WD ephemeris is critical for other studies, such as a possible correlation that has been reported between the WD spin period and possible pulsar like emission towards higher energies.A comparative analysis of the soft and hard X-ray spectra will also be considered. Utilizing the latest calibration data-base models the spectra will be analysed and compared to previous studies to confirm the thermal nature of the soft X-ray components and to determine the full nature of the hard X-ray component. There exists an uncertainty as to whether the hard X-ray component is thermal or non-thermal. In conclusion the significance of the results obtained will be explored.

144 - Investigating gamma-ray fluxes from globular clusters

Astrophysics (2) - Thursday 07 July 2016 10:20 *[For award: MSc]*
Primary author: *NDIYAVALA, HAMBELELENI (NORTH-WEST UNIVERSITY)*
Co-authors: *VENTER, Christo (North-west University, Potchefstroom Campus); KRUGER, Paulus (NORTH-WEST UNIVERSITY)*

(For the H.E.S.S. Collaboration) Globular clusters (GCs) are large collections of old stars that are orbiting the core of a galaxy. Our Milky Way Galaxy has about 160 known GCs, with perhaps more to be discovered. We analysed 20 GCs observed by the H.E.S.S. very-high-energy (>100 GeV) gamma-ray telescopes. The detection of Terzan 5 was confirmed and flux upper limits were obtained for the remaining 19 sources. We accumulated the necessary parameters for each GC and ran a numerical model that predicts the inverse Compton gamma-ray flux expected from each cluster. The five most promising GCs for future observations by Cherenkov Telescope Array (CTA) will be highlighted.

145 - Quantum Boltzmann evolution of the Quark-Gluon Plasma

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 11:30 *[For award: MSc]*
Primary author: *GRUNOW, William (University of Cape Town)*

The rapid equilibration of the Quark-Gluon Plasma, produced in nucleus-nucleus collisions in a far-from-equilibrium initial state, seems to be difficult to understand theoretically. One reason could be that almost all existing approaches based on the relativistic Boltzmann equation neglect quantum-statistics features of the quarks and gluons. Against this background we put forward a novel Monte-Carlo method to solve the Boltzmann equation, with quantum effects included.

146 - Development of a free space, LED illuminated Spectral Domain Optical Coherence Tomography setup

Photonics - Wednesday 06 July 2016 14:00 *[For award: MSc]*
Primary author: *SULIALI, Nyasha (National University of Science & Technology)*
Co-authors: *NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); ROHWER, Erich (University of Stellenbosch); BARICHOLO, Peter (National University of Science &Technology)*

A Spectral Domain Optical Coherence Tomography (SD-OCT) setup has been developed. Axial reflectivity profiles of single reflectors have been simulated and determined. A Michelson interferometer model developed using Matlab was used to simulate broadband light interference. The simulated electric fields showed modulation of field oscillations in the frequency domain resulting in a Gaussian spectral interferogram. A high resolution monochromator using a Glaz line-scan CCD camera was locally assembled and calibrated using a Mercury lamp. A light emitting diode centered at 540 nm with a nominal spectral width of 35 nm was used as the light source in the interference experiments. Mirror reflectivity as a function of surface depth was obtained from inverse Fourier transforms of differential interferograms generated from measured reference, sample and source arm spectra. Measurements of the output spectral interferogram and source spectrum were stored in a 2048×2 matrix created by the line-scan camera data acquisition program. One dimensional OCT images for a fused Silica mirror and glass plates positioned at depths up to 100 µm were obtained. Measured input and output spectra as well as axial scans fairly compared to simulations, hence validating our methodology.

147 - Quantum channel tomography with classical light

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 14:40 *[For award: MSc]*
Primary author: *NDAGANO, Bienvenu (University of the Witwatersrand)*
Co-authors: *ROSALES-GUZMAN, Carmelo (University of the Witwatersrand); ZHANG, Yingwen (CSIR National Laser Centre); KONRAD, Thomas (UKZN); FORBES, Andrew (University of the Witwatersrand); PEREZ-GARCIA, Benjamin (Tecnologico de Monterrey); MCLAREN, Melanie (University of the Witwatersrand)*

Entanglement is a salient feature of quantum mechanics, summarizing the correlations between systems which cannot be described independently; the state of the composite system cannot be expressed as a product state of its constituents. This non-separable property is however not unique to quantum systems; in fact, classes of classical electromagnetic fields have long been known to exhibit entanglement properties: here, the entanglement is between degrees of freedom rather than individual photons. We thus pose the question: given a classically entangled field, can one make predictions about the dynamics of quantum entangled photons, subject to perturbations in a given channel? Our findings are two folds: on one hand we show that classically entangled fields can accurately model the dynamics of quantum entangled systems, particularly the decay of entanglement resulting perturbations of the quantum state leading to decoherence. On the other hand, again using classical fields, we prove the Choi-Jamiolkowski isomorphism which, for quantum systems, states that the complete channel information can be obtained from a state tomography of the maximally entangled states, acted upon by the channel operator.

148 - Quantum transport with vector beams

Photonics - Thursday 07 July 2016 10:00 *[For award: MSc]*
Primary author: *NDAGANO, Bienvenu (University of the Witwatersrand)*
Co-authors: *ROSALES-GUZMAN, Carmelo (University of the Witwatersrand); ZHANG, Yingwen (CSIR National Laser Centre); KONRAD, Thomas (UKZN); FORBES, Andrew (University of the Witwatersrand); PEREZ-GARCIA, Benjamin (Photonics and Mathematical Optics Group, Tecnológico de Monterrey); MCLAREN, Melanie (University of the Witwatersrand)*

Using spatial modes of light is poised to be the next step in free-space bandwidth increase in point-to-point optical communication. Light carrying orbital angular momentum (OAM) is being extensively studied for this very purpose as it provides an additional degree of freedom that spans a discrete and infinite dimensional Hilbert space. As such, it would allow an infinite amount of information to be encoded on a photon. The propagation of spatial modes of light is however hindered by atmospheric turbulence which introduces random intermodal coupling, thereby affecting the fidelity of the detected signals. Here we propose a scheme in which vector vortex modes would be for communication instead of OAM modes. In vector vortex modes, the polarization and spatial degree of freedom are non-separable – a fundamental property of quantum entangled states. As the atmosphere is non-birefringent the polarization degree of freedom remains unaffected during propagation. We built an optical setup to generate and detect vector vortex modes using a q-plate. We simulate the atmospheric turbulence with the help of phase plate based on Kolmogorov's theory of turbulence. We determined the intermodal coupling between four nearly degenerate vector modes as well as the energy transfer to higher order spatial modes as result of the turbulence plate. By evaluating the non-separability of the vector modes through a measurement of the concurrence, we showed that the polarization enhances the resilience of OAM modes to atmospheric turbulence.

149 - NON-SPECIALIST LECTURE: The gravitational wave event GW150914

Astrophysics (1) - Wednesday 06 July 2016 14:00
Primary author: *BISHOP, Nigel (Rhodes University)*

This talk reviews the LIGO observations of GW150914, and shows how this data leads to the interpretation that it represents the merger of two black holes each of mass about 30 Msun at a distance of about 400 Mpc. We also review the observation of a possible coincident gamma ray burst. The implications for astrophysics and fundamental physics are also discussed.

155 - Using Design Based Research to improve teaching, testing and learning.

Physics Education - Wednesday 06 July 2016 10:00 *[For award: PhD]*
Primary author: *FISH, Derek (Unizul Science Centre)*
Co-authors: *ALLIE, Saalih (UCT); PELAEZ, Nancy (Purdue University); ANDERSON, Trevor (Purdue University)*

Design Based Research (DBR) claims to provide solutions to real educational challenges by refining both the interventions offered by teachers (or lecturers) and the instruments used to test their effectiveness. From the literature: Wang and Hannafi n (2005) proposed five basic characteristics of design-based research: "Pragmatic, Grounded, Interactive, iterative and flexible, Integrative, and Contextual".The author made use of this methodology in the refinement of a science show presented at Unizulu Science Centre. The show uses music and musical instruments to introduce students to topics around sound and waves. An extensive study of this show (conducted towards a Masters degree) measured what students learnt from the show. The study looked separately at students coming from rural, urban and township schools.As an extension to this study (conducted towards a doctoral degree) the author used the data from the above study to refine the show and to attempt to boost learning achieved by the students – especially in the weaker rural group. The survey instruments used were simultaneously refined to try to avoid ambiguity and misunderstanding of the questions. Students were presented with the “new improved” show and then tested using the refined instruments. Learning was contrasted with that previously achieved.While performed in the context of science shows in science centres, this study nevertheless has relevance to all educational interventions. It offers a feedback instrument (using DBR) to assist educators in refining their teaching (and the instruments used to evaluate it) to suit the classes they present to. Data and conclusions from the two studies will be presented, and some aspects of the show performed.

157 - Tracking Electrons Produced by Compton Scatter within a Prompt Gamma Imaging Device

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 15:20
Primary author: *PETERSON, Stephen (University of Cape Town)*
Co-authors: *POLF, Jerimy (University of Maryland School of Medicine); MACKIN, Dennis (University of Texas MD Anderson Cancer Center); DREAGER, Emily (University of Maryland School of Medicine); BEDDAR, Sam (University of Texas MD Anderson Cancer Center)*

Proton therapy requires precise delivery of the accelerated particles to the cancerous tissue in order to maximize its considerable benefits. Unfortunately, there is no way to directly monitor the actual dose delivered to the patient. Prompt Gamma Imaging (PGI), specifically a Compton camera, is a promising option for in vivo verification of the 3D dose distribution. A Compton camera relies on an incident gamma undergoing multiple Compton scatters within its multiple stages. The information (energy deposited and location) from the Compton scatters (2 or more) can be used to reconstruct a cone of origin. With a sufficient number of cones and appropriate image reconstruction techniques, a 3D image of the dose can be produced. Of course, the accuracy of the image reconstruction relies heavily on the quality of the data measured by the detector, specifically the energy and position of the detected electron.This work uses the Geant4 Monte Carlo toolkit to track the Compton electrons within the individual stages of the Compton camera in order to better understand the accuracy of the detected election position and energy. The energy and range of the secondary electrons are broken down by direction and scatter sequence order. A number of different detector configurations were also investigated. The work provided some clear indications of the expected accuracy from the energy and position measurements of the electrons in a Compton camera.

158 - Supercontinuum Generation in Highly Birefringent Photonic Crystal Fibers

Photonics - Tuesday 05 July 2016 14:20 *[For award: MSc]*
Primary author: *JENA, James (National University of Science and Technology)*
Co-authors: *BARICHOLO, Peter (National University of Science & Technology); DLODLO, Temba (National University of Science & Technology); BUAH-BASSUAH, Paul (University of Cape Coast)*

We have simulated the propagation of femtosecond laser pulses in highly birefringent photonic crystal fibers to understand the supercontinuum generation spectral broadening process. The dynamics involved were analysed through the variation of pulse properties and fiber parameters. Photonic crystal fibers possess elevated nonlinearity to the extent that laser pulses of low energy than was previously required, can now be used for the super coherent white light sources. This super coherent white light is crucial for use in optical coherence tomography, microscopy and spectroscopy applications whose relevance extend to materials processing and the medical fields. A variety of pulse energies were used in each setup where 100 fs pulses at 800 nm pump wavelength were launched into a 30 cm photonic crystal fiber with normal group velocity dispersion and single zero dispersion wavelength close to the pump. Several supercontinuum spectra of bandwidths extending to a span covering the visible range were observed for the different setup conditions. The effect of varying the pulse energy, pump wavelength, fiber dispersion and birefringence on the broadening of the spectrum were investigated and the dynamics analysed. The photonic crystal fiber birefringence had little effect on the spectral broadening and the obtained supercontinuum. Self phase modulation and Raman scattering were identified among the nonlinear effects responsible for the spectral broadening. It was also observed that higher energy input pulses with a pump power of 800mW resulted in a broader spectral continuum, spanning from 500nm to 1350 nm whilst a lower intensity spectrum with a bandwidth of 280nm was achieved with 300mW pump power.

159 - NON-SPECIALIST LECTURE: Nonequilibrium processes and their fluctuations

Theoretical and Computational Physics (1) - Friday 08 July 2016 09:40
Primary author: *TOUCHETTE, Hugo (National Institute for Theoretical Physics (NIThePP) Stellenbosch)*

This talk will give a brief overview of important problems currently studied in nonequilibrium statistical mechanics related to systems driven in steady states and their fluctuations. One particular problem, which has come to be studied only recently, is the following: When a random system is seen to fluctuate away from its average or most probable behavior, how does it do it? In other words, can we find an effective dynamics explaining how the system produces that fluctuation? This problem, as I will explain, is related to the conditioning of probabilities, the Onsager-Machlup theory of noise-activated transitions, and the notion of statistical ensembles generalized to trajectories of stochastic processes.

160 - Chemical contamination and radiological risk assessment of Richards Bay waters

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 10:00 *[For award: PhD]*
Primary author: *MASOK, Felix Bitrus (University of Johannesburg)*
Co-authors: *MAVUNDA, Dazmen (UJ / Necsa); MALEKA, Peane (iThemba LABS)*

South Africa can be pronounced a dry country. Though Kwazulu-Natal has a higher rainfall than most parts of the country, it has recorded cases of austere droughts. Drilling of bore hole is prohibited by the municipal by-laws. Advancement of heavy industries and their support services could produce a source of contamination to the surface and ground waters and possibly the main water resources of Richards Bay. Any potential contaminants need to be identified in order to control the activities that cause them. Water samples were collected from a stream within Transnet precinct, Lake Mzingazi, Indian Ocean, Esikawini tape and Richards bay effluent water. The samples were analyzed using inductively coupled plasma mass spectroscopy (ICP-MS) for elemental composition of elements considered to be possibly poisonous even at low concentration and the results revealed none of the samples was contaminated with Pb and U, but a gross contamination of Mn was established in effluent, river and stream samples. In this work we will report on the radio analysis results obtained and the conclusions drawn on the suitability of these water for domestic and irrigational usage.

162 - Getting WISE on Star Formation

Astrophysics (2) - Thursday 07 July 2016 10:00 *[For award: MSc]*
Primary author: *AUGUST, Tamlyn (University of Cape Town)*
Co-author: *JARRETT, Thomas (UCT/Caltech)*

In order to understand the evolution of a galaxy, it is essential to determine its star formation properties as well as its growth in stellar mass over cosmic timescales. *WISE*, the all-sky, mid-infrared survey, affords us the opportunity to investigate both these parameters for galaxies with a wide range of morphologies, activity types, and stellar masses.In this talk, I will discuss our investigation of the two WISE star formation indicators at 12 (W3) and 22 (W4) microns, using ancillary data from the *Spitzer* Infrared Nearby Galaxy Survey (SINGS).I will present results on the reliability of W3 as a star formation indicator, introduce a new star formation rate (SFR) relation based on our analysis, as well as a comparison of existing SFR relations to our new relation. I will also comment on future work to be done on the spatially detailed, albeit qualitative, analysis of a few selected well-resolved galaxies to investigate local star formation processes.

163 - First Run 2 Soft QCD Results from ATLAS

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 14:00
Primary author: *KAR, Deepak (University of Witwatersrand)*

The LHC Run 2 started with a new highest center-of-mass energy of 13 TeV in the middle of last year. The first measurements were observables sensitive to soft-QCD processes, to validate the Monte Carlo (MC) generator models at this unprecedented collision energy. In this talk, I will summarise the ATLAS results, and comment on the implications of the results on improving the MC modelling.

165 - BPS Geometries

Theoretical and Computational Physics (1) - Wednesday 06 July 2016 11:30 *[For award: PhD]*
Primary author: *NKUMANE, Lwazi (University of the witwatersrand)*
Co-authors: *DE MELLO KOCH, Robert (University of the witwatersrand); GOSSMAN, David (university of the witwatersrand); TRIBELHORN, Laila (University of the witwatersrand)*

We study the example of the AdS/CFT correspondence betwee type IIB string theory on spacetimes that are asymptotically $AdS_5 \times S^5$ and N = 4 super Yang-Mills Theory. We consider states in the field theory dual to 1/2 and 1/4 BPS string theory backgrounds. The boundary condition for the supergravity solution is determined by a function which satisfies the Laplace equation. For regular geometries, this function must take values ±1/2 on a certain two dimensional plane. In the dual theory, this plane is identified with a phase space of Fermions by mapping the regions with ±1/2 to occupied and unoccupied states. This can be visualized as separated white and black regions. The boundary separating these two region can have any shape for 1/2 BPS geometries. For 1/4 BPS geometries, the boundary is constrained by a non-tirival differential equation.

166 - Anomalous Dimensions of Heavy Operators from Magnon Energies

Theoretical and Computational Physics (1) - Thursday 07 July 2016 11:30 *[For award: PhD]*
Primary author: *HASINA TAHIRIDIMBISOA, Nirina Maurice (University of the Witwatersrand)*
Co-authors: *DE MELLO KOCH, Robert (University of the Witwatersrand); MATHWIN, Christopher (University of the Witwatersrand)*

We propose operators with definite scaling dimension, dual to submaximal giant gravitons.Our analysis makes heavy use of techniques using group representation theory.The systems we study consist of strings suspended between maximal and submaximal giant gravitons and are described using spin chains with boundaries.The system enjoys an su(2|2) symmetry which determines the anomalous dimensions in the gauge theory.Complete agreement with energies computed in the dual string theory is demonstrated.Further, the symmetry determines the reflection/scattering matrices for boundary and bulk magnons.The resulting S-matrix passes a number of highly non-trivial checks. The boundary condition on the open spin chain is inconsistent with the Yang-Baxter equation so that ultimately the system is not integrable.

167 - Interacting Double Coset Magnons

Theoretical and Computational Physics (1) - Thursday 07 July 2016 11:50 *[For award: PhD]*
Primary author: *MAHU, Augustine Larweh (University of the Witwatersrand)*
Co-authors: *DE MELLO KOCH, Robert (University of the Witwatersrand); HASINA TAHIRIDIMBISOA, Nirina Maurice (University of the Witwatersrand); MOHAMED ADAM ALI, Abdelhamid (University of the Witwatersrand)*

Anomalous dimensions of operators in N = 4 super Yang-Mills theory in the large N limit, are evaluated.The operators considered have a classical dimension of order N and are constructed using complex matrices Y and Z. Non-planar diagrams contribute already at the leading order in N and the planar and large N limits are distinct.The number of Y fields m ~ O(N) is much smaller than the number of Z fields n used to construct the operators.The ratio m/n is thus a small parameter that can be used to organize a systematic expansion.A major goal of this study is to develop this expansion and we succeed in computing the first subleading order.Our system can be mapped to an integrable model at leading order. The subleading terms spoil the identification with an integrable system.

169 - Seeing is believing?

Physics Education - Wednesday 06 July 2016 11:50
Primary author: *FISH, Derek (Unizul Science Centre)*

Presenting science in South Africa often faces the challenge of differences between religious views and scientific ones. But, given that over 80 % of South Africans profess to some form of belief (Stats SA), we cannot afford to ignore this factor when promoting science. Ian Barbour has identified four typologies which characterise the relationship between Science and Religion and which are helpful in setting up dialogue between the two sides. These typologies will be presented and discussed and practical suggestions made as to how presenters and lecturers can present science while being sensitive to strongly held beliefs. A practical example is given of a unique series of science shows presented by the author in a place of worship. Derek Fish is Director of Unizulu Science Centre and following from his concern about the perceived gap between science and belief, a series of science shows was presented on Sunday evenings in a place of worship. These covered various aspects of Physics, including electrostatics, optical illusions and perception, sound and music, colour and light, also tackling more controversial topics such as the Big Bang and creation, astronomy vs astrology, luck vs chance and others. Each presentation involved a number of exciting physics demonstrations, appropriate (for a family audience) explanations of the phenomena and a discussion about issues of belief surrounding the topic. As an example, the electrostatics presentation focussed mainly on lightning and a discussion followed on the common belief that lightning can be considered a supernatural act or something controlled by humans rather than merely an electrostatic phenomenon. Response to the series has been excellent with the hall filled out on every occasion. It is hoped that the series will establish more dialogue between science and belief and allow the two sides to establish common ground. Robust debate and discussion on this topic is encouraged.

170 - Coupling of single proton configurations to collective core excitations in ^{162}Yb: the nucleus ^{161}Tm

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 09:40 *[For award: MSc]*
Primary author: *JONGILE, SANDILE (UNIVERSITY OF ZULULAND/ ITHEMBA LABS/UNIVERSITY OF THE WESTERN CAPE)*
Co-authors: *SHARPEY-SCHAFER, JOHN (UNIVERSITY OF THE WESTERN CAPE); NTSHANGASE, SIFISO (UNIVERSITY OF ZULULAND); DINOKO, TSHEPO (iThemba Laboratory for Accelerator Based Sciences); MAJOLA, SIYABONGA (iThemba Laboratory for Accelerator Based Sciences); BARK, ROB (iThemba Laboratory for Accelerator Based Sciences); BVUMBI, SUZAN (UNIVERSITY OF JOHANNESBURG)*

Most nuclei are deformed with some having axial symmetry and the rest being triaxial. For the study of nuclei more than two mass units away from the stability line, it is not possible to investigate their properties using direct reactions. Therefore gamma ray spectroscopy is the most productive way studying their structure. In recent years experimental evidence suggests that 0+ bands do not have properties of β vibrations [1]. This contradicts old models. Single particle orbitals in odd A nuclei with even-even N=92 as a core, will couple to any collective core excitations of that core. Previous experiments have been done on neutron deficient isotopes of Thalium [2]. In this research we focus on the ground state proton of 161Tm in [404]7/2^{+} Nilsson orbit that couples to any collective excitations in ^{162}Yb. The experiment ^{152}Sm(^{14}N,5n)^{161}Tm was performed to study this at iThemba LABS. An AFRODITE spectrometer was used.This presentation will discuss the results and analysis of data obtained in the experiment.[1] J. F. Sharpey-Schafer et al., Eur. Phys. J. A47, 5(2011)[2] C. Foin et al.,Nucl. Phys.A417, 511(1984)This work is supported by the National Research Foundation of South Africa

172 - Jet substructure techniques for identifying boosted bosons in ATLAS

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 10:20 *[For award: Hons]*
Primary author: *MOODLEY, Chane Simone (University of the Witwatersrand)*
Co-author: *KAR, Deepak (University of the Wiwatersrand)*

At LHC Run 2, many heavy particles decaying to jets can be identified with jet substructure techniques. Various techniques for reconstructing boosted bosons were used in LHC Run 1 at ATLAS, and they are being tested with the Run 2 data. Some early results comparing signal and background shapes from these techniques will be shown, with comments on their possible usage on new physics searches.

173 - The search for crystal undulator radiation

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 10:00
Primary author: *HENNING, Colleen (St John's College, Houghton)*
Co-authors: *BOSHOFF, Dutliff (St John's College); MOTSOAI, Malaika (Barnato Park High School); CONNELL, Simon (University of Johannesburg); COPELAND, Michael (St John's College); HAFFEJEE, Fayad (St John's College); KILBOURN, Quintus (St John's College); MACKENZIE, Brandon (St John's College); MERCER, Connor (St John's College); OSATO, Antonio (St John's college); WILLIAMSON, Connor (St John's College); SIHOYIYA, Professor (Barnato Park High School)*

The channelling phenomenon applies to the correlated motion of charged particles within a crystal lattice in a direction closely aligned with atomic rows (strings) or crystal planes. When the incident charge particle is highly relativistic, the emitted channeling radiation is boosted by a factor of γ2, where γ is the Lorentz factor. Bremsstrahlung may also be coherent for these conditions, and coherent enhancement leads to both quasi monoenergetic peaks and also significant increases in intensity as compared to the normal process. In the special condition that the crystal is periodically bent, such as in a periodic superlattice, one may also have undulator radiation. All of these phenomena are potential sources of MeV and GeV range intense gamma radiation. The latter phenomenon is proposed as potentially the most important source of monochromatic high energy photons. In principal it can also lead to coherent radiation based on the Free Electron Laser (FEL) principal with intensities similar to an extrapolation of what may be obtained at modern light sources. In this contribution we describe a search for crystal undulator radiation using 2.5 – 6.0 GeV positrons incident on a diamond crystal undulator. The experiments were performed at the T9 Beamline of the Proton Synchrotron at CERN. The experiment was the result of a winning proposal for the 2015 CERN Beamline for Schools Competition.

176 - Free-space Optical Communications through Turbulence

Applied Physics (1) - Tuesday 05 July 2016 11:10 *[For award: PhD]*
Primary author: COX, Mitchell *(University of the Witwatersrand)*
Co-authors: *FORBES, Andrew (CSIR); ROSALES-GUZMAN, Carmelo (University of the Witwatersrand, Johannesburg)*

Due to exponentially increasing internet bandwidth demands, existing subterranean and undersea fiber optic links will soon become saturated in terms of their information capacity, as dictated by the Shannon Limit. Installation of additional fiber optic links is expensive and can only lead to a linear increase in bandwidth. Free space optical communications may provide a solution to this problem by enabling very high bandwidth point-to-point communications between satellites in orbit as well as buildings on the ground, compared to traditional radio-based systems. Modes carrying Orbital Angular Momentum provide a basis for both modulation and multiplexing due to their orthogonal nature. Both scalar, Laguerre-Gaussian modes as well as vector vortex modes have been used to dramatically increase the information capacity of optical links in lab environments. Outside the lab, however, atmospheric turbulence degrades the orthogonality of the modes upon propagation, lowering their information capacity. It has been suggested that vector modes, due to their weaker coherence compared to scalar modes, are more resilient to atmospheric turbulence and would therefore be a more suitable basis for communication.Here we present an experimental investigation into whether there is indeed a significant difference between scalar, Laguerre-Gaussian modes and vector vortex modes by propagating them through simulated Kolmogorov turbulence of varying strengths and measuring the crosstalk between modes. We use the results to demonstrate a practical link using a commercial device, potentially increasing the bandwidth by a factor of four.

177 - Electronic structure and bandgap of gamma-Al2O3:Ce compound using LDA+U exchange potential

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 14:40 *[For award: PhD]*
Primary author: MULWA, Winfred Mueni *(University of the Free State)*
Co-authors: *DEJENE, Francis Birhanu (University of the Free State); OUMA, Cecil Moro (Council for Scientific and Industrial research); ONANI, Martin (University of the Western Cape)*

Gamma-Al2O3 is a porous metal oxide and described as a defective spinel with some cationic vacancies. In this work, we calculate the electronic density of states and band structure for the bulk of this material doped with Cerium. The calculations are performed within the density functional theory (DFT) with the Hubbard correction U (DFT+U) as implemented in the quantum ESPRESSO code. The Kohn-Sham equations are solved self-consistently, employing local density approximation (LDA) with the Hubbard U correction (LDA+U) for the exchange-correlation potential. We show that LDA+U exchange potential as a local method can predict the bandgap in a better agreement with the experiment. Our electronic structure analysis indicates that the character of the valence band maximum mainly originates from the p orbitals of the oxygen electron atoms that are close to the vacancy. The charge density results show that the polarization of the oxygen electron cloud is directed towards aluminium cations, which cause Al and O atoms to be tightly connected by a strong dipole bond.Key words: Bandgap, LDA+U exchange potential, DFT.

178 - Holographic toolkit for optical communication beyond orbital angular momentum

Photonics - Friday 08 July 2016 11:10
Primary author: ROSALES-GUZMAN, Carmelo *(University of the Witwatersrand, Johannesburg)*
Co-authors: *DUDLEY, Angela (CSIR National Laser Centre); NDAGANO, Bienvenu (University of the Witwatersrand); FORBES, Andrew (CSIR); TRICHILI, Abderrahmen (University of Carthage, Engineering School of Communication of Tunis (Sup'Com)); BEN SALEM, Amine (University of Carthage, Engineering School of Communication of Tunis (Sup'Com)); ZGHAL, Mourad (University of Carthage, Engineering School of Communication of Tunis (Sup'Com))*

Very recently, it was pointed out that orbital angular momentum (OAM) multiplexing alone does not increase the bandwidth of optical communication systems. Indeed in all work to date, multiplexing schemes based on OAM have not provided with a real bandwidth increment.In this work, we demonstrate a new holographic tool to realise a communication link using a densely packed LG mode set incorporating both radial and azimuthal degrees of freedom. Moreover, we show experimentally that it is possible to multiplex/demultiplex over 100 spatial modes on a single hologram, written to a spatial light modulator, in a manner that is independent of wavelength. For this, a set of 35 optical modes multiplexed in 3 different wavelengths was experimentally generated to create a set of 105 information carriers. This modes were used as information carriers over a free space link to illustrate the robustness of our technique. The information was recovered by simultaneously detecting all different modes employing a single hologram. Using this approach we are able to transmit several images with correlations higher than 98%. Although our scheme is a proof-of-concept, it provides a useful basis for increasing the capacity of future optical communication systems.

180 - Identifying new narrow-line Seyfert 1 galaxies and white dwarfs from the second ROSAT all-sky survey catalogue

Astrophysics (1) - Friday 08 July 2016 14:20
Primary author: ODENDAAL, Alida *(University of the Free State)*
Co-authors: *BOLLER, Thomas (Max-Planck-Institute for Extraterrestrial Physics); HABERL, Frank (Max-Planck-Institute for Extraterrestrial Physics); MEINTJES, Pieter (University of the Free State)*

The second ROSAT all-sky survey (2RXS) source catalogue has now been published, containing approximately 135000 X-ray sources. Spectral fits using three different models were reported in this catalogue: a power law, an optically thin plasma emission model and an optically thick blackbody model. For the current study, all sources with power law photon indices greater than 3 have been selected from the main 2RXS catalogue, provided that the error in the fitted index is smaller than 1.5. This yielded a list of 1022 sources, representing the 2RXS sample with the softest X-ray spectra. Sources with such soft X-ray spectra can be expected to be primarily narrow-line Seyfert 1 galaxies (NLS1s) or white dwarfs (WDs). Many of the soft 2RXS sources are already known as NLS1s or WDs, but several are still unidentified, and this project is aimed at confirming the classification for these unknown sources. One of the main challenges of the process is evidently to distinguish between NLS1s and WDs. To aid in this process, a study of the infrared properties of known NLS1s and WDs has been performed, based on entries in the AllWISE catalog. It was found that the two classes can be well separated based on infrared magnitudes and colours, allowing a preliminary identification and classification to be made for the unknown sources. Follow-up optical spectroscopy and multi-wavelength archival studies will be performed to confirm the preliminary classification, and also to investigate the properties of these sources.

182 - Synthesis of ZrC coatings in a vertical-wall CVD system

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 11:50 *[For award: PhD]*
Primary author: BIIRA, Saphina *(Department of Physics, University of Pretoria.)*
Co-authors: *ALAWAD, Bilal (Department of Physics, University of Pretoria); BISSET, Hertzog (Applied Chemistry Division, Necsa); NEL, Johann (Applied Chemistry Division, Necsa); HLATSHWAYO, Thulani (Department of Physics, University of Pretoria); MALHERBE, Johan (Department of Physics, University of Pretoria); CROUSE, Philip (Department of Chemical Engineering, University of Pretoria)*

Polycrystalline ZrC coatings were grown on graphite substrates by chemical vapour deposition technique. Zirconium Tetrachloride (ZrCl4) powder and methane (CH4) gas were used as zirconium metal source and carbon source respectively. Argon and hydrogen were used as carrier and dilutant gas respectively. ZrC thin films were deposited at substrate temperatures ranging from 1200 oC to 1600 oC for two hour at atmospheric pressure. The impact of substrate temperature on surface morphology and microstructure of ZrC coatings were examined using X-ray diffraction (XRD) and Scanning electron microscopy (SEM). The variations in crystallite size, dislocation density, texture coefficient, lattice constant and degree of preferred orientations of ZrC films with substrate temperature were established. At lower temperatures of about 1200 oC, the plane (111) had the preferred orientation and as temperature increased to about 1500 oC the preferred orientation shifted to plane (200). The surface morphology and microstructure of ZrC thin films at various substrate temperature were observed using SEM. The SEM results indicated that as the temperature increased from 1400 oC to 1600 oC the uniformity of the surface morphology of ZrC coatings improved.

183 - Thermospheric neutral density observations by radar

Space Science - Wednesday 06 July 2016 15:20
Primary author: KOSCH, Michael *(SANSA)*
Co-authors: *SARNO-SMITH, Lois (University of Michigan); YAMAZAKI, Yosuke (Lancaster University); YEOMAN, Tim (University of Leicester); OGAWA, Yasunobu (National Institute of Polar Research); RIETVELD, Mike (EISCAT Scientific Association)*

Radars are sensitive to backscatter from the ionosphere, i.e. the charged component of the upper-atmosphere, and are normally completely insensitive to the thermosphere, i.e. the dominant neutral component of the upper-atmosphere. Manipulation of the ion-momentum equation permits the ion-neutral collision frequency to be estimated and hence from this the neutral density. We show examples for two basic geometries: (1) Parallel to the magnetic field using incoherent scatter radar, and (2) Perpendicular to the magnetic field using coherent scatter radars. Applications include the long-term trend due to climate change and the short-term variability due to solar storms.

186 - Effect of Solar tracking on a PV system operating in the CSIR (South Africa)

Applied Physics (1) - Wednesday 06 July 2016 14:40
Primary author: RORO, Kittessa *(Energy Center - CSIR)*
Co-author: *BISCHOF-NIEMZ, Tobias (Energy Center - CSIR)*

Recently, there has been a renewed interest in solar photovoltaic (PV) tacking systems in the PV industry globally. It has been demonstrated that tracking significantly increases the average yearly energy yield. However, a study on the effect of solar tracking on the performance of PV systems operating in South Africa is rare. The purpose of this study is, therefore, to analyse the operational performance of a 558 kWp ground mounted single-axis tracker solar PV system operating at the CSIR's Pretoria campus with regards to the solar gain compared to a fixed-tilt installation and to prepare the grounds for a subsequent development of a tracking model that will optimise the energy yield. It is observed that on a sunny day the direct normal irradiance accounts for up to 90% of the total irradiation whereas the remaining 10% was from diffused irradiation. During cloudy days, however, nearly all of the solar radiation is from diffused radiation. Over the entire observation period of six months analysed (October 2015 to March 2016), the tracking gain was 20% compared to the global irradiance on the horizontal plane. It is also found that tracking the astronomical movement of the sun cannot be the optimal tracking strategy. Possible explanation for this will be presented and discussed. The results of this study will be used for the subsequent development of an improved tracking algorithm in which the tracking of a solar array would be used such that it optimises total energy yield.

187 - Internal quantum efficiency and energy transfer processes in Ce3+ co-doped ZrO2: Eu3+ nanorods

Division for Physics of Condensed Matter and Materials (2) - Friday 08 July 2016 11:30
Primary author: AHEMEN, Iorkyaa *(University of the Free State-Qwaqwa Campus)*
Co-author: *DEJENE, Francis B. (University of the Free State-Qwaqwa Campus)*

Cerium co-doped ZrO2: Eu3+ nanorods was synthesized by a simple chemical dehydration route and their structural, morphological and optical properties were investigated. Structural studies revealed mixed-phases of monoclinic and tetragonal Bravis lattices. Nanorods of different dimensions were observed on the scanned images. Excitation and absorption spectra revealed the dominance of the Eu3+ - O2- charge transfer states band over the intraconfigurational lines of the activator ion. A broad emission band with center maximum at 465 nm is attributed to both Ce3+ ion and the host band emissions. Electronic transitions in the range 500 nm to 650 nm are assigned to the Eu3+ ion. No significant energy transfer was observed because concentration quenching process dominated the energy transfer process. The internal quantum efficiency decreased with increasing Ce3+ concentration.

189 - Computational study of TiO_2 polymorphs as an anode material for energy storage devices

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 15:00 *[For award: PhD]*
Primary author: GANDAMIPFA, Mulatedzi *(University of Limpopo)*

Energy production and storage plays an important role concerning our daily life, e.g. electronic devices. The increasing demand for powering systems of portable electronic devices and zero-emission vehicles stimulates research towards high energy and high voltage systems is a challenge. In lithium-ion battery, graphite is a widely used anode material, but it has some disadvantages as compare to anatase TiO_2 nanotube anode such as electrical disconnection, structural deformation, and initial loss of capacity. Given these exciting properties, it becomes necessary not only to synthesize such solid-state and molecular systems but also to model their properties at an appropriate size and time scale. In this work we have predicted the structural parameters for TiO_2 polymorphs and these parameters were found to be in agreement with an experimental data. We also calculated the band gap energies, predicted band structures and density of states for these polymorphs in an effort to validate the DFTB+ potentials. The geometry optimizations were performed using DFTB+ potentials that we derived. Moreover, these properties will determine which TiO_2 polymorph can be used as an anode material in future storage devices.

192 - Investigation of the number of time ground-backscatter occurs for all the beams and range gates using the SuperDARN SANAE HF radar data.

Space Science - Wednesday 06 July 2016 09:40
Primary author: MTUMELA, Zolile *(South African National Space Agency (SANSA))*
Co-authors: *KOSCH, Michael (SANSA); SMITH, Lois (University of Michigan)*

Ray tracing is widely employed in the study of radio waves through the ionosphere. Radiosignals are modelled as rays and traced through the ionosphere where they are reflected orrefracted back to the earth. The SuperDARN radars can identify two types of backscatter, namely ionospheric and ground scatter. The ray reaching the ground after reflection in the ionosphere is identified as ground backscatter. Ionospheric scatter predictions are based on the relative orientation of the background magnetic field with each ray. The HF ray from the SuperDARN radar is subject to refraction in the ionosphere because of the varying electron density with altitude. The radar ray usually peaks at ~300 km altitude before returning to the ground, about 1500 km down range. This ground-scatter is usually easily detected by the radar because the spectral width and Doppler shift of the ground scatter is zero. The exact location of the ground-scatter depends on the radar frequency and the ionospheric electron density profile downrange of the radar. We show initial results of ground scatter statistics over 5 years from the SANAE SuperDARN radar.

193 - Simple models for cytoskeleton

Applied Physics (1) - Thursday 07 July 2016 11:10
Primary author: MÜLLER-NEDEBOCK, Kristian *(University of Stellenbosch)*

The mechanical properties of a cell certainly depend on the type of filaments of which the cytoskeleton is composed. But how these are linked into networks also plays a role, together with the geometry the constraining cell membrane or wall cause. In this presentation we address these aspects in simple models for the elastic and geometrical properties of the cytoskeleton. The distribution and orientation of filaments within the confining region also vary with position within the cell - for example, recent molecular dynamics simulations show that confinement affects the orientation and distribution of filaments within the cell [1]. We introduce a monomer ensemble technique [2], and discuss the role of membranes or cell walls on the elastic. Finally, the role and type of cross-linking in such systems will be discussed.[1] Azari, A. & Müller-Nedebock, K. K. Entropic competition in polymeric systems under geometrical confinement. EPL 110, 68004 (2015).[2] Pasquali, S. & Percus, J. K. Mean field and the confined single homopolymer. Molecular Physics, 107(13), 1303 (2009).

194 - Searching for exotic shapes in silicon-28

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 11:50
Primary author: ADSLEY, Philip *(Stellenbosch University and iThemba LABS)*

The wide range of exotic nuclear shapes in light N=Z nuclei such as Mg-24 and Si-28 provides a significant challenge to nuclear theory. Of particular importance in this regard is trying to understand the connection between the observed nuclear clustering phenomenon in these nuclei and the well-established nuclear shell model.Inelastic scattering reactions using a beam of alpha particles can be used to locate states associated with deformation and clustering at high excitation energies and low spin. An experiment was performed at iThemba LABS using the K600 investigating the scattering of alpha-particles from a silicon target. New states are identified; structural interpretations will be discussed.

196 - Confirmation of low latitude electrodynamics in driving poleward waves

Space Science - Tuesday 05 July 2016 11:30
Primary author: HABARULEMA, John Bosco *(South African National Space Agency)*
Co-author: *KATAMZI, Zama Thobeka (South African National Space Agency)*

This talk will discuss the physical mechanisms responsible for launching poleward waves originating from the geomagnetic equator. In particular, satellite and radar data will be utilised in confirming that vertical drift contributes to poleward motion of waves through Lorentz coupling.Results show that such waves can travel up to 20-30 degrees on both sides of the geomagnetic equator and therefore contribute to some ionospheric features such as electron density increase in part of the mid-latitude region.

198 - The production of multiple leptons due to heavy bosons at the Large Hadron Collider

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 11:30 *[For award: MSc]*
Primary author: FADOL, Abdualazem *(University of Witwatersrand)*
Co-author: *MELLADO, Bruce (University of Witwatersrand)*

We are investigating the implications of the presence of heavy neutral, H, A, and charged bosons, H+-, in terms of the production of multiple leptons in proton proton collisions at the Large Hadron Collider. Due to the conservation of gauge invariance it is postulated that the heavy scalar, H, decays into an intermediate lighter scalar, S, and the Higgs boson, h with the decays H->SS,Sh. The scalar S is assumed to decay into a pair of dark matter particles and pairs of SM particles. One of the most prominent decays would be S->WW(*), leading to the production of leptons. In addition, the decays A->ZH and H+- -> W+- H are allowed yielding multiple lepton final states, as well. The final states in interest and the distinct kinematic features will be summarised.

199 - Modelling the unbinding of membranes tethered randomly to a network substrate.

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 10:20 *[For award: PhD]*
Primary author: GUMEDE, Sthembiso *(Stellenbosch University)*
Co-author: *MUELLER-NEDEBOCK, Kristian (Stellenbosch University)*

In erythrocytes the plasma membrane is coupled to the underlying spectrin network. We develop a model to treat the detachment of a membrane from such a substrate, which might be a model for structural failure of the red blood cell. We consider a flexible membrane elastically linked at random points to a substrate. This quenched randomness requiresthe use of the replica formalism, which we investigate from both replica symmetric and weakly broken replica symmetry perspectives. Criteria for detachment under an applied pressure differential across the membrane are derived. We also sketch how a more detailed spectrin network can beincluded in this model.

200 - Student difficulties with DC circuits: misconceptions or sense-making?

Physics Education - Thursday 07 July 2016 11:50
Primary author: JOHN, Ignatius (CPUT)
Co-author: ALLIE, Saalih (UCT)

As part of a long-term study into student difficulties with regard to DC circuits we probed the effect on student responses when fine-grained contextual changes were made to questions related to an open DC circuit. An eight item instrument was used, each question consisting of a choice (from 4 options) followed by a written explanation. Previously we presented (a) details of the instrument (SAIP 2010), (b) selected findings from the analysis of the free writing responses (SAIP 2011), and (c) the main ideas underlying the answer choices (SAIP 2014). In the first part of the present talk we summarize the essence of the overall findings by presenting a portion of the detailed analysis from the choice responses, in particular to the questions related to (1) swapping the resistive elements (heater, light bulb and resistor) and changing the words (charge flow to current, heat up for heater to light up for light bulb) in the question. The results emphasize that the students do not respond to the different elements in a manner that is consistent with the physics perspective that all three elements are equivalent from an electrical resistance perspective. In the second part of the talk we note that the findings are better described by a “knowledge in pieces” model rather than by a unitary (mis)conceptions account. We propose a simple explanatory model of an individual student response as follows: (1) a correct but limiting interpretation of an everyday experience is triggered by the question context, and, (2) together with attempts at sense-making on the part of the student, leads to a response that is interpreted as a misconception by an instructor. The claims that students are engaged in sense-making are based on (limited) interviews.

201 - Student understanding of vectors

Physics Education - Thursday 07 July 2016 11:10
Primary author: JOHN, Ignatius (CPUT)
Co-author: KUDINHA, Martin (CPUT)

This study probes the first year university students’ understanding of vectors in one dimension and two dimensions. The aim of the study is to develop a research based curriculum to first year non-major physics students. The probe used in the study was independent of context. A pair of vectors of different magnitude and direction were given in each question and students asked to find the resultant vector in each case. The vectors were graphically represented in the question, changing only the angle between them in each case. The answers were given as options from which they had to choose one of them. In addition, students were requested to explain the reason for choosing a particular option. The given options were in comparison with the previous questions and answers. The result showed a high level of consistency with the method each student used, irrespective of the suitability of the situation or the correctness of the answer. The results also showed that the instruction and the instructional materials has a high degree of influence on students’ responses.

202 - Irrotational-fluid cosmologies in fourth-order gravity

Astrophysics (1) - Wednesday 06 July 2016 14:40 *[For award: PhD]*
Primary author: ELMARDI, Maye (UCT)
Co-author: ABEBE, Amare (North-West University)

We explore classes of irrotational-fluid cosmological models in the context of f(R)-gravity in an attempt to put some theoretical and mathematical restrictions on the form of the f(R)- gravitational Lagrangian. In particular, we investigate the consistency of linearised dust models for shear-free cases as well as in the limiting cases when either the gravito-magnetic or gravito-electric components of the Weyl tensor vanish. We also discuss the existence and consistency of classes of non-expanding irrotational spacetimes in f(R)-gravity.

206 - Effect of calcination on structural and magnetic properties of nickel chromite

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 11:50
Primary author: MOHANTY, Pankaj (University of Johannesburg)
Co-authors: SHEPPARD, Charles (Department of Physics, University of Johannesburg); PRINSLOO, Aletta (University of Johannesburg)

Spinel nickel chromite demonstrates ferrimagnetic ordering below T_C = 74 K, and it undergoes several temperature dependent structural and magnetic phase transitions [1]. Recently, it has shown the exchange bias effect, attributed to an anisotropic exchange interaction between the ferrimagnetic and antiferromagnetic components of magnetic moment [2]. These results motivated a detailed investigation into the high temperature structural phase transitions of this material, as well as the effect of calcination on magnetic properties, that are reported here. *In-situ* high temperature XRD studies of the as synthesized nickel chromite samples measured in air and He atmospheres suggests the phase formation takes place around 800 to 900 °C. The cubic structure of nickel chromite is retained up to almost 1100 °C, contrary to the reported tetragonal phase observed at such elevated temperature [3]. Upon cooling no change in crystal structure is observed. Nickel chromite samples calcined at 900 °C and 1100 °C, respectively, have been used for microstructural and magnetic studies. The particles are found to have a broad size distribution. T_C is obtained to be 86 K for the sample calcined at 900 °C, whereas it is reduced to 74 K for the other. The magnetic transition observed at T_S = 31 K marking the onset of ordering of antiferromagnetic component, remain unchanged for both the samples. The spontaneous magnetization values for samples calcined at 900 °C and 1100 °C are found to be lesser than reported values [1,4] and they do not show exchange bias effect.References[1] Ishibashi H, Yasumi T 2007 J. Magn. Magn. Mater 310 e610[2] Barman J et al. 2015 J. Magn. Magn. Mater. 385 93[3] Ptak M et al. 2013 J. Sol. Stat. Chem. 201 270[4] Mufti N et al. 2010 J. Phys.:Condens. Matter 22 075902

208 - Search for a heavy scalar decaying into the Higgs boson and missing energy with the ATLAS detector

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 11:50 *[For award: MSc]*
Primary author: PELWAN, Chad (University of Witwatersrand)
Co-authors: MELLADO, Bruce (University of Wisconsin - Madison); RUAN, XIFENG (WITS); LIAO, Shell-may (University of the Witwatersrand, School of Physics, 1 Jan Smuts Avenue, Braamfontein, Johannesburg, 2000, South Africa”); REED, Robert (University of Witwatersrand); VON BUDDENBROCK, Stefan (University of the Witwatersrand); TOMIWA, Kehinde (University of the Witwatersrand)

A distortion of the Higgs transverse momentum spectrum was observed with Run I data. This feature can be interpreted as the production of a heavy scalar, H, decaying into the Higgs boson and something else, including missing transverse energy. This heavy scalar H has been hypothesised and is allowed to decay to the SM Higgs and a dark matter candidate, X, in order to probe the search for Higgs plus missing transverse momentum. Limits were placed on the brancing ratio on the H to hXX decay using Run II data. Prospects for the future analysis of this will be discussed. Techniques for the reconstraction of missing transverse momentum for Run II will also be reviewed.

210 - Coupling of single neutron configurations to collective core excitations in $^{162}_{70}$Yb , the nucleus $^{163}_{70}$Yb.

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 10:20 *[For award: MSc]*
Primary author: SITHOLE, Makuhane (University of the Western Cape)
Co-authors: SHARPEY-SCHAFER, John F (UWC); DINOKO, Tshepo (iThemba LABS); MAJOLA, Siyabonga (UCT/ iThemba Labs); NTSHANGASE, Sifiso Senzo (University of Cape Town / iThemba LABS); BARK, Robert (iThemba LABS); BVUMBI, Suzan Phumudzo (University of Johannesburg); MDLETSHE, Linda (University of Zululand); SANDILE, Jongile (University of Zululand)

In odd-nuclei the single nucleon can couple to collective excitations of its even-even core nucleus. These collective excitations lie in within the pairing gap and are therefore the lowest energy excitations of the core. Our physics motivation is to search for structures where an odd neutron couples to collective excitations of the ^{162}Yb core. In addition we will search for high-K structures in this nucleus. The experiment ^{152}Sm(^{16}O,5n)^{163}Yb at E_{lab} = 93 MeV was performed to study ^{163}Yb at iThemba LABS. The gamma-decays from the reaction products have been detected using the AFRODITE gamma-ray spectrometer equipped with eight escape-suppressed clover detectors. This presentation will discuss the preliminary results and analysis of data obtained in the experiment.

213 - Physics of noise and its impediment to the health of mine workers

Physics Education - Wednesday 06 July 2016 10:20 *[For award: MTech]*
Primary author: *KOMBO TSOUMBOU, AMOUR DORICK (University of Johannesburg)*
Co-author: *MULABA-BAFUBIANDI, Antoine-Floribert (School of Mining, Metallurgy and Chemical Engineering, University of Johannesburg)*

This paper covers the physics of noise and its impact on the health of mine workers at a typical manganese mine in the Northern Cape. It also covers the status-quo of the noise exposure levels and prevalence of Noise Induced Hearing Loss(NIHL) over the past three years at that mine in order to assess the effectiveness of the HCP implemented at the mine. Wessels Mine was selected to conduct this study. A review of NIHL data of the employees was performed. The information was accessed from the database of the mine's clinic and analysed. A walk through survey was conducted to observe the work practices and employees' behaviour as related to noise in their working sections. Note that noise levels measurements were taken around the mine both on the surface and underground beforehand. The results obtained showed that at least two employees were diagnosed with early NIHL each year from 2012 to 2015. In addition, three cases of severe NIHL were identified in the same period. It was also noticed that high noise level at the mine was generated by mechanized equipment. The principal sources of noise were mostly from production areas underground and processing plant on the surface. Since the audiometric data collected from the clinic indicated little incidences of NIHL, it is clear that NIHL is well mitigated at the Mine. This informs us that the HCP employed at Wessels mine is yielding good results and is therefore effective in preventing the spread of NIHL. However, the average noise level in most working sections exceeds the tolerable permissible level. This is an indication that people working in those areas are likely to develop NIHL in the near future. It is important for the mine to think of new strategies to further control noise from sources both in underground and surface working areas.

214 - A beam quality measure for vector beams

Photonics - Thursday 07 July 2016 10:20 *[For award: PhD]*
Primary author: *SROOR, Hend (University of The Witwatersrand)*
Co-authors: *NDAGANO, Bienvenu (University of the Witwatersrand); MCLAREN, Melanie (University of The Witwatersrand); ROSALES-GUZMAN, Carmelo (University of The Witwatersrand); FORBES, Andrew (University of The Witwatersrand)*

Cylindrical vector(CV) beams are spatial modes of light with spatially variant polarization states in the transverse profile. Over the years, CV beams have found their way into plenty of applications ranging from material processing and lithography to electron acceleration and particle trapping. Though qualitative measurements are routinely used to analyse CV beams, there is no quantitative measure of CV beam purity. Here, we introduce new measure, the vector quality factor (VQF), that maps the purity of CV beams to a scale ranging from 0 to 1. We demonstrate a simple optical setup to generate and detect CV beams using a birefringent phase plate known as a q-plate. Real time tomographic measurements are performed using principles of modal decomposition and demultiplexing. Real time measurements are encoded as a demultiplexing of the modal decomposition of the CV beam into its circular basis states. The measurements give a twelve on-axis intensity outputs represent full state tomography which used to evaluate the VQF of CV beams.

223 - Nuclear structure studies relevant to double beta decay of 136Xe

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 11:30 *[For award: PhD]*
Primary author: *REBEIRO, Bernadette (University of the Western Cape, South Africa)*
Co-authors: *TRIAMBAK, Smarajit (University of the Western Cape, South Africa); RADICH, Allison (University of Guelph); FAESTERMANN, Thomas (Technische Universitat Munchen); HERTENBERGER, Ralph (Ludwig-Maximilians-Universitat Munchen); WIRTH, Hans (Ludwig-Maximilians-Universitat Munchen); MABIKA, Zandile (University of the Western Cape); LEACH, Kyle (Colorado School of Mines); JIGMEDDORJ, Badamsambuu (University of Guelph); LINDSAY, Robert (University of the Western Cape); ADSLEY, Philip (iThemba Laboratory for Accelerator Based Sciences and University of Stellenbosch); GARRETT, Paul (University of Guelph); BALL, Gordon (TRIUMF); RAND, Evan (University of Guelph); BILDSTEIN, Vinzenz (University of Guelph); BURBADGE, Christina (University of Guelph); DIAZ VARELA, Alejandra (University of Guelph)*

Presently there is significant interest to experimentally observe neutrinoless double beta ($0\nu\beta\beta$) decays. This exotic decay mode, observed in a few isotopes over the nuclear chart, would signify physics beyond the current standard model. A measured $0\nu\beta\beta$ rate can further be used to determine the effective neutrino mass. A major difficulty in extracting the neutrino mass from the decay rate arises from the uncertainties associated with the matrix element calculated for the decay. In this talk I present the results from ^{138}Ba(p,t) and the ^{138}Ba(d,a) transfer reactions performed using a high resolution spectrometer to provide useful spectroscopic information for matrix element calculations in ^{136}Xe$\beta\beta$ decay.

224 - Faculty-Student Interaction - The Informal Revolution

Physics Education - Friday 08 July 2016 14:00
Primary author: *SCHWARTZ, Marthnis Johannes (University of Zululand)*

Informal faculty-student interaction has been shown to positively influence students' retention, academic achievement, educational aspirations, intellectual and personal development, and personal attitude toward their host institution (i.e. university). Such informal interactions frequently exist between the students and academic staff with whom they work, either as a lecturer or research supervisor. As a number of universities within South Africa now host science centres, which specialize in informal science education, is it possible for science centres to positively contribute to the informal faculty-student interaction? The presentation will examine the interactions that are currently conducted by science centres in engaging university students. The nature and potential benefit, as reported by the various science centres, will form part of the presentation. The presentation will also include results from a pilot study conducted by the Unizulu Science Centre. The pilot study examined current faculty-student interactions between the science faculty and first year physics students from the University of Zululand. Interviews will be conducted to clarify expectations and challenges held by both students and faculty toward informal faculty-students interactions. It will further aim to begin to quantify the potential impact a science centre can have on the faculty-student interactions and how such interactions could become a valuable tool for universities.

225 - Exciton dynamics of individual plant light-harvesting complexes as revealed by fluorescence lifetime and intensity shifts.

Photonics - Wednesday 06 July 2016 11:50 *[For award: MSc]*
Primary author: *BOTHA, Joshua (University of Pretoria)*
Co-authors: *STOLTZ, Herman (University of Pretoria); KRÜGER, Tjaart (University of Pretoria); GRUBER, Micahel (Vrije Universiteit of Amsterdam); VAN GRONDELLE, Rienk (VU University Amsterdam)*

The fundamental mechanisms involved in photosynthesis not only provide an opportunity to study physical principles that span over both classical and quantum scales but also take us a step closer to the development of viable alternative energy sources such as cheaper biofuel production and more effective photovoltaics. Some of said mechanisms play a critical role in the photoprotection of oxygenic photosynthetic organisms against high light intensities and are generally referred to as non-photochemical quenching (NPQ). In plants, the fast, reversible, energy-dependent component of NPQ (qE) likely takes place in the major light-harvesting pigment-protein complex (LHCII) and compete with the exciton dynamics that ensure efficient light harvesting. Recent time-resolved studies have revealed that single, isolated LHCII complexes exhibit binary switching between a bright and a dim emission state, a phenomenon called fluorescence intermittency, which is very likely related to slow protein conformational dynamics. We will show the fluorescence lifetime and intensity correlations of single LHCII complexes in NPQ states emulated to different degrees with a particular focus on the less frequently accessed intermediate levels.

227 - Is the Abstract/Concrete Distinction a Useful Tool in Physics Education Research?

Physics Education - Thursday 07 July 2016 11:30 *[For award: PhD]*
Primary author: *SOUTHEY, Philip (UCT)*
Co-author: *ALLIE, Saalih (UCT)*

The terms "abstract" and "concrete" are widely used in physics education research, and are linked to core educational concepts such as transfer and conceptual change. They are also pivotal in arguments for the development of educational materials. For example, a "modern" first year physics text book contains an abundance of concrete examples. Some commentators argue that this allows the material to be more accessible and relevant for students. Others argue that it obscures the underlying abstract physical principles and hinders knowledge transfer. However, given that the terms "abstract" and "concrete" originated in a priori philosophical inquiry, and have since been adopted by diverse disciplines including cognitive psychology, linguistics and artificial intelligence, it is unsurprising that their meaning can differ substantially both between and within disciplines. We present four different ways in which the "abstract/concrete" distinction is employed in education research: (i) immaterial/material; (ii) general/particular; (iii) sparse/rich; (iv) unfamiliar/familiar. In particular, we critique the "sparse/rich" distinction as it is used in the widely cited studies of Kaminski et al. and suggest that other theoretical concepts, such as cognitive resources and working memory may be more productive in explaining their results. In sum, we argue that an interrogation of the reasons for using the terms "concrete" or "abstract" will point toward more productive theoretical tools that provide greater conceptual clarity, and avoid the inherent ambiguity of the "abstract/concrete" distinction.

229 - Yang-Lee and Fisher zeros in a model of adsorbing self-avoiding walks

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 10:00
Primary author: JANSE VAN RENSBURG, Esaias J *(Mathematics and Statistics, York University, Toronto, Ontario)*

The theory of Yang-Lee zeros and the Fisher edge singularity is an accepted and useful approach in the understanding of phase transitions in statistical physics. While there are numerous studies of Yang-Lee and Fisher zeros on lattice spin systems, such as the q-state Potts models and lattice field theories, much less is known about these zeros and their relation to phase transitions in models of lattice clusters (such as the self-avoiding walk). In this talk numerical results on Yang-Lee and Fisher zeros in a model of an adsorbing self-avoiding walk will be presented. This is a model of polymer adsorption, and the properties of the Yang-Lee and Fisher zeros will be considered on the one hand, while the relation of the zeros to the physics of model will be considered as well. This includes, for example, the location of the critical point and scaling in the model. The numerical results are based on estimated microcanonical data, which were obtained by sampling states in the partition function of the model using the GAS algorithm.

230 - Exact Magnon Dynamics

Theoretical and Computational Physics (1) - Thursday 07 July 2016 11:10
Primary author: DE MELLO KOCH, Robert *(University of the Witwatersrand)*

In this talk we will review some recent progress on the computation of anomalous dimensions of heavy operators in N=4 super Yang-Mills theory. The approach adopted makes a novel use of the symmetries of the problem. Exactly the same symmetry structures appear in both the field theory and the dual string theory, so that this construction has a natural interpretation in terms of the AdS/CFT correspondence.

232 - HYDROGEN FUEL CELL STUDIES USING NEUTRON RADIOGRAPHY

Applied Physics (1) - Thursday 07 July 2016 10:00
Primary author: DE BEER, Frikkie *(Necsa)*

The neutron, as radiation probe, has a high penetration capability through dense materials as well as unique and effective detection characteristics for low Z materials such as hydrogen and hydrogen based compounds, which are inaccessible to X-ray radiography.. Due to the high neutron attenuation of hydrogen, neutron radiography and tomography techniques have proven itself capable of visualising distribution of hydrogen / compounds even imbedded within dense materials such as Pb, Cu and Fe. The transport of water in porous media such as high density civil engineering materials is one application where neutron radiography allows for the qualitative and quantitative analysis of two phase flow processes within the objects. This presentation focusses on recent studies where neutron radiography has been applied in the detection of hydrogen compounds in a working hydrogen fuel cell. Neutron radiography is a key analytical diagnostic extensively applied in the optimisation of the fuel cell. The principle of the technology (radiography & fuel cell technology) and what can be learned through neutron radiography about the usage of a fuel cell in the electrolysis process, using the reverse operation of a fuel cell, will be highlighted.

233 - A Tunable Vacuum Ultraviolet Light Source and High Intensity Saturation of the Nonlinear Medium

Photonics - Wednesday 06 July 2016 09:40
Primary author: RIGBY, Charles *(Laser Research Institute, Stellenbosch University)*
Co-authors: STEENKAMP, Christine *(University of Stellenbosch)*; ROHWER, Erich *(University of Stellenbosch)*

A wavelength tunable vacuum ultraviolet (VUV) light source of high peak power and narrow spectral bandwidth has been developed at the Laser Research Institute of Stellenbosch University. Two-photon resonant four wave sum-frequency mixing in phase matched magnesium vapour-krypton gas was used to produce wavelengths in the range 143 nm to 146 nm. The maximum VUV peak power obtained was 4.4 watts at 144.7 nm and a total laser input intensity of 420 $MW.cm^{-1}$. A quantum efficiency of 1.7 x 10^{-7} was obtained. Applications of this source include absorption and fluorescence spectroscopy of molecular gases and crystals.Saturation effects in the nonlinear medium leading to a decrease in VUV generation efficiency near the two-photon resonance are investigated and compared to existing theoretical models. It is shown that two-photon absorption dominates in a narrow wavelength region around resonance, leading to significant population of the excited state, resulting in a change of the effective refractive index which in turn causes destruction of the phase matching conditions. The intensity dependent change of index of refraction causes the VUV generation efficiency to the blue and red of the resonance to differ. Failure to account for these changes can lead to a reduction of the VUV peak power obtained by 20 % or more.

234 - How Cool is the Gluon Plasma?

Theoretical and Computational Physics (1) - Wednesday 06 July 2016 09:40 *[For award: PhD]*
Primary author: GIOVANNONI, Dino *(Rhodes University)*
Co-author: PESHIER, Andre *(University of Capw Town)*

It has been established that the initial stages of a heavy-ion collision is characterized by an overoccupied gluon density. Furthermore, it has been postulated by Blaizot et. al. that the early stages of the evolution may exhibit approximate conservation of the gluon number density. This necessitates the introduction of a non-zero gluon chemical potential hence establishing the possible dynamical formation of a gluonic Bose-Einstein condensate (BEC). Following this argument, we make an assumption that the plasma may reach a transient, quasi-equilibrium state in which the system reaches thermal equilibrium, with gluon number being conserved. We investigate the thermodynamic properties of this quasi-equilibrium, overoccupied gluon plasma within a quasiparticle framework in which QCD interaction effects are encapsulated in an effective gluon thermal mass. The results indicate that a gluon plasma may be quite cool, possibly being `supercooled' to temperatures as low as about 20% of the usual confinement temperature Tc. It was also possible to deduce a gluonic phase diagram in which phase boundaries between a gluon plasma, gluon BEC and glueballs are proposed.

235 - Effect of thermal annealing on the electrical characteristics of Au/Ni Schottky contacts on high doped n-type 4H-SiC

Division for Physics of Condensed Matter and Materials (2) - Friday 08 July 2016 11:50
Primary author: OMOTOSO, Ezekiel *(University of Pretoria)*
Co-authors: DIALE, Mmantsae *(University of Pretoria)*; AURET, Danie *(University of Pretoria)*; MEYER, Walter *(University of Pretoria)*

Au/Ni contacts have been resistively fabricated on highly doped n-type 4H-SiC. The effect of annealing temperature on the electrical characteristics of the Schottky barrier diodes (SBDs) has been successfully investigated using current-voltage (I-V) and capacitance-voltage (C-V) techniques measured at room temperature (~300 K). Prior to the annealing of the contacts, the I-V measurements results confirmed the good rectification of the SBDs with ideality factor, Schottky barrier height and series resistance of 1.06, 1.33 eV and 7 Ω, respectively. From the I-V and C-V measurements, a decrease in the quality of the contacts with increasing annealing temperature was observed from the values of electronic parameters such as Schottky barrier height, ideality factor, series resistance and saturation current and net donor concentration obtained. The SBDs maintained their rectification quality up to the annealing temperature of 500 °C before the contacts start deteriorate with increase in annealing temperature.

237 - Solar water geysers - a South African perspective

Applied Physics (1) - Thursday 07 July 2016 09:40
Primary author: FERRER, phil *(wits)*

It is generally agreed that a solar water geyser represents both a moral and financial asset to a household. Yet it is very difficult to determine what financial benefits such a system delivers, and there are numerous incorrect approaches, which generally aim to hype the system and justify its large capital outlay.In this presentation, I attempt to answer the question of thermodynamic benefit precisely by determining an upper limit to the usefulness of a solar geyser, and further highlight shortcoming of existing systems' philosophy by comparing the geyser's performance relative to hot water consumption patterns. I finally present an outline of how the financial benefits of a solar geyser can be estimated in the current financial climate.

239 - Excitation spectroscopy with vibration selective detection for self-absorption free rovibronic spectra of CO

Photonics - Wednesday 06 July 2016 10:00 *[For award: MSc]*
Primary author: DE BRUYN, Andre *(Laser Research Institute, Stellenbosch University)*
Co-authors: STEENKAMP, Christine *(University of Stellenbosch)*; ROHWER, Erich *(University of Stellenbosch)*; DU PLESSIS, Anton *(Stellenbosch University)*

In this project the excitation and fluorescence wavelengths for carbon monoxide (CO) in the VUV region are investigated. The narrow spectral bandwidth of the light of our tunable VUV laser source (yielding high spectral resolution and high spectral brightness) allows detection of the fluorescence from weakly absorbing transitions, such as forbidden transitions (FT) of $^{12}C^{16}O$. The weak spectral lines of CO are important in astrophysics and laboratory data is lacking. Flow-cooling of CO in a supersonic jet makes it possible to do spectroscopy in conditions similar to conditions in space: collision-free and at temperatures down to a few Kelvin. By incorporating a scanning monochromator into the existing system we recorded the CO fluorescence spectrum upon VUV excitation and measured self-absorption free rotational excitation spectra of CO in the VUV region. This information was used to accurately determine the temperature of the supersonic jet gas sample. Using the monochromator it was possible to increase the spectral resolution from 0.93 pm to 0.42 pm. The upgraded system has excellent potential for recording of weak forbidden transitions of CO and other molecular gases.

244 - A small-amplitude study of solitons near supercritical points

Space Science - Tuesday 05 July 2016 10:20
Primary author: OLIVIER, Carel *(SANSA)*
Co-authors: *VERHEEST, Frank (Universiteit Gent); MAHARAJ, Shimul Kumar (South African National Space Agency (Space Science) (formerly NRF Hermanus Magnetic Observatory))*

We study supercritical points in parameter space for a general fluid model consisting of an arbitrary number of species, each with a number of compositional parameters, such as temperatures and number densities. The approach uses a two-dimensional Taylor series of the Sagdeev potential expanded about both the acoustic speed and the equilibrium electrostatic potential. We show that a sech-type soliton arises at such a supercritical point, in agreement with results of Verheest et al. [1]. A small perturbation in parameter space results in a number of possibilities, depending on the “direction” of the perturbation. These possibilities include coexistence and acoustic speed double layers. A novel finding in this study is the description of small-amplitude supersolitons. Our analysis allows us to determine the exact existence criteria for these structures, as well as lower and upper bounds of the Mach numbers and amplitudes of the structures. We therefore establish an interesting link between supercritical points and supersolitons.Reference: [1] F. Verheest, C. P. Olivier and W. A. Hereman, J. Plasma Phys. 82, 905820208 (2016).

245 - Effect of 1.712 GHz RF-Clock Signal Distribution on 10 Gbps 1550.89 nm VCSEL Based Transmission over Single Optical Fibre for Square Kilometre Telescope Array

Applied Physics (1) - Tuesday 05 July 2016 10:20
Primary author: ISOE, George *(Centre for Broadband Communication,Nelson Mandela Metropolitan University)*
Co-authors: *LEITCH, Andrew (NMMU); GIBBON, Timothy (NMMU Physics Department); BOIYO, Duncan (Nelson Mandela Metropolitan University); WASSIN, Shukree (NMMU); GAMATHAM, Romeo Reginald Gunther (NRF, Square Kilometre Array South Africa)*

Distribution of timing and frequency reference signals from the central science processor station to each of the antenna array over optical fibre is of extreme importance to overall Square Kilometre Array (SKA) project. Clock tones are used for data time-stamping, as well as other monitoring and control functions that ensures the telescope array maintains phase coherence during an astronomical observation. After a fast, high resolution sampling process, individual dishes collect enormous amount of data which needs to be transmitted back to the central processor station. The current telescope array network distributes clock tones to digitizers at individual dishes over optical fibres. The collected data from these remote antennae is then transmitted over separate optical fibres back to the processor centre. This does not only increase the complexity in the telescope array network, but also increases the fibre deployment cost due to large amounts of optical fibres required in such a network. In this work, we experimentally demonstrate a cost effective bidirectional VCSEL based clock tone distribution and data transmission over single optical fibre for a telescope array network. A 10 Gbps VCSEL was modulated with a 1.712 GHz RF-clock signal and tuned to achieve different wavelengths by varying its bias current from 4.95 mA to 5.68 mA. Its effect on a 10 Gbps 1550.89 nm VCSEL based transmission at 8.5 mA bias current was then studied for 50 GHz, 75 GHz and 100 GHz channel spacing, at counter propagation direction. A negligible RF-clock interference penalty of 0.07dB, 0.05 dB, and 0.04 dB was incurred for 50 GHz, 75 GHz and 100 GHz channel spacing respectively. Results from this work show that the two signals can be integrated successfully over a single optical fibre without any remarkable interference penalty on the transmitted data, even at a small channel spacing of 50 GHz

246 - Direction Dependent Calibration for the KAT-7 radio data

Astrophysics (1) - Thursday 07 July 2016 10:00 *[For award: PhD]*
Primary author: KASSAYE, Ermias *(Rhodes University)*

Signals from radio sources in the universe are detected by radio telescopes after passing through the medium between sources and radio telescopes. During the process, the signal propagation is highly affected by the intervening medium, such as the atmosphere, and the primary beam. These are direction dependent effects, which essentially give wrong information about the sources of interest if they are not estimated and corrected properly with suitable models. The main objective of the presentation will be to discuss how we are dealing with them for the KAT-7 observations. More importantly, we emphasise on the results that have been obtained so far from the KAT-7 observations when applying only direction independent models and both direction independent and dependent models. Additionally, we discuss how the models are logically developed using mathematical formulation of electromagnetic wave, which is known as the Radio Interferometer Measurement Equation (RIME).

247 - ADC trigger board for the PROMETEO test-bench of the ATLAS Tile Calorimeter

Applied Physics (1) - Wednesday 06 July 2016 11:10 *[For award: MSc]*
Primary author: SPOOR, Matthew *(WITS)*
Co-author: *KUREBA, Chamunorwa Oscar (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa)*

The implementation of the High luminosity upgrade of the ATLAS Tile Calorimeter (TileCal) is planned 2026. The TileCal will have both its on- and off-detector electronics completely redesigned and replaced. A Hybrid demonstrator is currently being developed to test the new upgrade architecture while providing backwards compatibility with current legacy systems. The PROMETEO (A Portable ReadOut ModulE for Tilecal ElectrOnics) standalone test-bench system has been in development in parallel with the demonstrator. The test-bench will serve as a tool to perform functionality checks as well as fully certify the new TileCal electronics. By reading out digital and analog samples from the front-end electronics in real time, data quality can be assessed and system malfunctions can be diagnosed. PROMETEO is currently based around a Xilinx VC707 evaluation board with a dual QSFP+ FMC module for high speed readout. Additional functions are provided by a multiple custom boards: ADC trigger board, LED board and High voltage board. This work focuses on the development of the ADC trigger board which is used to digitise differential analog trigger signals coming from the adder boards on the front-end of TileCal. The ADC board employs two ADC5271 chips to sample 16 analog data channels at 40 Mega Samples Per Second (MSPS) leading to a data flow of 7.86Gbps to a FPGA on the VC707.

249 - Characterization of a Direct Current Discharge Based Microthruster

Space Science - Tuesday 05 July 2016 11:10 *[For award: PhD]*
Primary author: WRIGHT, William *(University of the Witwatersrand)*
Co-author: *FERRER, phil (wits)*

A novel electrical micro-thruster is currently being developed at the University of the Witwatersrand and is intended to be used commercially on small satellites and deep space probes. The system utilizes a coupling of the ionization and acceleration mechanisms to achieve miniaturization. A direct current glow discharge is used to generate a plasma which is then exploited to generate thrust. Proof of concept testing has shown that the system operates in the expected manner. A thrust balance has been developed to measure the amount of thrust generated by the system and will be discussed. Thrust measurements using air as a propellant have been performed and the results of these tests will be presented. A computational model has been developed in COMSOL Multiphysics in an attempt to understand the physical phenomena that result in thrust generation and the features and results of the model will be discussed. Future work and attempts to develop the concept into a workable prototype will be presented.

250 - Discovery of the First White Dwarf Pulsar

Astrophysics (1) - Friday 08 July 2016 11:30
Primary author: BUCKLEY, David *(SAAO)*
Co-author: *POTTER, Stephen (SAAO)*

The first example of a White Dwarf which shows spin modulation of its flux in both the radio and optical wavelengths has recently been discovered. It is in a close binary system with a M-dwarf companion and has a 3.6h orbital period. Polarimetric observations undertaken at the SAAO has revealed remarkably high linear polarization, which is also strongly pulsed on the 59s first harmonic of the spin or beat period, reaching levels of 80%. In addition, the position angle of the linear polarization can change by up to 360 degrees over this period. Observations over two consecutive nights shows that the level and amplitude of the polarization modulation changes, possibly on the orbital period. We interpret these results as evidence of a precessing synchrotron jet in this system, which is powered by the spin-down energy of the White Dwarf.

252 - Postgraduate Studies: Influences that make students to choose their respective research fields

Physics Education - Tuesday 05 July 2016 11:30
Primary author: SONDEZI, Buyi *(University of Johannesburg)*

There is a widely known perception that opting for a career in the Sciences is challenging undertaking and also one of the difficult choices that postgraduate students make as they pursue careers. A study was conducted on the influences that inform postgraduate students to embark on their respective careers. Over and above the challenges that the students come across, especially after their undergraduate studies, the data gathered in this study reveals that most students and consequently academics and professionals end up in their fields of specialty due to other reasons other than the passion for the field. Data has been collected from students from various faculties although a special attention was given to Physics-related careers.

255 - Spatially-Dependent Modelling of Pulsar Wind Nebulae

Astrophysics (1) - Friday 08 July 2016 11:10
Primary author: VAN RENSBURG, Carlo *(North-West University)*

We present results from a leptonic emission code that models the spectral energy density of a pulsar wind nebula by solving a Fokker-Planck-type transport equation and calculating inverse Compton and synchrotron emissivities. We have created a time-dependent, multi-zone model to investigate changes in the particle spectrum as the particles traverse the pulsar wind nebula, by considering a time and spatially-dependent magnetic field, and spatially-dependent bulk particle motion causing convection, diffusion, as well as energy losses (synchrotron radiation, inverse Compton scattering and adiabatic). Our code predicts the radiation spectrum at different positions in the nebula, yielding the surface brightness versus the radius and the pulsar wind nebula size as function of energy. We calibrated our new model against more basic models using the observed spectrum of PWN G0.9+0.1, incorporating data from H.E.S.S. as well as radio and X-ray experiments. We also fit our predicted radiation spectra to data from G21.5-0.9, G54.1+0.3, and HESS J1356-645 and found that our model yields reasonable results for young pulsar wind nebulae. This model allows us to potentially constrain spatial properties of several quantities, e.g. the B-field, bulk flow speed, and diffusion coefficient. The development of this type of model is necessary in light of the development of the Cherenkov telescope array (CTA) which will yield far better resolution than current telescopes.

257 - Short Path Length Energy Loss in the Quark Gluon Plasma

Theoretical and Computational Physics (1) - Wednesday 06 July 2016 10:00 *[For award: PhD]*
Primary author: KOLBE, Isobel *(University of Pretoria)*
Co-author: *HOROWITZ, William (University of Cape Town)*

High Energy Particle Physics collider experiments at the Relativistic Heavy Ion Collider (RHIC) in the USA and the Large Hadron Collider (LHC) in Geneva, Switzerland, are probing the most fundamental properties of matter by accelerating a range of particles, from protons to Lead nuclei, to relativistic speeds and causing them to collide. The decay products of these violent collisions can be studied in detail and have revealed that a new state of matter in which the constituents of nucleons, quarks and gluons, exist in a deconfined state, creating what appears to be a perfect fluid called the Quark Gluon Plasma (QGP). The QGP only exists for a few femto seconds and is therefore extremely difficult to characterize. The manner in which a highly energetic particle loses energy as it traverses the QGP has proven to be an effective probe of the QGP, but recent results in smaller colliding systems such as proton-lead (pPb) have brought into question our understanding of perturbative Quantum Chromodynamical (pQCD) descriptions of energy loss, particularly in small systems of QGP. We present a short separation distance correction to the well-known (static scattering centre) DGLV (Djordjevic, Gyulassy, Levai, Vitev) pQCD energy loss calculation, revealing a number of shortcomings and problematic assumptions. We also investigate the feasibility of a similar small system correction in the (dynamical scattering centre) thermal field theory formalism.

260 - Proton induced radiation damage to the fluorescence capability of plastic scintillators for the Tile Calorimeter of ATLAS

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 11:30 *[For award: MSc]*
Primary author: JIVAN, Harshna *(University of the Witwatersrand)*
Co-authors: *MADHUKU, Morgan (iThemba LABS); LIAO, Shell-may (University of the Witwatersrand); MELLADO, Bruce (University of the Witwatersrand); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); ERASMUS, Rudolph (University of the Witwatersrand)*

Plastic scintillators are organic materials which exhibit the effect of luminescence upon interaction with ionising particles. Their properties of high optical transmission, fast rise and decay times, low cost and ease of manufacture make them particularly useful for high energy physics detection systems. As such, the Tile Calorimeter of ATLAS employs tiles of plastic scintillators to detect hadronic jets and showers of quarks and gluons that result from the proton-proton collisions generated by the LHC. The fluorescent light emitted by the plastic tiles is read out using wavelength shifting optical fibers coupled to photomultiplier tubes. As the plastics are exposed to harsh radiation environments, their subsequent radiation induced damage results in a degradation of the fluorescence light yield. Presently, the LHC is undertaking several upgrades in order to broaden the scope of physics that can be studied. These upgrades will result in a much harsher radiation environment. In order to ensure that the ATLAS detector performance can be sustained for several years to come, scintillators from the GAP region of the TileCal will be replaced with more radiation tolerant plastics in 2018.A series of investigations are currently being conducted into the radiation hardness of several PVT and PS based plastic scintillators which are candidates for the upgrade. In this study, we investigate the damage induced by 6 MeV protons to the light transmission and fluorescence capability of 350 µm thick scintillators. Presented here are the results of the damage for proton doses ranging between 800 kGy to 80 MGy conducted using the 6 MV tandem accelerator of iThemba LABS. A breakdown in the light transfer mechanism between base and fluor components, as well as damage to the primary scintillation mechanism is observed for increasing doses. The commercial plastics EJ208 or UPS923A are suggested for the upgrade.

266 - Efficiency measurement system for thermoelectric devices

Applied Physics (1) - Friday 08 July 2016 14:20
Primary author: MARIOLA, Marco *(University of KwaZulu-Natal)*
Co-authors: *BEMONT, Clinton (University of KwaZulu-Natal); PETRUCCIONE, Francesco (University of KwaZulu-Natal)*

A fraction of the energy used to supply mechanical, electronic and electric devices is lost in the form of mechanical and heat energy. The efficiency of a general device is defined as a ratio of the energy used for the purpose for which the device was designed and the total power supplied to the device. The new devices are designed to reduce the energy loss, but it is not possible to consider all the environmental variables that act against the system. The electronic devices, e.g. the radio transmitter or engines, loose energy in the form of heat and this reduces the efficiency. To mitigate the energy loss it is possible to exploit the Seebeck effect which is a thermoelectric phenomenon that occurs when the two junction of two different conductors have two different temperature. When the difference of temperature increase a current flows through the conductors, and this current can be suitable to supply the energy for other electronic devices. The process is reversible, if the current flows into the conductors where a difference of temperature is present between the two junctions. The aforementioned effect is used to cool down the temperature of the microprocessors or for general refrigeration purposes. In this research we intend to design an energy harvesting device using commercial thermocouples. An efficiency measurement system is presented. The thermocouple is located in a box where it is possible to create two different temperatures between the first junction and the second junction. A numerical algorithm combined with an electronic system is capable to measure the supplied energy, the energy lost in the measurement box and the energy produced by the thermocouple. In this way it is possible to calculate the efficiency for different temperatures and study a way to obtain a well designed system for energy harvesting.

267 - Thermal Model Description of Collisions of Small Systems

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 10:00
Primary author: CLEYMANS, Jean *(University of Cape Town)*
Co-authors: *REDLICH, Krzysztof (Institute of Theoretical Physics, University of Wroclaw, Pl-45204 Wroclaw, Poland; ExtreMe Matter Institute EMMI, GSI, D-64291 Darmstadt, Germany; Department of Physics, Duke University, Durham, NC 27708, USA}); OESCHLER, Helmut (University of Heidelberg, Germany); SHARMA, Natasha (Department of Physics, Panjab University, Chandigarh 160014, India); HIPPOLYTE, Boris (Institut Pluridisciplinaire Hubert Curien (IPHC), Universit\'e de Strasbourg, CNRS-IN2P3, Strasbourg, France)*

Recently, two experimental observations have attracted high interest: 1. The maxima in the excitation function of the K+/pi+ and Lambda/pi+ ratios around sqrt(sNN) = 8 GeV, while no maximum is seen in the K-/pi- ratio. 2. A continuous evolution of the ratios (multi-)strange-over-pi as a function of the multiplicity in pp, p-Pb and Pb-Pb collisions at LHC energies.Prediction within the thermal-statistical model of particle ratios from the lowest up to LHC energies and from pp up to central heavy-ion collisions will be given. It will be shown why maxima occur, how they evolve when studying smaller systems (E.g. the maximum of the K+/pi+ ratio will hardly be visible in pp, while the maximum in the Lambda/pi ratio is expected to remain also in pp).Using the strangeness canonical ensemble, the key parameter is the strangeness correlation volume. It turns out that this quantity also plays a dominating role in describing the variation of the particle ratios from pp to Pb-Pb collisions at LHC energies.

268 - Interactions of xanthates and dithiophosphate on (110) nickel-rich pentlandite ($Fe_4Ni_5S_8$) mineral surface

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 14:00 *[For award: PhD]*
Primary author: MKHONTO, Peace *(Materials Modelling Centre, School of Physical and Mineral Sciences, University of Limpopo, Private Bag x1106, Sovenga, 0727)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); CHAUKE, Hasani (University of Limpopo)*

*Ab-initio*density functional theory was employed to investigate the adsorption of sodium ethyl xanthate (SEX), sodium isobutyl xanthate (SIBX) and diethyl dithiophosphate (DEDTP) collectors on the nickel-rich pentlandite $Fe_4Ni_5S_8$ (110) surface. Two adsorption sites have been considered; the Ni-top and Fe-top sites. The electron density of the clean (110) surface is found to be high on Ni atoms than on Fe atoms suggesting a strong covalent bonding. Furthermore, the results show that the adsorbates coordinate mainly to the surface through interaction between their S atoms with the surface Fe or Ni atoms; the sulphur atoms of these thiol collectors being the centre of reactivity. The adsorption energies showed that DEDTP adsorbs stronger than the xanthates, and the predicted adsorption strength follows the order as: DEDTP > SIBX > SEX for both Ni-top and Fe-top sites. The DOS and Bader charge analysis suggest that the xanthates act as electron donors while the DEDTP has an electron accepting character at the surface. These properties suggest that the DEDTP exhibit good selectivity in the separation of pentlandites as compared to SIBX and SEX xanthates. This study offers an insight into the collecting performance of SEX, SIBX and DEDTP on (110) nickel-rich pentlandite mineral surface, which could guide recovery operations.

269 - Kozai-Lidov mechanism in LS I +61 303?

Astrophysics (1) - Tuesday 05 July 2016 11:30 *[For award: PhD]*
Primary author: MONAGENG, Itumeleng *(SAAO/UCT)*

Gamma-ray binaries are rare and intriguing members of the high mass X-ray binary population which exhibit emission across the entire electromagnetic spectrum (i.e. from radio to very high energy gamma-rays), which is typically modulated on the orbital period. These systems comprise a massive star and a compact object of unknown nature in an eccentric orbit. To date, only five of these systems have been confirmed: PSR B1259-63, HESS J0632+057, LS 5039, 1FGL J1018.6-5856 and LS I +61 303. In this talk I will present optical spectroscopic results of LS I +61 303 to show the Be disc variability and how that is used to study observational signatures of the Kozai-Lidov mechanism in this system.

271 - Study of the performance of a Cadmium Telluride photovoltaic system

Applied Physics (1) - Tuesday 05 July 2016 14:20
Primary author: DOBREVA, Petja *(NMMU)*
Co-authors: *VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU)*

Thin film photovoltaic (PV) modules, due to their lower thermal coefficients, are often suggested for deployment in warm climates. This paper models and analyses the performance of a 15.66 kW rooftop PV system installed using Cadmium Telluride modules. The location of the system is Gueldenboden Farm, 150 km north-east of Windhoek in Namibia and has an average annual temperature of 20°C. The measured energy yield is 23% lower than the expected when compared to the calculated yield based on long-term meteorological data. Measurements of the current-voltage (IV) characteristic curves of the system strings show that 2 of the 24 strings are not functioning. This fact, however, does not account completely for the lower energy production. The reasons for the lower energy output are investigated and a detailed analysis of the system configuration and performance is done.

272 - Effect of atmospheric turbulence on entangled photon field generated by partially coherent pump beam

Applied Physics (1) - Friday 08 July 2016 11:50
Primary author: JOSHI, Stuti *(University of KwaZulu-Natal, Westville Campus, Durban, South Africa)*
Co-authors: *ISMAIL, Yaseera (University of KwaZulu-Natal, Westville Campus, Durban, South Africa); PETRUCCIONE, Francesco (University of KwaZulu-Natal, Westville Campus, Durban, South Africa)*

Spontaneous parametric down-conversion (SPDC) is one of the convenient sources of entangled photon fields. These photons are entangled in position, momentum and polarization. In all the previous studies pump field was considered to be spatially fully coherent. Recently, Jha and Boyd [1] showed theoretically that the spatial coherence properties of the pump field were entirely transferred to the down-converted two-photon field. Recently, the effect of atmospheric turbulence on the entangled photon fields produced by the down-conversion of the fully spatially coherent pump has been reported [2-3]. However, the effect of atmospheric turbulence on the entangled photon fields produced by partially coherent pump beam has not been reported yet. Recently, a theoretical model for the influence of atmospheric turbulence on entangled photon fields produced by partially coherent dark hollow beam has been reported [4]. It has been shown that the detection probability of the entangled two-photon field is higher and less susceptible to turbulence if the field is produced by a lower mode of partially coherent pump beam.In the present paper, we have theoretically studied the influence of atmospheric turbulence on entangled photon fields produced by spatially partially coherent pump beam. We show that the photon field produced by spatially partially coherent pump beam is less affected by atmospheric turbulence than the photon field produced by the fully spatially coherent pump beam. Present work provides new insights into the nature of SPDC emission by considering pump beam spatially partially coherent and have application in free-space quantum communication.References[1] A. K. Jha, R. W. Boyd, Phys. Rev. A 81, 013828 (2010).[2] C. Gopaul, R. Andrews, New J. Phys. 9, 94, (2007).[3] A. Semenov,W Vogel, Phys. Rev. A 81, 023835 (2010).[4] Y. Qiu, W She, Appl. Phys. B 108, 683-687 (2012).

273 - I taught them everything, but they still couldn't get it right

Physics Education - Friday 08 July 2016 15:00
Primary author: MOLEFE, Paul *(University of Johannesburg)*
Co-author: *SONDEZI, Buyi (University of Johannesburg)*

The focus of students, especially at the first year level is in going through their years of undergraduate studies with ease, where their primary focus is on passing the course, not necessarily understanding the content of the subjects. This attitude of students is observed mostly in the way they approach the concepts that they come across. The approach that most students have during assessments and questioning is to get the answer correct without understanding the concepts. This attitude has made it difficult for some to grasp the fundamentals of their respective studies. This study focuses on the continuous observation of this behavior as we look at a particular Physics concept studied at a first year level. The concept was taught in various ways and students' understanding was tested. The expectation was that they should solve the problem without major difficulty, but the analysis of the test showed that most of the students strive to get to the answer even though the Physics concepts were not correctly applied.

274 - Colloidal InSe nanostructures: effect of morphology on their chemical sensitivity to methanol and formaldehyde fumes

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 14:20 *[For award: PhD]*
Primary author: AIRO, Mildred *(University of the Witwatersrand)*
Co-author: *MOLOTO, Nosipho (Univerity of the Witwatersrand)*

Two morphologies of indium monoselenide nanocrystals have been obtained by varying reaction parameters (time and precursor concentration) during their colloidal synthesis. The synthesized nanostructures crystallized in the same phase, rhombohedral InSe. However, the different morphologies had an influence in the optical properties with the nanoparticles more blue shifted from bulk. Herein we report for the first time, on the synthesis and characterization of indium monoselenide nanoparticles and nanosheets and their application as chemical sensors. We investigate the effect of the different morphologies on methanol and formaldehyde sensing. Since sensing ability is related to the electronic structure, it was palpable that the different morphologies will bring about different results. The sensors fabricated using the InSe nanoparticles gave a good response to HCOH fumes and methanol vapour. The sensor also showed selectivity towards HCOH fumes by giving a better response compared to that of acetone and chloroform vapours. The sensors fabricated using the InSe nanosheets similarly gave good response towards HCOH; however it recovered half way. For the methanol detection using a similar device, the noise to signal ratio was relatively high. The operating temperature range for the InSe sensor devices was determined to be near room temperature. The sensors' response was observed to decrease with increasing temperature from 30 °C – 90 °C. The low sensing abilities of the nanostructures observed could be attributed to the surface capping molecule (oleylamine) employed to stabilize the nanostructures during synthesis.

276 - Laser Effect on the RF Signal Stability for Clock Signal Distribution over Optical Fibre

Applied Physics (1) - Tuesday 05 July 2016 11:30 *[For award: MSc]*
Primary author: DLAMINI, Phumla *(optical fibre research unit (nelson mandela metropolitan university))*
Co-authors: *GIBBON, Timothy (NMMU Physics Department); BOIYO, Duncan (Centre for Broadband Communication, Nelson Mandela Metropolitan University); GAMATHAM, Romeo Reginald Gunther (NRF, Square Kilometre Array South Africa); LEITCH, Andrew (NMMU)*

The optical clock signal should maintain a certain level of stability for successful operation of the MeerKAT and Square Kilometer Array (SKA) telescope. The flicker (1/f) noise of active devices in the optical link is converted into phase noise through the nonlinearities of devices, and degrades the spectral purity. The phase and frequency stability required for detection of the reference signal is affected by the linewidth of the laser source which is affected by intensity and frequency fluctuations. In this work, the phase noise contribution of the laser is measured to observe the degradation in purity of the clock tone short-term stability. The comparison is made between the C-band vertical-cavity surface-emitting laser (VCSEL) and distributed feedback (DFB) laser driven by a 10GHz signal generator at 10dBm power level. The single sideband phase noise at 1 kHz offset is -92.3 and -97.2dBc/Hz for VCSEL and DFB laser respectively.

277 - Reduction of noise in CSDG MOSFET with HfO2

Theoretical and Computational Physics (1) - Friday 08 July 2016 11:50
Primary author: SRIVASTAVA, VIRANJAY M. *(Howard College, University of KwaZulu-Natal, Durban)*

The cylindrical surrounding double-gate (CSDG) MOSFET is an extended version (rotated across one gate) of double-gate MOSFET. It is a hollow cylindrical structure having gate on the external and internal peripheral. With the scaling of device, the gate size and dielectric thickness reduces which clues to large gate-current leakage because of quantum mechanical tunneling of carriers through the thin gate oxide. In the application of traditional MOSFET as switch, various noises are available (such as thermal noise and flicker noise). In the CSDG MOSFET a high dielectric HfO2 has been used for the oxide. The CSDG MOSFET has two resistive channels each under external and internal gate. Since the channels (from drain to source) has resistance Ron1 and Ron2, which exhibits *thermal noise* (source of noise) in the small-signal equivalent circuit. This increase in thermal noise may be attributed to hot electrons in short-channel (nanotechnology) devices. This effect can be minimized using the HfO2 (band gap 6.0 eV) compared to SiO2 (8.9 eV).Also, with the use of HfO2, just below the oxide layer, a resistance creates from source to drain which will be in parallel combination with other oxide resistances. The combination of overall resistance reduces due to parallel combination. Since the noise is proportional to the resistances, hence, the noise with the use of HfO2 will reduces.The CSDG MOSFET conduct current near the surface, where surface states act as traps that capture and release current carriers, which generates the flicker noise. Since the *flicker noise* is inversely proportional to the gate oxide capacitance, and with the use of HfO2, the CSDG MOSEFET can achieve higher gate oxide capacitance due to higher value of ε.In conclusion these noises are lowers in CSDG MOSFET, for use in nanotechnology devices.

ORAL ABSTRACTS

279 - Simonkolleite nano-platelets: Synthesis and temperature effect on hydrogen gas sensing properties

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 14:00
Primary author: SITHOLE, Joseph *(University of South Africa)*

In this work, the new refined mineral platelets-like morphology of simonkolleite based particles described by Shemetzer et al. (1985) were synthesized in zinc- nitrate aqueous solution by a moderate solution process. The morphological and structural properties of the platelets-like Zn5(OH)8Cl2·H2O were char- acterized by scanning electron microscope energy dispersed X-ray spectroscopy, transmission electron microscope, powder X-ray diffraction and selected area electron diffraction as well as attenuated total reflection infrared spectroscopy. The morphology as well as the size in both basal and transversal directions of the simonkolleite Zn5(OH)8Cl2·H2O nano/micro crystals was found to be significantly depending on the specific concentration of 0.1 M of Zn2+/Cl– ions in the precursor solution. The simonkolleite Zn5(OH)8Cl2·H2O nano-platelets revealed a significant and singular H2 gas sensing characteristics. The operating temperature was found to play a key role on the sensing properties of simonkolleite. The effect of temperature on the simonkolleite sample as a hydrogen gas sensor was studied by recording the change in resistivity of the film in presence of the test gas. The results on the sensitivity and response time as per comparison to earlier reported ZnO based sensors are indicated and discussed.Keywords: Nano-particles Zinc oxide Simonkolleite HydrothermalPhotonics and gas sensing

282 - Simulations of systematic effects for 21-cm observations

Astrophysics (1) - Tuesday 05 July 2016 14:00 *[For award: PhD]*
Primary author: NUNHOKEE, Chuneeta Devi *(Rhodes University)*

Observations of the redshifted 21-cm line are the best probe of the evolution of the intergalactic medium and the Universe reionization. As the expected 21-cm signal is, however, very faint, its observations are challenged by the need of an extremely careful control of systematic errors. Here we show realistic simulations that estimate the level of contamination on the 21-cm observations from Galactic polarized foreground emission

284 - Constraining Lorentz Invariance violation using directional correlations of Gamma-Ray Bursts with IceCube cosmic neutrinos

Astrophysics (1) - Wednesday 06 July 2016 15:20
Primary author: MOHARANA, REETANJALI *(University of Johannesburg, Auckland Park-2006)*
Co-author: *RAZZAQUE, Soebur (University of Johannesburg)*

A violation in Lorentz invariance (LI) proposed in quantum gravity theories, delays theflight of extremely high energy gamma rays and neutrinos from their origin. Gamma raybursts (GRBs) are among the most promising candidate sources of extremely energetic gamma rays and neutrinos. With the recent discovery of astrophysical neutrino events by the IceCubeobservatory, a path is opened to search LI at PeV energies. We use directional correlations of IceCube neutrino events and GRBs to constrain the LIV parameters at PeV energies from the observed time delay between the prompt gamma-ray and the neutrino events.

285 - 14 W Mid-Infrared Optical Parametric Oscillator based on Zinc Germanium Phosphate

Photonics - Friday 08 July 2016 10:20
Primary author: KOEN, Wayne *(CSIR National Laser Centre)*
Co-authors: *MORRIS, Daniel (University of Pretoria); JACOBS, Cobus (CSIR National Laser Centre); WU, Lorinda (CSIR-NLC); STRAUSS, Hencharl (CSIR (National Laser Centre))*

Although laser sources emitting in the 3-5 micron region is of great interest for applications in remote sensing, medicine, and directed infra-red countermeasures; the availability of high-power sources emitting in this region remains limited. An efficient approach to obtain coherent light in the 3-5 micron region is by converting light from a 2 micron laser source, such as a pulsed solid-state Ho:YLF laser or thulium fibre laser, by pumping an optical parametric oscillator (OPO).In this paper we present a high-power mid-infrared OPO based on Zinc Germanium Phosphate (ZnGeP2). The OPO consisted of a linear, single-pass-pump cavity containing a single ZGP crystal. The ZGP crystal was pumped with a 2064 nm Ho:YLF master oscillator power amplifier (MOPA) that was developed at the National Laser Centre. The input coupler mirror was highly reflective for 3 to 5 micron light and highly transmissive for the pump light, while the output coupler mirror was partially reflective from 3 to 5 micron, while being highly transmissive for the pump light. The OPO had a slope efficiency of 35% with regards to incident pump power when operated at a pulse repetition frequency of 20 kHz. A maximum output power of 14 W was measured when pumped with 48.8 W. This was a significant improvement on previous work, where we obtained 5 W from a similar configuration. The OPO operated near degeneracy at a centre wavelength of 4.1 micron. The beam quality factor was measured to be better than 4 at 10 W of output power.

287 - Near-Earth Object Avoidance Mitigation: Profiting One Rock at a Time

Space Science - Thursday 07 July 2016 09:40
Primary author: MACLEOD, Gordon *(HartRAO)*

Several NEO avoidance mitigation concepts have been investigated. A simplified metrical analysis methodology is presented to demonstrate the viability and added benefits of methods. In particular an associated cost/additional benefit analysis (benefits beyond Earth protection) is presented; whether economies of scale can be reached, and/or the ability to attract private investment are estimated. Nuclear weapons remain the clear method of choice to deflect a NEO, but it has little economic value beyond that. Other NEO avoidance mitigation methods offer potentially greater economic return and may warrant development. More research is required to create objective, measurable criteria for each NEO avoidance mitigation method. Saving the Earth one rock at a time might be profitable.

288 - Beyond ½-BPS: Symmetry Generators in *su(2)* and *su(3)*

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 15:00 *[For award: MSc]*
Primary author: TRIBELHORN, Laila *(Student)*
Co-authors: *DE MELLO KOCH, Robert (University of the Witwatersrand); BORNMAN, Nicholas (The University of Pretoria)*

The spectrum of anomalous dimensions in large N, non-planar limits of N=4 supersymmetric Yang-Mills theories are considered. Restricted Schur polynomials provide a useful basis for this study. We will argue that the action of the one loop dilatation operator on restricted Schur operators is largely determined by the *su(2)* R-symmetry algebra. Our results generalize existing studies, allowing a study of operators that are not ½-BPS or small deformations thereof. An application of this result would be to study operators whose dimensions grow like N^2. These operators are dual to new background spacetime geometries in the quantum gravity.

290 - The re-definition of the of mass

Applied Physics (2) - Wednesday 06 July 2016 09:40
Primary author: KARSTEN, Aletta *(NMISA)*

Worldwide, all mass measurements done according to the International System of Units (SI) are traceable the International Prototype Kilogram (IPK). The IPK is defined as the mass of a Pt-Ir alloy cylinder that is kept as the International Bureau of Weights and Measures (BIPM) in Paris, France. The international definition of the kilogram in the SI has not changed since 1889. Although the IPK was “fit-for-purpose” in the late 19th century, it is not sufficient for the 21st century. One of the challenges is a slight change in the mass of the IPK and/ or the six reference copies of the IPK to the order of 50 µg over a 100 year period. Although it is kept in a safe, the risk of theft does exist. In metrology and the defining of SI, the trend is to move away from artefacts towards realising the SI through physical constants. Mass is the only SI still defined through a physical object, the IPK.In order to redefine mass, two experiments are currently under investigation, namely the Avogadro constant and the Planck constant projects. Before the final decision on the re-definition both projects are investigated in detail. The Avogadro constant project links the kilogram unit to the Avogadro constant, NA, (6,022 140 76 × 1023 mol–1) using a single-crystal Si sphere. In 2015 the link was established to an accuracy of 2 x 10-8. In the Planck’s constant, h, experiment (using a Watt balance) the weight of a test object is measured by measuring the strength of an electric current and a voltage. An accuracy of 1,8 x 10-8 was achieved for the value of h with a Watt balance.This paper will discuss NMISA’s Watt balance project to position South Africa for this redefinition that is planned for 2018.

292 - Development of a large mode area (LMA), high-power, thulium-doped fibre laser

Photonics - Tuesday 05 July 2016 10:00 *[For award: MSc]*
Primary author: MORRIS, Daniel *(Council for Scientific and Industrial Research)*
Co-authors: *WU, Lorinda (CSIR-NLC); KOEN, Wayne (CSIR National Laser Centre); FORBES, Andrew (CSIR)*

Thulium-doped fibre lasers are useful 2 micron sources that can be used for light detection and ranging (LIDAR), free space propagation of light, medical surgery and pumping of optical parametric oscillators (OPO). We investigated a high-power, large mode area (LMA), free space coupled, thulium-doped fibre laser which was pumped by 793 nm laser diodes. The fibre laser was characterized with regard to efficiency, beam quality, output power stability, and wavelength. Characterisation was also done with two intra-cavity volume Bragg gratings (VBG’s). We achieved more than 60 W of stable, continuous wave output from a 3.7 m long thulium-doped fibre with a near theoretical limit slope efficiency of 54%. This output was achieved at the free running output wavelength of 2014 nm. The beam profile had a measured beam quality factor (M2) of 1.85 at 60 W of average laser power.

296 - Ultrafast mapping of structural changes in organic radical salts

Photonics - Tuesday 05 July 2016 14:00 *[For award: PhD]*
Primary author: *SMIT, A. Bart (Stellenbosch University)*
Co-authors: *PAYNE, Nancy (Stellenbosch University); OLAOYE, Olufemi (Stellenbosch University); SCHWOERER, Heinrich (Stellenbosch University)*

The radical salts of Cu(DCNQI)2 show a wide variety of Peierls transitions, depending on their chemical composition. Upon the Peierls transition - which is a change in the atomic structure of the crystal - the initially metallic crystal becomes an insulator. This dramatic change in conductivity of 8 orders of magnitude, which is known to be ultrafast (20 picoseconds), can be photo-induced. By employing our Ultrafast Electron Diffractometer (UED), we map the ultrafast photo-induced metal-to-insulator transition in both time (femto- to picoseconds) and space (atomic resolution). By doing so, underlying mechanisms of the transition can be investigated. Our UED-machine firstly photo-induces the transition with an ultrashort (150 fs) pump pulse, and probes it with an ultrashort (500 fs) electron pulse. Electron patterns are acquired in transmission from an ultrathin (50 nm) Cu(DCNQI)2 crystal slice by our probe beam. By changing the delay between pump and probe, a full transient of the dynamics is obtained.Changes in the crystal are observed in the electron diffraction pattern by decreases and increases in Bragg reflection intensities, with the full destruction or creation of a Bragg peak as an extreme case. The new data analysis method that we developed, processes and displays these intensity changes. By comparing the changes observed in an experiment with simulated electron diffraction patterns, changes in the positions and orientation of the crystal planes in real space can be reconstructed. Our ultimate goal is to reconstruct a full transient of the real-space changes in the photo-induced metal-to-insulator phase transition in Cu(DCNQI)2, thereby creating a 'molecular movie'.

298 - Activated carbon derived from tree bark biomass for high performance electrochemical capacitors

Applied Physics (1) - Friday 08 July 2016 09:40
Primary author: *MOMODU, Damilola (UNIVERSITY OF PRETORIA)*
Co-authors: *MADITO, Moshawe (Student); BARZEGAR, farshad (University of Pretoria); MASIKHWA, Tshifhiwa Moureen (University of Pretoria); UGBO, Faith (University of Pretoria); OYEDOTUN, Kabir (University of Pretoria); KHALEED, Abubakar (University of Pretoria); OLANIYAN, Okikiola (University of Pretoria); BELLO, Abdulhakeem (Department of Physics University of Pretoria); DANGBEGNON, Kouadio Julien (University of Pretoria)*

ABSTRACTActivated carbon from tree bark (AC-B) has been synthesized by a facile and environmentally friendly activation and carbonization process at different temperatures (600, 700 and 800° C) using potassium hydroxide (KOH) as an activation agent with different mass loading in an attempt to optimize the activation process in obtaining a uniformly porous material. The physicochemical characteristics of the as-obtained AC-B material were studied using scanning and (SEM), N2-adsorption/desorption measurements, Raman spectroscopy, X-ray photoelectron spectroscopy etc. The microscopy results reveal an interconnected porous architecture with an ion-accessible surface required for fast ion transport. The BET specific surface area (SSA) obtained show an improved SSA with increasing carbonization temperature up to 1018 m2 g-1 and a high pore volume of 0.67 cm3 g-1 in the presence of active micro/mesopores. The electrochemical capability of the AC-B material was investigated as a potential supercapacitor device electrode in different neutral aqueous electrolytes (NaNO3, Na2SO4, and KCl) via different techniques such as cyclic voltammetry, galvanostatic charge/discharge and impedance spectroscopy in a three (3) electrode configuration. The device electrode exhibited the best EDLC behaviour with the Na2SO4 electrolyte working in both positive and negative potential range. A specific capacitance of 155 F/g at a current density of 1 A/g was obtained for the AC-B material in a 0.80 V operating potential window. The cycling stability of the device was depicted in its overall coulombic efficiency which remained relatively stable even after 2,000 cycles. The result obtained provides a means of using cheaper biomass material in the production of high surface area activated carbon with outstanding electrochemical properties for supercapacitor applications.

302 - Next to leading order electron-quark interaction

Theoretical and Computational Physics (1) - Friday 08 July 2016 15:20
Primary authors: *KEMP, Garreth (University of Johannesburg); HOROWITZ, William (University of Cape Town)*

We compute the massless q + e -> q + e t-channel differential cross-section at next-to-leading order in the MS-bar renormalisation scheme. We only consider interactions pertaining to the incoming and outgoing quark. In particular, we first explain how the LSZ formula is modified in MS-bar. We then demonstrate the delicate cancellation of IR-divergences present in the vertex correction, soft gluon emission and hard collinear gluon emission. Such a study is relevant for studying energy loss and running coupling effects in the quark-gluon-plasma.

304 - Survey of Southern Local Group Dwarf Galaxies.

Astrophysics (1) - Tuesday 05 July 2016 14:20 *[For award: PhD]*
Primary author: *NAMUMBA, BRENDA (UNIVERSITY OF CAPE TOWN)*
Co-authors: *CARIGNAN, Claude (University of Cape Town); PASSMOOR, Sean (SKA South Africa)*

Dwarf irregular galaxies are the common type of galaxies in the region surrounding our own Galaxy, the so called Local Group. They are known to be gas-rich with low metallicity, suggesting that they are in an early stage of star formation. Their simple structure, compared to other galaxies, makes it easier to study the various physical processes related to star formation and galaxy evolution occurring in these galaxies. The structural information about galaxies can be obtained from HI measurements. The distribution of HI gas in dwarf irregular galaxies is very clumpy and irregularly distributed and is frequently more extended. Most of the available HI data on irregular galaxies has been obtained from arrays with higher resolution. This means that we could be missing out on the extended low surface brightness emission mostly associated with these galaxies, therefore underestimating their derived HI properties.With the unique capabilities of KAT-7 angular resolution and low receiver temperature, we have selected a well defined sample of 7 dwarf irregular galaxies with the aim of detecting the low surface brightness extended HI emission which cannot be detected by other synthesis arrays such as the VLA and ATCA. These observations will help us constrain the distribution, kinematics and physical conditions of the atomic gas which are relevant to answering questions related to star formation and galaxy evolution.

306 - The energy density as a function of spacetime for a light quark jet in AdS/CFT

Theoretical and Computational Physics (1) - Friday 08 July 2016 14:20
Primary author: *MORAD, Razieh (University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

Jets are produced due to hard scattering processes in heavy ion collisions and probe the Quark-Gluon Plasma (QGP). Analyses the energy loss of these energetic partons as they travel throw QGP may reveal extremely valuable information about the dynamics of the plasma.Our studies of jet of light quark using AdS/CFT revealed two interesting results: 1) With our new jet prescription, light quark jet energy loss regains the “explosive,” late-time Bragg peak in both static and expanding plasmas. 2) The resulted nuclear modification factor RAA shows good agreement with the experimental data on the Rjet of most central Pb-Pb collision at LHC.That the results of our simple model are in such good agreement with data suggests that we attempt to better define the jet in AdS/CFT. The best way to map the string initial conditions to the physical states in QFT is computing the energy-momentum tensor associated with the propagation of the classical string solution. With the energy- momentum tensor in hand, we should be able to compute directly from the string theory the actual quantities measured experimentally.

307 - Characterisation of the optical thermometry properties of a phosphor material

Applied Physics (1) - Tuesday 05 July 2016 15:20 *[For award: MSc]*
Primary authors: *TERBLANS, JJ (Koos) (UFS); ERASMUS, Lucas (University of the Free State)*
Co-author: *SWART, Hendrik (University of the Free State)*

This study is focused on the investigation of the optical thermometry properties of Lanthanum Oxysulphide doped with Europium (La2O2S:Eu) phosphor material by utilising an in-house modified Photo-luminescence (PL) system. After a literature study it was concluded that the optical thermometry properties of phosphor materials can be measured by several techniques. The technique discussed in this presentation is the fluorescence intensity ratio technique where the fluorescence spectra of a phosphor material was obtained and the intensity ratio between two thermally coupled levels was monitored. The peak intensities of the different PL peaks due to the different transitions from Eu3+ in La2O2S:Eu were monitored at different temperatures. It was clear that La2O2S:Eu can be used as a temperature sensor. The viability of La2O2S:Eu as a stable temperature sensor was also evaluated by investigating it’s structural and chemical properties by utilising the X-ray Diffraction and X-Ray Photo-electron Spectroscopy techniques.

309 - The photocatalytic degradation study of Rhodamine B using zinc oxide as an alternative catalyst to titanium dioxide

Division for Physics of Condensed Matter and Materials (2) - Tuesday 05 July 2016 15:00 *[For award: MSc]*
Primary author: *NKABINDE, Siyabonga (University of the Witwatersrand)*
Co-author: *TETANA, Zikhona (Microscopy and Microanalysis Unit (MMU), University of the Witwatersrand)*

Colored dye waste waters are released in huge quantities to the environment and cause negative effects to living organisms. As a result, a technique called advanced oxidation processes has been developed to effectively degrade such pollutants. In this study, rod-like and spherical ZnO nano-particles are synthesized and their photocatalytic activity is investigated. Photocatalytic degradation of Rhodamine B was carried out by irradiating an aqueous solution of the dye containing ZnO using solar light. The effect of dye concentration (5 – 50 mg\L) and pH (2 – 12) are reported. Degradation was followed by measuring absorbance of aliquots spectrophotometrically. Experimental results indicated that an increase in catalyst amount or decrease in dye concentration resulted to high degradation rate. A pH study showed that the dyes were degraded efficiently under neutral and basic conditions and a significant decrease in the degradation efficiency was seen under acidic conditions, with maximum degradation observed at pH 8.

310 - Characterising new Be/X-ray binaries in the Large Magellanic Cloud

Astrophysics (1) - Thursday 07 July 2016 11:30 *[For award: PhD]*
Primary author: *VAN JAARSVELD, Johanna (University of Cape Town)*
Co-authors: *MCBRIDE, Vanessa (University of Cape Town & SAAO); BUCKLEY, David (Southern African Large Telescope)*

From the XMM-Newton X-ray survey of the Large Magellanic Cloud, 30 high mass X-ray binary (HMXB) candidates were identified. The work presented here identifies and characterises new Be/X-ray binaries (BeXBs) from this list of candidates through the nature of their optical counterparts. SALT Hα spectra were obtained for 19 of the candidates. From the observations, 13 of the candidates exhibited Hα emission, classifying them as Be/X-ray binaries. Additionally, power spectra of 11 OGLE light curves were produced in search of orbital periods of the newly discovered BeXBs.

311 - Measurements of gamma-ray production cross sections of proton beam at energies of 80-125 MeV with calcium target.

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 14:40 *[For award: MSc]*
Primary author: *KUNYANA, AYANDA (UNIVERSITY OF ZULULAND)*
Co-authors: *LAWRIE, ELENA (iThemba LABS); RAMANATHAN, V (University of Cape Town); REBEIRO, B (University of Western Cape); NTSHANGASE, SIFISO (UNIVERSITY OF ZULULAND); LAWRIE, J.J (iThemba LABS); KIENER, J (Centre des Sciences Nucleaire et des Science de la Matiere); OUICHAOUI, S (Universite des Sciences et de la Technologie H.Boumediene); BELHOUT, A (Universite des Sciences et de la Technologie H.Boumediene); JONES, P (iThemba LABS); MOUSSA, D (Universite des Sciences et de la Technologie H.Boumediene); BENHABILES, H (Universite M'Hamed Bougara); DAMACHE, S (Division de Physique); CHAFA, A (Universite des Science et de la Technologie H.Boumediene); DEDABI, M (Universite des Sciences et de la Technologie H.Boumediene); YAHIA-CHERIF, W (Universite des Sciences et de la Technologie H.Boumediene); DELONCLE, I (Centre ds Sciences Nucleaire et des Sciences de la Matiere); DINOKO, T.S (iThemba LABS); BUCHER, T.D (iThemba LABS); RAJU, M.K (University of Western Cape)*

During cancer treatment therapy a lot of proton particles with incident energy of 200 MeV enter the human body of the patient. They interact with the elements in the body such as 40Ca, 16O, 14N and release their energy step by step in nuclear reaction processes. To understand well the processes we need to know the probability of the proton interactions with each of the elements inside the patient's body as a function of the proton energy. In this work gamma-ray spectra obtained when calcium is bombarded by accelerated protons in the energy range from 80 to 125 MeV are analysed. This analysis yields experimental data for cross sections for gamma-ray production in these nuclear reactions. The results on the cross sections and their importance for medical therapy will be discussed.

315 - Galaxy stacking strategies for MeerKAT

Astrophysics (1) - Friday 08 July 2016 14:00
Primary author: *ELSON, Ed (University of Cape Town + South African Astronomical Observatory)*

The LADUMA survey, to be carried out on MeerKAT, aims to indirectly detect neutral hydrogen line emission (HI) from galaxies at redshifts from 0.5 to unity, and beyond. To do this, galaxy HI spectra will need to be co-added in order to generate high S/N stacked spectra representative of the total HI content of distant samples. The stacking method is intrinsically susceptible to source confusion: a spectrum extracted for a particular galaxy will be contaminated by emission from other nearby galaxies. As such, stacked HI spectra usually over-estimate the total HI content of a sample. Traditionally, properly correcting for this has been difficult.We have developed the theoretical and computational machinery to produce synthetic, yet very realistic, HI line data cubes. We have started using them to quantify the confusion rates in generic HI stacking experiments. I will present some details of these simulations, and show how they are being used to optimise LADUMA observing and data analysis strategies.

317 - Optimising GPU Integration into the ATLAS Trigger

Applied Physics (1) - Wednesday 06 July 2016 10:20 *[For award: MSc]*
Primary author: *SACKS, Marc (University of the Witwatersrand)*
Co-author: *MELLADO, Bruce (University of Wisconsin - Madison)*

General Purpose Graphics Processing Units (GPGPU) are suited to rapidlyperforming independent (non-sequential) computations on large datasets and it seems likelythat it will be the workhorse for applications involving massive parallelism in the near future.The ATLAS detector in the Large Hadron Collider is currently the subject of investigationwith regards to the use of GPGPU. The planned increase in detector luminosity will lead toincreased pile-up (a time-energy resolution artifact). Preliminary tests indicate a reduction intrigger latency with the introduction of GPUs, implying they can be used to run more complexalgorithms in a similar or smaller amount of time than CPUs, thereby reducing pile-up associatederrors. These tests have been conducted on high-end server-grade GPUs for demonstrativepurposes. However when selecting a GPU platform for large-scale integration into the ATLASTrigger, performance/watt and performance/dollar are the parameters of interest. It is nottrivial to categorise the relative performance of GPUs because of the factors involved in itsdetermination i.e. FLOPS, global and local memory bandwidth and size, core count, etc. Thisinvestigation focuses on the categorisation of GPUs representative of those most likely to beintegrated into the trigger system. Criteria include power consumption, cost, ease-of-use, andreliability. Preliminary results indicate that lower-end, more energy-efficient GPUs could, inthis context, be used in place of high-end GPUs with similar results.

318 - COMPARISON OF TWO MODELS OF PROBLEM SOLVING IN PHYSICS: A STUDY OF SECONDARY SCHOOL STUDENTS IN ADAMAWA STATE, NIGERIA

Physics Education - Tuesday 05 July 2016 11:50 *[For award: PhD]*
Primary author: *ABUBAKAR, Ishiyaku Mbela (College)*

While problem solving is a key part of learning physics, it is not easy to teach. Thus, a number of models have been proposed that attempt to provide some structure to the process, each emphasizing different aspects and differing in approach. However, it is not clear whether these differences lead to different outcomes or, to what extent, they are dependent on the nature of a particular problem. As part of an attempt to find a way to answer these questions two problems solving models were compared in a study with secondary school students in which the following two models were used: (a) Understanding Basic Mechanics (Reif, 1995) and (b) the Logical Problem-Solving Model (Heller and Heller, 1995). The study consisted of the construction of four problems, two qualitative and two quantitative open-ended questions and administered to form four and form five students. After applying the two different models in solving the problems, a comparison was made in terms of the strengths and weaknesses that emerged from the exercise. The key finding was that Reif's model appeared to be well suited for approaching qualitative problems while that of Heller and Heller worked well for solving quantitative problems.

319 - Heterogeneous powders ID by means of fracture mechanics

Applied Physics (1) - Friday 08 July 2016 14:00
Primary author: *VIGLIATURO, Ruggero (University of KwaZulu-Natal)*
Co-authors: *MARENGO, Alessandra (University of Torino); BITTARELLO, Erica (University of Torino); PETRUCCIONE, Francesco (UKZN)*

Toxicology was provocatively defined as a "scientific field in which the core experimental protocols have remained nearly unchanged for more than 40 years". The aim of the presented work is to review, with a new approach, the description of heterogeneous powders, a complex toxic agent.Starting with asbestos vicissitude, going through the concern on nanotechnologies and the rising need of nano-safety legislation, with the aim to promote a healthy nano-revolution, new approaches in the description of morphologically, structurally, chemically and functionally heterogeneous particle populations are needed.By means of fracture mechanics, heterogeneous powders can be described with minimal parameters. These parameters can be used to set references on which it is possible to describe several bio-interaction pivotal features such as: adhesion, surface forces and possible reaction path of surfaces. The final aim is an attempt to describe this particle population as a single entity with disparate properties.For this purpose we have dimensionally studied a mineral powder as is and after two different mechanical stresses: gentle grinding and sonic bath.Preliminary results shows that using a best fit probability distribution, combined with fracture mechanics theory, it is possible to fully describe many properties of the particles population as a whole. In particular those properties with an influence in the interaction between the subject powder and the bio-sphere.Testing several mechanical stress exposition time, a relationship between time and maximum probability (curve top-hat) seems to be detectable, allowing to foresee probability distribution and particle dimensional distribution (and related characteristics) for longer time of mechanical stress exposure and also to eventually identify the starting state of the material.

321 - Computational study of TIO2 Brookite (1 0 0) surface doped with Ruthenium for application in dye sensitised solar cells

Theoretical and Computational Physics (1) - Friday 08 July 2016 11:10
Primary author: *MALUTA, Nnditshedzeni Eric (University of Venda)*
Co-authors: *DIMA, Ratshilumela Steve (University of Venda); NEMUDZIVHADI, Hulisani (University of Venda); MULAUDZI, Sophie (University of Venda); SANKARAN, Vaith (University of Venda); NEMANGWELE, Fhulufhelo (University of Venda)*

Recently, there has been a renewed interest in TiO2 brookite as charge transfer layer in dye-sensitized solar cells (DSSCs). In this work, the structural optimizations, band structure, and electronic density of states of doped and un-doped TiO2 (100) surfaces were performed by using the first principles calculations based on DFT using a plane-wave pseudopotential method. The generalized gradient approximation (GGA) was used in the scheme of Perdew-Burke-Ernzerhof (PBE) to describe the exchange-correlation functional. All calculations were carried out with CASTEP (Cambridge Sequential Total Energy Package) code in Materials Studio of Accelrys Inc. The calculations showed that band gap of Ru-doped TiO2 decreases with an exception of the case when Ru is placed at a distance 2.0 Å from the top layer. The overlap among the Ru 3d, Ti 3d, and O 2p states enhances photocatalytic activity in the visible light region. TiO2 brookite (100) surface doped with Ru at a distance of 2.0 was found to have the highest band gap amongst the different displacements considered in this study and it also has the highest negative total energy of -2.24480572 eV. For the structures of TiO2 brookite (100) doped with Ru, whereby one Ti atom was replaced with Ru, total energy of doped structures shows that they are energetically favourable, with the band gap being reduced to 0.223 eV compared to 2.376 eV of the pure structure.

323 - Digital simulation of many-body non-Markovian dynamics

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 14:20 *[For award: PhD]*
Primary author: *SWEKE, Ryan (Ukzn)*
Co-authors: *SINAYSKIY, Ilya (Ukzn); PETRUCCIONE, Francesco (Ukzn)*

We present an algorithmic method for the digital quantum simulation ofmany-body locally-indivisible non-Markovian open quantum systems. It consistsof two parts: Firstly, a Suzuki-Lie-Trotter decomposition of the k-localglobal system propagator into the product of strictly k-local propagators,which may not be quantum channels, and secondly, an algorithmic procedure forthe implementation of the strictly k-local propagators through unitaryoperations and measurements on a dilated space. By providing rigorous errorbounds for the relevant Suzuki-Lie-Trotter decomposition, we are able toanalyse the efficiency of the method, and connect it with an appropriatemeasure of the local indivisibility of the system. In light of our analysis,the proposed method is expected to be experimentally achievable for a varietyof interesting cases.

324 - Measuring prompt gamma cross-section data for Carbon target using AFRODITE clover detectors

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 15:00 *[For award: PhD]*
Primary author: *RAMANATHAN, VIJITHA (University of Cape Town)*
Co-authors: *PETERSON, Stephen (University of Cape Town); JONES, Pete (iThemba LABS); MOUSSA, Djamel (Université des Sciences et de la Technologie H.Boumediéne (USHB)); HINDA, Benhabiles (Université de Boumerdés); DAMACHE, Smail (Centre de Recherches Nucléaires (CRNA)); CHAFA, Azzedine (Université des Sciences et de la Technologie H.Boumediéne (USHB)); DEBABI, Mohammed (Université des Sciences et de la Technologie H.Boumediéne (USHB)); M, Kumar Raju (UWC); DINOKO, Tshepo (iThemba LABS); BUCHER, Daphney (iThemba LABS); LI, Kevin (Stellenbosch University, iThemba LABS); PAPKA, Paul (Stellenbosch University, iThemba LABS); LAWRIE, Elena (iThemba LABS); LAWRIE, Kobus (iThemba LABS); KIENER, Jurgen (Centre de Spectrométrie Nucléaire et de spectrométrie de Masse (CSNSM)); OUICHAOUI, Saad (Université des Sciences et de la Technologie H.Boumediéne (USHB)); YAHIA-CHÉRIF, Walid (Université des Sciences et de la Technologie H.Boumediéne (USHB)); BELHOUT, Amel (Université des Sciences et de la Technologie H.Boumediéne (USHB))*

Over the last few decades remarkable progress has been made in radiotherapy treatment modalities towards effectively delivering a radiation dose to the planning target volume (PTV) while increasing the survival and reducing the side effects of cancer patients. Proton therapy has become an increasingly popular treatment modality due to its superior dose distribution. However, the advantage of proton beams cannot be fully utilized since no proper method is currently available to measure in-patient proton dose. The detection of secondary prompt gamma rays have been proposed as a in-situ method to determine the proton range since the location of the prompt gamma emission is strongly correlated with the proton depth dose profile. Previous work, using Monte Carlo simulations, has shown discrepancies with the production of prompt gamma data particularly in prominent elements found in tissue within the therapeutic range (50-250 MeV).The goal of this study is to investigate (using simulations and measurements) the prompt gamma cross-section for the element of carbon. Measurements using a thin target of natural Carbon over the energy range of 66-125 MeV were performed at iThemba LABS using the AFRODITE detector system. The experimental setup was then simulated using the Geant4 Monte Carlo toolkit and the results were compared to the measurements. Those comparisons will be discussed.

326 - Orthonormal vector polynomials in a general pupil

Astrophysics (1) - Wednesday 06 July 2016 09:40
Primary author: *MAFUSIRE, Cosmas (University of Pretoria)*
Co-author: *KRÜGER, Tjaart (University of Pretoria)*

In optical wavefront analysis of telescope images acquired utilising circular mirrors, such as the Large Zenith Telescope, it is sometimes necessary to represent the phase in terms of its gradient in a unit circle. A suitable infinite discrete orthonormal vector circle (OVC) polynomial set spanning a circular mirror can be used to uniquely represent the phase gradient for analytical purposes. We present a novel approach in which we use matrices to derive the OVC polynomials and accordingly deduce a matrix relationship between OVC expansion coefficients and Zernike circle coefficients. We use a matrix similarity transformation to extend the model to general noncircular mirrors such as the hexagon, the shape of the Southern African Large Telescope mirror. This model may be applied to the analysis of measurements from microlens-based wavefront sensors in other applications, such as light beam analysis, and may be used to characterise radiation from any part of the electromagnetic spectrum.

327 - Orthonormal polynomials for centred non-uniform rotationally symmetric pupils

Photonics - Friday 08 July 2016 11:30
Primary author: *MAFUSIRE, Cosmas (University of Pretoria)*
Co-author: *KRÜGER, Tjaart (University of Pretoria)*

We derive a formulation for the orthonormal polynomials for rotationally symmetric non-uniform light beams going through a centred rotationally symmetric pupil by presenting a formulation derived using the QR decomposition form of the Gram-Schmidt orthogonalization procedure. We expand this model to derive an algorithm for performing the Cholesky decomposition in a way that makes it possible perform such calculations in a simpler and much faster way. We also investigate a method for calculating normalized coefficients when measuring phase in the pupil using Zernike circle polynomials from which we obtained a relationship between the two sets of coefficients. We verify the efficacy of the model by fitting both Zernike circle and orthonormal polynomials to experimental results of Gaussian beams going through circular apertures. This model may be used for imaging applications, such as super resolution microscopy, in communications, astronomy and in the general analysis of the propagation of aberrated light beams.

328 - NLO Rutherford Scattering and Energy Loss in a QGP

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 10:20 *[For award: MSc]*
Primary author: *IBRAHIM, Abdullah (University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

We calculate to next-to-leading order the cross section of a massless electron scattered off of a static point charge, in which we use dimensional regularization to tame the UV divergences and electron and photon masses to regularize both soft and collinear divergences. We include all NLO diagrams from QED such as the vertex correction, vacuum polarization, electron self energy, box correction and bremsstrahlung (both soft and hard). We find that all UV divergences cancel in the MS-bar renormalization scheme, which we've chosen in order to avoid any additional divergences in the limit of taking the mass of the electron to 0. When taking the photon mass to 0, the IR divergences are canceled through an application of the Bloch-Nordsieck theorem, while the collinear divergences are canceled by the more general KLN theorem. We then investigate the importance of the BN vs. KLN theorems in various theories as we work towards computing the NLO corrections to the energy loss of a QCD particle propagating in a quark-gluon plasma.

329 - Combustion synthesis and characterization of Eu3+ doped Ba5(PO4)3OH phosphors

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 14:40 *[For award: PhD]*
Primary author: *MOKOENA, Puseletso Pricilla (University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); NTWAEABORWA, Odireleng (University of the Free State)*

Barium orthophosphate or Ba3(PO4)2 is known to be a good host for rare earth dopant ions to prepare light emitting materials or phosphors [1]. In this study Ba5(PO4)3OH was doped with europium (Eu3+), by using the combustion method, resulting in a phosphor material that emitted red light when excited with ultraviolet radiation. The following characterization techniques: X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy, and photoluminescence (PL) spectroscopy were used to determine the structure, morphology, chemical composition and luminescent properties of the Ba5(PO4)3OH:Eu3+ phosphor powders with different concentrations of Eu3+. The XRD data exhibited characteristic diffraction patterns of the hexagonal phase of Ba5(PO4)3OH referenced in the standard JCPDS card number 00-001-0811, while the SEM results confirmed the formation of needle-like particles with diameter approximately equal to 100 nm. The red PL emission was attributed to transitions of the Eu3+ ions. The PL intensity of the Ba5(PO4)3OH:Eu3+ phosphors was shown to improve when the concentration of Eu3+ was increased from 0.1 to 3 mol% and the intensity was quenched for concentrations higher than 3 mol% due to the concentration quenching effects. This material was evaluated for possible applications in photodynamic therapy or PDT. [1] M. Cheng, H. Junhui, Material Letters, 2012, 70, 101-104

331 - Constraints on new hypothetical particles in the Higgs sector using LHC Run 1 and 2 data

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 11:30 *[For award: MSc]*
Primary author: *VON BUDDENBROCK, Stefan (University of the Witwatersrand)*
Co-authors: *KUMAR, Mukesh (University of the Witwatersrand); MELLADO, Bruce (University of Wisconsin - Madison); CORNELL, Alan (NITheP); REED, Robert (University of Witwatersrand); RUAN, XIFENG (WITS); KAR, Deepak (University of Witwatersrand)*

With Run 2 of the LHC currently underway at a record-breaking energy of 13 TeV centre of mass energy, new physics searches have come to the fore. In particular, the ATLAS and CMS collaborations are beginning to focus more on extending the Higgs sector of the Standard Model. Previous work has shown that Run 1 data from both ATLAS and CMS hint at the existence of a new heavy scalar with a mass around 270 GeV. This work will extend this idea by introducing a full Two-Higgs Doublet Model and outlining the potential Run 2 searches which could constrain the parameters of such a model, should it exist in nature. This will be presented in the context of searches for Higgs production in association with missing energy, leptons and large jet multiplicities. Some preliminary studies related to the rates and kinematic distributions of processes of interest are presented and their implications are discussed.

ORAL ABSTRACTS

333 - Upgrades to the iThemba LABS quasi mono-energetic neutron beam facility

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 14:00
Primary author: SMIT, Frederick David *(iThemba LABS)*
Co-authors: *MALEKA, Peane (iThemba LABS); NCHODU, Rudolph (iThemba LABS); BUFFLER, Andy (University of Cape Town); COMRIE, Angus (University of Cape Town)*

iThemba LABS (iTL) signed a Memorandum of Agreement with the National Metrology Institute of South Africa (NMISA) to designate the quasi mono-energetic neutron beam facility of iTL as a metrology facility in the energy range 30 – 200 MeV. A program to upgrade the facility is being undertaken. The improvements and the motivations for them will be explained.

335 - Non-reversal Open Quantum Walks

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 14:00 *[For award: PhD]*
Primary author: GOOLAM HOSSEN, Hazmatally *(UKZN)*
Co-authors: *PETRUCCIONE, Francesco (UKZN); SINAYSKIY, Ilya (University of KwaZulu-Natal and National Institute for Theoretical Physics)*

A new model of non-reversal quantum walk is proposed. In such a walk, the walker cannot go back to previously visited sites but it can stay static or move to a new site. The process is set up on a line using the formalism of Open Quantum Walks (OQWs). Afterwards, non-reversal quantum trajectories are launched on a 2-D lattice to which a memory is associated to record visited sites. The "quantum coins" are procured from a randomly generated unitary matrix. The radius of spread of the non-reversal OQW varies with different unitary matrices. The statistical results have meaningful interpretations in polymer physics. The number of steps of the trajectories is equivalent to the degree of polymerization, *N*. The root-mean-square of the radii determines the end-to-end distance, *R* of a polymer. These two values being typically related by $R\sim N^{\nu}$, the critical exponent, ν, is obtained for $N\leq 400$. It is found to be closely equal to the classical Flory exponent. However, for larger *N*, the relationship does not hold anymore. Hence, a different relationship between *R* and *N* is suggested.

338 - Structural and optical properties of Holmium doped α-Fe_2O_3 nanoparticles

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 15:00 *[For award: PhD]*
Primary author: MATHEVULA, Langutani *(Department of Physics, University of South Africa, P. O. Box 392, 0003, south Africa)*
Co-author: *DHLAMINI, Mokhotjwa (Department of Physics, University of South Africa, P. O. Box 392, 0003, south Africa)*

Due to its optical, magnetic, electrical and catalytic properties, iron oxide has attracted attention of researchers from different areas of science. α-Fe_2O_3 is an environmentally friendly n-type semiconductor with the band gap of ~2.1 eV. It is the most stable iron oxide under ambient conditions. It is widely used in gas sensing, high density magnetic recording media, clinical therapy, Magnetic resonance imaging and diagnosis [1-3]. Rare earth atoms recently have been introduced into the iron oxide matrix which leads to a material that shows multiple interesting effects. Holmium atoms were incorporated into an iron oxide nanoparticle and the concentration of the dopant atom was changed in order to determine its influence on the host crystal.Un-doped and doped α-Fe_2O_3 particles were successfully synthesized by sol-gel method using PVA as polymerizing agent. The main advantage of PVA is to provide long stability for nanoparticles and by preventing the particles agglomeration. The synthesized powder was separated and annealed at different temperatures. The shape, size, structural and lumenescence studies of the synthesized powder were characterized by XRD, TEM, FT-IR, UV-Vis and PL spectral techniques. A high crystallinity was observed with increasing annealing temperature by XRD. An increase in absorbance and a red shift was observed with increasing annealing temperature. The estimated band gaps of the powders were found to be 5.5 eV and 2.3 eV for powders at 300°C and 600°C respectively. Un-doped and doped Fe_2O_3 samples were subjected to radiation from the laser beam source to investigate anti-stokes luminescence.References1. M. N Batin and V. Popesca, optoelectronics and advanced materials-rapid communications, Vol. 6, 2012, 727-729

339 - Dynamics and thermodynamics of open quantum Brownian motion

Theoretical and Computational Physics (1) - Friday 08 July 2016 10:20
Primary author: SINAYSKIY, Ilya *(School of Physics and NITheP, University of KwaZulu-Natal)*
Co-author: *PETRUCCIONE, Francesco (UKZN)*

Open quantum Brownian motion was introduced as a scaling limit of Open Quantum Walks and is a new type of quantum Brownian motion for Brownian particles with internal quantum degrees of freedom. We use a particular example of the microscopic derivation of open quantum Brownian motion [I. Sinayskiy and F. Petruccione, Phys. Scr. T165, 014017 (2015)] to study the possibility of control of the external degrees of freedom of the "walker" (position) by manipulating the internal one, e.g. spin, polarization, occupation numbers. The connection between dynamics of the "walker" and thermodynamical parameters of the system is established.

340 - Facile synthesis of mesoporous $NiCo(OH)_2$/CNT composite for high performance energy storage application

Applied Physics (1) - Wednesday 06 July 2016 11:30 *[For award: PhD]*
Primary author: UGBO, Faith *(Department of Physics, University of Pretoria)*
Co-authors: *DANGBEGNON, Kouadio Julien (University of Pretoria); BELLO, Abdulhakeem (Department of Physics University of Pretoria); KHALEED, Abubakar (University of Pretoria); BARZEGAR, farshad (University of Pretoria); MOMODU, Damilola (UNIVERSITY OF PRETORIA); MADITO, Moshawe (Student); MASIKHWA, Tshifhiwa Moureen (University of Pretoria); OLANIYAN, Okikiola (University of Pretoria); MANYALA, Ncholu (University of Pretoria)*

Mesoporous $NiCo(OH))_2$/CNT composite was synthesized by a facile solvothermal technique using ethylene glycol as structure directing agent to improve the textural parameters. The electrochemical performance of the composite material was studied in two different current collectors: Chemical vapor deposition grown graphene on nickel foam and nickel foam. The former exhibits the best performance with a specific capacity of 734 mAh/g at 1 A/g compared to 416 mAh/g for NF alone. The specific capacity still remains as high as 605 mAh/g at high current density of 10 A/g. This represents only ~17% of capacity loss for an order of magnitude increase in the current density. This electrode material on graphene –nickel foam also shows an excellent stability with a columbic efficiency of 99 % after 1000 cycles.

341 - Strings with Finite Endpoint Mass

Theoretical and Computational Physics (1) - Wednesday 06 July 2016 14:00
Primary author: HOROWITZ, William *(University of Cape Town)*

We compute the motion of strings whose endpoints are coupled to massive point particles in an AdS-Schwarzschild geometry. Our work generalizes the usual AdS/CFT dictionary correspondence between a fundamental heavy quark in a field theory and its representation in the string theory.We then compute the stopping distance and differential energy lost by our heavy quark strongly coupled to an N = 4 SYM plasma via the AdS/CFT correspondence, compare the result to weak-coupling calculations, and comment on the relevance of our work to the quark-gluon plasma phenomenology investigated at the multi-billion euro Relativistic Heavy Ion Collider (RHIC) and Large Hadron Collider (LHC).

342 - The Analysis of Zh in association with missing transverse momentum using the CxAOD Framework with the ATLAS detector

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 11:10 *[For award: MSc]*
Primary authors: MTHEMBU, Skhathisomusa *(University of the Witwatersrand); PELWAN, Chad (University of Witwatersrand); LIAO, Shell-may (University of the Witwatersrand, School of Physics, 1 Jan Smuts Avenue, Braamfontein, Johannesburg, 2000, South Africa"); MOLUPE, Tshidiso (University of the Witwatersrand)*
Co-authors: *KAR, Deepak (University of Witwatersrand); MELLADO, Bruce (University of Wisconsin - Madison); REED, Robert (University of Witwatersrand); VON BUDDENBROCK, Stefan (University of the Witwatersrand)*

With the discovery of the Higgs boson at the Large Hadron Collider in 2012 a new window of opportunity has opened to discover physics beyond the Standard Model. In order to study the distortion of the Higgs transverse momentum spectrum observed with Run I data a heavy boson, H, wth a mass around 300 GeV that decays into the Higgs boson, h, and something else, including missing energy, has been hypothesised. If embedded into a second complex doublet, the decay channel A->ZH opens up, where A is the cp odd boson, leading to the Z+h+missing energy final state. The ‘zhmet’ analysis was created to work within the CxAOD Framework, as does the pre-existing ‘VHbb’ analysis. Using the ‘zhmet’ framework, the 13TeV ATLAS data and MC samples are used for the analysis. The decay Z->ll resulting in either same or different flavour leptons is presented.

344 - Search for chirality in 192Tl

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 11:10
Primary author: NDAYISHIMYE, Joram *(iThemba LABS)*
Co-author: *ELENA, Lawrie (iThemba LABS)*

It was revealed at iThemba LABS that chiral symmetry can develop in the thallium isotopes with mass A ~ 190. In order to search for chiral candidates in these isotopes, γ-spectroscopy measurements on 192Tl were performed at iThemba LABS, using a heavy-ion reaction of 160Gd(37Cl, 4n) at 167 MeV beam energy and a thin target of 1.0 mg/cm2. Previous level scheme of 192Tl was considerably extended. Spins and parities were assigned to most of the levels and relative intensities of γ-ray transitions were measured. Most important is that a weak band that is suggested as a possible chiral partner to the yrast band was discovered. Both bands are built on πh9/2×νi13/2 configuration. More details on these new results will be presented.

345 - Production of ion beams with ECR ion sources and the pre-acceleration with injector cyclotrons at iThemba LABS

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 11:10
Primary author: *MIRA, Joele (iThemba LABS)*
Co-authors: *THOMAE, Rainer (iThemba LABS); DE VILLIERS, John Garrett (iThemba LABS); FOURIE, Dirk (iThemba LABS); NEMULODI, fhumulani (iThemba LABS); CLOETE, Jaci (iThemba LABS); SAKILDIEN, Muneer (iThemba LABS); CONRADIE, Lowry (Member)*

Charged particle beams at iThemba LABS are produced with different ion sources before pre-accelerated with the Solid Pole Injector Cyclotrons (SPCs). From the injector cyclotrons the beam is transported and injected into the Separated Sector Cyclotron (SSC) for final acceleration to the required energy. For high intensity beam application an internal Penning Ion Gauge (PIG) source is used. For the production of heavy ions with high charge states, two Electron Cyclotron Resonance (ECR) ion sources are being used. The two sources are as follows, a 14.5 GHz ECRIS4, originally built for the Hahn Meitner Institute (HMI) and a new ECRIS based on the design of the Grenoble Test Source (GTS). The GTS operates at room temperature and uses two microwave frequencies of 14 GHz and 18 GHz. The two ECR ion sources deliver highly charged ions of sufficient intensity for Nuclear Physics experiments. Principles and the performance of the different ion sources, as well as the transport, injection and pre-acceleration of charged particles with SPCs will be discussed.

349 - EXPERIMENTAL STUDY OF INNER SHELL IONIZATION IN AN ECRIS PLASMA

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 11:30 *[For award: PhD]*
Primary author: *SAKILDIEN, Muneer (iThemba LABS)*
Co-author: *JONES, Pete (iThemba LABS)*

A new plasma diagnostic technique is currently being investigated with the Electron Cyclotron Resonance Ion Source (ECRIS) at iThemba LABS. With this diagnostic, it would be possible to gauge the average ionization state in the line-of-sight volume of an ECRIS plasma by non-destructively measuring the characteristic x-rays emitted from the plasma. This technique will especially be valuable for plasma simulations to gauge the accuracy of assumptions built into the simulations. We will report here on the results of preliminary measurements on the ECR ion source at iThemba LABS.

352 - Parallel computing solutions to the Balitsky-Kovchegov equation

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 11:10 *[For award: MSc]*
Primary author: *HILLEBRAND-VILJOEN, Charlotte (UCT)*
Co-author: *WEIGERT, Heribert (University of Cape Town)*

The JIMWLK (pronounced "gym walk") equation describes the energy evolution of observables in the colour glass condensate (CGC) state of matter, which is particularly relevant to collider physics. Currently there are many implementations of JIMWLK evolution in the spirit of the factorised Balitsky-Kovchegov (BK) equation for the total cross section. These include a number of efforts to consistently implement evolution at next-to-leading-order. Aside from NLO, there is a growing interest in studying new, more exclusive, observables, such as single transverse spin asymmetries and transverse momentum distributions.These require the inclusion of new degrees of freedom, which can be done systematically by extending the Gaussian truncation of the JIMWLK equation. This necessarily increases the computational demands, both in terms of floating point operations and of storage requirements. After introducing the theoretical context, we will address the first computational step and show new, parallelised methods in code that evolves the BK equation.Parallelisation of BK evolution using NVidia Cuda with implementation on a commercially available graphical processing unit (GPU) results in performance improvements of roughly an order of magnitude over comparable serial programmes. This will make possible significantly more accurate BK calculations for a number of applications in the CGC context.

353 - Boundary Current Response in $Ba_{0.34}K_{0.64}Fe_2As_2$ Single Crystals Probed by Non-Resonant Microwave Absorption.

Division for Physics of Condensed Matter and Materials (2) - Tuesday 05 July 2016 15:20 *[For award: MSc]*
Primary author: *RAMASHITJA, Tshiwela Caroline (University of South Africa)*

Non-resonant microwave absorption (NRMA) in superconducting materials has become a new experimental technique to probe and understand superconducting materials [1]. For example cuprate superconductors are well studied with this technique [2]. At the same time the technique is also evolving. This technique (NRMA) has been used to study magnetic shielding effects/boundary current in $Ba_{0.34}K_{0.64}Fe_2As_2$ single crystals of iron pnictides superconducting sample measured at 9.4 GHz below TC (4.2K-36K). It has been established that a small modulation field used in NRMA experiment yield the boundary current response.

354 - Solar power prediction model using quantum machine learning algorithm

Applied Physics (1) - Wednesday 06 July 2016 14:20
Primary author: *SENEKANE, Makhamisa (Quantum Research Group, School of Chemistry and Physics, University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa)*
Co-author: *TAELE, Molibeli (National University of Lesotho)*

Classical machine learning is the intersection of artificial intelligence and statistics. It studies the algorithms that can be used to analyze data and also make predictions about the data. The quantum version of classical machine learning is Quantum Machine Learning (QML). As a sub-field of quantum computing, it uses quantum mechanical concepts such as superposition, entanglement and quantum adiabatic theorem to analyze data and make predictions about data. Currently, QML research has taken two directions. The first approach involves implementing the computationally expensive subroutines of classical machine learning algorithms on a quantum computer. The second approach concerns using classical machine learning algorithms on quantum information. In this paper, we propose a solar power prediction algorithm which implements quantum support vector algorithm. Simulation results underline the utility of this prediction model.

355 - Determining the spectroscopic quadrupole moment Q_s of the first 2^+ state in ^{40}Ar

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 14:00 *[For award: MSc]*
Primary author: *MOKGOLOBOTHO, Makabata Jeremia (UWC)*
Co-authors: *ORCE, Nico (University of the Western Cape); MEHL, Craig (UWC); MUKHI, Kumar Raju (UWC)*

The present study aims at determining the spectroscopic quadrupole moment Q_s of the first 2^+ excited state in ^{40}Ar by carrying out second order Coulomb-excitation reorientation-effect measurements at safe energies. Similar measurements were done in the 1970's by Nakai et al [1,2] with no record of the distance separating two nuclear surfaces (S_{min}). The first 2^+ state at 1461 keV in ^{40}Ar was populated through a safe Coulomb excitation experiment carried out at iThemba LABS (Cape Town) using 143.2 MeV ^{40}Ar beams on a a 1.39 mg.cm^{-2} ^{208}Pb target. The scattered particles were detected using a double sided S3 silicon detector placed 10.05 mm from the target at backward angles in coincidence with the de-excitation of γ rays detected using 8 HPGe clover detectors in the AFRODITE array [3]. The semi-classical coupled -channel Coulomb excitation code GOSIA [4] calculates theoretical integrated γ -ray yields and normalised them to the experimental integrated γ -ray yields (which carries information about the Q_s) is being used to extract the diagonal matrix element of the exited state which are proportional to the Q_s.References :1) R. H. Spear, Phys. Rep. 73, 369 (1981).2) K. Nakai, J. L. Quebert, F. S. Stephens, and R. M. Diamond, Phys. Rev. 24, 16, (1970).3) M. Lipoglavsek et al., Nucl. Instr. Meth. Phys. Res. A557, 523 (2006).4) Gosia Manual 2012.

356 - Identification of chiral pairs in multiple chiral bands associated with the same nucleon configuration

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 11:30
Primary author: *SHIRINDA, OBED (iThemba LABS, University of Stellenbosch)*
Co-author: *LAWRIE, Elena (iThemba LABS)*

A nuclear chiral system is formed when the total angular momentum of the nucleus is aplanar, i.e. when it has significant projections along all three nuclear axes [1]. Most important for the identification of chiral bands is to establish a pair of $\Delta I = 1$ bands that are near-degenerate in energy, but also in B(M1) and B(E2) transition probabilities [1]. Up to date, chiral candidates showing two- or multi-quasiparticle partner bands have been observed in several nuclei in A ~ 80, 100, 130 and 190 mass regions. The existence of multiple chiral partner bands (MχD) with large triaxial deformation, but with different particle-hole configuration was proposed in a single nucleus [2]. The MχD was firstly experimentally confirmed in 133Ce [3]. Contrary to MχD that differ from each other in their particle-hole configurations and may correspond to different triaxial deformations. We investigated the existence of multiple chiral bands built on the same configuration. Our calculations using the two-quasparticle-plus-triaxial-rotor (TQPRM) and multi-particle-plus-triaxial-rotor (MPR) models, confirm that more than one pair of chiral bands may exist in a nucleus with the same nucleon configuration [4]. Multiple chiral systems were found in the 100, 130 and 130 mass regions, but they may not necessarily form well defined pairs of near-degenerate bands. The present work studies how one can identify or group chiral pairs in multiple chiral bands associated with the same nucleon configuration. The results from these calculations will be presented and discussed.This work is supported by the National Research Foundation, South Africa.[1] S. Frauendorf, J. Meng, Nucl. Phys. A617, (1997)131[2] J. Meng et al., Phys. Rev. C73, (2006)037303[3] A.D. Ayangeakaa et al., Phys. Rev. Lett. 110, (2013)172504[4] O. Shirinda and E.A. Lawrie, Acta Phys. Pol. B46, (2015) 683

357 - SILVER MEDALLIST LECTURE: 3D Models of Stellar Wind Interactions

Space Science - Friday 08 July 2016 11:10
Primary author: MOHAMED, Shazrene (SAAO)

Evolved stars, e.g., Wolf-Rayet stars and red (super)giants, lose copious amounts of mass and momentum through powerful, dense stellar winds. The interaction of these outflows with their surroundings results in highly structured and complex circumstellar environments, often featuring knots, arcs, shells and spirals. Recent improvements in computational power and techniques have led to the development of detailed, multi-dimensional simulations that have given new insight into the origin of these structures, and better understanding of the physical mechanisms driving their formation. In this talk, I review one of the main mechanisms that shapes the outflows of evolved stars: interaction with a companion. I will discuss both wind-wind interactions where the companion also ejects a stellar outflow, and mass-transfer interactions where the companion has a weak or insignicant outflow. I will also highlight the broader implications of these stellar wind interactions for other phenomena, e.g, for planetary nebulae, symbiotic and X-ray binaries, novae and supernovae.

361 - Analyses of heliospheric magnetic field data as input for ab initio modulation models

Space Science - Wednesday 06 July 2016 11:50
Primary author: BURGER, Renier (North-West University)

Various approaches can be followed to calculate the intensity of galactic cosmic rays throughout the heliosphere. In the ab initio approach, turbulence quantities calculated from magnetic field data, obtained by various spacecraft, are used as input for a turbulence transport model. In turn, output from the latter model is used as input for the diffusion tensor of the cosmic-ray transport equation. I will discuss the structure of the turbulence that we believe characterizes the turbulent solar wind. I will then show how spacecraft data support a composite slab and two-dimensional structure, highlighting the difficulties and uncertainties that arise when we have no other option than to use data obtained by a single spacecraft.

362 - The efficiency of Hypericin used in Photodynamic Therapy Treatment with low intensity laser irradiation to induce the cell death of human breast cancer cells (MCF7).

Photonics - Wednesday 06 July 2016 11:10 *[For award: MSc]*
Primary author: NDIVITO, KIRO (University of Johannesburg)

Abstract. Background: Breast cancer is a life threatening heterogeneous disease, which is currently the second most common invasive cancer that affects women worldwide, after lung cancer. In addition to cancer recurrence, another challenge encountered during cancer therapy is the toxic effects cancer drugs have on healthy cells. Photodynamic therapy (PDT) offers targeted treatment of cancer cells using low intensity light (600-900 nm) in synergy with a photosensitizer (PS). A PS is, itself, a nontoxic drug and only becomes toxic to cells in the presence of light, at a specific wavelength, by inducing an overproduction of reactive oxygen species (ROS), which destroys cancer cells. The efficiency of the PS Hypericin (HYP) to induce cancer cell death after its activation using low intensity laser irradiation (LILI) was investigated in this study. Methods: A Commercially purchased breast cancer cell line (MCF-7) was treated with four different doses of HYP: 1 μM, 2 μM, 4 μM and 6 μM, and irradiated with three fluencies: 5, 10 and 15 J/cm2 using a 594 nm diode laser. The effect of HYP used in synergy with LILI was determined by assessing viability (trypan blue staining), proliferation (Adenosine triphosphate, ATP, luminescence assay), toxicity (Lactate Dehydrogenase, LDH) and cell death pathways (Caspase 3/7) of the breast cancer cells. Results: A Change in cellular morphology was seen in the PDT treated cells using a fluence of 10 and 15 J/cm2. A decrease in viability and proliferation, and an increase in cytotoxicity and caspase activity was also observed. Conclusion: HYP was identified as an efficient PS as it, together with LILI, was able to induce photo damage in MCF-7 cells. The most effective treatment combination was observed using 6 μM of HYP and a fluence of 15 J/cm2.

367 - ESKOM, Irradiance and Sunny Skies - the physics of solar irradiance in South African conditions

Applied Physics (1) - Wednesday 06 July 2016 14:00
Primary author: WINKLER, Hartmut (Dept. Physics, University of Johannesburg)

Solar power generation efficiency is not only a function of the detector technology and configuration, but also depends on the amount, spectral distribution and angular profile of sunlight at ground level. This paper reviews some common techniques used estimate the solar photon field at its interface with the detector. It examines the suitability of the associated light transmission and scattering models from a physical perspective under atmospheric conditions representative of the dry South African western plateau (where most local solar power stations are planned to be sited). The article concludes with a presentation of a simple ground-level spectral irradiance model formulation specific to South African condition that is readily adaptable to site conditions. Applied to the configuration and spectral responsiveness of a solar device this model is expected to yield better estimates of electricity generation than many internet-based tools commonly used for this purpose.

368 - The Shear-Free Perfect Fluid Conjecture in General Relativity: Progress

Astrophysics (1) - Wednesday 06 July 2016 15:00 *[For award: PhD]*
Primary author: SIKHONDE, Muzikayise (UCT)

The progress on the proof of the shear-free fluid conjecture in general relativity is discussed, we present a review of recent partial proofs of the conjecture, a new proof is given for the case of a general equation of state, including a non-zero cosmological constant.

369 - Fine structure of the Isovector Giant Dipole Resonance of neutron-rich calcium isotopes using the (p,p′) reaction at zero-degrees

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 10:00
Primary author: LATIF, Mouftahou (School of Physics, University of the Witwatersrand)
Co-authors: USMAN, Iyabo (University of the Witwatersrand, Johannesburg.); COOPER, Gordon (University of the Witwatresrand); RICHTER, Achim (Technische Universitaet Darmstadt, Germany); PONOMAREV, Vladimir (Technische Universitaet Darmstadt, Germany); DONALDSON, Lindsay (University of the Witwatersrand); FUJITA, Hirohiko (RCNP, Osaka); NEMULODI, fhumulani (iThemba LABS); SWARTZ, Jacobus (Stellenbosch University); CARTER, John (University of the Witwatersrand); NEVELING, Retief (iThemba LABS); SMIT, Frederick David (iThemba LABS); VON NEUMANN-COSEL, Peter (Technische Universitaet Darmstadt, Germany); SIDERAS-HADDAD, Elias (University of the Witwatersrand); PAPKA, Paul (Stellenbosch University); JINGO, Maxwel (University of the Witwatersrand); KUREBA, Oscar (University of the Witwatersrand)

High energy-resolution proton inelastic scattering measurements were carried out on 40,42,44,48Ca using the cyclotron facility of iThemba LABS together with the K600 magnetic spectrometer in zero-degree mode. Fine structure was observed in the excitation energy range of the Isovector Giant Dipole Resonance (IVGDR) which lies between 11 – 25 MeV. In a bid to account for the dominant mechanisms responsible for the spreading of the IVGDR in these isotopes, wavelet analysis was applied to the measured experimental data with the results being in excellent agreement with those of theoretical calculations based on the Relativistic Quasiparticle Time Blocking Approximation (RQTBA). In addition, the results of level density of the $J\pi = 1^-$ states extracted from the experimental excitation energy spectra by means of fluctuation analysis agree well with the parameterisation of existing microscopic models.

370 - The design and simulation of a new experimental set up for measuring short nuclear level lifetimes.

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 11:50
Primary author: SINGH, Bhivek (University of the Western Cape)
Co-authors: TRIAMBAK, Smarajit (University of the Western Cape); ORCE, Nico (University of the Western Cape); CONRADIE, Lowry (Member); DYERS, Zaid (iThemba Labs); PESUDO, Vicente (iThemba labs)

Measurements of nuclear level lifetimes play an important role in studies nuclear astrophysics. The lifetime of a state is related to its gamma width and therefore impacts the rates of resonant capture reactions in stars. This provides a constraint on models of stellar evolution. Lifetime measurements can also be used to investigate nuclear structure. The lifetime is directly related to the transition strengths to other states. The transition strengths are related to the transition matrix elements connecting states. In this regard measuring lifetimes is a useful complementary to technique to Coulomb excitation for measuring quadrupole moments.In this talk I discuss the design and simulation of a new experimental set up at iThemba LABS to be used for measuring short lifetimes with the Doppler shift attenuation method in inverse kinematics. The design was done using the Solid Edge software package for computer assisted design (CAD), with a particular focus on providing the cleanest possible environment in which the experiments can be conducted. I will also give an overview of the codes developed to simulate the set up. Preliminary results of gamma ray lineshapes using Geant4 simulations will be presented.

372 - Implementation of the preamplifier response function for the iThemba LABS segmented clover detector

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 15:00
Primary author: BUCHER, Thifhelimbilu Daphney (iThemba LABS)
Co-authors: SHIRINDA, OBED (iThemba LABS); LAWRIE, Elena (iThemba LABS); NONCOLELA, Sive (UWC); DINOKO, Tshepo (iThemba LABS); ERASMUS, Nicholas (University of the Western Cape); EASTON, Jayson (iThemba LABS and University of the Western Cape); MTHEMBU, Sinegudu (University of Western Cape)

In June 2013, iThemba LABS acquired the ADL [1] software to simulate the response of the segmented clover detector for an arbitrary gamma-ray interaction within a germanium crystal. In order to generate realistic pulse shapes that match the measured pulses for a specific position in (x,y,z), the detector characteristics, such as geometry, impurity profile, charge sensitive preamplifier response to a input of a step function, cross-talk parameters and crystal orientation (which is the topic of another SAIP 2016 presentation [2]), must be measured and implemented into the software in high precision. The implementation of those detector characteristics into the ADL software is progressing well. The charge sensitive preamplifier serves as the interface between the detector's (which output the charge pulse), and the data acquisition electronics. It amplifies the signal and due to its limited bandwidth [3] it effectively slows down and smoothies the shape of the pulses. Hence, in order to compare the simulated pulse shapes with the measured ones, the simulated charge pulses have to be convoluted with the function, f(x), which represents the response of the charge sensitive preamplifier of that particular detector.The charge sensitive preamplifier response of the iThemba LABS segmented clover detector was measured [4]. In this contribution, its implementation into the ADL software will be discussed. Results showing the excellent performance of the ADL software in convoluting the simulated step function with the preamplifier response will be presented. 1. ADL, http://www.ikp.uni-koeln.de/research/agata/index.php?show=download2. S. Mthembu, et.al, Crystal Orientation Measurements of the iThemba LABS segmented clover detector, SAIP 2017.3. M. R. Dimmock, Characterisation of AGTA Symmetric Prototype Detectors, PhD thesis, University of Liverpool, 2008.4. O. Shirinda, et.al, SAIP2013 Proceedings, ISBN: 978-0-620-62819-8, (2014), measuring the performance of the iThemba LABS segmented clover detector.

373 - Computational modelling of sulphides mineral (FeS_2)

Division for Physics of Condensed Matter and Materials (1) - Thursday 07 July 2016 11:50
Primary author: LETSOALO, Thabo *(University of Limpopo)*
Co-author: *NGOEPE, Phuti (University of Limpopo)*

Sulphides minerals are important group of minerals. They are found in nature and are of significant industrial and economic importance. They are the main source of various precious metals such as iron, cobalt, nickel and lead. Density functional based Tight Binding (DFTB+) method was used to investigate the electronic and structural properties of pyrite. DFTB+ molecular dynamics simulation was used to study the large structures of FeS_2 at high temperatures. The density of states (DOS) showed a decreased band gap at high temperatures. However alloyed FeS_2 with oxygen produced an increased band gap. The electronic and structural properties such as lattice parameters, bulk modulus and elastic constants of FeS_2 are in good agreement with previously studied theoretical and experimental results.

374 - Single-photon, single-pixel camera

Applied Physics (2) - Wednesday 06 July 2016 11:50 *[For award: MSc]*
Primary author: BERRY, Gareth *(Structured Light Lab , School of Physics, University of the Witwatersrand)*
Co-authors: *FORBES, Andrew (CSIR); MCLAREN, Melanie (University of the Witwatersrand)*

Traditional imaging techniques require light to interact with the object of interest, however, quantum entanglement allows the formation of images without each photon interacting with the object, this is known as ghost imaging. The optical image is revealed in the coincidences between pairs of entangled photons, with only limited information available in counts from either one of the detectors alone. Ghost imaging offers multiple advantages in comparison to standard imaging; as it offers a non-destructive imaging system and imaging at the single photon level has enabled sub-diffraction limited imaging. Typically, quantum imaging is used to recover the amplitude of the object by implementing a scanning detector in one arm of the entanglement setup. We demonstrate that both the amplitude and phase of the object can be reconstructed using digital holography and single photon detectors. The latter reduces the complexity of the scanning device to single pixel.

375 - Probing students perceptions of first year physics labs: a focus on learning and enjoyment aspects

Physics Education - Tuesday 05 July 2016 10:00
Primary author: TLOWANA, Munene *(Student)*
Co-author: *ALLIE, Saalih (UCT)*

As part of a broader initiative to probe students' experience of first year physics laboratories, a written instrument, Perceptions of Physics Labs Questionnaire (PPLQ) was developed. The PPLQ comprises 5 questions probing the following: expectations, enjoyment, learning, perceived correlation of theory done in lectures and lab work, and notions of the relationship between theory and experiments in physics. Each question on the PPLQ was constructed around a debate offering various opinions, followed by: (1) a Forced Choice Responses (FCR) in which a particular opinion has to be chosen and (2), a Free Writing Response (FWR) in which the reasons for the choice are explained. In a previous talk the analysis of the FCR's was presented for the 5 probes. In this talk the emphasis will be on the analysis of the FWR's for two of the key probes, namely, Enjoyment and Learning. The data were analyzed using the approach suggested by Grounded Theory. Based on a sample of written responses, a coding scheme was developed. Thus, starting with a fine-grained level of coding, a number of categories emerged that were then used to analyze the full data set. The results from the exercise will be discussed in detail. Further exploration of the data suggests that the detailed responses can be viewed as either positive or negative manifestations of two underlying constructs, Socio-Emotional and Knowledge-Skills, that can be used to characterize the overall lab experience.

376 - Power Budget Analysis of Passive Components along an Optical Fibre Link of a Frequency Dissemination System within the MeerKAT Telescope Array

Applied Physics (1) - Tuesday 05 July 2016 10:00 *[For award: PhD]*
Primary author: WASSIN, Shukree *(NMMU)*
Co-authors: *GIBBON, Timothy (NMMU Physics Department); LEITCH, Andrew (NMMU); GAMATHAM, Romeo Reginald Gunther (NRF, Square Kilometre Array South Africa); ISOE, George (Centre for Broadband Communication,Nelson Mandela Metropolitan University); BOIYO, Duncan (Centre for Broadband Communication, Nelson Mandela Metropolitan University)*

The Square Kilometre Array (SKA) project aims to address the unsolved mysteries of fundamental astrophysics and physics. MeerKAT, the South African precursor to the SKA consisting of 64 interlinked receptors will be incorporated into SKA phase 1. A total of 170 km buried optical fibre will be used to aggregate large volumes of astrological data from each dish within the MeerKAT antenna array to the Karoo Array Processing Building (KAPB). The maximum length of fibre to be installed between the KAPB and an individual receptor is 12 km. Ultra high, precise time and frequency reference clock tones will be disseminated across the buried fibre to the digitizers located on each antenna, thereby providing phase coherence amongst the relevant MeerKAT telescopes. Temperature variations and external environmental conditions may have a detrimental effect on the phase stability of the optical signal transmitted along the fibre. This paper reports on a power budget analysis conducted of various passive components within the optical fibre link, of a phase noise compensation scheme using a vertical cavity surface emitting laser (VCSEL) actuating system. Furthermore, -18.1 dBm and -25.7 dBm were measured at the receiver side of the one way (12 km) and round trip (24 km) optical fibre transmission links respectively. PIN and APD photodiodes, with receiver sensitivities of -18 dBm and -25 dBm, were found to be suitable for optical detection along the one way and round trip links respectively. Using an APD receiver rules out the possibility of incorporating an erbium doped fibre amplifier (EDFA) into phase noise compensation scheme thereby reducing the cost and complexity of the system.

379 - Ion beam modification of diamond to DLC: A SBS, Raman and HRTEM study.

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 14:20
Primary author: NAIDOO, Shunmugam Ramsamy *(DST-NRF Centre of Excellence in Strong Materials,Wits University)*
Co-authors: *MOTOCHI, Isaac (DST-NRFCentre of Excellence in Strong Materials,University of the Witwatersrand); MATHE, Bhekumusa (University of the Witwatersrand); OLIVIER, JACO (Centre for HRTEM, Nelson Mandela Metropolitan University, Port Elizabeth); DERRY, Trevor (University of the Witwatersrand)*

Single crystal CVD diamond samples were implanted with a total fluence of 1.5×10^{16} ions/cm^2 at an energy of 150 keV using carbon ions. In this work we show for the first time the elastic properties of the ion implanted and annealed damaged layer created near the surface of the diamond using surface brillouin scattering (SBS). The results also show that it is possible to create a reflective layer in diamond, which allows for the use of the Kruger geometry to analyse the elastic properties of damaged diamond. The results in correlation with Raman spectroscopy and HRTEM show that the onset of the formation of graphitic carbon in diamond does occur during high fluence ion implantation and the SBS signatures of the layer become apparent after annealing at a temperature of 500°C. This implies an ''Ótswald'' ripening process which leads to the formation of extended sp2 structures with a degree of sp3 bonding. This layer is shown to have a sound velocity (elastic properties) similar to those reported for tetrahedral amorphous carbon (ta-C).

380 - A new approach to teaching graphs to first year science students

Physics Education - Friday 08 July 2016 14:20
Primary author: TSIPA, AJ *(University of Zululand)*

Despite being one of the most important concepts in the study of physics, graphs continue to be a problem area for most first year students. Most of them arrive at university without a strong background in understanding basic concepts like graphs. Graphs are a very important part in the study of physics at university. Interpretation of data is the cornerstone of science education. Graphs show rates at which things happen, relationship between variables and are a good tool for representing data visually to see relationships and trends. The Unizulu Science Centre developed a very simple method of teaching graphs to first year physics students through the use of multimedia technology. Because data can be abstract, using simple tools like user-friendly software programmes which are freely downloadable from the internet can make graphs very clear to the students. This paper seeks to showcase the use of these simple teaching tools in teaching abstract concepts in physics at university level. The presenter will demonstrate these concepts with the hope that others can learn and use them to improve physics teaching.

381 - Cross Section Measurements for Neutron Induced Reactions on Bi Target using Quasi Mono-Energetic Neutron Beams of 90 and 140 MeV Energies.

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 15:20 *[For award: MSc]*

Primary authors: LAMULA, Thobeka *(University of Zululand); NCHODU, Rudolph (iThemba LABS); MALEKA, Peane (iThemba LABS); NTSHANGASE, Sifiso Senzo (University of Zululand); NDLOVU, Ntombizikhona (Stellenbosch University); SMIT, Frederick David (iThemba LABS); BUFFLER, Andy (University of Cape Town); GEDULD, Dieter (Stellenbosch University)*

Cross section measurements for the $^{209}Bi(n,5n)^{205}Bi$, $^{209}Bi(n,4n)^{206}Bi$ and $^{209}Bi(n,3n)^{207}Bi$ reactions were performed using quasi-monoenergetic neutron beams of 90 and 140 MeV energies. Neutron beams were produced from $^{7}Li(p,n)^{7}Be$ reaction using the neutron beam facility of iThemba LABS. Gamma rays emitted by the radioactive samples were measured using High Purity Germanium (HPGe) detector of the Environmental Radioactivity Laboratory (ERL) available at iThemba LABS. The acquired gamma ray spectra were analyzed using Multi Channel Analyzer (MCA), in order to identify the long lived radionuclides produced. The cross section data found from this work was compared with the existing experimental as well as the available evaluated data of the International Reactor Dosimetry Fusion File (IRDFF) library. The comparison shows good agreement between the compared data. The cross section data from this work will be important for testing, improving and extending the IRDFF library since the existing experimental data for high energy neutron is insufficient. To the IRDFF library, the current contribution from iThemba LABS will improve the Bi data for high threshold energy (n,xn) reactions with cross section peaks located at 90 and 140 MeV neutron energies in order to meet the requirements of the higher energy nuclear installations.

384 - Ambient noise tomography (Passive Seismic) to image the Cape-Karoo transition near Jansenville, Eastern Cape.

Applied Physics (1) - Tuesday 05 July 2016 11:50 *[For award: PhD]*

Primary author: BEZUIDENHOUT, Lucian *(Nelson Mandela Metropolitan University)*
Co-author: *DOUCOURE', Moctar (Nelson Mandela Metropolitan University)*

Between August and September 2015, a seismic network consisting of 17 stations was installed in the south-eastern Cape-Karoo, near Jansenville. Ambient seismic signals were continuously monitored for a 6 week period. In this paper we present the retrieval and coherency analysis of Rayleigh waves extracted from the ambient noise. Green's empirical function between receiver pairs are extracted from cross correlation of the vertical component records. We average the measured group velocity dispersion curves of the Rayleigh waves in the period range from 2.5 to 5.5 seconds (approximately 2-5 km depth). The arrival times of the Rayleigh waves are picked at various periods and then inverted to compute 2-D group velocity maps at different periods. This resulted in a velocity model at depths down to 5 km. The results reveal two contrasting velocity regions, corresponding broadly to the Cape Fold Belt and the flanking Karoo Basin, where the higher group velocity anomalies most likely represent the Permian-Triassic basin depot centers (3 to 5 km in thickness). A lowermost velocity region in the south-eastern study area could correspond to the Jurassic-Cretaceous depot center of the Algoa Basin overlying the Cape Fold Belt. Keywords: Ambient noise, group velocity maps, tomography, Karoo depot center, Algoa Basin

385 - Observing Gamma-Ray Bursts with the H.E.S.S. experiment

Astrophysics (1) - Friday 08 July 2016 14:40

Primary author: GARRIGOUX, Tania *(North-West University)*

Gamma-ray bursts (GRBs) are some of the most powerful and exotic events in the universe. Due to their high luminosity, they are visible to high redshifts (up to z~8 but typically z~1-2), thus providing excellent probes of the distant universe. Although their emissions are detected across the electromagnetic spectrum, from radio to gamma rays, their behavior at the highest energies (> 100 GeV) is unknown. The detection of these very high energy (VHE) photons is of importance, as it would help understand their emission mechanism and could provide evidence of UHECR acceleration in GRB jets. Hence, it is among the primary science goals of HESS-II, the second phase of the HESS experiment that started with the addition of a fifth telescope to the center of the array. With its 600m^2 mirror area, this new telescope allows us to probe the sub-100 GeV energy range, while maintaining the large collection area of ground based gamma-ray observatories.

386 - First Principle Investigation of Structural, Thermodynamic, Electronic and Elastic Properties of Ru-Cr-Z Ternary Alloys

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 14:20 *[For award: MSc]*

Primary author: MNISI, BHILA *(UNIVERSITY OF SOUTH AFRICA)*
Co-author: *TIBANE, MALEBO (UNIVERSITY OF SOUTH AFRICA)*

We report the first principle structural, elastic, thermodynamic, and electronic properties of Cr-Ru-X ternary alloys (where X = V, Mo, Fe, Pd and Mn) obtained from the density functional theory. The heats of formation, bulk modulus, density of states, elastic constants and the band structure energy are calculated and systematically compared to available theoretical and experimental data. The calculated heats of formation predicted an improved stability when the systems are doped with six atoms of Mo, Mn and Fe atoms. Band structures of Ru-rich and Cr-rich alloys indicate an overlap between the valence and the conduction band hence our systems are metallic with a zero band gap. Furthermore the elastic constants of the studied systems are predicted as mechanically stable under the Born criterion of cubic structures. The ratio of bulk to shear modulus was used to determine the ductility/brittleness of the material.

387 - Development of high-power and high-energy solid-state lasers and amplifiers

Photonics - Friday 08 July 2016 10:00

Primary author: STRAUSS, Hencharl *(CSIR (National Laser Centre))*
Co-authors: *KOEN, Wayne (CSIR National Laser Centre); JACOBS, Cobus (CSIR National Laser Centre); WU, Lorinda (CSIR-NLC); MORRIS, Daniel (University of Pretoria)*

An overview of laser source development at the CSIR National Laser Centre is presented. A number of different laser sources, based on various architectures were developed to fulfill a diverse range of needs. These systems included ultra-compact short-pulse 1 micron lasers, Large Mode Area (LMA) mid-infrared fibre lasers, bulk solid-state lasers and amplifiers, as well as Optical Parametric Oscillators (OPOs). The ultra-compact 1 micron lasers delivered multi-kW peak powers in nanosecond pulses at Pulse Repetition Frequencies (PRF) in excess of 100 kHz. This laser prototype was developed for use in ranging applications. Development of 2 micron, high-power bulk lasers and amplifiers for use as OPO pump sources as well as free space propagation has also proven highly successful, culminating in the successful completion of a fieldable Ho:YLF laser and amplifier system, delivering up to 60 W of laser power in a near-diffraction limited beam.We are also investigating mid-infrared parametric sources emitting in the 3 to 5 micron region. Sources in this wavelength region have applications in several fields, including medicine, optical communication, and defence. Results obtained thus far are very promising, with up to 14 W of output power demonstrated from a single-crystal OPO emitting at 4 micron.In conclusion, we present our vision and future strategy for aiding both the South African Photonics research community as well as industry.

388 - Observation of K-splitting in the Isoscalar Giant Quadrupole Resonance within the neodymium isotope chain using high energy-resolution inelastic proton scattering

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 10:20

Primary authors: *KUREBA, Chamunorwa Oscar (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa);* CARTER, John *(University of the Witwatersrand)*
Co-authors: *SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); JINGO, MAXWELL (UNIVERSITY OF THE WITWATERSRAND); FEARICK, Roger (University of Cape Town); NEVELING, Retief (iThemba LABS); SMIT, Frederick David (iThemba LABS); USMAN, Iyabo (University of the Witwatersrand, Johannesburg.); NESTERENKO, Valentin (JINR Dubna); VON NEUMANN-COSEL, Peter (IKP, TU Darmstadt)*

A systematic experimental investigation of the phenomenon of fine structure, with emphasis on the region of the Isoscalar Giant Quadrupole Resonance (ISGQR), in nuclei across stable even-even neodymium isotopes has been performed. Measurements were made using the K600 magnetic spectrometer of iThemba LABS, Cape Town, South Africa. Unique high energy-resolution inelastic proton scattering data were obtained at an incident proton energy of Ep = 200 MeV on targets 142,144,146,148,150Nd. Nuclei with mass number A ≈ 150 and neutron number N ≈ 90 are of special interest since they occupy that region of the nuclide chart wherein the onset of permanent prolate deformation occurs. Background subtraction using the Discrete Wavelet Transform (DWT) technique greatly enhances the ISGQR. After extraction of resonance widths, results show a systematic broadening of the ISGQR from spherical to highly deformed nuclei which is attributed to K-splitting of the ISGQR following the comparison with Skyrme separable RPA strength functions for isoscalar B(E2) and the use of the Continuous Wavelet Transform (CWT) technique.

392 - The contribution of photons from the circumstellar disc to gamma-gamma absorption in PSR B1259-63

Astrophysics (1) - Friday 08 July 2016 10:00

Primary author: VAN SOELEN, Brian *(University of the Free State)*
Co-author: *SUSHCH, Iurii (North-West University)*

The gamma-ray binary system PSR B1259-63, consists of a Be star and a pulsar, and is one of only a few know systems where their spectral energy distribution peaks in the gamma-ray regime. It is also the only gamma-ray binary where the nature of the compact object is known. Near periastron, the pulsar pass through the circumstellar disc that surrounds the Be star companion. Observations around periastron show a local minimum in the TeV gamma-ray flux at periastron, when the seed photon energy density, and hence the inverse Compton flux, should be highest. This may be explained through gamma-gamma absorption. Here we show that the contribution of the photons from the circumstellar disc surrounding the Be star significantly modifies the gamma-gamma absorption and may be sufficient to explain the very high energy light curve.

394 - PIRANA, an all optical time-domain ptychographic pulse characterisation method

Photonics - Tuesday 05 July 2016 14:40
Primary author: *SPANGENBERG, Dirk-Mathys (University of Stellenbosch)*
Co-authors: *ROHWER, Erich (University of Stellenbosch); FEURER, Thomas (Institute of Applied Physics, University of Bern); BRUEGMANN, Michael (Institute of Applied Physics, University of Bern)*

Pulse characterization of ultrashort laser pulses cannot be done directly as no detector is fast enough. Various methods utilising nonlinear second harmonic and sum frequency generation have been developed since such as FROG, SPIDER, MIIPS etc. We migrated an iterative spatial lens-less imageing technique, ptychography, to the time domain and modified the reconstruction algorithm such that it can be used to do pulse characterisation. The proof of principle experiment was done with a dynamic optical setup which uses spatial light modulators (SLM) in order to generate arbitrary pulse shapes which is then measured with the adapted time-domain ptychography method. Recently we have developed an optical setup which can do the time-domain ptychographic pulse characterisation methods which does not require the use of an SLM called PIRANA.

395 - A study into the rate of photo-bleaching undergone by radiation damaged plastic scintillators

Division for Physics of Condensed Matter and Materials (1) - Wednesday 06 July 2016 14:20 *[For award: MSc]*
Primary author: *JIVAN, Harshna (University of the Witwatersrand)*
Co-authors: *MELLADO, Bruce (University of the Witwatersrand); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); ERASMUS, Rudolph (University of the Witwatersrand); MADHUKU, Morgan (iThemba LABS)*

Plastic scintillators play an important role in the field of detector physics due to their ability to undergo luminescence when interacting with ionising radiation. They typically consist of a polymer base containing an aromatic ring structure as well as small concentrations of fluorescent dopants. The π-electrons from the aromatic structure give rise to the primary scintillation mechanism, whilst the added fluors boost the eventual light yield as well as shift the wavelength of the emitted light. Upon excitation by energetic UV light (< 250 nm) in air, the scintillation mechanism can be stimulated with the fluorescent medium being subjected to the effect of photo-bleaching. Photo-bleaching leads to the chemical alteration of fluors, and renders them unable to fluoresce, thereby reducing the light yield of the scintillators. In this study, we investigate the rate of photo-bleaching for several plastic scintillators using an excitation laser of 229 nm. We further investigate the effect on the photo-bleaching rate for samples which have been subjected to proton induced radiation damage. The study will contribute to a comparative to be used by the Tile Calorimeter of the ATLAS detector where scintillators employed in the GAP region will be replaced in 2018.

397 - The SCC-DFTB study of H_2O interaction with TiO_2 supported Pd catalyst

Division for Physics of Condensed Matter and Materials (1) - Tuesday 05 July 2016 15:20 *[For award: PhD]*
Primary author: *CHUMA, Moyahabo Hellen (University of Limpopo)*

The supported metal nanoparticles are of great importance in many industrial catalytic processes, such as oxidation of methane, carbon monoxide and formic acid. In particular, the platinum group metals (PGM) such as Pd, Pt and Rh supported on metal oxides are being considered. Palladium is often used as a catalyst for many processes in emissions control technologies. This is due to its potential of becoming a novel catalyst for low temperature methane combustion. During the methane oxidation, H_2O is produced and it is important to understand the behaviour of this molecule as it gets in contact with catalyst. The interaction of H_2O molecules with Pd nanoclusters and TiO_2 supported Pd nanoclusters were investigated using the self-consistent-charge density functional tight binding (SCC-DFTB) approach as implemented within the DFTB+ code [5]. Firstly, the interaction of H_2O molecule with Pd_{13} nanocluster was investigated. The results show that when H_2O interact with Pd nanoclusters, it dissociate into OH and H forming a Pd – O bond length of 1.992 Å and Pd – H bond length of 1.571 Å, respectively. Secondly, the interaction H_2O with TiO_2(101) supported Pd_{13} on various adsorption sites preferred the bridge adsorption site, however no dissociation was observed. This gave an average bond length of 1.979 Å with adsorption energy of -1.887 eV.Lastly, molecular dynamics (MD) calculations were performed on the most preferred orientation of H_2O adsorbed on TiO_2(101) supported Pd_{13} system. It was obtained that the H_2O molecule dissociates into OH and H at about 598 K.

398 - Characterization of elastic constants and electronic property of diamond-like carbon films.

Division for Physics of Condensed Matter and Materials (1) - Wednesday 06 July 2016 11:10 *[For award: phD]*
Primary author: *MBIOMBI, wilfred (wits university)*
Co-authors: *BHEKUMUSA, mathe (wits); WAMWANGI, daniel (wits); BILLING, dave (wits); ERASMUS, Rudolph (wits)*

Diamond like carbon (DLC) coatings continue to attract intensive research interest due to their excellent properties, in this work, the role of the sp3 and sp2 bonds on the electronic and elastic properties of diamond-like carbon(DLC) thin films is investigated. Diamond-like carbon thin films were prepared using a graphite target and CH4/Ar ambient by RF and DC reactive magnetron sputtering. The sputter power was set at 200W while the CH4 flow varied (3.5-25 sccm) at a constant argon flow rate. Raman spectroscopy was used to estimate the sp3/sp2 ratio in DLC films by using laser excitation wavelength of 514 nm. The density, thickness and the surface roughness have been studied X-ray reflectivity (XRR). The X-ray diffraction was used to characterize the crystal structure while the electrical properties were established by Current-Voltage (I-V) characteristics. The elastic constants have been evaluated using Surface Brillouin scattering on diamond-like carbon thin films /(001)Si under diverse conditions of growth.

399 - Long-term cosmic-ray modulation model: A simplified ab initio approach

Space Science - Wednesday 06 July 2016 11:10 *[For award: PhD]*
Primary author: *MOLOTO, KATLEGO (NORTH WEST UNIVERSITY)*

A simplified ab initio approach is followed to model long-term cosmic-ray modulation using a steady-state three-dimensional numerical code. Standard diffusion coefficients based on Quasilinear Theory (QLT) and Nonlinear Guiding Center Theory (NLGC) are used. The spatial dependence of turbulence quantities required as input for the drift- and diffusion coefficients follow from parametric fits to results from a turbulence transport model. The temporal behavior of these quantities is based on the magnetic variance. Effective values are used for the solar wind speed, magnetic field magnitude and tilt angle in the modulation model. Fairly accurate fits for the cosmic-ray spectra for the 1987, 1997 and the 2009 solar minima are obtained

400 - Room temperature CH4 gas sensor based on Au loaded ZnO nanorods: The effect of Au loading concentration on sensing properties.

Division for Physics of Condensed Matter and Materials (1) - Thursday 07 July 2016 09:40 *[For award: MSc]*
Primary author: *SHINGANGE, Katekani (CSIR and UFS)*
Co-authors: *MHLONGO, Gugu (CSIR); MOTAUNG, David (CSIR); NTWAEABORWA, Martin (UFS)*

This study reports on the synthesis of ZnO and Au loaded ZnO nanostructures through the microwave-assisted hydrothermal method. X-ray diffraction (XRD), Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM) were used to confirm the presence of the Au nanoparticles on the surface of the ZnO nanostructures. The effect of Au loading concentration on the sensing performance of the ZnO nanostructures to different concentrations of methane (CH_4) at room temperature was also studied.

401 - Supercontinuum characterisation and compression

Photonics - Tuesday 05 July 2016 15:00 *[For award: MSc]*
Primary author: *VILJOEN, Ruan (Stellenbosch University)*
Co-authors: *SPANGENBERG, Dirk-Mathys (University of Stellenbosch); NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); ROHWER, Erich (University of Stellenbosch)*

Working towards non-linear microscopy we set out to build a dynamic pulse compressor that produce the ultra short laser pulses needed for such experiments. Increasing the bandwidth from an already transform limited laser oscillator is essential in creating shorter pulses. This is done by implementing an all-normal dispersion photonic crystal fibre (PCF) pumped by an fs oscillator to produce white light (supercontinuum). Dispersion from the PCF lengthens the pulses in time, which in turn needs to be compensated for to create near transform limited pulses. A 4f-shaper in combination with a 1D Spatial Light Modulator (SLM) is used to characterise the pulses as well as correct for dispersion, and in doing so compress the pulse. This presentation will focus on the optimisation algorithm investigated to compensate for the dispersion of the supercontinuum pulses. The algorithm yields the phase and amplitude of the compressed pulse. This is compared to other pulse characterisation techniques. The characteristics of the successfully compressed pulses will be presented and the potential application of these pulses in non-linear microscopy will be discussed.

402 - Measurements of Atmospheric Carbon Dioxide in South Africa

Applied Physics (1) - Friday 08 July 2016 10:00
Primary author: *MUDAU, Azwitamisi (Natural Resources and the Environment)*
Co-authors: *FEIG, Gregor (Council for Scientific and Industrial Research); LABUSCHAGNE, Casper (South African Weather Services)*

It has become essential to accurately measure the emission and uptake of atmospheric carbon dioxide (CO_2) around the globe. Atmospheric CO_2 plays a central role in the Earth's atmospheric, ocean and terrestrial systems and it has been recognized as the greatest contributor to the anthropogenic greenhouse gas effect. Monitoring of atmospheric CO_2 and other greenhouse gases has been identified as a priority by international agencies and governments departments that are interested in mitigating the effects of climate change. The Global Change and Ecosystem Dynamics research group of the Global Change competency area at the Council for Scientific and Industrial Research unit of Natural Resources and the Environment has been engaged in terrestrial carbon cycle research for over a decade. The group has also invested heavily in developing and adopting skills to monitor the concentration of atmospheric CO_2 using the traditional technique, notably the non-dispersive infrared spectroscopy (NDIR) analyzers and emerging laser based technique (Wavelength-scanned cavity ring-down spectroscopy (WS-CRDS) Analysers). This paper will report on the ambient concentrations of atmospheric CO_2 measured over three geographically different regions within South Africa, using the traditional technique at Skukuza and Malopeni flux towers in the Kruger National Park, and laser based technique employed at Elandsfontein and Lephalale within the Highveld and Waterberg air quality priority areas in the interior of South Africa and at the coastal site of Cape Point.

404 - Galaxy Dynamics and Star Formation in the Inner Regions of SINGG Galaxies.

Astrophysics (1) - Tuesday 05 July 2016 14:40 *[For award: PhD]*
Primary author: *MOGOTSI, Moses (UCT)*
Co-author: *CARIGNAN, Claude (University of Cape Town)*

SINGG-SINGG is an H-alpha, R-band and UV survey of HI-selected star forming galaxies from HIPASS. A spectroscopic survey of a subsample of the SINGG galaxies was performed using the WIYN SparsePAK integral field spectrograph in order to study the link between galaxy dynamics and star formation over a wide range of HI masses, metallicities and star formation rates. I reduced and analyzed the WIYN SparsePAK data and produced velocity fields and rotation curves. WISE near-infrared and mid-infrared observations of these galaxies were used in combination with the optical observations to characterize the star formation and stellar properties of the galaxies. We developed and expanded star formation models that incorporate the kinematics of galaxies in order to predict their star formation surface densities. The data and observations were used to determine the star formation rates and kinematic properties of the inner regions of the galaxies in our sample. These were used to test the star formation models and models of the gravitational potential wells in the inner parts of galaxies.

405 - Effect of Hydrochloric Acid on the Structure, Defect States and Gas Sensing Properties of TiO_2 Nanotubes by Hydrothermal Method

Division for Physics of Condensed Matter and Materials (1) - Thursday 07 July 2016 10:00 *[For award: MSc]*
Primary author: *TSHABALALA, Zamaswazi (CSIR and UFS)*
Co-authors: *MOTAUNG, David (CSIR); MHLONGO, Gugu (CSIR/UFS); NTWAEABORWA, Martin (UFS)*

We report on the enhanced gas sensing properties of TiO_2 nanotubes synthesized following a microwave assisted hydrothermal method followed by washing with various concentrations of Hydrochloric acid (HCl) and distilled water (DW). The Scanning electron microscope displayed a change in morphology from nanoparticles to nanotubes after hydrothermal treatment. The nanotubes washed with DW only displayed narrow nanotubes with diameter approximately 13.92 nm. Samples washed with 0.25 and 0.5 M of HCl have diameters approximately 15.08 and 17.09 nm respectively. Introducing 1.0 M HCl more nanotubes were formed with average diameter approximately 22.27 nm. The structural analyses displayed a mixture of anatase and rutile phase with anatase dominating. Moreover, an increase in crystallinity and growth in diameter of the nanotubes is observed at higher HCl concentration. The Photoluminescence (PL) and the Electron paramagnetic resonance (EPR) analysis showed high concentration of oxygen vacancies (V_o) which have a high contribution on the gas sensing. The gas sensing properties such response, sensitivity and selectivity were carried out towards CH_4, H_2, NH_3, CO and NO_2 gas at different temperatures. The enhanced sensitivity of the TiO_2 nanotubes was attributed to the high surface area provided by the one dimensional nanotubes since they behave as nanochannels for gas diffusion.

410 - The study of organic photovoltaics with Illumination intensity

Applied Physics (1) - Wednesday 06 July 2016 15:00
Primary author: *RANGANATHAN, Kamalakannan (University of the Witwatersrand)*
Co-authors: *WAMWANGI, Daniel (wits university); COVILLE, Neil (University of the Witwatersrand); MATSOSO, Boitumelo (University of the Witwatersrand); MUTUMA, Bridget (University of the Witwatersrand)*

Photon harvesting in an organic photovoltaic (OPV) solar cells is a promising technology for future energy requirements [1]. The daily current and voltage outputs of a solar cell highly depend on the solar light intensity. The present study focuses on the illumination intensity dependent device characteristics to evaluate the OPV and understand the physics attributed to performance. The illumination intensities were controlled by neutral density filters with 1.7%, 5.4%, 15%, 30%, 100% (1 sun) of illuminated intensity. An OPV with ITO/ PEDOT:PSS/PCBM:P3HT/Al architecture has been used as a reference device to evaluate the open circuit voltage (Voc) and short circuit current characteristics (Jsc) [2]. The J-V characteristics show an exponential and linear increase in Voc and Jsc with illumination intensity, respectively. It is found that, all illuminated J-V characteristic curves intersect with the dark current at a single point which correlates with the built in voltage Vbi [2]. These characteristic parameters were compared with the modified hole transport layer (HTL) device ITO/Ag-GO-PEDOT:PSS/PCBM:P3HT/Al. The Ag/ GO modified PEDOT:PSS serves as an efficient hole extraction layer to improve photo conversion efficiency (PCE) by 126%. The characteristic parameters were compared and the enhancement in solar cell performance is discussed with supporting results from UV-Vis, Raman, TEM and cyclic voltammetry.

411 - Probing quark gluon plasma in pA collisions

Theoretical and Computational Physics (1) - Wednesday 06 July 2016 10:20 *[For award: MSc]*
Primary author: *ADAMIAK, Daniel (University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

We present novel predictions for the suppression of high momentum particles in high multiplicity proton-nucleus (pA) collisions at LHC. Shocking recent data from LHC demonstrates that high multiplicity pA collisions show signatures of the formation of a quark-gluon plasma (QGP), thought previously to only result from nucleus-nucleus collisions. Our work provides a new test of this QGP creation hypothesis.We generate our predictions by first computing the initial spectrum of high momentum quarks and gluons using leading order (LO) perturbative quantum chromodynamics (pQCD). These LO pQCD predictions use both the usual parton distribution functions (PDFs) and nuclear PDFs, which encapsulate the modifications of the usual PDFs by the presence of multiple nucleons in a nucleus. We find that our results consistently describe the p\bar{p} data at Fermilab, across multiple orders of magnitude in centre of mass energy \sqrt{s}, and over many orders of magnitude in transverse momentum. Next we implement state-of-the-art LO pQCD energy loss including radiative and collisional modes through a dynamical QGP medium. Finally, the particles are fragmented into hadrons and compared to the spectrum of high momentum particles in minimum bias pp collisions for future comparison with experimental data.

412 - Residual stress measurements in leached polycrystalline diamond using X-ray diffraction and Raman spectroscopy techniques

Applied Physics (1) - Wednesday 06 July 2016 10:00 *[For award: PhD]*
Primary author: *VHARETA, Maxwell (DST/NRF Centre of Excellence in Strong Materials, University of the Witwatersrand)*
Co-authors: *ERASMUS, Rudolph (University of the Witwatersrand); COMINS, Darrell (University of the Witwatersrand)*

It is widely believed that the presence of cobalt in polycrystalline diamond compacts (PCD) makes them have limited heat resistance and causes graphitisation. The cobalt binder also influences the residual stresses in the PCD compacts and therefore the removal of the cobalt certainly alters the residual stresses present especially on the surface. A systematic investigation and evaluation of the average in-plane residual stress fields on the surface of a number of leached PCD tool bits was conducted using two complementary non-destructive techniques namely; X-ray diffraction and Raman spectroscopy. The Raman peak reveals both the nature and magnitude of the stress present in the material but it is essentially a surface technique with the depth penetration of the visible light being limited by the transparency of the PCD to only a few microns. The X-ray Diffraction technique probes the change in the spacing of the atomic planes of the diamond crystals with strain and has a larger penetration depth. Fatigue measurements were conducted under constant amplitude loading at a frequency of 4 Hz. The 514.5 nm line of the Ar+ ion laser was used as an excitation source and measured results from both the X-ray diffraction and the Raman techniques two are quite comparable with average compressive residual stresses in the range of 220 to 450 MPa being observed.

413 - CODE-RADE - Community Infrastructure for the Delivery of Physics Applications

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 10:20
Primary authors: *MURRAY, Sean (CHPC/UCT); BECKER, Bruce (Meraka Institute)*

Since the very first translation of a mathematical express into executable code, the process of porting applications to computational resources has been at the core of scientific computing. Of the thousands of scholarly communications published every year, at the heart of the majority of them is the analysis of some data, the simulation of a physical, chemical, biological or other process and the interpretation thereof. Scientific computing can therefore in some sense be distilled to the execution of an application - or rather sets of applications which are combined into complex workflows. Due to the complexity and number both of scientific packages as well as computing platforms, delivering these applications to end users has always been a significant challenge through the grid era, and remains so in the cloud era.In this contribution we describe a platform for user-driven, continuous integration and delivery of research applications in a distributed environment - project CODE-RADE. Starting with 6 hypotheses describing the problem at hand, we put forward technical and social solutions to these. Combining widely-used and thoroughly-tested tools, we show how it is possible to manage the dependencies and configurations of a wide range of scientific applications, in an almost fully-automated way.The CODE-RADE platform is a means for developing trust between public computing and data infrastructures on the one hand and various developer and scientific communities on the other hand. Predefined integration tests are specified for any new application, allowing the system to be user-driven. This greatly accelerates time-to-production for scientific applications, while reducing the workload for administrators of HPC, grid and cloud installations.Finally, we will give some insight into how this platform could be extended to address issues of reproducibility and collaboration in scientific research in Africa.

415 - Photobiomodulation of Isolated Lung Cancer Stem cells

Photonics - Wednesday 06 July 2016 11:30 *[For award: MSc]*
Primary author: CROUS, Anine *(Student at University of Johannesburg)*
Co-author: *ABRAHAMSE, Heidi (Director: Laser Research Center University of Johannesburg)*

Background: Research has uncovered that one of the plausible reasons for cancer relapse is the existence of stem like cells, possessing cancer properties, called cancer stem cells (CSCs). Cancer research is highly focused on improving current cancer treatments. One method of targeted cancer therapy is Photodynamic therapy (PDT), where Low Intensity Laser Irradiation (LILI), along with a photochemical compound, is used. When implementing a mechanism by which CSCs are targeted, LILI might pose as a viable treatment option. Studies have shown that using high fluences of LILI (HF-LILI) can induce cell death in normal and neoplastic cells. Further investigations on cell death induced by HF-LILI of CSCs still needs to be explored. Methodology: Lung CSCs were isolated using the stem cell marker CD 133 and were exposed to LILI at wavelengths of 636, 825 and 1060 nm at fluences ranging from 5 J/cm2 to 40 J/cm2. Post irradiation biochemical assays were conducted to monitor cellular responses including; proliferation and cytotoxicity, after 24 hours incubation. Discussion: Studies have indicated that LILI, when treating lung CSCs, can induce either a bio-stimulatory or bio-inhibitory effect depending on the wavelength and fluence used. This study indicated successful cell damage of lung CSCs when using HF-LILI, as well as, stimulation of ATP production, when using lower fluences of LILI.

416 - The hierarchal decision making algorithm as an analytical tool for a natural understanding physical systems

Theoretical and Computational Physics (1) - Friday 08 July 2016 14:00
Primary author: AGWA-EJON, JOHN FRANCIS *(UNIVERSITY OF JOHANISBURG)*
Co-authors: *MULABA-BAFUBIANDI, Antoine (University of Johannesburg); PRETORIUS, Jan-Harm (University of Johannesburg)*

New technologies coupled with good innovative ideas are being developed at a very fast rate and as a result the world has become very dynamic with more complex decision problems to solve. These decisions often involve complex relationships and interactions among the decision elements. To assist decision makers and analysts, fundamental questions are asked in order to explain the existing phenomena. The suitable method used to decompose these problems in hierarchal levels and formulate hierarchal decisions was developed by Saaty in the late 1980. The AHP is a mathematical decision making tool for solving very complicated process planning decisions problems by decomposition, determination and synthesis.This paper explores comprehensive algorithm of the Analytical Hierarchy Process (AHP) basic concept which uses different pairwise comparisons scales and judgement quantification techniques based on expert opinion to develop a decision model. The paper brings about a better understanding to the academic paternity, business community and complex decision makers in the public sector.Keywords: Hierarchical decision, Physical Systems, Algorithms, Physics, Decision Models

417 - CHPC WLCG Tier2 status, plans and user analysis.

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 09:40
Primary authors: MURRAY, Sean *(CHPC/UCT); BECKER, Bruce (Meraka Institute)*

The Worldwide LHC Computing Grid (WLCG) provides computing resources to the four experiments at CERN's Large Hadron Collider (LHC). The Centre for High Performance Computing is the only South African Tier-2 centre in the WLCG.The site currently supplies resources for ALICE and ATLAS in the form of computing, storage and network bandwidth. An additional ALICE site, sited at iThemba LABS is used as a local analysis facility and as a test facility for ALICE online computing software. We will show the current site configuration and performance specifications, plans for the coming year to speed up the work of local South African users and the required deliverables as a Tier-2 centre for the WLCG.

419 - Crystals Orientation Measurements of the iThemba LABS Segmented Clover Detector.

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 11:50 *[For award: Hons]*
Primary authors: *DINOKO, Tshepo (iThemba Labs);* MTHEMBU, Sinegugu Happiness *(iThemba LABS); LAWRIE, Elena (iThemba LABS); BUCHER, Thifhelimbilu Daphney (iThemba LABS)*
Co-authors: *EASTON, Jayson (iThemba LABS and University of the Western Cape); NONCOLELA, Sive (UWC); SHIRINDA, OBED (iThemba LABS); ERASMUS, Nicholas (University of the Western Cape)*

The iThemba LABS segmented clover detector has four n-type hyper-pure germanium crystals, crystals A, B, C, and D, placed in a single cryostat [1]. The orientation of the germanium crystals inside the cryostat is investigated by measuring the T30, T60 and T90 rise-times. T30 refers to the time needed for the pulse to rise from 10% to 30% of its maximum amplitude [2]. The measurements were performed with a collimated 22Na source, where the axis of the collimator is perpendicular to the front face of the detector cryostat. The rise-times were measured using the traces of events corresponding to the full energy deposition of the 511 keV gamma-rays. We observe an evidence for the presence of a symmetry of the T30, T60, and T90 rise-times with respect to the diagonal of the detector. In addition our measurements have indicated the precise position of the core in crystal A. This presentation will show the analysis of the data obtained in crystal A and discuss the results.

421 - The interaction of high power cw laser beams with weakly absorbing optical elements

Photonics - Tuesday 05 July 2016 11:10
Primary author: RAMOKOLO, Rocky *(CSIR, National Laser Centre)*
Co-authors: *PREUSSLER, DIETER (CSIR/NLC); SINGH, Ann (CSIR,National Laser Centre); STRAUSS, Hencharl (CSIR (National Laser Centre))*

Laser Damage Threshold (LDT) data for Q-Switch lasers are readily available, whereas data on continuous wave (cw) and quasi-cw LDT are not. The LDT affects the choice of optics with regard to the material and the coatings which directly affect cost. In addition, even modest thermal lensing is also problematic since it causes a focus shift which dramatically changes the operating parameters of laser material processing applications. This paper will discuss investigations of determining LDT of high power cw laser systems as well as the effect of thermal lensing on optics and the interacting beam parameters.We have tested a number of optics specifically designed for high power lasers. The simplest test involved exposing the optics to different power densities and inspecting them for damage. We were thus able to measure LDT for different optics in both a clean room environment and in an operational dusty environment. The thermal lens experiments were done in an industrial environment, and in this case dust and metal vapour played an important role in contaminations of optics. In the thermal lens experiments, each optical element was tested individually with power levels starting at 500 W to 5 kW using a high power cw laser. The materials tested were various types of Fused Silica as well as Sapphire. The results quantify the thermal lensing of high-power laser radiation with weakly absorbing optical elements and indicates that certain optics were damaged at much lower LDT values than specified by their manufacturers. In addition it was found that even minute coating contamination leads to increased coating absorption which drastically increases thermal lensing and eventually causes laser damage.

422 - Spark Plasma Sintering of 2507 duplex stainless steel

Applied Physics (1) - Friday 08 July 2016 14:40
Primary author: SULE, Richard *(University of the Witwatersrand)*
Co-authors: *OLUBAMBI, Peter (University of Johannesburg); SIGALAS, Iakovos (University of the Witwatersrand); ASANTE, Joseph (Tshwane University of Technology)*

As technological development is advancing towards the use of powder metallurgical (P/M) processed stainless steels for automotive and structural applications, 2507 duplex stainless steel have gained considerable scientific attention and technological interest due to potential benefit associated with their unique properties such as corrosion and oxidation resistance and good formability. However, application of this material is hindered by its low mechanical strength and poor anti-friction properties resulting from the elongated porosity which acts as stress concentration sites that could lead to premature and brittle failure at a relatively lower load. These drawbacks can be improved using appropriate technology. Effort was made in this study to reinforce 2507 stainless steel with TiC particles and consolidate with spark plasma sintering (SPS). A relative density of 99.7% and Vickers hardness of 289.7 HV was obtained for 2507 DSS sintered at 1000 oC. The hardness value of 2507 stainless steel containing 10 vol%TiC was found to be 296.03 HV. The microstructure of the material produced was investigated using SEM.

424 - Coulomb excitation reorientation effect of the first 2^+ state at 4.439 MeV in ^{12}C

Nuclear, Particle and Radiation Physics (1) - Tuesday 05 July 2016 11:30
Primary author: MUKHI, Kumar Raju *(University of the Western Cape)*
Co-authors: *ORCE, Nico (University of the Western Cape); UWC AND TRIUMF COLLOBORATION, , (University of the Western Cape & TRIUMF, Canada)*

The reorientation effect (RE) plays a major role in Coulomb excitation theory as it facilitates information about the shape and degrees of quadrupole collectivity of even-even nuclei via measuring the diagonal matrix element $<2_1^+||E2||2_1^+>$ of the first 2^+ state. This in turn proportional to the spectroscopic quadrupole moment $[Q_S(2_1^+)]$ which provides direct information about the shape with its sign precisely. A safe Coulomb excitation reorientation effect measurement was performed at TRIUMF accelerator facility to determine the sign and magnitude of $Q_S(2_1^+)$ in ^{12}C. The first 2^+ state at 4439 keV in ^{12}C was Coulomb excited through inelastic scattering of ^{12}C beam at ~ 4.97 MeV/u energy impinging on a 1 mg/cm^2 thick ^{194}Pt target. The de-excited γ-rays were detected with highly-efficient and segmented TIGRESS clover detector array and the scattered particles were detected in coincidence with γ-rays using annular double sided silicon CD type detector (S2) which contains 24 rings and 32 sectors. The data have been analysed employing particle-γ coincidence, energy sharing and timing conditions. The Doppler corrected sum γ-ray spectrum shows the evidence for 4439 keV in ^{12}C. The experimental results and the details about determination of $Q_S(2_1^+)$ will be presented during conference.

ORAL ABSTRACTS

427 - Studying the Star formation - Neutral gas relation in WHISP Galaxies

Astrophysics (1) - Tuesday 05 July 2016 11:50 *[For award: PhD]*
Primary author: NALUMINSA, Elizabeth *(University of Cape Town)*

I present a study of the Kennicutt-Schmidt (KS) relation for star formation and neutral hydrogen gas (HI) in a sample of galaxies drawn from the Westerbok HI Survey of Spiral and Irregular galaxies (WHISP). 21cm HI data were used to derive the neutral gas properties while WISE (Wide-field Infrared Survey Explorer) infrared data were used to derive the star formation properties, hence availing us with two uniform data sets. The SFR was found to be tightly correlated with the HI mass with a logarithmic slope of 1.51 which compares favourably to a slope of 1.5 from a similar study of ALFALFA dwarf galaxies by Huang et al (2012). On investigating the surface densities, we find that the atomic gas density does not trace the SFR density probably due to the fact that despite spanning 5 orders of magnitude in HI mass, our sample spans ~ 1 order of magnitude in gas density, a range too narrow for a conclusive argument on the relation. However, this range falls in the region between 3 – 10Mpc–2 (0.5-1 in log space), where Bigiel et al (2008) also found no correlation between SFR and gas densities, but rather found a steep change in the star formation efficiency from lower (HI-dominated ISM) to higher (H2-dominated ISM) gas densities with a saturation point for atomic gas density at 9Mpc–2 , in line with the findings of Wong and Blitz(2002).Our results thus confirm results from earlier studies that much as the rate of star formation is a function of the mass of neutral atomic hydrogen in a galaxy, the surface density of the HI is not a good tracer of the star formation rate.

430 - Tests that promote physics learning

Physics Education - Friday 08 July 2016 10:00
Primary author: HERBERT, Mark *(University of the Western Cape)*

This paper reports on work that has been done in the Physics Department at University of the Western Cape (UWC). The mainstream mechanics physics first year module centers its focus on improving students' success by giving them epistemological access to the study of the physics. Central to the module teaching philosophy and pedagogy is the socio-cultural perspectives on learning in the sciences. This has guided the development of our intervention strategies to direct students' learning toward gaining access to the ways of knowing of the discipline. Such perspectives suggest that an exclusively individual or cognitivist approach may need to be complemented by those that recognize the social contexts in which science learning takes place, and which place a greater emphasis on learning as participation and identity development. This paper reports on the two-stage tests used to promote physics learning. The two-stage exam is a way to engage students' to participate and reflect on their learning by providing immediate formative and summative assessment of their learning. An overview of the mainstream mechanics physics first year module teaching and learning approach as well as the results of a survey of students' experiences of the two-stage test will be presented and discussed.

431 - An overview of the University of the Western Cape Physics Department Physics for teachers' program

Physics Education - Thursday 07 July 2016 09:40
Primary author: HERBERT, Mark *(University of the Western Cape)*

Since the mid-nineties South African schools have been in a state of education reform. At the centre of the reform was the establishment of the comprehensive curriculum project named Curriculum 2005. Deficiencies associated with the Curriculum 2005 resulted in the promulgation of the National Curriculum Statement in 2008. Curriculum reform as required by the National Curriculum Statement for Grade 10-12 physical sciences teachers implied that teachers have a deep understanding of the highly structured content knowledge as well as the pedagogical content knowledge to transform the content for effective teaching. However, every research has indicated that teachers found the curriculum challenging and that they were concerned that they did not have the necessary skills to deal with the content. The South African Institute of Physics (SAIP) in its draft document "Strategic Plan on the enhancement of Physics Training in South Africa" recommends that Physics Departments at South African Universities play a more active role in teacher training. This paper reports on the University of the Western Cape Physics Department Physics for teachers' program to help address the curriculum challenges teachers face in terms of content and pedagogical content knowledge. An overview of the program as well as teachers' experiences of the program will be presented and discussed.

432 - Optical and electronic properties of silicon nanowires fabricated by Metal Assisted Chemical Ecthing

Division for Physics of Condensed Matter and Materials (1) - Wednesday 06 July 2016 11:30 *[For award: PhD]*
Primary author: KHANYILE, Sfiso *(Author)*
Co-authors: *ARENDSE, Christopher (Supervisor); OLIPHANT, Clive (Co supervisor)*

Silicon nanowires are promising materials for use in low cost solar cell applications due to their high surface area, efficient light trapping and high carrier mobilities. In this paper, we report on the fabrication of silicon nanowires using the metal assisted chemical etching method for different etching durations and the doping of these intrinsic Si NWs with POCl3. Scanning electron microscopy revealed the correlation between the etching time and the morphological properties such as length of the as-grown Si NWs. The Si NWs were found to have diameters ranging from about 80 nm to 200 nm and their lengths ranging from about 1 μm to 4 μm. High resolution transmission electron microscopy investigation showed that the SiNWs had a crystalline core and amorphous silicon oxide shell structure with some Si nanocrystals embedded in it. The doped Si NWs exhibited very strong photoluminescence bands, namely the blue and yellow-orange emission bands which were attributed to the formation of Si nanocrystals embedded in a SiO2 matrix and some structural defects. The UV-Vis specular reflection measurements conducted on the Si NWs displayed enhanced anti-reflective properties with reflection dropping below 2 %. Hall-effect measurements also showed improved conductivity of the doped Si NWs compared to the intrinsic Si NWs.

434 - Magnetic Cataclysmic Variables in the Catalina Real-time Transient Survey

Astrophysics (1) - Thursday 07 July 2016 11:50 *[For award: PhD]*
Primary author: MOTSOALEDI, Mokhine *(South African Astronomical Observatory)*
Co-authors: *WOUDT, Patrick (Department of Astronomy, University of Cape Town); BUCKLEY, David (Southern African Large Telescope); WARNER, Brian (University of Cape Town)*

Cataclysmic variables (CVs) are mass transferring binary stars consisting of a low mass main sequence donor star and an accreting white dwarf star. The presence of a strong magnetic field affects the trajectory of the mass causing it to flow along the magnetic field lines into the magnetic poles of the white dwarf. An intermediate polar has a truncated inner accretion disc whereas the stronger magnetic field of a polar prevents an accretion disc from forming. The Catalina Real-time Transient Survey (CRTS) detects and characterises transients in the Northern and Southern hemispheres. Magnetic CVs were originally discovered from their X-ray properties but with the long nine year observing baseline of the CRTS, it makes it ideal for identifying magnetic CVs from their long-term optical photometric properties. We aim to use the CRTS to study the global population of magnetic CVs in terms of their low-high state duty cycles and also individually selected magnetic CV candidates. These individually selected candidates have been followed up with photometric and spectroscopic observations that were taken with the 1.0/1.9m telescopes and SALT at SAAO in Sutherland.

435 - Application of Ag nanocubes for efficiency enhancement in organic photovoltaic (OPV) devices

Applied Physics (1) - Tuesday 05 July 2016 14:40
Primary author: KOTANE, Lesias *(Wits University)*
Co-authors: *RANGANATHAN, Kamalakannan (University of the Witwatersrand); WAMWANGI, Daniel (wits university); SALOMON, Adi (Bar-Ilan University); LICHTENSTEIN, Elianna (Bar-Ilan University)*

Organic photovoltaics (OPVs) continue to receive intensive interest for the realisation of a cost-effective 'sunlight-to-electricity' energy conversion. Bulk heterojunction (BHJ) structures have underpinned extensive organic photovoltaic (OPV) research aimed at enhancing their power conversion efficiency (PCE). One of the limiting characteristics of a BHJ OPV device is their short exciton diffusion lengths which constrain the optimum thickness of its active layer to 100 nm despite their higher absorption coefficients. Hence light absorption is significantly reduced when the light absorption-charge transport trade-off is considered in the OPV device fabrication process. Metallic nanoparticles (NPs) have exhibited desirable characteristics with regards to the improvement of light absorption due to the localised surface plasmon resonance (LSPR) and charge transport properties. Silver nanocubes of 30 nm length were synthesized by using CF3COOAg, hydrochloric acid and polyvinyl pyrrolidone, the stabilizer, together with sodium hydrosulfide hydrate as a catalyst, in a diethylene glycol solution, for photovoltaic applications. Bulk heterojunction ITO/PEDOT:PSS/ P3HT:PC61BM/Al organic solar cells were fabricated with 10%, 20% and 40% silver nanocubes (AgNCs) incorporated into the hole transport buffer layer, the PEDOT:PSS. Together with the reference cell, the performances of the fabricated AgNCs incorporated devices were assessed. The device performances for AgNC incorporation (10% and 20%), were enhanced; however the device with the highest ratio of AgNCs i.e. 40% showed the poorest power conversion efficiency.

438 - Probing the role of mergers in galaxy evolution with HI profile asymmetries

Astrophysics (1) - Wednesday 06 July 2016 11:10 *[For award: MSc]*
Primary author: *BOK, Jamie (UCT)*
Co-authors: *BLYTH, Sarah (UCT); GILBANK, David (SAAO)*

Fundamental to understanding the Universe is understanding how galaxies (often referred to as the building blocks of the Universe) form and evolve- this makes galaxy evolution a key research area in astronomy. Common to all theories of galaxy evolution is that galaxies form hierarchically through a series of mergers; smaller bodies merge and interact over time to produce the large structures we see today. Key to probing the role of mergers in galaxy evolution is first being able to identify them. Current techniques include using morphological distortions in the stellar (optical) and gas (radio) components of galaxies to trace merger activity. Studies indicate that neutral hydrogen gas (HI) is the more sensitive diagnostic of merger activity, and furthermore that spatial distortions in HI often correspond to asymmetries in the global HI velocity profile. Here we study HI profile asymmetries of nearby galaxies in close pairs (candidate mergers) in order to assess if it is possible to use global HI velocity profile asymmetries to trace merger activity. Aside from their potential to trace merger activity in both the local Universe and towards higher redshifts with upcoming radio surveys, when used in conjunction with optical morphologies HI profile asymmetries might also enable us to identify interactions on different timescales.

440 - Experimental characterization of a metamaterial optical polarizer in the quantum regime.

Photonics - Wednesday 06 July 2016 14:20 *[For award: PhD]*
Primary author: *URIRI, Solomon A. (Center for Quantum Technology, School of Chemistry and Physics, University of KwaZulu-Natal, 4000, Durban, South Africa)*
Co-authors: *TAME, Mark (Center for Quantum Technology, School of Chemistry and Physics, University of KwaZulu-Natal, 4000, Durban, South Africa); TASHIMA, Toshiyuki (Center for Quantum Technology, School of Chemistry and Physics, University of KwaZulu-Natal, 4000, Durban, South Africa)*

Plasmonics is a fast growing field of research that enables ultra-compact devices in on-chip optical circuitry and a new class of optical material called metamaterials. Metamaterials are made from tiny plasmonic structures placed close together at the nanoscale, where the collective behaviour of all the structures gives rise to the bulk response of the material. Metamaterials have opened up many novel ways of controlling light, and in particular, controlling the polarization of light. An important optical component in this respect is the polarizer, which transmits light of one polarization while blocking light of another polarization. In our work, we have experimentally probed and characterized a metamaterial polarizer in the quantum regime. To do this, we prepared a range of different polarization-encoded single-photon statesand sent them through the metamaterial. We then performed quantum state tomography and obtained high fidelity output states (■ 96%), in full agreement with theoretical predictions for an optical polarizer. Our study shows that metamaterialsmay be used for building compact optical components in on-chip quantum photonic systems.

442 - Engineer inflation in realistic string compactifications

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 11:50 *[For award: PhD]*
Primary author: *PONTIGGIA, Luca (University of the Witwatersrand)*

We study slow roll inflation and invoke results from random algebraic geometry to construct a way of generating a variety of inflationary potentials, and then scan through these potentials to identify how many satisfy slow roll conditions. This is essentially done by searching for minimas in a polynomial based potential and then testing the slow-roll conditions. Based on the results of the analysis, we then want to be able to say something about the distribution of polynomials that give rise to inflation, and, if there are certain polynomial potentials (both of single and multifields) which favor slow-roll more than other polynomial potentials. Since we also want to engineer potentials in the context of particular Calabi-Yau compactifications, we need to not only scan for potentials but also infer properties of these compactifications by characterizing them. To do this we investigate the characterization of Calabi-Yau compactifications. This csn be done by characterization of the reflexive polytopes which are used to obtain Calabi-Yau geometries. To do this, we can look at how many Calabi-Yau geometries have a given set of $(h^{1,1}+h^{1,2}, h^{1,1}-h^{1,2})$. The weighting of the number of reflexive polytopes for different values of $h^{1,1}$(number of K\"ahler moduli) and $h^{1,2}$(number of complex moduli) is given by the Kreuzer-Skarke database. It is from this database where we study the distribution of $h^{1,1}$ and $h^{1,2}$. Since it is a very rich database, we propose an initial statistical approach by making use of various data analysis techniques of the distributions of $h^{1,1} + h^{1,2}$ and $h^{1,1} - h^{1,2}$.

443 - Single-photon probing of plasmonic waveguides

Photonics - Wednesday 06 July 2016 14:40
Primary author: *FRANCIS, Jason (UKZN)*
Co-authors: *TASHIMA, Toshiyuki (UKZN); TAME, Mark (UKZN)*

Plasmonics is the study of the interaction of light and conduction electrons at metal-dielectric interfaces. Here, surface plasmon polaritons (SPPs) are hybrid photon-electron excitations that can be confined to subdiffraction scales. This feature affords enhanced coupling of emitter systems (e.g. quantum dots) to SPPs, making them suitable candidates for a wide range of on-chip quantum photonic components – most notably single-photon sources. This potential use of SPPs, along with the nonlinearity provided by emitter systems, opens up quantum plasmonics as a potential realisation of quantum information processing. In this setting, the excitation of single SPPs on waveguides via single photons and the confirmation of single-photon states upon output is an important goal. In our work we experimentally probe plasmonic waveguides consisting of gold stripes with surface-relief diffraction gratings at either end (input and output). Single photons generated via parametric down-conversion were coupled into SPP modes by focusing them onto the input grating using a diffraction-limited microscope. A Hanbury-Brown and Twiss setup is then used with single-photon detectors and counting modules to determine a second order correlation coefficient of $g^{(2)}(0)=0.30 \pm 0.15$ from the output grating signal. A value less than 0.5 is indicative of single-excitation states. Our study serves as a first step in developing the capacity to explore further the quantum properties of single SPPs and their application to quantum information processing.

445 - Analysis of Electric Circuits using MATLAB and Simulink

Physics Education - Friday 08 July 2016 09:40
Primary author: *ERO, Felix (Lead City University)*

Circuit networks are pathways created for electrons to flow, they become convoluted or difficult as some students say, when they are connected to various electrical components; such as resistors, capacitors and inductors. Electric circuit analysis becomes a necessary course for the students of Physics, Computer Electronics and Electrical Engineering. The dropout rate is higher in these courses because students lose interest in just solving problems and analyzing them using textbook examples and simulation software packages. The pre-designed software packages are not helpful in understanding the calculation and analysis of electrical circuit components. This paper discusses the analysis of electric circuit with MATLAB and Simulink Package. Electrical circuit analysis activity demands an interdisciplinary approach which promotes collaborative project-based learning (PBL). During contact sessions in an undergraduate class, the students were given the task to solve problems in an electric circuit. However, the students had difficulty in having a 'sail through' understanding, until MATLAB was incorporated. It was observed that with implementing the problems in MATLAB the students were gaining a better understanding of electric circuit analysis problems and their interest level also increased - which resulted in better retention in the course. The name MATLAB stands for MATrix LABoratory. MATLAB was written originally to provide easy access to matrix software developed by the LINPACK (linear system package) and EISPACK (Eigen system package) projects. MATLAB is computational in nature and provides a conceptual approach for designing and solving problems in electrical circuits. MATLAB has embedded software called SIMULINK which provides an essential way to model, simulate and analyze electrical systems which are characterized by some inputs and outputs. This paper discusses most importantly the various examples carried out using MATLAB in testing the basic electrical circuits for the exploration of basic DC/AC circuit computations. Students' experience improved using MATLAB package and the awareness of usage was invoked.

446 - Heavy quark production at forward rapidity with ALICE at the LHC

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 14:40 *[For award: MSc]*
Primary author: *DINDIKAZI, Nomvelo (University Of Zululand)*
Co-authors: *BUTHELEZI, Zinhle (iThemba LABS); MARCHISONE, Massimiliano (University of the Witwatersrand and iThemba LABS)*

The study of matter under extreme conditions known as the quark gluon plasma (QGP) is key to the understanding of the early universe. QGP is a high density Quantum Chromodynamics (QCD) medium of “free” quarks and gluons (deconfinement), expected to form at high temperature and density where quark and gluon degrees of freedom dominate.At the LHC, ALICE (A Large Ion Collider Experiment) is a general purpose heavy-ion detector with the main physics goal to study the formation and properties of the QGP in heavy-ion collisions. ALICE is also studying proton-proton collisions both as a comparison with heavy-ion collisions and in physics areas where ALICE is competitive with other LHC experiments.Due to large masses heavy quarks (charm and beauty) are formed in the initial stage of the collision via hard scattering processes with short formation time. The study of heavy quark production in proton-proton collisions at LHC energies provides an important test for pQCD calculations and constitutes an essential baseline for the corresponding measurements in heavy ion collisions. Since heavy quarks are produced in the early stages of the collision they interact and lose energy in the QGP medium, therefore, they experience the full evolution of the QGP. Thus they are effective probes of the QGP. In proton-nucleus collisions heavy quarks are used to investigate cold nuclear matter (CNM) effects.In ALICE heavy quarks can be measured at forward rapidity exploiting their muonic decays using the muon spectrometer. In this talk a selection of recent measurements in pp, pPb and PbPb collisions will be shown and compared to various theoretical calculations.

448 - Physical stability of ionic liquid polymers for the recovery of Se and Te from metallurgical aqueous solutions

Applied Physics (1) - Friday 08 July 2016 15:00
Primary author: *ANTOINE F., Mulaba-Bafubiandi (Univesity of Johannesburg)*
Co-author: *MOGOMETSI, Mpho (University of Johannesburg)*

The use of ionic liquid (IL) has currently gained interest in many sectors (food industry, mining and process industry, etc..). The development of an appropriate IL for a specific application requires the knowledge of the physical system involved and of that of the IL's physical properties. Considering that ILs can be subjected to high temperatures and long-time exposures, ILs physical stability is essential when selecting the suitable IL constituting components for the application. Thermal stability of ILS is affected by parameters as length and type of the polymer, cation and anion type, structural modification of the cation for e.g. alkyl length, different functionalities in the alkyl chain and impurities as water or chlorides. Temperature has influence on the liquid state and emission of toxic vapours of ILs, the significant thermal analysis are melting point, the glass transition temperature, the crystallisation temperature and decomposition temperature. This paper discusses the physical stability, using Thermal Gravimetric Analysis, of the trihexyl (tetra) decyl phosphonium chloride based IL as used in the recovery of Se and Te from the base refinery aqueous solutions.

449 - Phenomenology of additional scalar bosons at the LHC

Theoretical and Computational Physics (1) - Friday 08 July 2016 15:00
Primary author: *KUMAR, Mukesh (University of the Witwatersrand)*
Co-authors: *MELLADO, Bruce (University of Wisconsin - Madison); CORNELL, Alan (NITheP); VON BUDDENBROCK, Stefan (University of the Witwatersrand); RUAN, XIFENG (WITS); REED, Robert (University of Witwatersrand); MUKHOPADHYAYA, Biswarup (HRI); CHAKRABARTY, Nabarun (HRI); MANDAL, Tanumoy (Uppsala University); KAR, Deepak (University of Witwatersrand)*

Following arXiv: 1506.00612, an effective field theory approach has been introduced to understand the distortion of the Higgs p_T and other excesses observed in Run I LHC data by considering two hypothetical particles H and χ, with the masses $2 m_h < m_H < 2 m_t$ and $m_\chi < m_h/2$ where m_h is mass of the SM Higgs, h and χ is considered as a dark matter candidate. A fit with the observed p_T spectrum of the Higgs boson at the LHC and a statistical combination of the different relevant processes results $m_H = 272^{+12}_{9}$~GeV with $m_\chi \approx 60$~GeV. In this study we introduce a real scalar S with mass $m_h \lesssim m_S \lesssim m_H - m_h$ in a effective theory to explain large branching ratios of $H \to h\chi\chi$. By introducing an intermediate S further simplifies the coupling structure with comparatively less branching fraction. Further we introduce a two Higgs doublet model (THDM) where we assume the particle spectrum of the THDM, h as the SM Higgs, H as heavy scalar as in the effective theory, A as a CP-odd scalar with $m_A > 2 m_t$ and charged Higgs $H^\pm$ with $m_H^\pm < m_A$. A proper theory with THDM in addition with S and χ as a real scalar assuming χ as a dark matter candidate is formulated to describe associated phenomenology with these particles. An explanation in multi-lepton final states with same-sign leptons expected to be observed in different processes $p p > H > h S$, $h, S \to W^+ W^-$; $p p > H^- t + h.c$ with possible decay of $H^\pm$ and t-quark in leptonic final states. A full analyses associated with these scalars for few benchmark scenarios have been presented in this work.

451 - Modelling of a 2 micron cladding-pumped cw Tm-doped silica fibre laser

Photonics - Friday 08 July 2016 09:40
Primary author: *WU, Lorinda (CSIR-NLC)*
Co-author: *MORRIS, Daniel (University of Pretoria)*

This work reports on the development of a model, using proprietary simulation software, for the design of large mode area diode-cladding-pumped 2μm Tm-doped fibre lasers. Mid-IR fibre lasers have a number of interesting applications from remote sensing, eye-safe LIDAR, non-linear frequency conversion, materials processing, to medical and defence applications.The rate equations are solved using published spectroscopic data for a 3-level Tm^{3+}-ion system hosted in an aluminosilicate glass. The doped fibre is optically pumped with a ~790nm diode source, thereby exploiting the "two-for-one" cross-relaxation (CR) process. Comparison of the simulated results in terms of the pump threshold, output power, slope efficiency and free-running wavelength showed very good agreement with the Tm:silica fibre laser constructed in our laboratory.

452 - Electrical characterisation of defects induced in GaN by electron beam exposure

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 14:40
Primary author: *NGOEPE, Phuti (University of Pretoria)*
Co-authors: *MEYER, Walter (University of Pretoria); DIALE, Mmantsae (University of Pretoria); AURET, Danie (University of Pretoria); OMOTOSO, Ezekiel (University of Pretoria, Pretoria, South Africa)*

Gallium nitride (GaN) is a wide bandgap semiconductor with a bandgap value of 3.4 eV. This semiconductor has been utilised in optoelectronic applications which include the fabrication of both detecting and emitting devices. In studying the properties of semiconductors it is important to understand the role that defects play in the operation of the fabricated devices. These defects can be introduced by different processes including sample growth and various deposition techniques. Electron beam exposure (EBE) is a process by which a sample is exposed to electron beam deposition conditions without the evaporation of the metal onto the sample. In this study, GaN was subjected to this process. The target metal was tungsten as it has a high melting point. The quality of the Ni/Au Schottky contact deposited on the GaN substrate sample was assessed by measuring the current-voltage characteristics. Deep level transient spectroscopy (DLTS) was then used to characterise the electronically active defects in the sample. A defect, which has an activation energy of 0.12 eV and an apparent capture cross section of 8.00×10^{-18} cm^2, was induced by the EBE method.

453 - Low mass supermassive blackholes of quasars and the low frequency radio luminosity correlation.

Astrophysics (1) - Friday 08 July 2016 10:20
Primary author: *MGUDA, Zolile (UCT Dept of Astronomy. UCT Astronomy, Cosmology and Gravity Center.)*
Co-authors: *VAN DER HEYDEN, Kurt (UCT); FINE, Stephen (University of the Western Cape)*

The low frequency (151 MHz) radio luminosity of moderate to high redshift AGNs has been found to correlate with the supermassive blackhole (SMBH) mass. This correlation if found to be weak at 5GHz and is not seen in 1.4GHz All Sky Surveys. The 151 MHz correlation has a small number of AGNs whose blackhole masses are limited to between about 10^(8.5) and 10^(9.5) Solar masses. To investigate if this correlation holds at lower blackhole masses, we use quasars from the Seventh Cambridge Redshift Survey catalogue, whose blackhole masses are as low as 10^(6.5) Solar masses.We find that the two samples overlap for SMBH masses of ~10^9 but for lower mass blackholes they diverge. This may suggest that the slope of the correlation for quasars is not as steep as the slope for AGNs. Alternatively, it may suggest that the correlation between SMBH mass and Radio luminosity at 151 MHz is as weak as it is at 5GHz and the apparent strength of the correlation is due to the luminosity bias of the SMBH at optical frequencies in the surveys that were used.

455 - Sustained pairing frees dipolar traits and the circular current's own magnetic dipolar nature

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 15:00
Primary author: *CHIRWA, Max (Walter Sisulu University)*

The traits and nature of a circular current as a magnetic dipole are traditionally not well formulated. This is partly due to an unfit notion or analogy of what a magnetic dipole moment should be. It is also due to duplicity in cheaply mono-deriving the circular current's approximate distant magnetic vector potential and field, initially in a fixed symmetry plane, and then likening them to those of the simple electric dipole. These unwittingly degrade or put aside various vanishing and/or origin-free physical quantities, or groups thereof, that truly distinguish a dipole from any other physical structure. Here we demonstrate how to redeem these by sustained pairing entities that constitute a dipole at every turn of the description. It is shown that a circular current has its own dipole nature, different from that of an electric dipole, and with a magnetic dipole moment twice the traditional value.

456 - ALICE MUON software upgrade for RUN3

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 15:00 *[For award: PhD]*
Primary author: *MURRAY, Sean (CHPC/UCT)*
Co-author: *CLEYMANS, Jean (University of Cape Town)*

The ALICE Detector at CERN's Large Hadron Collider (LHC) will undergo a major upgrade during Long shutdown 2 in 2019/20 in preparation for increased data rates during Run 3 of more than 1 TB/s for Pb-Pb interaction rates of 50 kHz. Several detectors, including the muon arm, will be upgraded to continuous readout. As part of the upgrade, the offline and online software will be merged into a single framework, running on a substantial computing farm at the site of the ALICE Experiment.We will discuss the upgrade of the software for the muon arm, specifically the cluster finder for the muon chambers, the mechanisms to run it in the new online-offline framework, and the strategy to achieve the desired performance increase compared to the current offline muon software.

457 - Lattice thermal conductivity properties of three binary type- I Sn clathrates from Density Functional Theory

Theoretical and Computational Physics (1) - Tuesday 05 July 2016 14:00 *[For award: PhD]*
Primary author: EGBELE, Peter *(University of Witwatersrand, Johannesburg)*
Co-author: *JOUBERT, Daniel (University of Witwatersrand, Johannesburg)*

A low thermal conductivity material is a good choice for a thermoelement provided the power factor is not affected adversely. In this study, the suppression of thermal conductivity, using the high temperature phase in the three binary type-I Sn clathrates , Cs8Sn44, K8Sn44 and Rb8Sn44 was studied using Density Functional Theory in the Local Densityapproximation. Analysis of the projected density of state suggests a decoupled oscillations of the guest atoms which is believed to scatter the acoustic phonons and hence reduce the lattice thermal conductivity [1]. Using ab initio molecular dynamics phonon calculations, an indication of any anharmonicity was investigated. Our result is confirmed by a detailed analysis of the lattice vibrations and the role the guest atoms play in reducing the lattice thermal conductivity from similar studies using Raman spectroscopy and inelastic neutron scatteri ng [2].[1] Voneshen, D. J., Refson, K., Borissenko, E., Krisch, M., Bosak, A., Piovano, A., ... & Roger, M. (2013). Suppression of thermal conductivity by rattling modes in thermoelectric sodium cobaltate. Nature materials, 12(11), 1028-1032.2] Christensen, Mogens, Fanni Juranyi, and Bo B. Iversen. "The rattler effect in thermoelectric clathrates studied by inelastic neutron scattering." Physica B: Condensed Matter 385 (2006): 505-507.

459 - 3D Radiation-Hydro Models of the Circumstellar Environments of Evolved stars

Astrophysics (1) - Wednesday 06 July 2016 11:50 *[For award: PhD]*
Primary author: AYDI, Elias *(University of Cape Town - South African Astronomical Observatory)*
Co-authors: *WHITELOCK, Patricia (SAAO and UCT); MOHAMED, Shazrene (SAAO)*

This work addresses 3D Radiation-Hydro Models of the Circumstellar Environments of Evolved stars". It consists of modeling Asymptotic Giant Branch (AGB) stars that has one or multiple Jupiter-like companions, aiming to understand the morphology of the circumstellar environment of such systems where the star is a mass losing via stellar wind (AGB). For this purpose, we build 3D models of pulsating AGB stars with one or several companions, and we simulate the evolution of these systems using the Smoothed Particle Hydrodynamic (SPH) method. The radiative equilibrium temperature and optical depths are derived for the atmosphere particles in order to simulate dust formation in the circumstellar environment of the AGB star. Dust formation, as well as shocks in the atmosphere are essential for rapid mass loss, hence we added both mechanism to the simulations. The results of our models can help us to explain the morphology of planetary nebulae as well as it serves as a method for exoplanet detection in planetary systems.

463 - Modelling and measurements of cosmic-ray related muon-fluxes in the Huguenot Tunnel near Paarl (Western Cape, South Africa)

Nuclear, Particle and Radiation Physics (1) - Thursday 07 July 2016 10:20 *[For award: PhD]*
Primary authors: *NEWMAN, Richard Thomas (Stellenbosch University);* DAWAM, Robert Rangmou *(Stellenbosch University)*
Co-authors: *WYNGAARDT, Shaun (Stellenbosch University); PAPKA, Paul (Stellenbosch University)*

A project was initiated to explore the feasibility of establishing a South African underground laboratory in the Huguenot Tunnel (near the town of Paarl, Western Cape, South Africa). It is envisaged that such a laboratory will be used for, amongst others, low-level radioactivity measurements, using for example high-resolution gamma-ray spectrometry. The rationale for performing these measurements underground is that the rock overburden provided by the Du Toitskloof Mountain above the tunnel provides shielding against cosmic-ray related muons, thereby reducing background in the gamma-ray spectra. In order to measure the cosmic muon flux in the Huguenot Tunnel we are preparing to a system comprising six plastic scintillator detectors and a digital signal processing-based data acquisition system.We present test results from measurements with this system at iThemba LABS. We also present results from simulating cosmic muon fluxes in the Huguenot tunnel using the MUSIC (MUon SImulation Code) code. MUSIC is software package used for simulating muon transport through matter. The code takes into account the energy loss of muons due to ionisation, bremsstrahlung, pair production and muon- nucleus inelastic scattering.

464 - Measurements of W-boson production in p-Pb collisions with ALICE at the LHC

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 14:00
Primary author: SENOSI, KGOTLAESELE JOHNSON *(University of Cape Town/iThemba LABS)*

ALICE (A Large Ion Collider Experiment) is designed and optimized to study ultra-relativistic heavy-ion collisions, in which a hot and dense, strongly-interacting medium is created. W bosons are produced in hard scattering processes and interact weakly with the medium formed in heavy-ion collisions. Thus, they are suitable references for processes which are heavily affected by the medium. In proton-nucleus collisions the production of W bosons is used to study the modification of parton distribution functions in the nucleus and to test the validity of binary collision scaling. The latter is investigated by measuring the yield of W bosons in different intervals of event activity. The production of W bosons is studied in p--Pb collisions at a center-of-mass energy of $\sqrt{s}_{NN}$ = 5.02 TeV with the ALICE muon spectrometer at forward ($2.03 < y^{\mu}_{cms} < 3.53$) and backward rapidity ($-4.46 < y^{\mu}_{cms} < -2.96$). The W-boson signal is extracted from the inclusive single muon differential p_T spectrum. Recent results are discussed, and the measured cross sections are compared to perturbative Quantum Chromodynamics calculations at next-to-leading order.

465 - Neutral meson and direct photon measurement with ALICE

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 15:20
Primary author: WHITEHEAD, Andile *(University of Cape Town)*

The verification of the existence of the Quark-Gluon Plasma (QGP) produced in high energy heavy-ion collisions is a procedure requiring the measurement of several complementary observables. Among these observables, is the measurement of direct photons. The direct photon spectrum, at high p_T, is expected to be dominated by prompt photonsproduced by hard initial scatterings in the earliest phases of the collision - describable using the methods of NLO pQCD - and at low p_T by thermal photons produced in thermal scatterings in the QGP and hot hadronic gas phase. Neutral mesons, particularly π^0 and η mesons, are the dominant source of decay photons in pp and Pb-Pb collisions, and their precise measurement is required in order to disentangle the decay and direct photon signals within the inclusive photon spectrum. High-quality measurements in pp collisions are required as a reference for Pb-Pb collisions. The ALICE detector is capable of accurately measuring neutral meson spectra over a large p_T range, via the use of several complementary measuring techniques. The Photon Conversion Method, discussed somewhat in detail in this presentation, uses the ITS and TPC subdetectors and is well suited to performing such measurements over low to intermediate p T . The PHOS and EMCal electromagnetic calorimeters on the other hand, are adept at performing measurements within the intermediate to high p T region. In this presentation, measurements of π^0's and η's obtained from the ALICEexperiment, for pp collisions at several collisional center of mass energies ($\sqrt{s}_{NN}$), from $\sqrt{s}$ = 0.9 TeV to 8 TeV and in Pb-Pb collisions at $\sqrt{s}_{NN}$ = 2.76 TeV, along with direct photon measurements will be presented.

467 - Radiation Shielding Calculation using FLUKA transport code for Radioactive-ion Beams Facility at iThemba LABS.

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 14:20 *[For award: MSc]*
Primary author: MANTENGU, Nkanyiso R. *(University of Zululand /iThemba LABS)*

The Separated Sector Cyclotron (SSC), which is the core and the primary driver of iThemba LABS, got it shared use being overloaded since there is a growing demand for production of radioactive isotopes for nuclear medicine, nuclear physics research, and cancer treatment. This has therefore lead to the need of the facility advancement to relieve the SSC.Therefore, the new Radioactive Ion Beams (RIBs) phase development was then proposed to respond to these demands. The RIBs facility proposal includes a 70 MeV negative ion cyclotron which will be the primary driver of the 5 new proposed Radioisotope production stations and two experimental areas for nuclear physics and material science research.To test the feasibility and the advantages of the overall RIBs project, the RIBs Demonstrator vault (RIBs testing facility) project was also proposed as the first step towards the big development which will include buying new cyclotron accelerator.The RIBs facility will produce the strong sources of ionizing radiation, and the challenging part of the produced ionizing radiation is the neutral/uncharged radiation (neutrons and photons). This kind of radiation doesn't interact electromagnetically, and when this kind of radiation interact, it interacts & ionizes indirectly which makes it not to be easily handled.So this project is aiming to use Monte Carlo simulations to calculate the optimal design, the design that will lower to radiation to recommended levels, for the test facility that will be constructed in year 2017 at iThemba LABS.The ideal computer code to simulate the optimal design with adequate shielding walls thicknesses is FLUktuierende KAscade (FLUKA), which is a fully integrated particle physics Monte Carlo simulation package. FLUKA is able to calculate activation on top of shielding, which makes it the chosen code for this project.

468 - The search for new bosons with the ATLAS detector at the LHC

Nuclear, Particle and Radiation Physics (2) - Wednesday 06 July 2016 11:10
Primary author: MELLADO, Bruce *(University of the Witwatersrand)*

After the discovery of the Higgs boson with a mass around 125 GeV, the search for new bosons has become an important focus of the ATLAS experiment. The observation of new bosons would be a direct indication of physics beyond the Standard Model and would signify a major discovery. Of particular relevance here is the search for scalar and pseudo-scalar bosons, entailing a number of final states. The status of searches performed with the ATLAS experiment in this area will be reviewed.

470 - Coupling of single neutron and proton configurations to collective core excitations in ^{162}Yb.

Nuclear, Particle and Radiation Physics (1) - Wednesday 06 July 2016 10:00 *[For award: MSc]*

Primary author: *MDLETSHE, Linda (University of Zululand)*
Co-authors: *SHARPEY-SCHAFER, J. F (University of the Western Cape); NTSHANGASE, S. S (University of Zululand); BARK, R. A (iThemba LABS); MAJOLA, S. N. T (iThemba LABS); DINOKO, T. S (iThemba LABS); KHUMALO, N. A (University of the Western Cape); SITHOLE, A. M (University of the Western Cape); JONGILE, S (University of Zululand); BVUMBI, S (University of Johannesburg)*

The detailed spectroscopy of ^{162}Yb was studied at iThemba LABS using the ^{150}Sm(^{16}O, 4n)^{162}Yb fusion-evaporation reaction. The 83 MeV ^{16}O beam was provided by the Separated Sector Cyclotron (SSC) and used to bombard 3 mg/cm^2 target. The gamma rays emitted from the reaction were detected using the AFRODITE gamma-ray spectrometer equipped with eight escape-suppressed clover detectors. The exact structure of the $K^{\pi}=2^+$ γ bands has not been properly established and all recent theoretical descriptions do not involve vibrations of the nuclear shape. The last standard spectroscopy of ^{162}Yb was published in 1987[1]. The decay scheme resulted from this work shows that, the ground state band is known up to (28)■. However a very little is know about the $K^{\pi}=2^+$ γ band where only the bandhead 2^+ level at 798 keV and 3^+ at 992 keV have been well established. The core nucleus ^{162}Yb has a very low-lying $K^{\pi}=2^+$ γ band. Our aim is to search for the structures where an odd neutron or proton couple to this collective excitation. We also intend to look for extensions to the γ band and second vacuum O_2^+ band in ^{162}Yb. We further intend to search for high-K structures in ^{162}Yb. The data collected from this experiment is being analysed and the results will be discussed in the South African Institute of Physics conference.[1] J.N. Mo et al., Nucl. Phys. A624, 257 (1987)

476 - Search for dilute magnetism in 3*d*doped III-Nitrides - Results from Mössbauer Spectroscopy

Division for Physics of Condensed Matter and Materials (1) - Friday 08 July 2016 15:20

Primary author: *MASENDA, Hilary (School of Physics, University of the Witwatersrand, Johannesburg, 2050, South Africa)*
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ZnO and GaN doped with transitions metals have attracted much attention since the theoretical prediction[1] that wide band-gap materials are potential dilute magnetic semiconductors with high Curie temperatures ($T_c \geq 300$ K), resulting from carrier mediated magnetic interactions due to itinerant holes coupling with localized dopant spins. This motivated our investigations on the site occupancy and magnetic behaviour of Fe ions in III-nitrides using emission Mössbauer spectroscopy (eMS) following the implantation of radioactive Mn^+ ions at ISOLDE/CERN. Angle dependent measurements performed at room temperature on the 14.4 keV γ-rays from the ^{57}Fe Mössbauer state (populated from the ^{57}Mnβ^- decay) reveal that the majority of the Fe ions are in the 2+ valence state located near substitutional and/or associated with vacancy type defects. eMS experiments conducted over a temperature range of 100-800 K show the presence of magnetically-split sextets in the “wings” of the spectra for GaN and AlN, as observed in ZnO[2]. The temperature dependence of the sextets relate these spectral features to paramagnetic Fe^{3+} (S=5/2) with rather slow spin-lattice relaxation rates which follow a T^2 temperature dependence characteristic of a two-phonon Raman process. However, InN did not show the presence of any magnetic structure in the spectra suggesting the absence of high spin Fe^{3+} in the material. These results will be compared to those obtained in 3*d*-doped ZnO[3].[1] Dietl, T. et al: Science, 287 (2000) 1019. [2] Gunnlaugsson, H. P., et al: Appl. Phys. Lett., 97 (2010) 142501.[3] Mølholt, T. E. et al: Phys. Scr., T148 (2012) 014006.

477 - Multiple Choice Question Responses: Right or Wrong?

Physics Education - Friday 08 July 2016 15:20

Primary author: *MASENDA, Hilary (School of Physics, University of the Witwatersrand, Johannesburg, 2050, South Africa)*
Co-authors: *CLERK, Douglas (School of Physics, University of the Witwatersrand, Johannesburg, 2050, South Africa); NAIDOO, Deena (School of Physics, University of the Witwatersrand, Johannesburg, 2050, South Africa)*

Multiple choice questions (MCQs) are a tempting alternative to constructed response questions, especially when large numbers of students are being examined, because of their potential to save labour during marking. However one criticism of the MCQ is that it does not address the issue of ‘part marks’. The student who chooses a partly correct answer is indistinguishable from an entirely incorrect choice, yet these are usually awarded the same marks in any MCQ-based examination. There exists a way to award different marks to each distractor in a MCQ, depending on the seriousness of the error resulting from the choice. Instead of having one correct option and three or four definitely wrong answers, each distractor must follow logically from an anticipated error. A different number of marks is awarded to each distractor depending on the gravity of the error, which effectively amounts to the awarding of part marks. The feasibility of doing this depends on the practicalities of marking – be it manually, or by whatever computer based marking system is available to the examiners. In the School of Physics at Wits, the marking of MCQs have been performed using an “old software” developed to cater for the evaluation of part-marks in MCQs. In our presentation a number of examples will be demonstrated and discussed.

478 - Tuning the Energetic Driving Force of P3HT-ZnO heterostructures for Enhanced Electron Transfer in Organic PV solar cells

Division for Physics of Condensed Matter and Materials (1) - Wednesday 06 July 2016 11:50 *[For award: PhD]*

Primary author: *KABONGO, GUY LEBA (Département de Physique,Université Pédagogique Nationale)*
Co-authors: *MOTHUDI, Bakang Moses (University of South Africa); HILLIE, Thembela (CSIR NCNSM); SWART, Hendrik (University of the Free State); DHLAMINI, Mokhotjwa Simon (University of South Africa); MBULE, Pontsho Sylvia (University of South Africa); MHLONGO, Gugu (CSIR/UFS)*

In this report, we successfully investigated the photophyscial properties of a polymer hybrid based heterostructure for photovoltaic applications. Several analytical characterization techniques were used to probe the effect of the acceptor semiconductor in the P3HT polymer donor. The study revealed enhanced chain order with the inclusion of ZnO and ZnO:RE3+ nanostructures in the P3HT polymer matrix. In addition, the light absorption was dramatically harvested in the visible range of the electromagnetic spectrum as a result of nanostructured ZnO and ZnO:RE3+ inclusion. Moreover, reduced relaxation energy in the case of the heterostructure based ZnO was found to originate from the improved chain order and higher root-mean square surface roughness, relative to pristine P3HT thin film. Interestingly, the widening of the bandgap of ZnO:RE3+ as compared to ZnO resulted in enhanced energetic driving force which was found to be a critical parameter in determining the interface heterojunction quality and further the performance of the organic/inorganic hybrid heterostructures. Finally, time-correlated single photon counting (TCSPC) revealed higher electron transfer in the P3HT heterostructure based on ZnO:RE3+ as compared to nanostructured ZnO. Keywords: energetic driving force, electron transfer, P3HT-ZnO:RE3+, Bandgap, TCSPC.

481 - Towards quantum feedback measurements with trapped Yb+ ions

Photonics - Thursday 07 July 2016 11:10

Primary author: *KHANYILE, Ncamiso (Department of Physics, Stellenbosch University)*
Co-author: *UYS, Hermann (National Laser Centre, CSIR/Department of Physics, Stellenbosch University)*

Trapped and laser-cooled atomic ions have allowed unprecedented precision in experiments ranging from atomic clocks, probes for fundamental physics, and the development of a quantum computer. In conventional protocols quantum states are probed with projective measurements thus collapsing the quantum wavefunction such that the experiment has to be restarted repeatedly to gather statistics. An alternative measurement method exploits so-called unsharp measurements which allow coherence to persist at the price of reduced information gain per measurement. We report steps towards realization of such measurements with trapped Yb+ ions, and prospects for precision measurement experiments based on the protocol.

482 - Fluid Dynamics as a precursor to a “Griffiths level” Electrodynamics course

Physics Education - Friday 08 July 2016 14:40

Primary author: *TUPPER, Gary (University of Cape Town)*
Co-author: *ALLIE, Saalih (UCT)*

Electromagnetic Theory beyond first year level is recognized as a challenging topic in physics. There are many reasons for this, including the requirement of having to have a grasp of mathematics beyond first level, while at the same time having to deal with levels of abstraction that are not commonplace in first year physics. Very often the topic is taught at second year so that the development of both the mathematics and the physics need to be introduced and mastered at the same time. Historically, many of the concepts that are familiar in electromagnetism were developed by several physicists, including Maxwell, in which the starting point for the abstraction was more tangible objects. For example, the terminology that is used to describe an abstract field has its origins in the area of fluids e.g. divergence and curl, as well as the visualization of a field via “field lines”. In an attempt to facilitate the transition to electromagnetism a course has been developed that starts with fluids and develops the necessary tools for engaging meaningfully with electrodynamics. The talk describes the nature of the course and also discusses some aspects of student understanding that appear to be enhanced by following this approach.

487 - Operating the New Naval Hill Planetarium - An innovative and entrepreneurial approach

Physics Education - Friday 08 July 2016 11:30
Primary author: HOFFMAN, Matthiam *(Full member)*
Co-authors: *DU PLESSIS, Marike (Naval Hill Planetarium, University of the Free State); ERASMUS, Lucas (Department of Physics, University of the Free State); ERWEE, Mariette (Science-for-the-Future, University of the Free State); FOURIE, Antonie (Department of Physics, University of the Free State); MANGOPE, Dinah (Naval Hill Planetarium, University of the Free State); SNYMAN, Leon (Department of Music, University of the Free State); SCHOCH, Magdaleen (Naval Hill Planetarium, University of the Free State); VAN DER WESTHUIZEN, Izak (University of the Free State)*

Within the context of the UFS's well established astrophysical research program and the high profile international astronomical endeavors in Southern Africa such as HESS and the SKA, the Naval Hill Planetarium opened on 1 November 2013. This is the first digital planetarium in sub-Saharan Africa. It is a robust tool for science education, communication and visualization. This comes at a time when South Africa urgently needs to develop human capacity to support its cutting edge international astronomical programs. To expand and enhance the digital content that the planetarium currently has at its disposal, an innovative and entrepreneurial approach is required. In this talk we discuss the international and local networking that will be necessary to make the Naval Hill Planetarium sustainable and enable it to acquire the necessary skills and to develop relevant content. The content will be developed using an iterative and participatory process. The tangible output of the project will be new digital planetarium content that is tailored to meet the needs of local, South African and even international audiences. In order to achieve this goal, equipment and institutional capacity are needed. Capacity will be developed through skills development and incubation programs. The project will ensure that the content of the planetarium's programs will speak to young children, the general public and the scientific communities. The content should provide a window to South Africa's national science facilities especially in the fields of physics and astronomy. Lastly we explain how the proposed new Free State Centre for Earth and Space, with the Naval Hill Planetarium as the first phase, will greatly enhance the sustainability of the planetarium. By including historical accents and conservation matters, the Centre for Earth and Space makes connections with the planetarium's historical astronomical roots and leverages its location in a game-reserve, thus ensuring an interdisciplinary approach.

489 - Evaluation of the Technical Feasibility and Economic Viability of Solar Heated underground fixed dome household size digesters suitable for Vhembe district of South Africa.

Applied Physics (1) - Wednesday 06 July 2016 11:50 *[For award: MSc]*
Primary author: MANDADA, Sharon Ntuwiseni *(University of Venda)*
Co-authors: *TINARWO, DAVID (UNIVERSITY OF VENDA); NEKHUBVI, vhutshilo 1st mountaineer (UNIVERSITY OF VENDA)*

Biogas technology (anaerobic digester) is finding increased relevance especially in rural communities not connected to the electricity grid. Most of these systems are meant to operate unheated regardless of seasonal climatic changes. However, the operation of anaerobic digestion is heavily dependent of the temperature of the digester slurry. So during colder seasons the systems underperform and hence the need to heat them up to maintain the temperature to optimal operational point values. In this regard the main challenge is that, the achievement of the optimal temperature comes with an extra cost and this has to be incorporated in the optimization process of the whole system starting from the designing stage. This paper gives a thorough review of the different heating mechanism designs suitable for underground fixed dome digester systems in typical temperate climate characteristic of the study area of Vhembe District of South Africa. Solar data for the district is used in the design and sizing of the heating system. A model created is used to determine the most cost effective design of the heating mechanism. The results of the study are expected to improve the operation of the typical household biogas digester systems in temperate climates.key words: optimal operation, heating mechanism, temperate climate

491 - Probing accretion in magnetic Cataclysmic Variables through fast photometry

Astrophysics (1) - Tuesday 05 July 2016 11:10 *[For award: PhD]*
Primary author: BREYTENBACH, Hannes *(University of Cape Town)*
Co-authors: *BUCKLEY, David (Southern African Large Telescope); WOUDT, Patrick (Department of Astronomy, University of Cape Town)*

Accreting compact binary star systems are unique astrophysical laboratories. The presence of a mass transferring donor star, spilling material into the magnetosphere of a rotating compact companion, creates a fascinating variety of phenomena. In the case of the Intermediate Polars (IPs), the central white dwarf rotates asynchronously, usually in the presence of a truncated accretion disc. Fast (many frames per second) photometry offers a probe into the dynamics of the luminous material within these systems. Power density spectra of the variability in these systems can, for example, be used to estimate the radius of the inner accretion disc. In discless systems, the stronger magnetic field dictates the gas flow, entirely disrupting the formation of a disc, and often even enforcing synchronous rotation. Almost all the luminous radiation emanates from magnetically confined plasma in the accretion column that forms above the surface of the WD where this high velocity material impacts. A few of these systems display quasi-periodic oscillations (QPOs) in their optical brightness - a phenomenon still poorly understood, but intriguing in its potential to reveal details about the dynamics of plasma under such extreme conditions. In this talk I will present results from a recent observational campaign at SAAO to search for- and characterize QPOs in Polar type Cataclysmic variables, detailing some tantalizing new discoveries, while also discussing the shortfalls of our current theoretical understanding of this phenomenon.

492 - Sol-gel Synthesis and Characterization studies of Er^{3+} doped TiO_2 nanoparticles

Division for Physics of Condensed Matter and Materials (1) - Thursday 07 July 2016 10:20 *[For award: MSc]*
Primary author: TALANE, Tsholo *(UNISA)*
Co-authors: *DHLAMINI, Mokhotjwa Simon (University of South Africa); MOTHUDI, Bakang Moses (University of South Africa); NOTO, Luyanda Lunga (University of Free State (Student)); MBULE, Pontsho Sylvia (University of South Africa); MHLONGO, Gugu (CSIR/UFS)*

Erbium doped titanium dioxide (TiO_2) nanoparticles were prepared via sol-gel synthesis method. Titanium tetraisopropoxide (TTIP) was dissolved in isopropyl alcohol and water, and the solution formed a gel, which was calcined at 400^{o}C. The X-ray diffraction patterns confirmed the formation of an anatase TiO_2 phase, from which the crystallite sizes were approximated to 7 nm. UV/Vis spectroscopy was used to measure the absorption characteristics of the sample, and the band gap was extrapolated from Tauc's relation. Phonon quantification in TiO_2 was achieved using Fourier Transform Infrared (FT-IR) spectroscopy. A laser beam with 980 nm wavelength was used to irradiate the sample, and the displayed emission lines of TiO_2:Er^{3+} in the visible region of the electromagnetic spectrum confirmed upconversion luminescence. The mechanism of upconversion process will be discussed, followed by their applications in different areas, especially in solar cells and biological fields for bio-imaging.Keywords: Sol-gel, TiO_2:Er^{3+}, crystallite size, upconversion luminescence, bio-imaging.

495 - NON-SPECIALIST LECTURE: Trapped ions for new frontiers in precision measurement

Photonics - Thursday 07 July 2016 11:30
Primary author: UYS, Hermann *(National Laser Centre, CSIR/Department of Physics, Stellenbosch University)*

Ultra-cold, trapped atomic ions have over decades yielded ground-breaking results in spectroscopy, atomic clock physics, and fundamentals of quantum optics. Modern trapped-ion experiments have lead to the creation of tunable quantum simulators of quantum magnetic phenomena, implemented many key steps in the march towards the creation of a general purpose quantum computational device, and more recently heralded in a new research field of ultra-cold molecular ion chemistry. In this talk we discuss the first laser-cooled trapped-ion experiment in South Africa. In particular we examine the prospects for achieving new regimes of precision in trapped-ion atomic clocks based on unsharp measurement protocols that overcome fundamental challenges limiting clock precision in current methods.

500 - Investigation of the isochronal annealing profiles of the E centres in n-type silicon

Division for Physics of Condensed Matter and Materials (2) - Tuesday 05 July 2016 11:30 *[For award: MSc]*
Primary author: BARNARD, Abraham *(University of Pretoria)*
Co-authors: *MEYER, Walter (University of Pretoria); AURET, Danie (University of Pretoria)*

The vacancy-dopant complex in Silicon, often referred to as the E-center, is a well-known defect. In this study, we investigated vacancy complexes with three common dopants namely the Sb, P and As by measuring isochronal annealing profiles of all three E centres in n-type silicon. Si doped with P and combinations of P with Sb and As were exposed to alpha radiation from an Am-241 source. By making use of high-resolution Laplace deep-level transient spectroscopy, we were able to distinguish the different E-centers from each other, and measure their annealing rates individually. Since the Schottky contacts degraded with temperature, a novel approach was taken, where annealings were done with the Schottky contacts replaced after each annealing.

502 - Modelling of Pyrite (FeS_2) surfaces and adsorption of dithiophosphate (DTP) onto pyrite surface.

Division for Physics of Condensed Matter and Materials (1) - Wednesday 06 July 2016 14:00 *[For award: PhD]*
Primary author: MULAUDZI, Masilu Godfrey *(University of Limpopo)*
Co-author: *NGOEPE, Phuti Ephraim (University of Limpopo)*

Computational modelling methods were employed to investigate pyrite surfaces, and the adsorption of DTP on pyrite surface. The calculated surface energies for {100}, {110}, {111} and {210} showed that {100} surface is most stable whereas {110} is the least stable. Morphologies of pyrite indicate predominance of the {100} facets and limited presence of others. The adsorption results suggest that the interactions of DTP collectors are via their S atoms bonding with the surface Fe atoms, indicating that the Fe atom participates in the bonding interaction.The analysis of density of states suggest that DTPs are composed of the S 3p orbital, indicating that the S 3p orbital are very active. In addition, the density of states of the S atom with a single bond is the same as the S atom with a double bond, indicating that the two S atoms in the thiol group have similar chemical reactivity, which may be ascribed to the conjugation effect of a pi bond.

505 - Electrical design of and reticulation to solar energy triggered microwave single mode system for sandstones processing: A feasibility study

Applied Physics (1) - Wednesday 06 July 2016 15:20
Primary author: *MULABA-BAFUBIANDI, Antoine F (University of Johannesburg)*
Co-authors: *MARWALA, Tshilidzi (University of Johannesburg); BABUSENA, Paul (University of Johannesburg)*

Sandstone, a weathered sedimentary aggregated rock, has been found in abundance in the Drakensberg mountain chains. The construction boom of 2009-2010 prompted by the soccer world cup in South Africa led to an increased market share in the use of sandstones. Principally artisanal mined in the Free State province in often family own small businesses, chisels and hammers are used in such labour intensive activity. Microwaves have been found to be able to ensure rock breaking especially along the grain boundaries of dissimilar minerals. The presence of a high solar intensity on the mountains of the Free State province in Qwaqwa and the possibility of designing and constructing a portable microwave cutter to effect the drilling and cutting of sandstones have been the motivating research factors. This paper will elaborate on the feasibility of the electrical design of and reticulation to solar energy triggered microwave single mode system for sandstones cutting. The design of and the construct the microwave single mode cavity to use will be discussed while , the required solar energy power to trigger / feed the magnetron of the microwave sandstone cutter will be calculated. The paper will end with a discussion on cavity materials to use.

506 - Optical interference with digital holograms

Physics Education - Wednesday 06 July 2016 11:30 *[For award: Hons]*
Primary authors: *GOSSMAN, David (University of the Witwatersrand); FORBES, Andrew (CSIR); PEREZ-GARCIA, Benjamin (Photonics and Mathematical Optics Group, Tecnológico de Monterrey)*

In 1804 Thomas Young reported the observation of fringes in the intensity of light, and attributed it to the concept of interference between coherent sources. We revisit this famous experiment and show how it can be easily demonstrated with digital holography. We look at the concept of interference in light and ask, fringes in what? We show that depending on how light interferes, fringe patterns in other observables besides intensity can be seen. We explain this conceptually and demonstrate how this can be observed experimentally. We provide a holistic approach to the topic, aided by modern laboratory practices for easy demonstration of the underlying physics.

509 - Physics behind the life cycle and life cycle analysis of artisanal clay brick making

Applied Physics (1) - Thursday 07 July 2016 10:20
Primary author: *MULABA-BAFUBIANDI, Antoine F (University of Johannesburg)*
Co-authors: *TSHIYOYO, Madjer Monatshiebe (University of Johannesburg); NYEMBWE, Didier Kasongo (University of Johannesburg)*

Life Cycle approach is a step by step description of a process of product value chain. Lifecycle analysis is a descriptive tool allowing an assessment of the effect on the environment. The intrinsic relationship between the life cycle and life cycle analysis will be discussed using the physics of systems. The case of artisanal brickmaking in the Dididi village of Nandoni dam (Venda) will be used to iluustrate the above. The present paper will shade light on the process involved in the mining of the clayey soil materials used in the artisanal brickmaking, the process involved of the brickmaking , their level of commitment to rehabilition and compliance to related legislation and their impact on the existing environment and landscape. Physics fundamentals will help on the above discussion.

511 - Comparison of low frequency accelerometer measurement results obtained from three different laboratories.

Applied Physics (2) - Wednesday 06 July 2016 14:40
Primary author: *TYALIMPI, Vumile (NMISA)*

The Vibration laboratory of the National Metrology Institute of South Africa (NMISA) has recently acquired new low frequency exciters during the recapitalization, in replacing the old low frequency exciters. These exciters will be used with the secondary vibration calibration system, also acquired recently, to disseminate measurements in low frequency ranges down to 0,2 HzMeasurements results of a particular transducer obtained from different laboratories using their own systems were compared. A transducer which was calibrated at Spektra and NMISA, using the primary calibration method, was used as the transfer standard to compare with the results obtained using the new secondary setup. The calibration systems used, are employed using different calibration methodologies, i.e. methods in compliance with ISO 16063-11 and ISO16063-21 standard documents. In practise one would not expect any significant differences between the calibration results obtained from different laboratories, though they might be using different exciter types, i.e. the air bearing and the ball bearing type for the measurement in low frequency. A study was undertaken where calibration results from three different laboratory systems were compared. The results were then evaluated in order to identify if there was any significant difference.The comparison protocol followed and the results thereof are presented in this paper. Conclusions will be made to identify best practises to be employed when performing accelerometer calibrations.

512 - Integrated optical tweezer and fluorescence microscope.

Photonics - Wednesday 06 July 2016 10:20 *[For award: MSc]*
Primary author: *ERASMUS, Anneke (Stellenbosch University)*
Co-authors: *VILJOEN, Ruan (Stellenbosch University); NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); BOSMAN, Gurthwin (Stellenbosch University); ROHWER, Erich (University of Stellenbosch)*

An integrated optical tweezer and fluorescence microscopy setup has been developed. The system allows a sample to be optically trapped using the tweezer setup and investigated further by looking at a fluorescence signal detected subsequent to an excitation laser. Optical tweezing is made possible by tightly focusing laser light onto a dielectric bead. In the focus, the difference in refractive index of the bead with respect to its surrounding environment causes a change in momentum of the focused light, which in turns imparts a force on the particle towards the centre of the focus. By attaching a fluorophore to an individual bead, the position of the fluorophore can be manipulated. The excitation laser that stimulates fluorescence in the sample (fluorophore) is coupled parallel to the optical tweezer system. Detection of this fluorescence signal at various positions on the sample permits the sample to be imaged. In this presentation the layout of the optical tweezer system and its characterization will be discussed. Piezo controllers allow x- and y- positioning of the sample. Detection using a spectrometer to record a spectrum at each x- and y- position hence allows spectral imaging of the sample. First fluorescence microscopy results will be presented. The proposed modification and adaptation of this setup to enable nonlinear microscopy techniques will be discussed. This includes combining the microscope setup with a compressed super continuum excitation source for near diffraction limited nonlinear microscopy. The nonlinear microscopy techniques to be considered is multiphoton absorption, second harmonic generation, third harmonic generation and coherent anti-Stokes Raman spectroscopy.

513 - Investigating the optical properties of ANDi-PCFs for nonlinear imaging application

Photonics - Tuesday 05 July 2016 15:20 *[For award: PhD]*
Primary author: *DWAPANYIN, George Okyere (Stellenbosch University)*
Co-authors: *VILJOEN, Ruan (Stellenbosch University); NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); ROHWER, Erich (University of Stellenbosch)*

Passive highly nonlinear Photonic Crystal Fibers (PCFs) can be pumped with short pulses to produce a supercontinuum of power distributed over a wide bandwidth. These PCFs are currently being considered for use in many applications including sensors, high power-pulse transmission and medical uses due to their varying advantages such low light loss. The Laser Research Institute (LRI) has recently developed new types of 'All Normal Dispersion' Photonic Crystal Fibers (ANDi-PCF) capable of spectrally broadening the femtosecond laser pulse into a supercontinuum (SC) which is smooth, stable and compressible for spectroscopic and biophotonics applications. Due to the nonlinear features inherent in the fibers, this research focused on the characterization of different ANDi-PCFs to investigate the optimal transmission and supercontinuum generation features of each fiber. The dependence of the output polarization on the input power and input polarization angle was also determined together with the spectral dependence on the input power and input polarization and angles. An in-house commercial femtosecond laser was used as a light source to deliver ultrashort laser pulses (10-13–10-14 seconds), capable of inducing nonlinear optical effects, to the PCF. The femtosecond laser source was optically coupled into the ANDi-PCF to generate a broadband SC source for analyses.

515 - Ads:CFT predictions for momentum correlations of bbbar pairs in heavy ion collisions.

Nuclear, Particle and Radiation Physics (1) - Friday 08 July 2016 14:20
Primary author: *HAMBROCK, Robert (University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

We use an energy loss model sensitive to thermal fluctuations to compute the azimuthal and momentum correlations of bbbar pairs traversing a strongly coupled plasma from Pb+Pb collisions at LHC ($\sqrt{s}$=2.76TeV). The azimuthal correlations are compared with those from perturbative QCD based simulations. When restricted to leading order production processes, we find that the strongly coupled correlations of high transverse momentum pairs (>4GeV) are broadened less efficiently than the corresponding weak coupling based correlations, while low transverse momentum pairs (1-4GeV) are broaded with similar efficiency, but with an order of magnitude more particles ending up in this momentum class. The strong coupling momentum correlations we compute account for initial correlations and reveal that the particle pairs suppressed from intially high momenta to the low momentum domain do not suffice to explain the stark difference to the weak coupling results in momentum correlations for 1-4GeV.From this, we conclude that heavy quark pairs are more likely to stay correlated in momentum when propagating through a strongly coupled plasma than a weakly coupled one.

516 - Simulaser, a graphical laser simulator based on Matlab Simulink

Photonics - Tuesday 05 July 2016 10:20
Primary author: *JACOBS, Cobus (CSIR National Laser Centre)*
Co-author: *KOEN, Wayne (CSIR National Laser Centre)*

Solid-state laser gain dynamics can be fairly accurately modelled using coupled rate equations for inversion population and cavity photon density. Numerical integration is typically required to simulate dynamics as general analytic solutions don't exist. These simulations are usually programmed in scripted programming languages like C and Java or higher level mathematical engines like Matlab and Mathematica. Customising these scripts for multiple laser systems can be complicated and time-consuming.Matlab Simulink is a graphical programming environment, providing an additional layer of abstraction for simulating dynamic systems. Its primary interface is a graphical block diagramming tool and a customisable set of block libraries. In the work presented here a set of three (also four) level laser rate equations were derived and simplified with a single element, plane-wave approximation. The differential equations were vectorised and variables logically separated into gain medium and laser cavity terms. When implemented in Simulink, these terms become functional blocks that can be easily linked together with lines representing photon absorption and emission. Functional blocks for Q-switching and laser diagnostics were also developed. As a result, complex laser architectures can be easily simulated using a drag-and-drop interface, including multi-wavelength, multi-crystal designs, and active laser control and stabilisation schemes.This simulation tool has been used to design and investigate a number of infrared laser systems at the CSIR. In particular, a comparison between simulated and measured results will be presented for an efficient Ho:YLF laser pumped by a Tm:fibre laser. This 2 µm laser consists of a Q-switched oscillator with two birefringent Ho:YLF crystals. The two crystals had their c-axes rotated 90° with respect to each other to optimise the unpolarised pump absorption. This two-crystal design is a good example of the flexibility of the simulation tool and the simplicity through which a relatively complex design can be investigated.

517 - Tube assembly experiments for optimal temperature sensor placement on the HartRAO Lunar Laser Ranger telescope

Space Science - Thursday 07 July 2016 10:20 *[For award: PhD]*
Primary author: *TSELA, Philemon (University of Pretoria)*
Co-authors: *COMBRINCK, Ludwig (HartRAO); NGCOBO, Bongani Lucas (University of Pretoria)*

Accurate measurements of temperature gradients are important for the operational performance of optical laser telescopes, particularly the Lunar Laser Ranging (LLR) telescope. This is more so on the LLR one-meter aperture telescope that is under development at the Hartebeesthoek Radio Astronomy Observatory (HartRAO) which is expected to achieve sub-centimeter range precision to the Moon, for enhanced tests of Earth-Moon system dynamics. This paper presents results of experiments that were conducted to determine the optimal placement of sensors in order to measure the temperature gradients across the entire surface area of the tube assembly. Ideally installation of a large number of sensors is needed to accurately measure the gradients across the whole tube system, notwithstanding the potential issues of cluttering of sensors and wires and the accompanying measurement noise. However, the choice on the quantity of sensors including placement, mainly depends on the opto-structural design, size, thermal properties and/ or prior thermal simulations of the tube assembly components coupled with performance requirements of the telescope. Thus in this study, the minimum number of sensors were placed at strategic locations on the tube in order to interpolate temperatures between the sensors and determine the temperature gradients as well as the induced structural deformations due to the varying ambient air temperature. This information is instrumental in the phases of a mathematical model under development at HartRAO for monitoring and mitigating thermal variations of the LLR telescope tube assembly to <= 1°C. Such model is expected to contribute toward the achievement of the stringent pointing accuracy requirement of about 0.5” to the corner cube retroreflectors mounted on the lunar surface.

520 - Using Particle Image Velocimetry (PIV) to determine velocities of TIDs over South Africa

Space Science - Tuesday 05 July 2016 14:20 *[For award: MSc]*
Primary author: *MAHLANGU, Fiso (South African National Space Agency)*
Co-authors: *KATAMZI, Zama Thobeka (South African National Space Agency); HABARULEMA, John Bosco (South African National Space Agency)*

PIV is a method used to determine displacement of tracer particles in a flowing fluid. This is done by correlating sub-images (interrogation windows) of images of the fluid successive times. The PIV method was applied to total electron content maps within 20-35 degree south and 15-35 degrees east. Results generated by this method for medium and large scale traveling ionospheric disturbance will be discussed.

521 - The metacurriculum of first year physics service courses

Physics Education - Friday 08 July 2016 11:50
Primary author: *TAYLOR, Dale (UCT)*
Co-authors: *LEIGH, Gregor (University of Cape Town); PETERSON, Stephen (University of Cape Town); WHEATON, Spencer (Department of Physics)*

Research reveals a wide variety of factors which affect student achievement in first year university physics courses. Lecturers may try to address these issues in their courses in some way, by input into their courses which is beyond physics – this can be regarded as the metacurriculum of a physics course. Our study investigates the metacurriculum in four physics service courses. Our research question is: what is the meta-curriculum of the first year physics service courses in the University of Cape Town physics department? The courses in our study are a course for medical students, a course for engineers, a course for students in an extended curriculum programme, and a course for BSc students who are not planning to continue with physics. Each of these courses is a successful course insofar as it has good throughput. The lecturers of these courses care about their teaching and are recognised by students as good lecturers. Each lecturer mapped out their meta-curriculum, and also answered the question: what are the maxims which you repeatedly say in your course? They then met to workshop and refine their representations of their meta-curricula. These representations were then analysed. We found that the metacurricula were idiosyncratic, based on the lecturers’ own experience and knowledge of their students’ needs. The issues addressed were diverse, for example, epistemologies of the relationship between science and indigenous knowledge, learning theories, and stereotype threat. The maxims communicated desired attitudes to physics, for example ‘you can be wrong but you can’t be apathetic’ and ‘there’s no such thing as a stupid question’. The lecturers found value in discussing their ad-hoc additions into their courses in terms of a curriculum which operates in parallel with the physics curriculum. Further study could investigate the effect of these meta-curricula on students.

522 - Meeting the World’s Needs for 21st Century Science Instruction – a synthesis of research and best practice

Physics Education - Thursday 07 July 2016 10:20
Primary author: *HORSZOWSKI, Peter (PERT INDUSTRIALS)*

This paper draws upon a review of the research and expert opinion related to science education, the use of technology in the classroom and how instructional resources provided by PASCO can support science education initiatives. Five key findings are reported: the worldwide need for qualified science, technology, engineering, mathematics (STEM) professionals; the necessity for “scientific literacy;” the role technology plays in deepening students’ understanding of science concepts; how inquiry-based science can increase student motivation and interest in science; and examples of how PASCO technology has improved student understanding and engagement in science around the world. Review of research from leaders in science education confirms the positive impact, value and efficacy of a technology-supported instruction. This paper examines the economic and social benefits for individual students, future workers and countries as reported from UNESCO, National Science Board, and the U.S Congress Joint Economic Committee. The call for students to be more “scientifically literate” and gain experience in the practice of doing science includes knowledge beyond the facts, but also an understanding about the practices of science. Blending technology into data collection, analysis and visualization as part of an inquiry-based instruction has been shown to deepen understanding. Examples of how low-cost, hands-on experiences can support scientific understanding while stretching precious resources further are provided. Case studies of how this technology has improved student understanding and engagement in science are also provided.

524 - Measurement of ^{238}U fission cross sections using quasi-monoenergetic neutrons with energies from 35 MeV to 100 MeV.

Applied Physics (2) - Wednesday 06 July 2016 14:00
Primary author: *GEDULD, Dieter (University of Cape Town)*
Co-authors: *BUFFLER, Andy (University of Cape Town); SMIT, Frederick David (iThemba LABS); NCHODU, Rudolph (University of Cape Town); NOLTE, Ralf (Physiklisch-Technische Bundesanstalt (National Metrology Institute), Germany)*

The fast neutron beamline at iThemba LABS is presently proposed to be developed into an accredited facility for fast neutron metrology. Cross sections of neutron-induced reactions on ^{238}U are very important as reference standards for fast neutron metrology. The cross section of the ^{238}U(n,f) reaction has been measured for quasi-monoenergetic neutron energies in the range from 35 MeV to 100 MeV using a fission chamber of natural uranium composition. Proton recoil telescopes, composed of thin silicon detectors coupled to a sodium iodide scintillation detectors were utilised for the determination of the incident neutron fluence using the well-known cross sections for n-p elastic scattering. Emphasis during the analyses was placed on data reduction and background subtraction to reduce measurement uncertainty. Presented are the measurements and the calculation method to determine the cross section values.

525 - NON-SPECIALIST LECTURE: Optical Fibre Communication: Silica Information Super-Highways

Division for Physics of Condensed Matter and Materials (1) - Wednesday 06 July 2016 09:40
Primary author: GIBBON, Timothy *(NMMU Physics Department)*

High speed Internet and global connectivity are indispensable aspects of modern lifestyle. Optical communication technologies form the cornerstone of broadband connectivity. Information transmitted through an optical fibre undergoes various effects as the lightwave signal interacts with the silica material. These material interactions include attenuation, dispersion, non-linear and polarization effects. In this non-specialist lecture, these effects and their impact on network performance, bitrate and reach are presented. The evolution of optical fibre material for long-haul, fibre-to-the-home and big data projects is also discussed.

526 - A comparison of measured TEC data with the IRI2011 and NeQuick 2 model results over the transition regions from low to mid-latitudes

Space Science - Tuesday 05 July 2016 14:40
Primary author: SIBANDA, Patrick *(University of Zambia)*
Co-author: *CHIPALABELA, Chrispine (University of Zambia)*

It is well known that the variations of the Earth's ionosphere are complicated and behave quite differently in various regions of the Earth. Over the past several years, the total electron content (TEC) has become an important and readily available parameter used to track the global characteristics of the ionospheric dynamics. In the recent past, a vast body of TEC data has been amassed over the African continent from numerous Global Positioning System (GPS) receiver stations in various locations giving a fair coverage of the mid and low latitude regions. This paper presents results of a comparative investigation of the TEC derived from three different sources namely: the International Reference Ionosphere (IRI) model, the NeQuick model and the GPS measurements. Measured TEC data over a chain of stations near the geographic meridian of 23o is used and the study highlights the complex ionospheric characteristics of the transition region from mid to low latitude regions and how the commonly used ionospheric models represent the ionospheric behaviour in this region

527 - NON-SPECIALIST LECTURE: Photonics Prototyping Facility

Applied Physics (1) - Friday 08 July 2016 11:10
Primary author: NAIDOO, Darryl *(Council for Scientific and Industrial Research)*

The Photonics Prototyping Facility (PPF) is being established in the CSIR, with the CSIR National Laser Centre (NLC) acting as the host institution where the programme is funded through the DST and CSIR. The principal function of the facility is to support the competitiveness of the existing South African Photonics industry. Currently, South Africa has a miniscule market share of the lucrative global Photonics industry. The contributing factors to this lack of impact are: many Photonics-based technologies conceived at science councils and HEIs are not commercialised, let alone prototyped. The barriers to cross this chasm are a lack of skilled manpower (scientific and business expertise needed to industrialise technologies) and a lack of the necessary infrastructure. The aim of the PPF is to address these issues by providing the Photonics community (HEIs and industry) with the necessary skills (optical engineering, industrial design and business development) and facilities (equipment and clean room space). This will support prototype development and characterisation to assist in the industrialisation of South African-based Photonics technologies. In this manner the PPF will bridge the "Innovation chasm" that is widely recognised as a barrier to successful technology transfer and commercialisation. Through partnerships with industry and the formation of SMMEs, the uptake of PPF developed prototypes will lead to novel Photonics products thus improving industry competitiveness and creating new jobs. The NLC will present this initiative and its plan toward successful technology transfer in prototype development.

539 - Performance characterisation for Positron Emission Particle Tracking at "PEPT Cape Town"

Applied Physics (2) - Wednesday 06 July 2016 15:00
Primary author: BUFFLER, Andy *(University of Cape Town)*
Co-authors: *COLE, Kathryn (University of Cape Town); GOVENDER, Indresan (University of Cape Town); LEADBEATER, Thomas (University of Cape Town); VAN HEERDEN, Michael (University of Cape Town)*

Since 2009, the Department of Physics at the University of Cape Town has run a dedicated facility, "PEPT Cape Town", for developing and applying the technique of Positron Emission Particle Tracking (PEPT). It is based at iThemba LABS, South Africa, and is one of only two such institutions in the world. Developed at Birmingham University, UK, PEPT has become one of the most powerful visualisation and characterisation techniques for investigating particle dynamics within opaque and often aggressive industrial environments. The facility operates an ECAT Exact3D "HR++" positron camera manufactured by Siemens medical systems. It was designed to achieve high sensitivity and a wide field of view through an increased number of detector elements compared to standard medical PET devices. Recently we have acquired an ADAC Vertex camera similar in design to the current flagship Birmingham system. This offers the opportunity for studying larger systems than can be accommodated within the HR++ ring system and for validating experimental results from both institutions. This paper presents an overview of the PEPT Cape Town facility, radiotracer production routes and initial performance characteristics of the positron camera systems. These data suggest the possible dynamic range in which PEPT can be performed. Under typical experimental conditions, a level of performance comparable to published metrics from Birmingham was achieved with the ADAC Vertex, in general locating particles at kHz rates and with millimetre accuracy in 3 dimensions. For the HR++, a greatly enhanced performance was measured, with particle location rates approaching 50 kHz whilst retaining similar location accuracy. The high sensitivity of this system offers the unprecedented tracking of low activity, or conversely of small, tracer particles in fast flowing systems, and extends the potential viability of PEPT. Exemplar applications in mixing, separation, fluidisation, and other particle phenomena are given to illustrate the power and range of the technique.

540 - Considerations when interpolating discrete measurements of continuous functions: applications to particle tracking in physical systems

Applied Physics (2) - Wednesday 06 July 2016 14:20
Primary author: LEADBEATER, Thomas *(University of Cape Town)*
Co-authors: *COLE, Kathryn (University of Cape Town); VAN HEERDEN, Michael (University of Cape Town); BUFFLER, Andy (University of Cape Town)*

Geographical curves are so involved in their detail that their lengths are often infinite or more accurately, undefinable. B. B. Mandelbrot Science: 156, 1967, 636-638.A wide range of techniques exist in order to measure the location(s) of particle(s) at discrete points along their trajectory. These techniques range from soft field optical techniques (e.g. high speed video, laser driven systems etc) into hard field tomography (e.g. x-ray, Positron Emission Particle Tracking (PEPT)). In all of these cases an image (or image analogue) is produced at a fixed time, usually as a local time average of system behaviour during an acquisition window. Images or their equivalent are repeatedly produced at a fixed rate defined by the hardware capability in many cases (optical, x-ray), or the emission rate of the measurement probe in other cases (emission tomography, PEPT).Of fundamental importance to any of these sampling methods is the concept of the Nyquist criterion, i.e. the fact that a periodic function must be sampled at twice its frequency in order to be properly resolved by measurement. In the case of particle tracking it is then clear that for discrete measurements any phenomena occurring between samples goes unobserved. Simple linear interpolation (including cross-correlation) is often used to describe particle motion between sampled points along the particle trajectory, but this is an approximation at best, and may be an incorrect interpretation of the physical system.In this paper we demonstrate the practical impact of Nyquist sampling upon the simple examples of measuring linear and circular motion. In these cases we demonstrate that the measured path length differs from the actual path length travelled by the particle. We propose a set of defined limits for measuring distance (and therefore velocity) and a standard for handling their uncertainties.

541 - Towards a new standard for electrical current in South Africa

Applied Physics (2) - Wednesday 06 July 2016 10:20
Primary author: BLUMENTHAL, Mark *(University of Cape Town)*

The Quantum Metrological Triangle relates the properties of frequency, voltage and current via quantum mechanical phenomena: the quantum Hall Effect, the AC Josephson Effect and the yet to be adopted, high frequency pumping of single electrons. In this talk I will highlight the new-state-of-the-art dilution refrigerator recently installed in the Department of Physics at the University of Cape Town and discuss how all three quantum mechanical phenomena mentioned above can be routinely measured on this new system. I will then focus on the present on-going research in our department on single electron transport in high frequency electron pumps aimed at realising a new standard for electrical current.

542 - Primary liquid scintillation radioactivity measurement capabilities of NMISA

Applied Physics (2) - Wednesday 06 July 2016 11:10
Primary author: *VAN ROOY, Milton (Stellenbosch University)*

The Radioactivity Standards (RS) laboratory of the National Metrology Institute of South Africa (NMISA) maintains the measurement standard for radioactivity in South Africa. Radioactivity standards and calibrations are mainly disseminated to the South African industry through secondary services. Radioactivity standards are established through absolute activity measurements (also known as primary standardisations) of various radionuclides. To maintain accreditation and ensure uniformity of measurement, the RS laboratory participates in various types of international and regional activity comparisons. During a type 1 comparison a solution of a standardised radionuclide is sent to the International Bureau of Weights and Measures (BIPM) for measurement in the International Reference System (SIR), comprising a number of ionisation chambers. Type 2 comparisons are organised by a pilot lab that makes up a master solution of the specific radionuclide, from which each participating metrology institute receives a sample to standardise. Other types of key comparisons involve either a transfer instrument for measurements of short-lived radionuclides at the participating institute, or participation in the extended SIR for pure beta emitters. Results are collated by the BIPM and a key comparison reference value (KCRV) determined for purposes of establishing equivalence and traceability. Primary measurements at NMISA are made on beta-gamma emitters via 4Pi-Beta-Gamma coincidence counting and on pure beta emitters via the Triple-to-Double Coincidence Ratio (TDCR) technique. The results from a primary beta-gamma measurement are used to obtain factors for a secondary standard ionisation chamber (IC) used at NMISA, thereby maintaining the standardisation for longevity. This factor can subsequently be used to convert the current produced by a radionuclide of unknown activity, measured in the IC, to an activity value. Through this process a chain of traceability to the national measurement standards and degrees of equivalence to the international community, are established. All results are reported with an uncertainty budget. This presentation describes the primary liquid scintillation measurement capabilities of the RS laboratory.

543 - Secondary standard instrumentation used at NMISA for radioactivity measurement

Applied Physics (2) - Wednesday 06 July 2016 11:30
Primary author: *LUBBE, Joline (NMISA)*
Co-author: *VAN ROOY, Milton (Stellenbosch University)*

The NMISA Radioactivity Standards Laboratory maintains SA's national measurement standard for radioactivity. Primary measurement standards obtained from absolute measurement methods are checked for uniformity and equivalence by regular participation in international and regional key comparisons. Due to the fleeting nature of radioactivity, the absolute standardizations are maintained through the calibration of secondary standard instrumentation. This traceability chain of activity measurements is disseminated to the user community via three instrument types, namely an ionization chamber (IC), a high purity germanium detector (HPGe) and a commercial liquid scintillation counter.Most measurements for the nuclear medicine community are made with an ionization chamber using radionuclide specific calibration factors. These factors are obtained by transferring the absolute standardization made on the given radionuclide to the IC. Radionuclide factors obtained for more than fifteen radionuclides have been compared with normalised factors supplied by the IC manufacturer, with excellent agreement throughout. The manufacturer's factors were normalised due to a loss of the original N_2 gas pressure during repairs to the IC. Where absolute standardizations on certain radionuclides have not yet been undertaken for NMISA to derive a factor, the manufacturer's normalised factor can be utilised with confidence. Where environmental radioactivity and radioactivity in consumer products are a concern, NMISA can carry out low level gamma-ray spectroscopy measurements on the samples and products, using a vertical HPGe detector, to ensure that they are safe and below the legally acceptable radioactivity limit. Samples are most commonly analysed for the following radionuclides: Co-60, Cs-134, Cs-137 (in milk, water, black mussels/ fish, green leafy vegetables, grass, soil, sediment and sewage) and I-131 in milk. A commercial liquid scintillation counter is available for detecting small amounts of beta and alpha radioactivity. This computer-controlled benchtop analyser is used to measure primarily pure beta-emitters such as H-3 (tritium) in fresh surface water, C-14 and Sr-90 in milk.

544 - SILVER MEDALLIST LECTURE: Manipulating Structured Light

Photonics - Tuesday 05 July 2016 11:30
Primary author: *DUDLEY, Angela (CSIR National Laser Centre)*

An overview of the research done within the CSIR's National Laser Centre and the University of the Witwatersrand's Structured Light group will be presented. Our main focuswill be on implementing digital holograms for the creation and detection of the spatial modes of light – the various patterns of light. We make use of modal decomposition theory todetermine the numerous properties of light, from the modal content of laser beams to decoding the information stored in optical fields carrying orbital angular momentum.Although the modal decomposition of light has been known for a long time, applied mostly to pattern recognition, we illustrate how this technique can be implemented with the use ofliquid-crystal displays. We demonstrate the versatility of these techniques to characterize both structured and vector fields with static and propagating optical fields. Finally, we showa holographic technique to realise a communication link using a densely packed spatial mode set where we experimentally multiplex and demultiplex over 100 spatial modes.

546 - Astronomy for a Better World!

Astrophysics (2) - Thursday 07 July 2016 11:10
Primary author: *GOVENDER, Kevindran (South African Astronomical Observatory)*

The Office of Astronomy for Development (OAD) is a partnership between the International Astronomical Union and the National Research Foundation, and is hosted at the South African Astronomical Observatory. Established in 2011 the OAD has been responsible for implementing a decadal strategic plan with the broad vision of "Astronomy for a better world". To date the OAD has established 9 regional offices (in Armenia, China, Colombia, Ethiopia, Jordan, Portugal, Nigeria, Thailand and Zambia); coordinated the funding and implementation of 86 projects around the world; gathered a database of skills from over 600 volunteers; and established institutional partnerships through 10 different agreements. For technical advice and reviews of project proposals, the OAD uses three "Task Forces" made up of experts from around the world in areas related to (i) universities and research; (ii) children and schools; and (iii) general public. Its activities over the past (first) 5 years of its existence have recently attracted the award of the Edinburgh Medal, a first for the host country South Africa. This talk will briefly cover the history and ambitions of this office and describe the status of the envisaged roadmap, with particular focus on the OAD's relevance to the growing international conversation around "science for development".

555 - Biological photovoltaic building blocks for solar energy harvesting

Winter School: The Biophysics of Cells and Macromolecules - Monday 04 July 2016 09:00
Primary author: *FRESE, Raoul (Vrije Universiteit Amsterdam)*

The harvesting of solar energy in photosynthesis is dependent upon an interconnected macromolecular network of membrane associated chlorophyll-protein complexes. In the past decade my workgroup and others have elucidated the structure and functioning of these networks to great detail. Here I will briefly discuss our efforts in high resolution AFM imaging of native membranes and the models derived from light spectroscopy. In the second part I will discuss our recent efforts in applying and mimicking the natural assemblies in hybrid biosolar cells, photosynthesis based electrodes as components for sensors, photovoltaics and, possibly, photofuels. If time allows, I end with our recently designed algae powered robot which showcases the possibilities and won the 18th Japan Media Arts Festival New Face Award.

556 - The cytoskeleton and membrane: thermal and mechanical properties

Winter School: The Biophysics of Cells and Macromolecules - Monday 04 July 2016 10:00
Primary author: *MÜLLER-NEDEBOCK, Kristian (University of Stellenbosch)*

Membranes encapsulate cells or cellular organelles and the cytoskeleton provides not only mechanical properties to cells but also is important in the internal transportation. In living systems these structures are highly dynamic and coupled to other processes in a complex way. In this lecture we will investigate how the experimental and theoretical methods of statistical physics of membranes, polymers and filaments can guide us to ask important questions relating form, fluctuation and function in cells. First, we shall address the role of thermal fluctuations on the elastic and spatial properties of membranes and filaments. We then also mention non-equilibrium processes of filament growth and shortening, and the fusion of membranes, before looking at how one can start to understand the more complex, coupled structures found in the cell. The lecture will conclude with a look at a selection of experimental techniques available that allow researchers to access forces and other related physical quantities directly in cells.

557 - Single-Molecule Spectroscopy: Beyond the Ensemble Average

Winter School: The Biophysics of Cells and Macromolecules - Monday 04 July 2016 11:30
Primary author: *KRÜGER, Tjaart (University of Pretoria)*

Single-molecule spectroscopy is powerful tool for studying the dynamics and properties of macromolecules. By unmasking phenomena that are hidden in standard ensemble approaches, single-molecule techniques enable us to obtain detailed information about the molecular machinery of the cell by quantifying their fundamental physical properties, revealing the heterogeneity of their biological functionalities, and by sensitively and selectively manipulating the interactions within and between individual biomolecules. This lecture will highlight a selection of popular single-molecule spectroscopy techniques and demonstrate their application to the light-harvesting pigment-protein complexes of different photosynthetic organisms.

558 - Higher order structures and noise filtering in biological signal cascades

Winter School: The Biophysics of Cells and Macromolecules - Monday 04 July 2016 12:15
Primary author: *MHLANGA, Musa (CSIR (UCT))*

The NF-κB pathway has critical roles in cancer, immunity and inflammatory responses. Understanding the mechanism(s) by which mutations in genes involved in the pathway cause disease has provided valuable insight into its regulation, yet, many aspects remain unexplained. Several lines of evidence have led to the hypothesis that the regulatory/sensor protein NEMO acts as a biological binary switch. This hypothesis depends on the formation of a higher-order structure, which has yet to be identified, using traditional molecular techniques. Here, we use super-resolution microscopy to reveal the existence of higher-order NEMO lattice structures dependent on the presence of polyubiquitin chains prior to NF-κB activation. Such structures may permit proximity-based trans-autophosphorylation leading to cooperative activation of the signalling cascade. We further show that NF-κB activation results in modification of these structures. Finally we demonstrate that these structures are abrogated in cells derived from incontinentia pigmenti patients

ORAL ABSTRACTS

559 - Structure and Affinity of Protein Complexes in Infectious Diseases

Winter School: The Biophysics of Cells and Macromolecules - Monday 04 July 2016 14:00

Primary author: *SCHUBERT, Wolf-Dieter (University of the Western Cape)*

Humans are protected against infections by a highly sophisticated and multi-tiered immune system. For microorganisms to successfully initiate an infection in humans they need to interfere with critical elements in signaling and metabolic pathways of the host to locally carve a niche for their survival. For this purpose the pathogens release dedicated molecules that selectively interact with central receptors and regulators of the host. We are investigating how virulence factors bind to host receptors to understand how they block or modify their function at the molecular level. This often provides a unique view to understanding critical host regulation pathways revealing unexpected entry points that may be exploited in drug development or in fundamentally understanding underlying processes. We combine X-ray crystallography with biophysical techniques such as isothermal titration calorimetry (ITC), surface plasmon resonance (SPR) spectroscopy and microscale- thermophoresis, as well as biomolecular techniques such as site-directed mutagenesis to obtain a comprehensive picture of individual molecular pathogen-host interactions.

560 - Studying large (>400 kDa) macromolecular complexes

Winter School: The Biophysics of Cells and Macromolecules - Monday 04 July 2016 14:40

Primary author: *WOODWARD, Jeremy (University of Cape Town)*

Proteins are nanoscale molecular machines that use chemical potential energy to shift chemical and mechanical processes away from equilibrium. These include components such as motors, chemical catalysts and switches with an average size of ~2000 atoms (30 kDa). These “modules” self-assemble to form large complexes that perform tasks such as reading and writing data, recycling, chemical manufacturing and data transfer. Over 80% of proteins physically associate with at least one other protein in the living cell, but crystallographic studies usually target only those that function in isolation, creating a bias in our understanding of biological function. Single-particle cryo-electron microscopy (Nature Method of the Year 2015) is used to study large macromolecular structures at close-to-atomic resolution in their native state. We have used this technology to understand the mechanism of large biological catalysts with potential biotechnology applications.

561 - An Experimental Physicist’s view of Enzyme Reaction Mechanisms

Winter School: The Biophysics of Cells and Macromolecules - Monday 04 July 2016 15:20

Primary author: *SEWELL, Bryan Trevor (University of Cape Town)*

Enzymes assist in the making and breaking of chemical bonds. They do this with astonishing specificity and economy. Sometimes Nature utilizes very similar active sites to catalyze different chemical reactions or to selectively catalyze a reaction with some substrates but not other, similar substrates. Biochemistry textbooks are replete with naïve explanations that seek to generalize to a point that would have students believe that the field is well understood, but close inspection reveals that this is not the case. We have studied amidases and nitrilases that belong to the same superfamily and in the crystalline forms have clusters of four amino acids that are directly superimposable. Yet nitrilases convert nitriles to the corresponding carboxylic acid and ammonia and amidases convert amides to the same products. However nitrilases differ from amidases in forming spiral oligomeric forms, which, evidence suggests, are essential for activity. In the case of the amidases, we have mutated the putative catalytic residues and determined the structures of the complexes that result when the mutated, inactive enzyme reacts with substrate. In most cases the observed reaction products were not predicted by the prevailing mechanistic hypotheses and this has prompted the proposal of a new mechanism supported by quantum mechanical computations of the transition states. Understanding of the amidase mechanism presents a conundrum for the prevailing nitrilase mechanism. This can be resolved only by postulating an entirely novel reaction sequence that must be experimentally verified.

582 - Using Wolfram Mathematica to Analyze and Visualize experimental data.

Physics Education - Friday 08 July 2016 16:00

Primary author: *DEMPERS, Clemens (Blue Stallion Technologies)*

Wolfram Mathematica was developed by the theoretical physicist, Steven Wolfram in the mid 1980’s. Since then it has evolved and branched out into many disciplines. Often researchers and teachers still have the impression that it is mainly suited as a tool for theoretical physics, or mathematics. Today that is no longer true, and the aim of this talk is to show it is a powerful environment for gathering and analyzing experimental data. The author will give a overview of functionality and cover some of the latest additions to this technical computing environment. Real time examples will include interfacing with Arduino based sensors and an automated curve fitting application developed for the flotation analysis of mineral ore.

BOOK OF ABSTRACTS:
Poster Contributions

POSTER ABSTRACTS

3 - Problems with the calculation of the refractive index of $In_xGa_{1-x}As$

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.003)*
Primary author: ENGELBRECHT, Japie *(Centre for HRTEM, NMMU)*

$In_xGa_{1-x}As$ is a binary alloy used in advanced optoelectronic devices such as laser diodes, photodetectors and optical modulators. The material also finds application in infrared optical fibre communications, since the optical band gap spans wavelengths required for this mode of communication. Consequently a knowledge of the refractive index n is required in order to model the optical properties of the alloy. The refractive index of a material is a function not only of the operating temperature, but also of the wavelength as well as the composition x in the case of an alloy.A literature search has revealed several theoretical models to calculate the refractive index of InxGa1-xAs. Theoretical formulas are based on: a single oscillator model, a modified oscillator model, the Sellmeier type equation and the dielectric function. Quantities that are required to be calculate include the energy Eo of the oscillator, the dispersion energy Ed and the band gap Eg (which depends on the compostion x).Upon assessing the models, some problems were encountered related to the interpretation of the composition x, and with scientific notation. An unwary researcher may thus inadvertently calculate incorrect values for the refractive index. Results obtained from the various models will be presented to highlight the problems encountered in this investigation.

5 - Creation and detection of vector Bessel beams using digital axicons

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.005) [For award: MSc]*
Primary authors: IDISI, David Omoefe *(University of Fort Hare, Alice); FORBES, Andrew (University of witwatersrand, Johannesburg)*

Bessel beams are optical fields that fall into the categories of non-diffracting beams. Vector Bessel beams have focal field distribution of cylindrical vector beams which has a high numerical aperture. These beams have found interesting applications in various facets of science ranging from biological optical trapping, optical communications and microscopy. In this work, Bessel beams are generated using digital axicons encoded into a spatial light modulator and converting the linearly polarized Bessel beams to circularly polarized vector Bessel beams. In addition, the orbital angular momentum modes in the beam were detected using modal decomposition. We further measured the degree of non-separability of the vector Bessel beams using state tomography quantum tool where we reconstructed the density matrix and calculated the concurrence and fidelity which explores the measure of vectorness of the beams. The results obtained are in agreement with literature.

8 - Modelling the Linke Turbidity for solar irradiance in South Africa

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.008) [For award: MSc]*
Primary author: NETHWADZI, LUTENDO CHRISTOPHER *(SAAPMB)*
Co-author: *WINKLER, Hartmut (Dept. Physics, University of Johannesburg)*

Solar irradiance losses in the atmosphere are traditionally quantified by the Linke Turbidity parameter. This paper analyses the measured energy yield of a tilted solar panel in Gauteng as a function of the relative solar position. The collected energy depends on a range of factors, including the panel size, spectral sensitivity and orientation, as well as the atmospheric composition. The analysis attempts to reproduce the measured irradiance through basic modelling of the spectral opacity of the atmosphere in terms of the Linke Turbidity. This includes estimating direct beam attenuation and the diffuse component, which are then combined with the panel spectral response in an attempt to match the measured and modelled energy yield. The Linke Turbidities determined in this manner are then compared with corresponding values given in online solar irradiance calculation tools such as PVGIS.

9 - Ab – initio study of transition metals impurities and stability of complexes in Ge.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.009) [For award: PhD]*
Primary author: IGUMBOR, Emmanuel *(University of Pretoria)*
Co-author: *MEYER, Walter (University of Pretoria)*

By means of density functional theory (DFT), we present *ab-initio* calculation of T(T: Cr, Mo, W, Mn and Fe) vacancy-interstitial complexes (T_{Ge}-$V_{nGe}I_T$, for n = 1,2 and 3) in Ge. The projector augmented wave (PAW) pseudopotentials within the generalized gradient approximation (GGA) was used for all the calculations. The structural properties and formationenergies of T_{Ge}-$V_{nGe}I_T$ for the neutral charge state were obtained. Our results show thatunder favourable energetic condition, vacancy-interstitial complex T_{Ge}-$V_{nGe}I_T$ will form with low formation energy. The formation energy show that the T_{Ge}-$V_{nGe}I_T$ is more energetically favourable for n = 1 and 2 than n = 3. The stability of the vacancy-interstitial complexes wereobtained from their binding energies. For all T, the binding energies of the T_{Ge}-V_{GeI_T} are positive and stable. Except for the W and Mo, for the T_{Ge}-$V_{2Ge}I_T$ and T_{Ge}-$V_{3Ge}I_T$ the binding energies for T are negative and the defect complexes are likely to dissociate into smaller fragments.

10 - Geomagnetic derivation of current strengths and electric fields of three current systems in the ionosphere and magnetosphere.

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.010)*
Primary author: DE VILLIERS, Jean *(South African National Space Agency)*

Geomagnetic data are usually a superposition of various different geomagnetic signatures from different source current systems in the ionosphere and magnetosphere. The geomagnetic field (B-field) also generates geoelectric fields (E-fields), which drives geomagnetically induced currents (GIC) in technological conducting media at the surface of the Earth, such as railways, pipelines and power networks. Fourier transforms of B-field measurements were used to calculate the current strengths and ground E-fields directly from a Fourier integral model function and in reverse by the Levenberg-Marquardt inversion technique. The reflection coefficient in the integral is calculated through the underlying surface impedance from layered-Earth profiles, as given and derived from the literature. We concentrate on three current systems [using three corresponding sources of B-field measurements]: the ring currents (RC) [Dst], equatorial (EEJ) [only Addis Ababa minus Dst] and auroral electrojets (AEJ) [northern EO]. The electrojets is at 100 km height in the ionosphere, while the RC is five Earth radii from the surface. It is found that the current strength behaviour accurately follows the variations of the B-fields with high correlations. The current strength time derivative correspondingly follows the variations of the E-fields. The E-field of the AEJ is significantly stronger than the other current systems, due to its unique position under the fields imposed by and energetic particle precipitation received from the magnetosphere. The EEJ E-field is weakest, while the RC is between the two extremes. The EEJ has the weakest current strength, since no field-aligned currents is connected to it, unlike the AEJ. The RC current strength is the strongest. The current strength also serves as the source for developing solar wind empirical models just outside the Earth's magnetosphere.

13 - Structural and electrical properties of ruthenium thin films on 6H-SiC annealed in the air

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.013)*
Primary author: MUNTHALI, Kinnock Vundawaka *(University of Pretoria and University of Namibia)*
Co-authors: *THERON, Chris (University of Pretoria); AURET, Danie (University of Pretoria)*

Ruthenium (Ru) Schottky contacts and thin films on n-type 6H-SiC were fabricated and characterised by physical and electrical methods. The characterisation was done after annealing the samples in air at various temperatures. Rutherford backscattering spectroscopy (RBS) analysis of the thin films indicated the oxidation of Ru, after annealing at a temperature of 400 oC , and interdiffusion of Ru and Si at the Ru-6H-SiC interface at 500 C. XRD analysis of the thin films indicated the formation of RuO2 and RuSi in Ru-6H-SiC after annealing at a temperature of 600 C. The formation of the oxide was also corroborated by Raman spectroscopy.The ideality factor of the Schottky barrier diodes (SBD) was seen to generally decrease with annealing temperature. The series resistance increaseed astronomically after annealing at 700 C which was an indication that the SBD had broken down. The failure mechanism of the SBD is attributed to deep inter-diffusions of Ru and Si at the Ru-6H-SiC interface as evidenced from the RBS of the thin films.

14 - Evaluation of Fission Energy Deposition in the SAFARI-I Nuclear Reactor

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.014) [For award: Hons]*
Primary author: JURBANDAM, Linina *(University of Witwatersrand)*
Co-author: *ZAMONSKY, Oscar (Necsa)*

The knowledge of the amount of energy released during a nuclear fission reaction is extremely important for the safety analysis of a nuclear reactor. In this work, we estimate the fission Q-Value of the SAFARI-I nuclear reactor using the MCNP-5 (Monte Carlo N-Particle) code. MCNP is a probabilistic transport code that has the capability of calculating most of the heating contributions due to particle interactions with matter. In particular, we present the calculations performed to obtain the energy deposited by fission products, prompt neutrons and photons as well as neutron induced photons. Currently, the MCNP-5 code cannot calculate the heat deposition due to beta particles and gamma rays produced during fission product decay. Such values were therefore estimated using typical values reported in the libraries. The calculations were performed for the beginning and end of cycle of a typical operation cycle of SAFARI-I. Using the ENDF-VII data, the fission Q-value for SAFARI-I was calculated as 197 MeV. Typical fission Q-values reported for nuclear reactors are around 200MeV. Further studies will focus in the improvement of the accuracy of our calculations by performing energy deposition calculations due to fission products decay of typical used fuel elements in SAFARI-1.

15 - Analysis of the rich optical iron-line spectrum of the x-ray variable I Zw 1 AGN 1H0707-495

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.015)*
Primary author: WINKLER, Hartmut *(Dept. Physics, University of Johannesburg)*
Co-author: *PAUL, Bynish (Department of Physics, University of Johannesburg)*

Thirty years ago the optical counterpart of the x-ray source 1H0707-495 was discovered to be a 15th magnitude broad-line Seyfert galaxy with a rich FeII emission line spectrum typical of the AGN subclass sometimes referred to as the I Zw 1 objects after their progenitor. This object became the subject of much interest and investigation just over five years ago when it was shown to have undergone dramatic x-ray luminosity variations. This paper presents an extensive series of medium resolution spectra recorded at the 1.9 m telescope at Sutherland in January 2016. Through co-adding the spectra, we are able to achieve a signal-to-noise hitherto not achieved for this object, allowing us to resolve individual FeII lines and measure their relative strengths and profiles to a degree of accuracy not previously available for this AGN. We provide possible physical interpretations of our measurements and investigate links between the spectral evidence collected in this study and the known x-ray behaviour.

23 - The effects of Cd2+ concentration on the structure, optical and luminescence properties of MgAl2O4:x% Cd2+ nanophosphor prepared by sol-gel method

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.023)*
Primary author: *MOTLOUNG, Setumo Victor (Sefako Makgatho Health Science University)*
Co-authors: *SITHOLE, Enoch (Sefako Makgatho Health Science University); KOAO, Lehlohonolo (UFS (Qwa Qwa Campus)); NTWAEABORWA, Odireleng (University of the Free State); SWART, Hendrik (University of the Free State); MOTAUNG, Tswafo (University of Zululand); HATO, Mpitloane (University of Limpopo); DEJENE, Francis (University of the Free State)*

Cadmium doped magnesium aluminate (MgAl2O4:x% Cd2+) powders with different cadmium concentrations were prepared by the sol-gel method. Energy dispersive x-ray spectroscopy (EDS) analysis confirmed the presence of the expected elements (Mg, Al, O and Cd). The x-ray diffraction (XRD) analysis revealed that the powders crystallized into the cubic spinel structure. Cd2+ doping influenced crystallinity of the powder samples. The crystallite size and particle morphology were not affected by variation in the Cd2+ concentration. Ultraviolet-visible spectroscopy (UV-vis) measurements revealed that the band gap of the MgAl2O4 was influenced by Cd2+ doping. Un-doped and Cd2+-doped MgAl2O4 nanophosphor exhibit the violet emission at 392 nm. There was no evidence on the emission peak shift, which suggests that all emissions originated from the defects within the host material. Increasing the Cd2+ concentration up-to 0.88 mol% lead to luminescence intensity enhancement, while further increase of Cd2+ concentration lead to concentration quenching. The critical energy transfer distance (Rc) between the neighbouring donors and acceptors was found to be 5.21 Å, suggesting that the multipole-multipole interaction (M-MI) is the major cause of concentration quenching. CIE colour coordinates confirmed non-tuneable violet emission whose intensity was dependent on the Cd2+ concentration.

24 - Growing zirconium carbide (ZrC) layers by CVD using ZrCl4 mixed with CH4,Ar and H2

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.024) [For award: PhD]*
Primary author: *ALAWAD, Bilal (Department of physics, university of Pretoria,0002 - department of physics, sudan university of science and technology, Khartoum Sudan)*
Co-authors: *BIIRA, saphina ((Department of physics ,university of Pretoria ,0002 South Africa)); BISSETT, Hertzog ((Applied Chemistry Division,South Africa Nuclear Energy (NECSA),Pretoria 0001 South Africa)); NEL, Johann ((Applied Chemistry Division,South Africa Nuclear Energy (NECSA),Pretoria 0001 South Africa)); HLATSHWAYO, Thulani ((Department of physics ,university of Pretoria ,0002 South Africa)); CROUSE, Philip ((Department of Chemical Engineering ,university of pretoria,0002 South Africa)); MALHERBE, Johan ((Department of physics ,university of Pretoria ,0002 South Africa))*

Zirconium carbide (ZrC) layers were grown on graphite substrate by chemical vapor deposition (CVD) using zirconium tetrachloride (ZrCl4) and methane (CH4), hydrogen (H2) and argon (Ar) as precursors. The layers were deposited at 1400 °C in atmosphere pressure. P=-5 Kpa The growth rate of ZrC layers as a function of temperature was investigated. The morphology of ZrC layers on graphite substrates were observed by scanning electron microscopy (SEM) and (EDS). The thickness of the layers was directly measured by SEM. The phases of the layers were characterized by X-ray diffraction (XRD). The results indicated that the deposition of ZrC was dominated by gas nucleation. Keyword: Chemical vapor deposition (CVD), surface morphology, zirconium carbide (ZrC).

30 - University physics students' perceptions of teaching methods

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: E.030)*
Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-author: *RAMNARAIN, Umesh (University of Johannesburg)*

Maximization of students' academic experience through meaningful pedagogic tasks is central to the improvement of instruction in various instructional settings. The effectiveness of various teaching methods through which instruction is provided remains a key imperative for the realization of meaningful student academic performance. As part of this inquiry, physics students' perceptions of various teaching methods were established through the administration of a survey questionnaire after which interviews were conducted to corroborate the views expressed. Responses to the questionnaire appeared to gravitate towards the lecture method and group discussion as preferred instructional methods. Implications for the improvement of instruction are discussed.

31 - Self-efficacy beliefs of physical science teachers

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: E.031)*
Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-author: *RAMNARAIN, Umesh (University of Johannesburg)*

This study explored self-efficacy beliefs of physical science teachers in view of their impact on motivational and self-regulation processes. The investigation was carried out through the administration of a questionnaire consisting of items about self-efficacy beliefs with physical science teachers. The items are categorized according to two broad dimensions in the form of Personal Efficacy Belief of Physics Teachers and General Efficacy Belief in Physics Teaching. Teachers' self-efficacy beliefs appeared to be characterized by varied and fragmented views in terms of the two broad dimensions specified. Implications for teacher professional development are discussed.

32 - University science students' self-efficacy – A case of physics learning

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: E.032)*
Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-author: *RAMNARAIN, Umesh (University of Johannesburg)*

This study examined university science students' self-efficacy in relation to physics learning as learning is a dynamic process underpinned by a myriad of pedagogic factors. Students' self-efficacy beliefs were established through the administration of the Survey of Self-Efficacy in Science Courses – Physics (SOSESC-P) questionnaire. Questionnaire items are categorized according to the four dimensions in the form of Mastery Experiences, Vicarious Learning, Social Persuasion and Physiological State. Students' self-efficacy beliefs appeared to be characterized by varied and fragmented views in terms of the four dimensions specified. Implications for effective learning are discussed.

33 - Synthesize and characterisation of optical properties of a down-converting Y_2O_3 phosphor co-doped with Bi^{3+} and Yb^{3+}.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.033) [For award: MSc]*
Primary author: *LEE, Edward (University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); TERBLANS, JJ (Koos) (UFS)*

For silicon (Si) solar cells, phosphor materials are necessary for the conversion of ultraviolet (UV) to near-infrared (NIR) radiation. The emission of more than one NIR photon for each UV photon absorbed was demonstrated using a down-converting Y_2O_3 phosphor co-doped with Bi^{3+} and Yb^{3+}. Synthesis of Bi^{3+} and Yb^{3+} co-doped Y_2O_3 phosphor was accomplished by using the co-precipitation method with varying the pH levels of the obtained solution. The influence of pH on the crystal structure, luminescent properties and the size and morphology of the particles were investigated using x-ray diffraction, photoluminescence and scanning electron microscopy. Strong NIR emission was observed at around 1 m. The strong NIR emission at around 1 m, under UV excitation, was due to the 2F5/2 to 2F7/2 transition of Yb^{3+} as a result of energy transfer from Bi^{3+} to Yb^{3+} ions. An energy transfer mechanism was proposed and will be presented. This phosphor proves to be promising for enhancing the efficiency of c-Si solar cells.

38 - Measurements of the hyperfine and weak field Zeeman spectra of Rb 85 and Rb 87

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.038) [For award: MEng]*
Primary author: *WYNGAARD, Adrian (Cape Peninsula University of Technology)*
Co-authors: *GOVENDER, Kessie (Cape Peninsula University of Technology); STEENKAMP, Christine (University of Stellenbosch)*

In this presentation we report on the measurement of the hyperfine structure of rubidium 85 and rubidium 87 using a saturated absorption spectroscopy setup. This setup is part of a larger project involving laser cooling of rubidium atoms and will form part of the laser feedback system to lock the laser to a particular hyperfine transition of rubidium.An external cavity diode laser was frequency modulated using a ramp signal. The output laser beam was split into three beams, one of which was a strong pump beam. The other two being weak probe beams that were sent through a rubidium vapour cell. The pump beam was configured to be counter-propagating and overlapping one of the probe beams. The probe beam intensities were monitored using photodiodes. A portion of the modulated laser beam was also separately analysed using a Michelson interferometer. The output of this interferometer was monitored using another photodiode. All signals were recorded using a digital oscilloscope.The time axis, of each oscilloscope recording, was converted to frequency using a calibration factor determined by analysing the output signal of the Michelson interferometer. The converted spectra were fitted with Lorentzian curves to estimate resonant frequencies and lifetimes. Our estimates of the energy separation between hyperfine levels are consistent with published values in the literature. As an additional experiment, a magnetic solenoid was placed around the rubidium vapour cell and the Zeeman separation as a function of weak magnetic fields was investigated. These results are also included.

40 - $Ce_{1-x}La_xCu_4Al$ as a case study for the investigation of Ce 4*f* wave function evolution from a coherent to a local Kondo effect

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.040)*

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$CeCu_4Al$ is a heavy fermion system as well as a dense Kondo lattice, where long-range antiferromagnetic correlations emerge as a result of the strong hybridization between the Ce 4*f* and conduction electrons. The gradual replacement of Ce by La in the diluted series $Ce_{1-x}La_xCu_4Al$ leads to an increase of the lattice parameters due to the larger ionic radius of La, which results in the gradual decrease of the Ce 4*f* hybridization strength. Consequently, the Kondo exchange coupling goes from being fully coherent towards a local/incoherent on-site effect as the La content increases.We have used $Ce_{1-x}La_xCu_4Al$ as a case study for the investigation of the changes in the electronic structure during the coherent-to-incoherent transition of the character of the Ce 4*f* wave function. We have exploited synchrotron-based x-ray absorption and (resonant) photoemission spectroscopies as ideal probing tools of the dual character of the 4*f* electrons and the extent of the 4*f* hybridization.Among other findings, our results show that, while the incoherent part of the Ce 4*f* wave function is virtually unmodified throughout the series, the effect of La doping is to suppress the coherent Kondo resonance peak at the Fermi level, as well as to shift both the Kondo resonance peak and its spin-orbit counterpart towards the Fermi level. This is in agreement with the trend found in thermoelectric power measurements, and provides the electronic structure fingerprint of the effects of the fine-tuning of the 4*f* electron hybridization on the Kondo lattice properties in this series of diluted alloys.

43 - Enhanced properties of thermoelectric materials for technological applications

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.043)*

Primary author: MANYALI, George S. *(Masinde Muliro University of Science and Technology, Kakamega, Kenya)*

Energy harvesting requires clean and highly efficient energy conversion technologies. Thermoelectricity is one such technology that achieves thermal-to-electric conversion and vice versa. This is achieved purely by solid state means and has a great potential for applications in waste heat recovery, air conditioning and spot cooling of electronic devices. Attempts have been directed towards exploration of high performance compounds which are yet to be realized. To predict the enhanced electronic structure of Cadmium Oxide (CdO), we doped it with Zn and Mn. The structural properties in terms of volumes and lattice parameters, the band structure and the density of state for both the doped and undoped CdO were determined by the modern ab initio methods based on density functional theory (DFT).

44 - The effect of activated carbon on the CO sensing performance of NiO

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.044) [For award: PhD]*

Primary author: KHALEED, Abubakar *(University of Pretoria)*

Co-authors: *BELLO, Abdulhakeem (Department of Physics University of Pretoria); DANGBEGNON, Kouadio Julien (University of Pretoria); UGBO, Faith (University of Pretoria); AKANDE, Amos (Dept. of Physics, University of Limpopo, DST/CSIR National Centre for Nano-Structured Materials, P O Box 395, Pretoria 0001, South Africa); MOMODU, Damilola (UNIVERSITY OF PRETORIA); MWAKIKUNGA, Bonex (CSIR National Laser Centre); MANYALA, Ncholu (University of Pretoria)*

In recent years there has been exponential growth in research activities dealing with nanoparticles for chemi-resistive gas sensing applications. This is because of the high demand for simple, responsive and stable electronic sensors suitable for environmental monitoring in industries, air pollution control, safety at mining sites and firefighting. Different materials in cluding metal/metal oxide nanoparticles, inorganic semiconductors and carbon nanoparticles have all been explored as potential materials for chemi-resistive gas sensing applications. In this work, spherical NiO/activated carbon (AC) composite with flowerlike structures as revealed by field emission scanning electron microscope (FESEM) were successfully synthesized for their application as carbon monoxide (CO) gas sensor via a hydrothermal reflux process. X-ray diffraction (XRD) analysis was used to investigate the crystallinity of the samples while gas sorption analysis was used to probe the surface area of the both the pristine and composite. The materials were subjected to continuous cycles of different CO concentrations and purge with air after each cycles, followed by variations in a normalized resistance study. The results obtained from the gas sensing analysis disclose that the incorporation of AC into flowerlike NiO spheres increased the conductivity and surface area of NiO/AC composite and subsequently enhancing the CO sensing performance of NiO/AC based sensors. These results suggest that the NiO/AC composite could be an excellent electrode material for CO gas sensors.

46 - Effect of pressure on the nanostructured of TiO2 during recrystallisation

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.046) [For award: MSc]*

Primary author: PHAAHLA, Tshegofatso Michael *(University of Limpopo)*

Titanium dioxide (TiO2) nanoparticles, nanowires, nanosheets and nanoporous are of great interest in many applications. This is due to inexpensive, safety and rate capability of the material. It has being considered as a replacement of graphite anode material in rechargeable lithium batteries. In this work we use molecular dynamics simulations to investigate the effect of pressure on nanostructures of TiO2 during recrystallisation, employing DL_POLY code. We have successfully recrystallised all four nanostructures from amorphous precursors. Configuration energies, calculated as a function of time, were used to monitor the recrystallisation. Calculated X-Ray Diffraction (XRD) spectra, using the model nanostructures, reveal that the nanostructures are polymorphic with TiO2 domains of both rutile and brookite in accord with experiment. At higher pressure the configuration energy depict that systems takes long to recrystallise and also indicate that the brookite phase is disappearing. Compression of 75 and 1000 KPa structures is equivalent to the insertion of lithium atoms generated by Matshaba. Bulk structure indicate channels where lithium atoms can move during charging or discharging.

48 - Assessment of biomass torrefaction effect on gasification efficiency

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.048) [For award: PhD]*

Primary author: ANUKAM, Anthony *(University of Fort Hare)*

Co-authors: *MAMPHWELI, Sampson (University of Fort Hare); REDDY, Prashant (Durban University of Technology); MEYER, Edson (University of Fort Hare); OKOH, Omobola (University of Fort Hare)*

Sugarcane bagasse was torrefied to improve its quality in terms of thermal and physical properties prior to gasification. Torrefaction of sugarcane bagasse was undertaken at 300 °C in a chemically inactive atmosphere of N2, and at 10 °C min-1 heating rate. A residence time of 5 minutes allowed for the rapid reaction of the material during torrefaction. Torrefied and untorrefied (untreated) bagasse were characterised to compare their suitabilities as feedstocks for gasification. The results showed that torrefied SCB has a lower O-C ratio, a higher H-C ratio and a higher heating value of 20.19 MJ kg-1 than untorrefied bagasse, confirming that the former is much more suitable as a feedstock for gasification than the latter. SEM results also revealed a fibrous structure and pith in the micrographs of both torrefied and untorrefied bagasse, indicating that both materials are carbonaceous in nature, with torrefied bagasse exhibiting a more permeable structure with larger surface area; these are features which favour gasification. The gasification process of the torrefied material relied on computer simulation to establish the impact of torrefaction on the conversion efficiency of the process. Optimum conversion efficiency was achieved with torrefied bagasse due to a number of factors, one of which included the slightly modified properties of torrefied bagasse. Conversion efficiency of the gasification process of torrefied bagasse increased from 50 % to approximately 60 % after computer simulation, whereas that of untorrefied bagasse remained constant at 50 % even as gasification time increased.

49 - Phase Stability Study of Nickel Doped Spinel $LiMn_2O_4$ Using Cluster Expansion Method

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.049)*

Primary author: MALATJI, kemeridge Tumelo *(University of Limpopo)*

One of the challenges for improving the performance of lithium-ion batteries to meet increasingly demanding requirements for energy storage is the development of suitable cathode materials. Spinel-structured $LiMn_2O_4$(LMO) is a desirable cathode material for Li-ion batteries, due to its low cost, abundance and high power capability. However, LMO suffers from limited cycle life that is triggered by manganese dissolution into the electrolyte during electrochemical cycling. Doping in battery materials tends to improve the efficiency in maintaining electrochemical capacity over a large number of cycles without sacrificing initial reversible capacity at room temperature. In this paper, Universal Cluster Expansion (UNCLE) code implemented in cluster expansion formalism is used to investigate nickel doped LMO phase stabilities. The method determines stable multi-component crystal structures and rank metastable structures by enthalpy of formation, while maintaining the predictive power and accuracy of first-principles density functional methods. Complex configurations of nickel doped LMO systems with various concentrations are determined at different temperatures by means of Monte Carlo random sampling. The ground state phase diagram generated various structures with different concentrations and symmetries. The findings predict that nickel doped LMO with 50:50 concentration of manganese and nickel is the most stable phase.

52 - Nonlinear optical processes and saturated absorption spectroscopy in two and multi-level atoms: a theoretical and numerical study

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.052) [For award: MEng]*
Primary author: PATEL, Meena *(Cape University of Technology)*
Co-authors: *GOVENDER, Kessie (Cape Peninsula University of Technology); DE JAGER, Gerhard (University of Cape Town); NKOSI, Zakhele (Cape Peninsula University of Technology)*

In this presentation we report on the study of two-level and multi-level atoms interacting with one or more laser beams. The system is analyzed using the semi-classical approach where the dynamics of the atom is described quantum mechanically using the Liouville equation, while the laser is treated classically using Maxwell's equations. Firstly, we present results of a two-level atom interacting with a single laser beam and demonstrate Rabi oscillations between the two levels. We then examine the effects of laser modulation on the dynamics of the atom. Plots of the density matrix elements (population and coherence terms) as a function of time are presented for various parameters such as laser intensity, detuning, modulation etc. In addition phase-space plots and Fourier analysis of the density matrix elements are provided. The atomic polarization is estimated from the coherence terms. This, together with the populations, is used to determine the behavior of the laser beams as they pass through the atomic ensemble.The behavior of the laser as it propagates through the atomic ensemble is studied by solving Maxwell's equations numerically, initially with an assumed polarization and population from theory and later from the solution of the Liouville equation. The two-level system is further extended to include a second counter propagating laser beam and the effects of saturation and hole burning is demonstrated. The above work will be expanded to simulate saturated absorption spectroscopy of Rubidium gas.

53 - Outreach and Education with the Virtual Observatory

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.053)*
Primary author: EL BOUCHEFRY, Khadija *(HartRAO)*

The Virtual Observatory (VO) is an international astronomical community-based initiative. It is a global collaboration of the world's astronomical communities under the International Virtual Observatory Alliance (IVOA). The VO allows global access to the astronomical archival data from space and ground-based astronomical observatories, multi-wavelength catalogues and related computational resources. It is a collection of tools for accessing and visualizing multi-wavelength data that collectively provide a scientific environment, rather than a physical observatory. The VO not only enable astronomers with new mode of research through the VO tools, it also offers a great opportunities for education and public outreach. For teachers and astronomers who are involved in promoting a better understanding of astronomy in society the VO is a powerful tool to access and use real astronomical data needed in an educational situation.

56 - Effect of annealing temperature on LiMn2O4 nanostructures prepared by chemical bath method

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.056)*
Primary author: KOAO, Lehlohonolo *(UFS (Qwa Qwa Campus))*
Co-authors: *SWART, Hendrik (University of the Free State); DEJENE, Birhanu (UFS (Qwa Qwa))*

LiMn2O4 powders were prepared by chemical bath method using ammonia solution as a catalyst. The effect of annealing temperature on the thermal analysis, structure, morphology and optical properties of LiMn2O4 nanostructures were investigated. The annealing temperatures were varied from 25 up to 1000°C. The thermogravimetric analyses (TGA) and differential scanning calorimeter (DSC) showed that the final yield decreases with an increase in the annealing temperature. The X-ray diffraction (XRD) patterns of the LiMn2O4 nanostructures correspond to the various planes of a spinel LiMn2O4 phase. It was observed that the secondary phases decreases with an increase in annealing temperature. The diffraction peaks increase in intensity with an increase in annealing temperature. The estimated average grain sizes calculated using the XRD spectra were found to be in the order of 50 ± 1 nm. It was observed that the estimated average grain sizes increases with an increase in annealing temperature. The surface morphology study revealed the irregular nanoparticle. The irregular nanoparticle increased in size with an increase in annealing temperature. The UV-Vis spectra showed a red shift with an increase in annealing temperature. The band gap energy of ZnO was also found to decrease.

57 - Thermoluminescence investigation of Sm^{3+} activated $NaSrBO_3$ phosphors for gamma dosimetry.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.057) [For award: PhD]*
Primary author: BEDYAL, Ankush Kumar *(Department of Physics, University of Free State)*
Co-authors: *NTWAEABORWA, Odireleng (University of the Free State); SWART, Hendrik (University of the Free State); KUMAR, Vinay (Shri Mata Vaishno Devi University, Katra)*

Thermoluminescence characteristics of Sm^{3+} activated $NaSrBO_3$ phosphors synthesized by solid state method and combustion method have been studied. The phosphors were investigated for their crystal structure using powder X-ray diffraction. A Thermoluminescence (TL) study was carried out after exposing the samples to γ-radiation in the range of 0.01-5 kGy. The TL glow curves exhibited a prominent peak at a lower temperature 402 K and a small hump at 466 K for the samples synthesized by combustion method whereas the glow peaks position shifted towards higher temperature for the samples synthesized by solid state method. The intensity of the peaks raised with the increase in the dose of the gamma rays (0.01–5 kGy). The TL intensity has also improved when synthesis by combustion method. The phosphors exhibited sublinear TL response to gamma-radiation over a wide range of gamma doses (0.01–5 kGy). To analyze the glow curves the TLanal program was used at different doses (0.2–5 kGy). In addition to this, the trapping parameters of all the samples were also calculated using Chen's peak shape method.

63 - Investigating the Gamma-Ray Strength Function in 74Ge using the Ratio Method

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.063) [For award: MSc]*
Primary authors: SOWAZI, Khanyisa *(University of the Western Cape); WIEDEKING, Mathis (iThemba LABS)*
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As excitation energy increases from the ground state towards the separation energy, the density of nuclear states increases exponentially. In this region of high level density, called the quasi-continuum, it is impossible to distinguish between individual states, since the level spacing becomes very small and in some cases the levels can even overlap. This is the regime where nuclear properties are best described by statistical quantities. As such, the gamma-ray strength function, which is the ability of atomic nuclei to emit and absorb photons with energy Eγ, is a measure of the probability for an excited nucleus to decay to low-lying states. These gamma-ray strength functions are input parameters to calculate cross sections such as (n,γ) and (p,γ) which are vital to improve our understanding on how elements are generated in astrophysical processes. I will present preliminary results of our research focusing on 74Ge, populated in the 74Ge(p,p') reaction at a beam energy of 18MeV. The data was collected with the STARS-LIBERACE array at Lawrence Berkeley National Laboratory. Silicon detector telescopes were used for particle identification and gamma rays in coincidence were detected in 5 Clover-type high-purity germanium detectors. The gamma-ray strength function of 74Ge is extracted through the recently established Ratio Method [1] and will be discussed in the context of other work done in 74Ge using the (γ,γ') [2], (3He,3He') [3] and (α,α') [4] reactions.

69 - Blue-yellow luminescence of Eu-doped CaSnO3 nanopowders synthesized by the sol-gel autocombustion process

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.069)*
Primary author: YIHUNIE, Moges Tsega *(University of the Free State (qwaqwa campus))*
Co-author: DEJENE, F. Birhanu *(UFS)*

Undoped and Eu-doped CaSnO3 nanopowders were prepared by a facile sol-gel autocombustion method calcined at 800 oC for 1h. The crystal structure of the nanopowders is identified by the X-ray diffreaction (XRD) technique, and it is found that all samples showed pure orthorhombic CaSnO3 structure. Photoluminsence measurements indicated that the undoped sample exhibits a broad blue emission at about 420■440 nm, which can be attributed to the recombination of self-trapped excitons. Additional sharp emission lines at 465, 592 nm were obtained in the Eu-doped CaSnO3 sample and these emission lines were assigned to the f-f transition of 5D1■5D0, 5D0■7F1 in Eu3+ ions. The mixture of this blue and yellow luminescence gives white color in Eu-doped doped CaSnO3 sample under UV excitation.

70 - Facile hydrothermal synthesis of $Ni(OH)_2$-graphene foam composite for supercapacitor application

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.070) [For award: PhD]*
Primary author: KHALEED, Abubakar *(University of Pretoria)*
Co-authors: *BELLO, Abdulhakeem (Department of Physics University of Pretoria); DANGBEGNON, Kouadio Julien (University of Pretoria); MOMODU, Damilola (UNIVERSITY OF PRETORIA); MANYALA, Ncholu (University of Pretoria)*

Recently, one of the greatest scientific and engineering problems is the realization of a highly efficient energy and storage systems. Electrode materials are key to enhancing performance in a number of important energy storage technologies such as supercapacitors and batteries. Electrochemical capacitors also known as supercapacitors or ultracapacitors have become attractive and suitable in energy storage systems due to their extremely high power performance, moderate energy density and excellent cycle life. $Ni(OH)_2$ has been identified as one of the most interesting transition metal hydroxide material owing to its easy synthesis, low cost and high theoretical capacitance. Thus, the design and synthesis of the nanoscale $Ni(OH)_2$ based electrodes for high performance supercapacitors ha attracted many attentions. In this work, we explore the synthesis of $Ni(OH)_2$-graphene foam (GF) composite via a facile hydrothermal reflux technique, and have investigated its potential use for supercapacitor application. The results obtained from the scanning electron microscopy showed that $Ni(OH)_2$ spheres were uniformly distributed on the surface of the graphene foam. The specific capacitance of $Ni(OH)_2$-GF composite electrode was found to be 2420 F/g at a current density of 1 A/g with a coulombic efficiency of ~93% after 1000 charge/discharge cycles, demonstrating excellent cycle stability in 6.0 M KOH aqueous electrolyte. These results suggest that $Ni(OH)_2$-GF composite could be a potential electrode material for high performance electrochemical applications.

73 - van Hove singularities in $Sr_3Ru_2O_7$

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.073) [For award: Hons]*
Primary author: *TSUEN, Jessica (University of Johannesburg)*
Co-authors: *CARLESCHI, Emanuela (Department of Physics, University of Johannesburg); DOYLE, Bryan (University of Johannesburg)*

The metamagnetism found in the 4d transition metal oxide $Sr_3Ru_2O_7$ is investigated by analysing a large set of high quality angle-resolved photoelectron spectroscopy (ARPES) data on $Sr_3Ru_2O_7$, that was collected at the synchrotron radiation facility BESSY in Berlin, Germany. The unusual iterant metamagnetism is theoretically predicted to be caused by van Hove singularities (vHs), which are narrow peaks in the electronic bands in the vicinity of the Fermi energy level, E_F. The application of a magnetic field can cause these peaks to move and cross E_F. The peaks are spin-polarised giving rise to a sharp incline in the magnetisation when they shift past E_F. The ARPES data obtained was used to locate such peaks in the electronic density of states. Normalised line profiles were extracted at various values of $k_{//}$ and peaks close to E_F were fitted to determine their energy. The histogram counting method developed by Tamai et al. [1] was used to find the position of the vHs's as a function of energy at various locations on the Fermi surface. This method ignores matrix element effects and statistically allows for a higher resolution than the experimental one. The majority of the peaks were found within 5 meV of E_F, which corresponds to the Zeeman shift at the metamagnetic transition. This supports the hypothesis that spin-polarised vHs's underlie the metamagnetism in this system.[1] A. Tamai *et al.*, Phys. Rev. Lett. 101, 026407 (2008).

76 - First-principle study of $Ti_{50-x}Pt_{50}Zr_x$ High temperature shape memory alloys

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.076) [For award: MSc]*
Primary author: *MASHAMAITE, Mordecai (Materials Modeling Centre)*
Co-authors: *CHAUKE, Hasani (University of Limpopo); NGOEPE, Phuti (University of Limpopo)*

Shape memory alloys (SMAs) exhibits two unique properties namely the shape memory effect and superelastisity which occur as a results of face transformation. These properties enable the metals to remember their previous shape after being deformed when heated above certain temperatures. The effect of ternary addition Zr on B2 TiPt SMAs has been investigated using density functional theory. The supercell approach embedded in VASP code was used to partially substitute Ti with Zr atom on the cubic TiPt to form TiPt(Zr). Their structural, mechanical properties and temperature dependence have been calculated. It was found that the shear modulus for $Zr_{6.25}Ti_{43.75}Pt_{50}$ and $Zr_{18.25}Ti_{31.25}Pt_{50}$ is negative suggesting mechanical instability, while a positive shear modulus is observed for $Zr_{25}Ti_{25}Pt_{50}$ (mechanical stability). The phonon dispersions for the $Zr_{6.25}Ti_{43.75}Pt_{50}$, $Zr_{18.25}Ti_{31.25}Pt_{50}$ and $Zr_{25}Ti_{25}Pt_{50}$ shape memory alloys were calculated and the phonon dispersion curves revealed a softening of modes along high symmetry directions M, R and Γ. This is due to C44 being > C', which corresponds to branches in the negative direction. Furthermore, LAMMPS code was used to determine the lattice expansion of the $Ti_{50-x}Pt_{50}Zr_x$ ternaries at various temperature range. It was observed that as Zr content is increased with increased temperature, the structure remains cubic below 900K. However, at temperature above 900K, the lattice parameter are different ($a \neq b \neq c$) suggesting a possible transformation from a cubic to triclinic phase.

78 - Improving gas sensing properties of multi-walled carbon nanotubes by vanadium oxide encapsulation

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.078)*
Primary author: *CHIMOWA, George (Council of Scientific and Industrial Research)*
Co-authors: *TSHABALALA, Zamaswazi (Council of Scientific and Industrial Research); MWAKIKUNGA, Bonex (Council of Scientific and Industrial Research); RAY, Suprakas S. (Council of Scientific and Industrial Research)*

Manipulation of electrical properties and hence gas sensing properties of multi-walled carbon nanotubes by filling the inner wall with vanadium is presented. Using a simple capillary technique, multi-walled carbon nanotubes are filled with vanadium oxide and this significantly enhances their sensitivity for gas detection. The encapsulated vanadium oxide inside the inner walls of carbon nanotubes increases the density of states around the Fermi level for the composite material and this improves the sensitivity of the filled carbon nanotubes. An adsorption mechanism on three different sites on the carbon nanotube surface based on the Langmuir model is proposed. This work further highlights the influence of ambient oxygen in carbon nanotubes based sensors an aspect which has not been clearly outlined in many earlier theoretical and experimental studies.

79 - Characterization and implications of Soot generated from Pinewood gasification

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.079) [For award: MSc]*
Primary author: *MELAPI, Aviwe (University of Fort Hare)*
Co-authors: *MAMPHWELI, Sampson (University of Fort Hare); KATWIRE, David (University of Fort Hare); MEYER, Edson (University of Fort Hare)*

Pinewood gasification refers to a thermochemical process whereby Pinewood is broken down to syngas and some byproducts in the presence of a limited supply of gasifying agent which may be oxygen, steam, hydrogen or even air. Syngas is a composition of carbon monoxide (CO), hydrogen (H2), nitrogen (N2), carbon dioxide (CO2), methane (CH4) and some hydrocarbons. The syngas is normally used for power generation, space heating and production of some chemicals. As the syngas is produced, simultaneously the byproducts are produced and one of the byproducts produced is the soot, a carbonaceous material resulting from an incomplete combustion of wood. The generated soot was characterized using different analytical techniques such as Fourier Transform Infrared (FTIR), Scanning Electron Microscope (SEM), Oxygen Bomb Calorimeter as well as the Elemental Analyzer. Preliminary results of the study have shown the caloric values of 25.54, 24.80, 25.20MJ/Kg with a calculated mean value of 25.18MJ/Kg. The FTIR spectrum revealed that the sample is composed of C=C, O-H, C-H, C-O, C-C functional groups. The elemental analyzer revealed an elemental composition of 78.9% Carbon, 2.0% Hydrogen, 0.8% Nitrogen, 1.1% Sulfur and 17.3% Oxygen. The final paper will present the rest of the obtained results.

80 - Structure and luminescence of sol-gel spin coated ZnO films

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.080) [For award: MSc]*
Primary authors: *HASABELDAIM, Emad (University of the Free State); COETSEE, Elizabeth (University of the Free State)*
Co-authors: *KROON, Ted (University of the Free State); NTWAEABORWA, Odireleng (University of the Free State); SWART, Hendrik (University of the Free State)*

ZnO thin films were successfully synthesized by the sol-gel method using spin coating. The films were annealed at 600 °C in air for 2 h and then in a flowing Ar-H2 reducing atmosphere for different times. The unannealed film was amorphous. A c-axis preferred orientation exhibiting the (002) plane was obtained for the films that were annealed at 600 °C in air. The films annealed in the reducing atmosphere contained a secondary phase of ZnOH identified by X-ray diffraction. Scanning electron microscopy images confirmed that the annealed films contain spherically shaped particles. The annealing temperature and environment have an effect on the optical properties of the thin films. The unannealed film exhibited a strong ultraviolet (UV) emission around 387 nm as well as a weak deep level emission in the visible range. Annealing in air increased the deep level emission relative to the UV emission. The films annealed in the reducing atmosphere exhibited primarily a green emission around 511 nm and the UV emission was very weak. The films were also exposed to a prolonged electron bombardment in vacuum and the films annealed in a reducing atmosphere for longer times showed reasonable stability these conditions.

83 - The design of a cost effective high precision time measurement unit for use in a Hanbury-Brown Twiss interferometer

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.083)*
Primary author: *JAMES, Stubb (CPUT)*
Co-authors: *DE JAGER, Gerhard (UCT); GOVENDER, Kessie (Cape Peninsula University of Technology)*

Single and entangled photon sources are usually characterized by measuring the first and second order coherence function. The Hanbury-Brown Twiss interferometer is used to measure the second order coherence function. This research will discuss the design of a cost effective high resolution time measurement unit, which will be used to characterize entangled photons generated via four-wave-mixing in Rubidium vapour. This requires the design of a device that will be capable of measuring the time interval between the arrivals of two photons with a resolution of about 1ns. Currently field programmable gate arrays (FPGA) are a popular choice to perform these types of measurements. We review the design methods implemented by FPGAs such as tapped delay lines, the Vernier Method and the use of ISERDES and describe the potential resolution an FPGA can achieve. We report here on the design and construction of a device with similar capabilities using a PIC micro-controller, making use of its capacitive time measurement unit (CTMU) to implement a time-to-amplitude conversion (TAC). The digitized output of the TAC is then relayed to Labview for further processing.

84 - Characterization and Thermal Load Impact of Reflective Coatings on a Low Cost House in Alice, South Africa

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.084) [For award: PhD]*
Primary author: *OVEREN, Ochuko Kelvin (Physics Department, University of Fort Hare)*
Co-author: *MAKAKA, Golden (Physics Department, University of Fort Hare)*

Optical properties of paint include transmission or reflection of infrared radiation. These properties can improve building energy consumption by minimizing uncontrolled heat transfer through the thermal envelope. The aim of this study is to investigate the thermal insulation properties of reflective coatings. Scanning Electron Microscopy/Energy Dispersive X-ray spectroscopy (SEM/EDX) was adapted to characterize the surface morphology and elemental composition of the coat. The IR wavelength transmission range of the coat was also analyzed using Fourier Transform Infra-Red (FTIR) techniques while thermal camera was used to analyze its thermal resistance. A low-cost house in Golf Course, Alice was used to analyze the thermal load impact of the reflective coats on the wall inner surfaces. The thermal load of the building before and after coating was determined using monthly energy-balance method. The SEM image shows that the coat is transparent to light. The presence of Al as Al2O and other elements were revealed by the EDX spectrum. A strong reflection of IR radiation between 8.00 µm and 15.00 µm of the Mid-IR region was observed from the FT-IR spectrum. To maintain the indoor temperature within the comfort zone, the occupants will consume a maximum heating energy of 9.35 kWh/m2 in winter season and cooling energy of 5.66 kWh/m2 in summer season. After coating, the heating energy was reduced by 34%, amounting to 4.99 kWh/m2 and 30% reduction in the cooling energy, to give 2.53 kWh/m2. The reflective coating reduces the heat transfer through the building walls by reflecting mid-IR radiation, thereby decreasing the thermal load. Hence, it is a suitable building thermal insulation material.

85 - Precise visualisation of dispersive low-energy features in ARPES spectra

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.085) [For award: Hons]*
Primary author: *VAN NIEKERK, Chani (Department of Physics, University of Johannesburg, PO Box 524, Auckland Park 2006, South Africa)*
Co-authors: *CARLESCHI, Emanuela (Department of Physics, University of Johannesburg, PO Box 524, Auckland Park 2006, South Africa); DOYLE, Bryan (Department of Physics, University of Johannesburg, PO Box 524, Auckland Park 2006, South Africa)*

It is known that the band structure of crystalline solids can be represented in the form of two dimensional images produced experimentally by Angle Resolved PhotoElectron Spectroscopy (ARPES). The images reproduce the energy of the bands as a function of momentum in reciprocal space. Various parameters can be extracted from the dispersion of the above mentioned bands and the line shape of the quasi-article peaks associated with them. This provides very valuable information on the interaction between low energy electrons and other excitations, e.g. phonons. It is these interactions that lead to the exciting phenomena found more recently in condensed matter.When ARPES data is measured, it can be found that the above mentioned parameters are sometimes difficult to extract directly from the raw data due to the nature of the bands formed at low energies. Recently Zhang and co-workers at the Chinese Academy of Sciences have developed a method [1] which uses the mathematical concept of two-dimensional curvature to better image features in bands, in particular in shallow bands. We have used this technique to analyse the low-energy band dispersion of the correlated oxides $Sr_3Ru_2O_7$ and $Sr_4Ru_3O_{10}$ and have accurately extracted the parameters of those bands. Results of this analysis will be shown and discussed.In particular our analysis reveals the existence of flat bands (of bandwidth ~ 5 meV), which give rise to van Hove singularities and kinks around the high symmetry points of the first Brillouin zone in the proximity of the Fermi level. These bands are deemed to be responsible for the metamagnetic ground state of these systems.

87 - Stochastic differential equations as a powerful numerical tool

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.087)*
Primary author: *STRAUSS, Du Toit (Centre for Space Research, North-West University)*
Co-author: *MOEKETSI, Daniel Mojalefa (CSIR Meraka Institute (CHPC))*

Any diffusion equation (second-order partial differential equation) can, in principle, be re-written into a set (as is the case for higher dimensions) of stochastic differential equations (SDEs), which are, for the most part, much easier to solve numerically. Applying this approach to simulating the propagation of charged particles in astrophysical plasmas, we illustrate the use of this powerful numerical solver. Example solutions are shown and discussed for a variety of different model set-ups and boundary conditions. We also illustrate the effectiveness of this numerical approach when executing the model on parallel computing systems and graphical processing units (GPUs).

88 - Dynamic Model to Evaluate the Performance of Residential Air Source Heat Pumps in South Africa

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.088) [For award: MSc]*
Primary author: *NANA, YONGOUA (Fort Hare Institute of Technology)*
Co-authors: *TANGWE, Stephen Loh (Fort Hare Institute of Technology, University of Fort Hare); SIMON, Michael (FHIT)*

The market of air source heat pumps water heaters for sanitary hot water production is fast gaining maturity in South Africa following the Rebate program that targeted the installation of 65,580 Air source heat pump units by 2013. The performance of these Air source heat pump units are expected to vary depending in which of the 6 climatic zones they are installed. In a bid to quantify the energy savings from these air source heat pump water heaters as well as to predict with better accuracy their performance depending on their locations, a steady-state model using the Number of Transfer unit method for the heat exchanger is developed that simulates air source heat pump water heater units under typical weather conditions as depicted in the 6 different climate zones classification by SANS 204. Results shows that all the air source heat pump water heaters achieve a COP (Coefficient of performance) between 2.8 to 3.3 with the highest COP in climate zone 3. The steady-state model also reveals strong correlation with experimental data collected in climate zone 5 (Alice, Eastern Cape), with a determination coefficient of 0.963.Keywords: Steady-state model, Air source heat pump water heater, COP and Renewable and energy efficient technology, Climate zone

89 - Performance evaluation of a domestic split-type air conditioner in South Africa, a case study of ALICE

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.089) [For award: MSc]*
Primary author: *BANTAN MAFOR, GLORY (UNIVERSITY OF FORT HARE)*
Co-authors: *SIMON, Michael (FHIT); TANGWE, Stephen Loh (Fort Hare Institute of Technology, University of Fort Hare)*

Air conditioners (AC) are gaining grounds in the South African community especially in the residential and commercial sectors. Approximately 2.6 million air conditioners were installed by 2010 and an anticipated 73% increase in this number is expected to be installed by 2020. The split-type is more popular than other types of AC and simple to install and maintain. Increase in the utilization of this device without strategic controlled measures implies increase in power and energy consumption, defeating the purpose for which South African Electricity public Utility company initiated the Demand Side Management and Integrated Demand Management programs. Hence, there is a need to ensure that these systems are energy efficient to minimize constraint on the national grid. The paper presents an evaluation of the electrical and thermodynamic performance of a domestic split-type AC by demonstrating how the temperature of the refrigerant at some critical points in both the indoor and outdoor unit, relative humidity and ambient temperature (RH/T) influence the Coefficient of Performance (COP) and power consumption of the system with the aid of a regression model. The split-type AC system was sized for a living room of a residential home in Alice, Eastern Cape Province. A power meter, temperature and RH/T sensors were used to build up the Data Acquisition System. The result obtained revealed that the regression model could be conveniently used to depict the COP and the power consumption of the system since the determination coefficient of COP and Power consumption were 0.98 and 0.97 respectively. It also showed the impact of temperature at critical points in the AC and RH/T on the performance of the system.

96 - Molecular dynamics studies of Lithium intercalation into amorphous structure of Titanium dioxide (TiO_2) nanoparticle

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.096)*
Primary author: *MATSHABA, Malili (University of Limpopo)*
Co-authors: *NGOEPE, Phuti (University of Pretoria); SAYLE, Dean (University of Kent)*

Titanium dioxide (TiO_2) has been confirmed as a safe anode material in lithium ion batteries due to its higher Li-insertion potential, (1.5V) in comparison with commercialised carbon anode materials. Besides being used as an anode material it has a wide range of applications such as photo-catalysis, insulators in metal oxide, dye sensitized solar cells etc. In this work amorphous nanoparticle (NP) of TiO_2 comprising of 15972 atoms was lithiated with a different concentration of Lithium atoms. Simulation of amorphisation and re-crystallisation was employed to attain Li-TiO_2 nanoparticles and its microstructures. Molecular dynamics has been performed to crystallise all intercalated nanoparticles using the computer code DL_Poly. The crystallisation of the materials, starting from amorphous precursors, and the complex microstructure of the material was captured within each structural model including: polymorphic rutile and brookite structures, dislocations, grain boundaries, micro-twinning, vacancies, interstitials, surfaces and morphology. Microstructure depict the Lithium atoms situated on the tunnels and vacancies, shows that the material can store and transport Lithium during charging and discharging, making it an attractive anode material. Calculated X-Ray diffractions are in accord with the experimental data revealing the presence of brookite and rutile phases.

100 - Formation of a Thin Film of AB compound Layer at a Low Irradiation Temperature under the Influence of Radiation Induced Interstitial.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.100) [For award: PhD]*
Primary author: *AKINTUNDE, Samuel (University of Pretoria)*

A radiation-induced defect generation approach is developed that describes the formation of a thin-film of an AB compound layer under the influence of radiation-induced interstitial. The A and B immiscible layers are irradiated with a beam of energetic particles and this process leads to the displacement of lattice atoms in both layers by energetic particles. A number of surface lattice atoms in A and B layers moves into interstitial sites and thereby become A and B interstitial atoms. The interstitial atoms diffuse via interstitial mechanisms to the reaction interfaces A/AB and AB/B. The AB compound layer formation occurs as a result of chemical transformation between the diffusing interstitial atoms and surface lattice species at reaction interfaces. This chemical reaction takes place under a diffusion limited process due to the dependence of reaction rate on both interstitial and surface lattice species' densities. The approach described here reveals radiation- induced interstitial (a radiation enhanced diffusion type) as the dominant diffusion mechanism during the formation of a thin-film of an AB-compound layer. This process takes place at a temperature lower than AB compound layer formation under non-radiation process using cobalt silicide and tungsten disilicide as a case study. This approach is in good agreement with experiment.

101 - Pulsed laser deposited KY3F10:Ho3+ phosphor thin films

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.101) [For award: PhD]*
Primary author: *DEBELO, Nebiyu (University of the Free State)*
Co-authors: *DEJENE, Franscis (University of the Free State); RORO, Kittessa (CSIR)*

Thin films of KY_3 F_10:Ho^(3+)phosphor have been successfully prepared by pulsed laser deposition on (100) silicon substrate. The effect of high and low deposition pressures on the structural, morphological and luminescence properties of the films were investigated. The X-ray diffraction (XRD) results show that the films crystallized in tetragonal polycrystalline phase of KY_3 F_10 (in agreement with JCPDS card No 27-0465). Field Emission Scanning Electron Microscope (FE-SEM) and Atomic Force Microscope (AFM) results show clear grains of the deposited films. The EDS elemental mapping result shows Yttrium excess. The thickness of the films was estimated using a weight difference method employing a sensitive electronic microbalance. Green PL emission at 540nm was investigated at four excitation wavelengths; namely, 362, 416 and 454 and 486nm. The highest PL intensity occurred at excitation of 454nm. In addition, red emission was observed at 650 and 750nm for all the excitations. The green emission at 540 nm is ascribed to the 5F4–5I8 and 5S2–5I8 transitions, the red emission at 750 nm are due to the 5F4 –5I7 and 5S2–5I7 transitions of Ho^(3+).

102 - Characterization of a Q-Plate in terms of Hyper-Geometric Gaussian modes

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.102) [For award: MSc]*
Primary author: *SEPHTON, Bereneice (CSIR National Laser Centre; Wits Physics Department)*
Co-authors: *FORBES, Andrew (CSIR); DUDLEY, Angela (CSIR National Laser Centre)*

The q-plate (QP) is a recently (2006) developed geometric-phase optical element, proving to be invaluable due to its ability to couple the spin and orbital angular momentum (OAM) of light. Currently gaining importance in the advancement of scientific research, the q-plate is utilized in quantum information transfer, quantum cloning, encoding information in photons and precise, non-contact measurement of mechanical rotations as well as recent research into the physical implementation of the quantum walk. Imperfect transformation has been indicated to occur within the QP, whereby the input beam incurs additional radial modes which can be mathematically described in terms of Hyper-Geometric Gaussian modes. It is therefore important to characterize its operation. In this work, characterization of a QP and quarter wave plate (QWP) for the implementation of a quantum walk was executed. Theoretical and experimental studies on polarization and modal transformation were employed on these two optical elements. The effect of the QWP orientation and fast axis angle on linearly polarized light is demonstrated. Further confirmation of polarization and OAM transformations exacted by a q = 0.5 QP are quantified. The outcomes were found to correlate well with theoretical expectations. Furthermore, the incurrence of additional radial modes on an incident beam is demonstrated by experimental decomposition of the generated beam into a Laguerre-Gaussian basis set. Finally, the mathematical description of a QP output mode as a Hyper-Geometric Gaussian mode is experimentally verified.

110 - Synthesis of nanostructured molybdenum disulfide (MoS2) for photodegradation of organic dyes from aqueous solution

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.110) [For award: MSc]*
Primary author: *MADIMA, Ntakadzeni (University of Johannesburg)*

The increase in wastewater pollution of ground and surface water as a results of organic dyes and toxic metal ions have become a greater threat to human health and other organisms. Greater attention has been paid on removal of organic dyes from wastewater using two-dimensional (2D) nanomaterials. 2D nanomaterials such as transitional metal dichalcogenides (TMDs) have shown a greater potential towards wastewater treatment. Nanostructured MoS2 belongs to TMDs family and has received much research interest due to its versatile application in catalysis. Here, we present the facile hydrothermal route for synthesis of nanostructured MoS2 by using sodium molybdate and different sulphur source and capping agents as the precursors, and evaluation of its applications toward the photodegradation of organic dyes. As synthesized MoS2 nanostructured were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), scanning electron microscopy (SEM), photoluminescence spectroscopy (PL), Raman spectroscopy, and UV–Vis spectroscopy. Rhodamine B and Methyl orange was chosen as a model for organic dyes and used to evaluate the photocatalytic performance of the MoS2 nanostructure under UV-Vis light. The prepared MoS2 nanostructure shows a greater potential in photodegradation of those organic dyes in water. Furthermore, we are fabricating hetero-structure of MoS2 with other semiconductor nanomaterials for enhancement of photo-catalytic study.Key words: Photodegradation, Rhodamine B, Methyl orange, Hydrothermal, Metal dichalcogenides.

114 - The design and performance monitoring of fabricated Biogas Digester using plastic

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.114) [For award: PhD]*
Primary author: *OBILEKE, KECHRIST (UNIVERSITY OF FORT HARE)*
Co-author: *MAMPHWELI, SAMPSON (UNIVERSITY OF FORT HARE)*

Biogas digester convert organic waste into biogas, which is a mixture of approximately 60% methane and 40% carbon dioxide with trace of gases such as sulphur dioxide.The gas can be used for cooking and heating applications as well as combustion in internal combustion engines and gas turbines for heat and electricity production.There exist various types of biogas digesters, which includes fixed dome,floating drum and balloon type. The construction or fabrication of fixed dome digesters is usually undertaken using bricks and in some cases the dome or gas holder is made of fiberglass. These digesters are mainly characterized by defects such as cracks in the bricks structure thereby making it necessary for consideration of alternative methods of construction or fabrication. This research employs sizing, fabrication and performance monitoring of fixed dome biogas digester using plastic.The final paper will present the results obtained from the study.

117 - Effect of annealing of P3HT:PCBM blend in the performance of organic solar cell devices

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.117) [For award: MSc]*
Primary author: *OTIENO, Francis (Witwatersrand University)*

The performance of bulk heterojunction organic solar cells based on Poly (3-hexylthiophene) (P3HT) and 1-(3-methoxycarbonyl)-propyl-1-phenyl-(6,6)C61 (PCBM) can be enhanced by annealing of the blend. In this work, the effect of pre-heat treatment of the donor material (P3HT) before P3HT:PCBM blend formation on the power conversion efficiency is investigated. Atomic force microscopy, UV-vis spectroscopy, Raman spectroscopy and Photoluminescence (PL) studies on the P3HT and P3HT:PCBM blend films are carried out to establish the optical properties and the kinetics of thermal annealing on the blend. AFM measurements have shown homogenous films with increased surface roughness upon annealing. This indicates an improved interpenetrated network which increases the optical absorption as corroborated by UV-Vis spectroscopy. Raman spectroscopy has shown that pre-heating of P3HT before blend formation increases its structural order, thereby limiting the diffusion of PCBM due to the formation of P3HT and PCBM domains in the blend matrix. Annealing of the pristine blend favoured the diffusion of the PCBM into the P3HT matrix forming a percolated network that enhanced the short circuit current density Jsc and carrier mobility by up to 6.5% and 4 fold respectively. Conversely devices made with a blend of pre- heated P3HT exhibit a higher degree of de-mixing which reduces the mobility by 84%. The enhanced photo conversion efficiency of 3.5% is attributed to increased P3HT crystallinity and acceptor – donor interfacial area as evident by the increased Raman peak intensity and the reduction of their full width at half maxima (fwhm). The J-V measurements were carried out under Air Mass 1.5, 100mW/cm2 illumination.References.[1] Renewable and Sustainable Energy Reviews 11 (2007) 1388–1413.[2] S.R. Forrest, The limits to organic photovoltaic cell efficiency, MRS bulletin, 30 (2005)28-32.

118 - Estimation of non-prompt fake muon background in scattering of two massive vector bosons (VBS), W W → W W .

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.118)*
Primary author: *MCCONNELL, Lucas (University of Cape Town)*

$W^{\pm}W^{\pm} \rightarrow W^{\pm}W^{\pm}$ is a rare Standard Model process which can be used to investigate the spontaneous symmetry breaking present in the Standard Model. Previous analysis using √s = 8 TeV proton-proton collision data recorded by the ATLAS detector at the Large Hadron Collider analysed $W^{\pm}W^{\pm}$jj production cross sections in two fiducial regions with different sensitivities to the electroweak and strong production mechanisms. Events with two reconstructed same sign leptons ($e^{\pm}e^{\pm}$,$e^{\pm}\mu^{\pm}$, and $\mu^{\pm}\mu^{\pm}$) and two jets were analysed. First evidence for $W^{\pm}W^{\pm}$ production and electroweak only production were observed to a significance of 4.5 and 3.6 standard deviations respectively. Starting in 2015, analysis is underway to attempt to increase the significance for the measurements using √s = 13 TeV proton-proton collision data recorded by the ATLAS detector at the Large Hadron Collider. Since the process is very rare, it is dominated by various backgrounds, one of which is $t\bar{t}$ decay. In this presentation we discuss estimating the fake muon background coming from $t\bar{t}$decay using Monte Carlo simulations.

128 - Metal Oxide N-doped CNTs decorated Gas sensors

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.128) [For award: PhD]*
Primary author: *USMAN, Ibrahim B. (University of the Witwatersrand)*

Carbon nanotube (CNTs) continues to exhibit great potential in their applications as chemical sensors due to their unique chemical and physical properties [1-3]. These hexagonal networks of carbon atoms have been used principally due to their large surface area and their ability to fine tune the electrical properties to increase surface reactivity to reagents such as CH4, CO, H2. In this work N-doped MWCNTs (CNx) were synthesised using horizontal chemical vapour deposition (CVD) at 850 ■C and decorated with metal oxides for sensor applications. The dependence of structural disorder and electrical properties on nitrogen concentration on CNTs is established. Furthermore functionalization of CNx through the side wall decoration with metal oxide (SnO2 and CuO) nanoparticles has been carried out to enhanced surface reactivity. The physo-chemical properties of the decorated CNx have been carried using XRD, Raman, TEM and EDX to establish the coverage and disorder of the nanoparticles onto CNx matrix. As a proof of concept decorated CNx were tested for gas sensing applications through measurements of the change in electrical resistance as a function of analyte composition (0-250ppm) at varying temperatures (300K-700K). REFERENCES1. Brahim, S., et al., Carbon nanotube-based ethanol sensors. Nanotechnology, 2009: p. 7.2. Klein, K.L., et al., Surface characterization and functionalization of carbon nanofibers. Journal of Applied Physics, 2008. 103: p. 26.3. Wang, Y. and J.T.W. Yeow, A Review of Carbon Nanotubes-Based Gas Sensors. Journal of Sensors, 2009. 2009: p. 24.

140 - Computational Model of solid-state lithium ion batteries

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.140) [For award: PhD]*
Primary author: *JULE, Leta (University of the Free State)*
Co-authors: *DEJENE, Francis (University of the Free State); RORO, Kittessa (CSIR-Energy center)*

It is important to have a simple but accurate model to evaluate the thermal behavior of batteries under a variety of operating conditions and be able to predict discharging currents as well. Theoretical models, which are usually based on a combination of electrochemistry and physics, can give accurate predictions even though they are complicated, need sophisticated measurements, estimation of transport properties and electrochemical reaction constants, to be accurately solved. To achieve this goal, one dimensional tertiary current distribution interface is used to model the electrolyte transport and the electrochemical reactions, solving for the electrolyte potential, the electrolyte concentration of Li ions, and the electric potential of the positive electrolyte-electrode interface boundary. In addition, the model is constructed in COMSOL MultiPhysics 5.2 with MATLAB R2012b to use optimization capabilities for validating the model with measured data. Transport of diluted species interface has been used to model the transport of lithium in the positive electrode, solving for the concentration of solid lithium. It is shown that the model can accurately predict various discharge currents and the different sources of voltage losses. Such models are well-suited for battery design purposes, though not optimal for the low computing-power environment of micro-controllers. Furthermore, it is believed that this modified model was adapted for implementation in battery management systems and can be used for the scale-up of large size batteries and battery packs.

142 - Density Functional Theory study of stability of rutile MnO_2, VO_2 and TiO_2

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.142) [For award: PhD]*
Primary author: *MAENETJA, Khomotso (University Of Limpopo (MMC))*
Co-author: *GRUU-CRESPO, Ricardo (Department of Chemistry, University of Reading, Whiteknights, Reading RG6 6AD, United Kingdom)*

We investigate the structural stability of metal oxides (MO) existing in similar structures, using the density functional theory (DFT) within the generalized gradient approximation (GGA). Stability (structural and electronic) properties of MO; MnO_2, VO_2 and TiO_2 tetragonal structure were determined looking at the tetragonal structure. Cell parameters of the bulk structures of the MO are in reasonable agreement with the experimental values (deviations of approximately 0.8% and -3.1% for a and c, respectively, and of 1.6 % in the cell volume). Phonon dispersion curves show that TiO_2(R), at low temperatures, is the most stable structure since it does not have vibrations in the negative frequencies.

143 - Density functional theory study of PtS surfaces

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.143) [For award: MSc]*
Primary author: *MASENYA, Mamogo (University of Limpopo)*

Precious metal sulphides such as PtS and PdS are major compounds occurring in the Pt and Pd ores, and play an important role as catalyst in the petroleum refining industry. In our previous work, the PtS and PdS minerals were investigated using density functional methods within planewave pseudopotential methods and predicted stability of PtS, $Pt_{12.5}Pd_{37.5}S_{50}$ and PdS phases. The current study is based on the surface properties of PtS and their interaction with oxygen and water molecules. It was found that the (010) surface displayed the lowest energy, hence is the most stable. Furthermore, it was observed that the sodium isobutyl xanthate (SIBX) adsorbs stronger on the surface compared to sodium ethyl xanthate (SEX).

150 - Tin oxides nanostructures: Synthesis, characterization and their photocatalytic application.

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.150) [For award: MSc]*
Primary author: *MALINDISA, RAMOKONE CHRISTINA (UNIVERSITY OF JOHANNESBURG)*

Contamination of waste water by dyes from textile industries is a major concern. Due to the disposal of dyes plants and animals are under hazardous threat. Some of these dyes colour the waste water and as a result they block the penetrating role of sunlight thus affecting the respiratory properties of aquatic animals. Semiconductors nanomaterials have a huge role to play in addressing this matter. In this respect, the semiconductor, Tin Oxide (SnO2) nanoparticles was synthesized and capped with different agents such as such as Arginine, Hexamethylenetetramine (HMT) and Sodium hexametaphosphate (SHMP). The purpose of the latter compounds was to reduce its band gap and improvement of its photocatalytic properties. The hydrothermal and co-precipitation methods were used for the synthesis process. The nanoparticles were characterized using X-ray diffraction (XRD), Transmission Electron Microscopy (TEM), Scanning electron microscopy (SEM), UV-VIS Spectroscopy, Fourier Transform Infrared spectroscopy. The photocatalytic degradation of dyes was investigated using the UV-Vis spectroscopy. The dyes which were employed in monitoring the photocatalytic degradation activity are the azo dyes such as Congo red and methyl red. It was noticed that photocatalytic properties were dependent on morphologies and band gap of SnO2 nanostructures. Furthermore, the detail result of evolved morphologies and catalytic study will be discussed in the presentation.

151 - Using Geant4 to create 3D maps of dosage received within a MinPET diamond sorting facility

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.151)*
Primary author: *COOK, Martin (University of Johannesburg)*
Co-author: *CONNELL, Simon (University of Johannesburg)*

The MinPET project aims to locate diamonds within kimberlite by activating carbon within kimberlite, then using Positron Emission Tomography (PET) to image carbon density. Although calculations suggest that long-term activation is insignificant, modelling is required to determine the dose received by workers operating close to recently activated material at different positions within a hypothetical MinPET sorting unit.Two modelling techniques are deployed to investigate received dose. The first is a full simulation of energy absorbed using the CERN created Geant4 particle tracking toolkit. The results for this are validated against a numerical computation of the attenuation of outgoing radiation using a simplified geometry. The result is a set of 3-dimensional dosage maps. These can be used to set guidelines around where and for how long workers could operate, and to identify areas that need additional radiation shielding. The techniques developed are not limited to MinPET, and could prove useful for any situation requiring the simulation of dose received by workers operating near radioactive material.

153 - A genetic algorithm approach to enhancing the performance of a PET detector array

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.153)*
Primary author: *COOK, Martin (University of Johannesburg)*
Co-author: *CONNELL, Simon (University of Johannesburg)*

The MinPET project aims to locate diamonds within kimberlite by activating carbon within kimberlite, then using Positron Emission Tomography (PET) to image carbon density. Distinguishing small diamonds from the background depends crucially on the accurate reconstruction of detector hit positions. This reconstruction is subject to two kinds of errors: local errors, where the position of a hit within a particular detector is not accurately reconstructed from the incoming photomultiplier tube signals, and global errors, where the internal parameters that describe the physical location and orientation of detector pixels do not accurately match reality. Because of the large number of detectors in a full MinPET unit, there are too many parameters involved to feasibly adjust them by hand. We have therefore developed a custom genetic algorithm that iteratively evolves detector parameters in order to optimise the image quality. Results are presented from before and after the optimisation is performed, indicating that image accuracy and resolution are improved. This algorithm could be employed periodically in an industrial or medical setting to automatically correct for detector movements or calibration drift.

154 - Multi-wavelength variability and optical identification of a selection of supersoft X-ray sources

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.154) [For award: MSc]*
Primary author: NYAMAI, Miriam Mumbua *(University of Free State)*
Co-authors: *ODENDAAL, Alida (University of the Free State); MEINTJES, Pieter (University of the Free State)*

Supersoft X-ray sources (SSSs) were established as a unique class on the basis of their low X-ray temperatures and extreme luminosities. Numerous SSSs are known in the Magellanic Clouds, where they were first discovered, as well as in external galaxies and also a few in the Milky Way. Optical identifications and photometric studies of several Magellanic Cloud SSS transients and binary supersoft sources are being conducted using archival data, and observations with the 1.5-m telescope at the Boyden Observatory are also being planned. The M31 galaxy (Andromeda) has been extensively studied with X-ray telescopes like ROSAT, Chandra and XMM-Newton, but for many of the M31 SSSs, not much has been reported in the optical waveband. The M31 SSS RX J0038.6+4020 was first detected during the ROSAT PSPC survey of M31 in 1991. It was classified as a SSS according to the X-ray hardness ratio, but little is known of this source in the optical. Using a ~9 year optical light curve of the SSS RX J0038.6+4020 from the Catalina Real-Time Transient Survey (CRTS) database, the long-term optical light curve of this source is presented.

156 - Computer simulation studies of spinel $LiMn_2O_4$ surfaces

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.156)*
Primary author: TSHWANE, David Magolego *(University of Limpopo)*
Co-authors: *MAPHANGA, Rapela (University of Limpopo); NGOEPE, Phuti (University of LImpopo)*

Lithium ion batteries are important electrochemical energy storage devices for consume electronics and the most promising candidate for electric and hybrid electric vehicles. The surface chemistry influences the performance of the batteries. Consequently, stable surface is a basic requirements for a perfect cathode material. The surface structures {100}, {110} and {111} of the spinel $LiMn_2O_4$ were investigated using computer simulation methods. In particular, density functional theory calculations within the generalised gradient approximation was used to determine surface structures and stability of $LiMn_2O_4$. The effect of surface termination and number of layers was determined. It was found that the surface termination and slab construction play a key role in determining the relative stability of {100}, {110} and {111} surfaces. Following the investigation of possible surface terminations and surface layer construction, results showed that {111} Li-termination surface is the most stable surface. The Wulff morphology of $LiMn_2O_4$ was constructed exhibits a cubo-octahedral shape with {111} facets dominating the morphology, in agreement with experimental studies.

161 - Measurement of the first $½^+$ state in $^9B^*$

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.161) [For award: MSc]*
Primary author: MUKWEVHO, ndinannyi justice *(university of the western cape)*

A measurement will be carried out using the $^9Be(^3He,t)^9B^*$ reaction at a beam energy of 50MeV at the iThemba LABS cyclotron facility with the K600 spectrometer in coincidence with a silicon detector array. The tritons are going to be detected with a silicon detector array CAKE (Coincidence Array for K600 Experiments). Kinematic calculations have been performed in order to get information on the behaviour of the reaction and will be used for the reconstruction of the excited states in the $^9B^*$ nucleus, specifically the energy of the first $½^+$ state.

164 - Determination of spectroscopic quadrupole moment of the first excited state in 32S.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.164) [For award: MSc]*
Primary author: MAVELA, Lihleli *(University of he western Cape)*
Co-author: *ORCE, Nico (University of the Western Cape)*

In this work we aim to determine the spectroscopic quadrupole moment (Qs) of the first excited state (2+) at 2230.6 keV in 32S via Coulomb excitation at safe bombarding energies. The experiment is performed at the iThemba LABS's AFRODITE vault, where 32S beams at 118 MeV are bombarded onto a 194Pt target of 1 mg/cm2 thickness. The beam energy is chosen such that the separation distance between the nuclear surfaces is greater than 6.5 fm in order to avoid nuclear interactions. An S3 silicon detector with 24 rings and 32 sectors is placed upstream at backward angles to detect the scattered particles. Gamma rays are detected with the AFRODITE clover array. This particle-gamma coincidence experiment allows for an angular distribution and Doppler correction of the gamma rays emitted at 9% the speed of light. The cross sections (or gamma-ray integrated yields) measured as a function of the ring scattering angle are sensitive to second-order perturbation effects in Coulomb excitation, and will yield information on the reorientation effect (an effective technique of determining (Qs)).The gamma-ray integrated yields obtained from the experiment will be compared with the GOSIA simulations to get the Qs(2+) value.

168 - Prediction of Coefficient of Performance of an Air Source Heat Pump Water Heater under Two Critical Operating Scenarios

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.168) [For award: PhD]*
Primary author: STEPHEN, Tangwe *(University of Fort Hare)*
Co-author: *MEYER, Edson (University of Fort Hare)*

The air source heat pump (ASHP) water heater is an efficient and renewable energy device for sanitary hot water production. Modeling and simulation of the coefficient of performance (COP) of an ASHP water heater can lead to optimization and prediction of its performance. A data acquisition system (DAS) was constructed to measure the predictor parameters (E, electrical energy consumed and , product of ambient temperature and relative humidity) as well as the thermal properties to compute the COP during the vapor compression refrigerant cycles (VCRC) of the ASHP unit. It was depicted that the mean COP in the both scenarios of the heating up cycles (firstly, where there was no successive hot water drawn off and secondly, where there was hot water drawn off occurring simultaneously with the ASHP running) was on average above 2. Again, using multiple linear surface fitting models in conjunction with the simulation linear model plots in the both scenarios, it was delineated that increases in both predictors resulted to increase in the COP in the drawn off mode. The models were used in the mathematical blocks of the Simulink to design the ASHP water heater's COP simulation application. The multiple comparison procedure test was employed to demonstrate that there exists no significant difference of COP under the both scenarios.

171 - First-principles studies of transition metal defects in a molybdenum disulfide (MoS_2) monolayer

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.171) [For award: PhD]*
Primary author: ANDRIAMBELAZA, Noeliarinala Felana *(University of Pretoria)*
Co-authors: *MAPASHA, Edwin (University of Pretoria); CHETTY, Nithaya (University of Pretoria)*

Over the past few years, two dimensional (2D) transition metal dichalcogenides (TMDs) MX_2 (M=Mo,Cr,Nb,W; X=S,Se,Te) have attracted tremendous attention due to their remarkable electronic, magnetic and optical properties. It is evident that TMDs are suitable for future nanoscale device applications. Using density functional theory (DFT) implemented within theVienna *ab-initio* simulation package (VASP), the effects of transition metal defects (Rhenium (Re) and Tantalum(Ta)) on the thermodynamic stability and electronic properties of a MoS_2 monolayer are investigated. Calculations are performed using the projector augmented wave method (PAW) with the Perdew-Burke-Ernzerhof (PBE) for the exchange-correlation interactions. We find that the formation energy of the Ta substituting Mo (Ta_{Mo}) defect is negative whereas that of Re substituting Mo (Re_{Mo}) is positive. We observe that Ta_{Mo} induces non-spin-polarized states at 0.18eV above the valence band maximum(VBM), whereas Re_{Mo} yields spin polarized states at 0.25eV below the conduction band minimum(CBM). This reveals that Ta is a *p*-type dopant and Re is a *n*-type dopant. We find that one and three Re dopants yield a magnetic moment of 1μB but two Re dopants do not show any magnetic effects. Our results indicate that *p*-type (Ta) and *n*-type (Re) doped MoS_2 monolayers are promising materials for various electronic applications.

174 - Pick-off annihilation of delocalized positronium in BaF2 at elevated temperatures

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.174)*
Primary author: JILI, Thulani *(University of Zululand)*
Co-authors: *SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); WAMWANGI, Daniel (wits university)*

. Positron lifetime components and associated intensities in the temperature range 300 – 800 K were measured using standard fast-fast coincidence technique. Two lifetime components were resolved after background and source corrections. The long lifetime component decreases in the temperature range from 500 ps at 300 K to 402 ps at 711 K. This corresponds to a fractional increase in the annihilation rate of 22% in the temperature range 300 K to 693 K. The de-trapping of positronium from the Bloch states followed by annihilation through the 'pick-off' process appears to be one of the dominant processes in the long positron lifetime components in the temperature range. Annihilation rates from positron annihilations with valence and core electrons of the individual atoms of the sample are also calculated using density functional theory in the framework of generalized gradient approximation.

175 - Generating Arbitrary Optical Vector Beams

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.175) [For award: PhD]*
Primary author: COX, Mitchell *(University of the Witwatersrand)*
Co-authors: *FORBES, Andrew (CSIR); ROSALES-GUZMAN, Carmelo (University of the Witwatersrand, Johannesburg)*

Vector beams have many uses in optics and photonics such as optical communications, trapping and microscopy. Dynamic generation of scalar modes has become commonplace with the use of Spatial Light Modulators, however, due to the polarization dependent nature of SLMs, they cannot readily be used to create vector modes. Static vector modes can be readily generated using elements such as Q-Plates, however, dynamic vector beams remain a challenge. Here we outline several approaches to creating such beams in an all-digital manner that overcomes the aforementioned problems. Our work paves the way for encoding and decoding of information into such modes.

179 - Disentangling second-order effects in Coulomb Excitation Theory: (Reorientation and Nuclear Polarizability Effects)

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.179) [For award: MSc]*
Primary author: *AKAKPO, Elijah (University of the Western Cape)*

We aim at disentangling the second order-effects in Coulomb Excitation (Reorientation Effect and Nuclear Polarizability). A safe coulomb excitation experiment was performed to study the nuclear polarizability and reorientation effects through measuring the spectroscopic quadrupole moment Q_s for the first 2_1^+ in ^{40}Ar. A beam of $^{40}Ar^{6+}$ at 134 MeV with typical currents of ≈ 0.5 to 1 nA was provided by the Cyclotron accelerator facility at iThemba Labs, which was Coulomb excited on a ≈ 1 mg ⁄ cm^2 ^{194}Pt target. A double sided CD-type S3 silicon detector was used to detect particles at forward angels in coincidence with γ-rays. The dexcited γ-rays from the residual nuclei were detected using the AFRODITE array (5 clover detectors at 90° and 3 at 135°). A semi-classical couple channel Coulomb Excitation code, GOSIA, will be utilized to extract the matrix element for the Q_s (2^+) from the experimental data.

181 - Effect of carbon doping on the structural, optical and electronic properties of zinc oxide nanoparticles synthesized by pneumatic spray pyrolysis technique.

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.181) [For award: MSc]*
Primary author: *NTOZAKHE, Luyolo (1Fort Hare Institute of Technology (FHIT), University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa. 2Chemistry department, University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa.)*
Co-authors: *MEYER, Edson (Fort Hare Institute of Technology (FHIT), University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa.); TAZIWA, Raymond (1Fort Hare Institute of Technology (FHIT), University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa. 2Chemistry department, University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa.); KATWIRE, David (Chemistry department, University of Fort Hare, Private Bag X1314, Alice, 5700, Republic of South Africa.)*

This work reveals the effect of doping on the structural, optical and electronic properties of zinc oxide nanoparticles synthesized by pneumatic spray pyrolysis technique (PSP) using zinc ethoxide as the precursor. The prepared samples were characterized by XRD, HRTEM, SEM-EDX, UV-Vis spectroscopy,Four point probe (I-V characterization) and Combined Confocal Raman & AFM spectroscopy. Raman spectroscopy (RS) analysis has revealed that the un-doped ZnO and doped ZnO samples have a characteristic Raman optic modes at 325 per cm, 373 per cm, and 432 per cm belonging to wurtzite ZnO structure. The XRD patterns of un-doped and doped ZnO also exhibited the characteristic peaks of hexagonal wurtzite structure. The in cooperation of Carbon species into ZnO lattice has been cross examined by monitoring the peaks positions of the (100), (002) and (001) planes. These three mains peaks of Carbon doped ZnO NPs show a peak shift to higher 2 theta degrees values which indicates substituional doping in zinc oxide samples. XRD analysis has revealed that the PSP synthesized nano particles have particles sizes ranging from 9.60 nm for Undoped to 9.96 nm for 0.015M C-ZnO samples. EDAX spectra of both undoped and doped ZnO nanoparticles have revealed prominent peaks at 0.51 keV, 1.01 keV, 1.49 keV, 8.87 keV and 9.86 keV. Peaks at, X-ray energies of 0.51 keV and 1.01 keV respectively represent the emmisions from the K-shell of oxygen and L-shell of Zinc. The occurrence of these peaks in the EDAX endorses the existence of Zn and O atoms in the PSP prepared samples.

184 - Applying the technique of Ultrafast Pump-Probe spectroscopy on the main plant light-harvesting complex of spinach leaves

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.184) [For award: MSc]*
Primary authors: *SINGH, Asmita (University of Pretoria); KRÜGER, Tjaart (University of Pretoria)*
Co-author: *VENGRIS, Mikas (Vilnius University, Faculty of Physics, Quantum Electronics Department, Sauletekio 9-III, LT10223 Vilnius, Lithuania)*

The ultrafast transient dynamics of the main plant light-harvesting complex (LHCII) of spinach leaves were studied, using the technique of pump-probe spectroscopy. Explicitly, the excitation energy transfer processes within and amongst the protein-bound pigments (viz. chlorophylls and carotenoids), were investigated. These pigments are responsible for the absorption of solar photons, and transfer the electronic excitation energy on ultrafast timescales to nearby complexes, and eventually to a reaction center where charge separation is induced. Nature is designed in such a way that plants are self-protected against the damage of over-illumination by activating a number of processes which collectively contribute to non-photochemical quenching (NPQ). This poster will outline the information extracted from the South African National Laser Centre (NLC) pump-probe facility, in comparison to the data previously obtained from an ultrafast transient absorption spectroscopy setup at Vilnius University in Lithuania. The wavelengths investigated in both cases were 489 nm and 506 nm, specifically targeting the excited-state dynamics of Lutein1 & Neoxanthin and Lutein2 & Violaxanthin carotenoids, respectively. An intensity dependence study was performed in order to understand possible variations in energy transfer kinetics of the carotenoids and how these changes influence the fast process of NPQ. Global analysis and some target analysis of the transient absorption results were performed using the free Glotaran software.

188 - Effect of Eu3+ ion concentration on phase transition, site symmetry and quantum efficiency of ZrO2 nanocrystal rods

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.188)*
Primary author: *AHEMEN, Iorkyaa (University of the Free State-Qwaqwa Campus, Private Bag X13, Phuthaditjhaba, 9866, South Africa)*
Co-author: *DEJENE, Francis B. (University of the Free State-Qwaqwa Campus, Private Bag X13, Phuthaditjhaba, 9866, South Africa)*

This work report the influence of Eu3+ ion concentration on the photophysical properties of zirconia nanocrytal rods including its intrinsic quantum efficiency (IQE). A simple chemical route was employed in the synthesis of the nanocrystal rods. X-ray diffraction results show mixed phases of monoclinic and tetragonal structures. Phase transition occurred at low (1 mol%) and high (7 and 8 mol%) Eu3+ concentrations. There are three forms of excitations for this phosphor; band edge excitation at 232 nm, charge transfer state transition at 274 and 263 nm, and direct excitation at 362, 395 and 535 nm. Photoluminescence emission for all the doped samples are entirely intraconfigurational Eu3+ emissions and depends both on the site symmetry as well as the Eu3+ concentration. The Eu3+ ions were distributed in both phases especially at high ion concentrations (7 and 8 mol% Eu3+). Two multipolar processes where found to be responsible for the luminescence quenching process in the mixed-structure; the dipole-dipole and the dipole-quadrupole transitions. The intensity parameters (,), asymmetry ratio, R0 and the average decay lifetime of the nanocrystals show dependence on concentration and excitation wavelength. High IQE values were obtained at 1, 7 and 8 mol% Eu3+ where the monoclinic phase is dominant. The CIE coordinates values are comparable to existing red phosphors and in combination with the high average IQE of 55% makes this phosphor a good candidate for red emitting phosphor application.

190 - Neutron irradiation and damage assessment of plastic scintillators of the TILECAL section of the ATLAS detector.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.190) [For award: MSc]*
Primary author: *MDHLULI, Joyful (University of the Witwatersrand)*
Co-authors: *ERASMUS, Rudolph (University of the Witwatersrand); DAVYDOV, Yuri (Joint Institue for Nuclear Research); JIVAN, Harshna (University of the Witwatersrand); LIAO, Shell-may (University of the Witwatersrand, School of Physics, 1 Jan Smuts Avenue, Braamfontein, Johannesburg, 2000, South Africa"); PELWAN, Chad (University of Witwatersrand); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); MELLADO, Bruce (University of Wisconsin - Madison); PETER, Gerrard (University of the Witwatersrand); SANDROCK, Charles (University of the Witwatersrand)*

Following the comparative study of proton induced radiation damage on various plastic scintillator samples from the ATLAS-CERN detector, a study on neutron irradiation and damage assessment on the same type of samples will be conducted. The samples will be irradiated with different dose rates of neutrons produced in favourable nuclear reactions using a radiofrequency linear particle accelerator as well as the SAFARI nuclear reactor at NECSA and the IBR-2 pulsed reactor at the Joint Institute for Nuclear Research (JINR) in Dubna. The MCNP 5 code will be utilized in simulating the neutron transport for determining the dose rate. Light transmission and light yield tests will be performed in order to assess the radiation damage on the scintillators. In addition, Raman spectroscopy and Electron Paramagnetic Resonance (EPR) analysis will be used to characterize the samples after irradiation. The project aims to extent these studies to include radiation assessment damage of any component that processes the scintillating light and deteriorates the quantum efficiency of the Tilecal detector, namely, photomultiplier tubes, wavelength shifting optical fibres and readout electronics will also be exposed to neutron irradiation and the damage will be assessed in the same manner.

191 - Magnetic properties of Cr +2.9 at.% Al thin films

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.191) [For award: MSc]*
Primary author: *MUDAU, patience (University of Johannesbug)*
Co-authors: *PRINSLOO, Aletta (University of Johannesburg); SHEPPARD, Charles (Department of Physics, University of Johannesburg); VENTER, Andrew (Necsa Limited); FULLERTON, Eric (University of California San Diego)*

Cr is an itinerant antiferromagnet with an incommensurate spin density wave structure, have an electron to atom ratio (e/a) of six and exhibits a Néel transition at TN = 311K [1]. If Cr is doped with elements with e/a > 6 an increase in TN is observed, while doping Cr with elements whose e/a < 6 results in TN decreasing [1]. However, despite the fact that Al has an e/a = 3, the Cr-Al magnetic phase diagram rather shows a sharp decrease in TN values, reaching a minimum near 2 at.% Al, where after the TN values unexpectedly increase [1, 2]. As thin films of Cr and its alloys show properties not observed in the bulk [3], this study extends existing knowledge through an investigation on Cr-Al alloy thin films. Cr97.1Al2.9 thin films of thickness 23 to 368 nm were deposited on fused silica, MgO(100) and MgO(110) using the DC magnetron sputtering techniques. X-ray diffraction was used to determine the structural properties of the films. Results obtained shows epitaxial growth for the films prepared on MgO, while those prepared on fused silica substrates are polycrystalline. Magnetic transition temperatures were obtained using standard four-point probe resistivity (ρ) as function of temperature (T) measurements. For samples deposited on fused silica no anomalies in ρ(T) associated with the TN are observed. ρ(T) curves for the films deposited on MgO showed weak anomalies in a form of domes associated with TN. In some cases these anomalies were weak resulting in difficulties in obtaining TN values. Interestingly, TN values found correlate well with those found in the magnetic phase diagram of bulk Cr-Al.[1] E Fawcett et al. Rev. Mod. Phys. 66 (1994) 25 [2] CJ Sheppard et al. J. Alloys Compd. 595 (2014) 164[3] HJ Zabel, J.Phys.: Condens. Matter 11(1999) 9380

195 - The Thermolysis of zinc acylthiourea complexes to form metal chalcogenides

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.195) [For award: MSc]*
Primary author: LETHOBANE, Manthako *(University of Witwatwersrand)*
Co-authors: *KOTZE, Izak (University of Witwatersrand); MOLOTO, Nosipho (University of Witwatersrand)*

The single source precursor method has proven to be an effective method for the synthesis of nanoparticles, due to the presence of the existing bond between the metal and chalcogenide.[1] Several attempts have been performed to synthesize nanoparticles using different single-source precursors. [1-3]. In this work, we present the synthesis of zinc complexes using various acylthiourea ligands for the synthesis of metal oxide and metal sulfide nanoparticles. The acylthiourea ligands synthesized were characterized using Nuclear Magnetic Resonance (NMR) and Fourier Transform Infra-red Spectroscopy (FTIR) which suggested and confirmed successful synthesis. The complexes synthesized were characterized using NMR, Mass spectroscopy (MS) and CHNS elemental analysis which confirmed bis-chelation between the metal and the ligand. The nanoparticles were characterized using Powder X-ray diffraction (PXRD), Transmission electron Microscopy (TEM) and UV-vis spectroscopy. The study provided insight in controlling the growth of the precursors as well as the growth of the nanoparticles which will then be tested in the fabrication of a solar cell.References:[1] N. Moloto, N. Revaprasadu, M.J. Moloto, P. O'Brien, M. Helliwell, Polyhedron 2006, 26, 3947.[2] N. Moloto, N. Nevapresadu, P. O'Brien, M. Malik, Journal of Materials Science: Materials in electronis, 2004, 15, 313-316.[3] J. Bruce, N. Revaprasadu, K. Koch, New J. Chem., 2007, 31, 1647–1653

203 - Development of Metal-flux based Crystal-growth Facility

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.203)*
Primary author: *KAMADURAI, Ramesh Kumar (Highly Correlated Matter Research Group, University of Johannesburg)*
Co-authors: SONDEZI, Buyi *(University of Johannesburg); STRYDOM, Andre (University of Johannesburg)*

Single crystals are solids in which the atoms/molecules are arranged in such way that the lattice periodicity is extended uninterruptedly till the edge of the materials. The advancement of micro-electronics research, laser-technology and solid state device research is due to the development in crystal growth technology. Among various growth methods, melt flux crystal growth technique is employed extensively for discovery of new materials owing to their diffusivity power, wide range of applicability and low equipment costs. We will present the detailed report of our single crystal growth facility by focusing on the physio-chemical process involved with metallic-flux technique, working principles of various experimental processes and optimization of the growth conditions for some cage compounds. Flux method is a crystal growth technique where the constituent elements are dissolved in a reactive metallic-solvent (Flux). Low melting point metals Sn, Ga, Bi, Al or Sb are used as solvent. The flux serves as a medium for the constituent elements to dissolve either completely or partially. The flux can act as a transporting medium which dissolves one component at particular place and grows the product at another location. The nucleation, reaction kinetics, and dimensions can be controlled by: flux:charge ratio, cooling-rate, homogenization conditions. The inert atmosphere and temperature stability are two essential requirements for synthesizing high quality single crystals. To provide inert atmosphere Alumina crucibles are placed in a quartz tube and evacuated to the pressure of 10^{-6} mbar before closing the tube under vacuum. The mixture is heated at 1000-1200 ° C for 24 hrs using a Carbolite Box furnace and then the temperature is reduced close to the melting of the flux in 2-3 temperature segments. At that temperature the tube is removed from the furnace and placed in one of the arms of a low speed centrifuge to remove the flux.

204 - Gas Accretion and Triggering in NGC 3998

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.204)*
Primary author: FRANK, Bradley *(University of Cape Town)*
Co-authors: *MORGANTI, Raffaella (ASTRON); OOSTERLOO, Tom (ASTRON); SERRA, Paolo (CSIRO); NYLAND, Kristina (NRAO)*

NGC 3998 is a nearby early-type galaxy which, in the optical, appears to be an average red-and-dead galaxy at the centre of a small group of galaxies at the edge of the Ursa Major cluster.However, when observed in the L-band with the WSRT telescope, a study of the NGC 3998 group reveals an intriguing picture of minor mergers between the galaxy members, remnants of tidal interactions and evidence for a poorly collimated radio jet emanating from the low-luminosity AGN at the centre of NGC 3998.In this work we explore the connection between the assembly history of NGC 3998, and the triggering of the AGN. We use multi-wavelength tracers to link an accretion event with the precession of the AGN major axis, which we tie to the AGN jet morphology.

207 - Role of swift heavy ion irradiation on structural and magnetic properties of $Ti_{0.95}Co_{0.05}O_{2-\delta}$ epitaxial thin films

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.207)*
Primary author: MOHANTY, PANKAJ *(University of Johanneburg)*
Co-authors: *RATH, Chandana (IIT (BHU), VARANASI, INDIA); SHEPPARD, Charles (Department of Physics, University of Johannesburg); PRINSLOO, Aletta (University of Johannesburg)*

Defects like oxygen vacancies are found to play a vital role in deciding the physical and magnetic properties of $Ti_{0.95}Co_{0.05}O_{2-\delta}$ [1-3]. These defects can be created during growth or may be induced by ion irradiation. The role of such defects by depositing non-stoichiometric polycrystalline films, as well as by irradiating with swift heavy ions on structural and magnetic properties have been reported [4, 5]. In this work, the structural and magnetic properties of epitaxial thin films under dense electronic excitation are discussed. Films were deposited by pulsed laser deposition technique and the oxygen partial pressure during growth was kept at 10 mTorr. Reflections, beside those corresponding to the planes (004) and (008) of anatase phase of TiO_2, are suppressed indicating epitaxial growth of the films along c-axis. In view of the important role of defects in manifestation of physical properties, films have been irradiated with 100 MeV Ag^{7+} ions with different fluences. X-ray diffraction of the irradiated films indicates successive amorphization of the films with increasing ion dose. The magnetic measurements indicate a significant enhancement of the magnetization of the film irradiated with fluence 1×10^{13} ions.cm^{-2}. This unexpected increase in magnetization is explained on the basis of bound magnetic polaron (BMP) model. The findings suggest the pivotal role of ion irradiation on tailoring structural as well as magnetic properties.References[1] Matsumato Y et al. 2001 Science 291 854[2] Rath C et al. 2009 J. Phys. D : Appl. Phys. 42 205101[3] Mohanty P et al. 2012 J. Phys. D : Appl. Phys. 42 205101[4] Mohanty P et al. 2014 J. Magn. Magn. Mater. 355 240[5] Mohanty P et al. 2014 J. Phys. D: Appl. Phys. 47 315001

209 - Understanding proton induced radiation damage in plastic scintillators using electron paramagnetic resonance and DFT modelling

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.209) [For award: MSc]*
Primary author: PELWAN, Chad *(University of Witwatersrand)*
Co-authors: *KEARTLAND, Jonathan (University of the Witwatersrand); PETERS, Gerrard (University of the Witwatersrand); SEKONYA, Kamela (iThemba LABS (Gauteng)); JOUBERT, Daniel (School of Physics, University of the Witwatersrand); DONGHO NGUIMDO, Guy Moise (University of the Witwatersrand, Johannesburg); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); JIVAN, Harshna (University of the Witwatersrand); MELLADO, Bruce (University of Wisconsin - Madison); MDHLULI, Joyful (University of the Witwatersrand); MADHUKU, Morgan (iThemba LABS); SANDROCK, Charles (University of the Witwatersrand)*

Plastic scintillators form and integral part of particle detectors, such as the ATLAS detector at the LHC, as they are able to measure energies and track momenta of particles after a collision. Electron paramagnetic resonance (EPR) has been employed to study unpaired electrons and ions that are present in pristine and damaged plastic scintillator samples. Six different types of plastics were investigated, based on either polystyrene or polyvinyl toluene (PVT) . Samples were subjected to irradiation doses between 0.8 – 80.0 MGy using 6 MeV protons. EPR studies conducted on these samples showed a decrease in g-factor of each sample with an increase dose. It is suggested that an increase in dose introduces secondary electrons and ions into the system increasing the spin density and the relaxation time. Computational DFT modeling of polystyrene and PVT monomers and dimers show that damaging the molecules decreases components of the g-tensor and alters the components of the hyperfine tensor related to the g-factor and relaxation time, respectfully.

212 - Estimation of the fake rate background in same sign $W^{+mn}W^{+mn}$ production at the LHC with ATLAS Detector

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.212) [For award: MSc]*
Primary author: THUSINI, Xolisile *(University of Cape Town)*

At the Large Hadron Collider, Vector Boson Scattering (VBS) has been identified as a promising interaction for understanding of the Elecroweak Symmetry Breaking (EWSB). One of its production mechanisms is the same sign $W^{+mn}W^{+mn}$ production process, and has never been observed. This talk present an estimation of the fake background in same sign $l^{+mn}l^{+mn} + E^{miss}_{T}$ + 2jets signature coming from the scattering of two W bosons with the same electric charge. The two W's are required to decay leptonically considering electrons and muons only. The background processes that can mimic the signature of same sign sign $l^{+mn}l^{+mn} + E^{miss}_{T}$ + 2jets are W +jet, ttbar, single top or QCD multijet processes where one or two jets are mis-reconstructed as leptons. The main objective is to estimate fake background coming from ttbar decay using Monte Carlo simulations. For this analysis only electrons were considered in the final state.

216 - Computerised Ionospheric Tomography (CIT) for supportive GNSS-derived ionospheric applications

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.216) [For award: Hons]*
Primary author: *ANSARI, Ahsan (University of Michigan)*
Co-authors: *CILLIERS, Pierre (SANSA Space Science); MOLDWIN, Mark (University of Michigan)*

Computerised Ionospheric Tomography (CIT) is a technique where multiple measurements from signals modulated when passing through an object, are used as inputs to reconstruct the three-dimensional structure of the object by employing mathematical inversion techniques. In CIT the "object" is the spatial distribution of the electron density composition of the Earth's Ionosphere, i.e., the ionised component of Earth's atmosphere extending from about 50-2000 km above Earth. SANSA's Matlab-based near real-time TEC imaging system utilizes GPS observations from a Southern African regional network of about 60 dual frequency GNSS receivers. The objective of the project will be to develop necessary algorithms and software to extend SANSA's present 2D ionospheric TEC imaging system to a 3D Computerised Ionospheric Tomography system.

217 - SQUID Magnetometer Filter Design and Data Analysis

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.217) [For award: Hons]*
Primary author: *AVERY, Megan (University of Michigan)*
Co-authors: *SAUNDERSON, Elda (SANSA); MOLDWIN, Mark (University of Michigan)*

The observation of very low magnetic fields is of primary importance for a better understanding of Earth and environment, as well as for early warning of potential hazards coming from space. Recent scientific studies have shown that magnetometers based on Superconducting QUantum Interference Devices (SQUID's) are able to detect magnetic storms in the upper atmosphere with a sensitivity far better than that of conventional magnetometers. This project involves filter design to analyze the data and a study of SQUID data, both from a low-Tc SQUID located underground at the Low Noise Laboratory (LSBB), France, and data from the high-Tc SQUID operating unshielded at SANSA Space Science, Hermanus, South Africa. The two SQUIDs form the first two nodes of a worldwide SQUID network aimed at identifying ionospheric, magnetic and/or seismic events using very sensitive magnetic measurements. The first step is an investigation into the correlation between the SQUID data from both locations, given that one SQUID is more sensitive and operates shielded, and the other SQUID is less sensitive and operates unshielded.

218 - Ionospheric Scintillation Proxies derived from geodetic GPS receiver data

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.218) [For award: Hons]*
Primary author: *AZZOPARDI, Nick (University of Michigan)*
Co-authors: *CILLIERS, Pierre (SANSA Space Science); MOLDWIN, Mark (University of Michigan)*

There are many more GPS dual frequency receivers deployed in mid and low-latitude regions of Africa than there are ionospheric scintillation receivers. The objective of the proposed study is to use the data from the four scintillation monitors managed by SANSA Space Science and other scintillation monitors in the SCINDA network, and data from co-located dual frequency GPS receivers to derive proxies for the amplitude and phase scintillation indices from variations in the total electron content. This is a key step towards extending the regions over which scintillation statistics can be derived over a full solar cycle. Such statistics are required for development of climatologies of ionospheric scintillations over low and mid-latitudes.

219 - HF Propagation Systems for African communications

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.219) [For award: Hons]*
Primary author: *LUCKEY, Clare (University of Michigan)*
Co-authors: *TSHISAPHUNGO, Mpho (SANSA Space Science); MOLDWIN, Mark (University of Michigan)*

We present a study that validates High Frequency (HF) propagation predictions in the South African region. Measurements of the ionospheric propagation from ionosondes, the international beacon project, and Doppler sounders located in Africa are used for a space weather study on the accuracy of the SANSA predictions. The HF predictions are crucial for communication within Africa, and are significantly affected by adverse space weather. SANSA operates the Regional Warning Centre for Space Weather in Africa, and as such is mandated to produce accurate predictions and forecasts as well as confidence levels on the regional impact of space weather.

220 - Calculation of air density through measurements of falling spheres

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.220) [For award: Hons]*
Primary author: *MCCAUGHNA, Andrew (University of Michigan)*
Co-authors: *KOSCH, Michael (SANSA); MOLDWIN, Mark (University of Michigan)*

We present experimental results from ball drop experiments to infer air density. Using a quadcopter drone to raise the ball to over 1000 ft, measurements of the velocity of the ball are made to infer the mass density. Using the measured terminal velocity enables an accurate measurement of the air density using falling spheres with known cross section and aerodynamic drag coefficient. Comparison with air density measurements using the measured meteorological parameters (temperature, pressure and humidity) will validate the results.

221 - Ionospheric Irregularities studies using GPS and radio astronomy interferometers

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.221) [For award: Hons]*
Primary author: *VARGO, Eric (University of Michigan)*
Co-authors: *KATAMZI, Zama Thobeka (South African National Space Agency); MOLDWIN, Mark (University of Michigan)*

The study of ionospheric structures and irregularities is beneficial to both the scientific advancement of knowledge as well as the practical applicability to high frequency (HF) communications, navigation, surveying and understanding various aspects of space weather effects on technological systems. For example ionospheric disturbances can cause errors in the accuracy of Global Positioning System (GPS) measurements, as much as 2 m in navigation error. Research is underway to utilise radio astronomy data in the investigation of ionospheric irregularities and structures (such as traveling ionospheric disturbances, geomagnetic storm induced ionospheric perturbations) over the African region. Radio interferometer instruments have been used to study ionospheric structures in the past. However such instruments have never been used over the African region mainly due their non-existence, but with the construction of the SKA (Square Kilometer Array) and the African VLBI (very large baseline interferometer) and the installation of MeerKAT and PAPER (Precision Array for Probing the Epoch of Reionization), study of this nature is feasible.

222 - Surface Brillouin scattering studies of VC thin films deposited on SiC

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.222)*
Primary author: *JAKATA, Kudakwashe (University of the Witwatersrand)*
Co-author: *WAMWANGI, Daniel (wits university)*

The surface Brillouin scattering (SBS) technique has been used to extract the elastic stiffnesses of thin films of vanadium carbide deposited by RF magnetron sputtering on 6H-SiC substrates. SBS is a non-destructive method where there is a frequency shift in the laser light scattered from a sample due to the propagation of acoustic phonons. Atomic force microscopy (AFM) and X-ray Reflectometry (XRR) measurements have also been used to determine the surface roughness which provides an indication of the high quality of the thin films. XRR was also used to determine their thickness and density which are used as input data in calculations to determine their elastic stiffness constants using the surface wave velocity dispersion curves measured by SBS.

226 - The ½ --> ½ branch in ^{19}Ne β -decay

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.226) [For award: MSc]*
Primary author: *MABIKA, Phumzile Zandile (University of Zululand)*
Co-author: *TRIUMF, 8-Pi collaboration (TRIUMF, Canada)*

Elementary particles and their interaction are successfully described by the Standard Model (SM) of particle physics. Nuclear beta decays allows for low-energy tests of the SM to probe for new physics.In this talk I shall describe the analysis of data from an experiment performed at TRIUMF, (Canada's National Laboratory for Particle and Nuclear Physics) to measure the *ft* -value of ^{19}Ne β -decay and its implications for tests of the Standard Model.

231 - Dust heating by Alfvén waves using non-Maxwellian distribution function

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.231)*
Primary author: *KIRAN, Zubia (GC University, Lahore, 54000, Pakistan)*

Quasilinear theory is employed in order to evaluate the resonant heating rate by Alfven waves, of multiple species dust particles in a hot, collisionless, and magnetized plasma, with the underlying assumption that the dust velocity distribution function can be modeled by a generalized (r, q) distribution function. The kinetic linear dispersion relation for the electromagnetic dust cyclotron Alfven waves is derived, and the dependence of the heating rate on the magnetic field, mass, and density of the dust species is subsequently investigated. The heating rate and its dependence on the spectral indices r and q of the distribution function are also investigated. It is found that the heating is sensitive to negative value of spectral index r.

238 - Air Source Heat Pump Water Heater: PID Controller Based Control System and Optimal Energy Management

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.238) [For award: MSc]*
Primary author: *NANA, YO NGOUA (University of Fort Hare Institute of Technology)*
Co-authors: *TANGWE, Stephen Loh (Fort Hare Institute of Technology, University of Fort Hare); SIMON, Michael (FHIT)*

Sanitary hot water production remains the principal issue to address in a typical residential house where electrical geysers still account for up to 45% of the total electrical energy consumption. Air source heat pump water heater could offer a permanent solution for water heating as it consumes 67% less amount of the energy use by a geyser for an identical heating load and operates at a COP of over 200% year round. But yet, air source heat pump (ASHP) water heater used in South Africa still present some possibilities for further system's optimization in a bid to achieve a higher operation efficiency from an energy management perspective.In this work, we present a MATLAB simulation of an ASHP water heater unit that incorporates a PID controller using ambient temperature feedback to adjust the speed of an inverter controlled variable speed compressor. A fan speed calibration curve is also determined that maps wind speed to the speed of the fan so as to reduce its energy consumption during minimal load. The simulation reveals a drop in power consumption of close to 8% during an average summer day and over 15% during a very sunny and windy day. Keywords: Air source heat pump water heater, PID controller, variable speed compressor, capacity control and fan speed control.

240 - Atomistic simulations studies on the structural change in Li_xTiO_2 (x: 2.82, 3.76, 6, 57) at high temperatures for energy storage in Lithium-ion Battery Applications.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.240) [For award: MSc]*
Primary author: RIKHOTSO, B.N *(University of Limpopo)*
Co-authors: *NGOEPE, P.E (University of LImpopo); MATSHABA, M.G (university of Limpopo)*

Molecular dynamics based amorphisation and recrystallisation technique was employed to produce lithiated nanosheet and porous structures of TiO_2 and to study their behaviour at high temperatures. Radial distribution functions and configuration energy vs time graphs, indeed showed that the structures architectures were highly twinned and reflected straight and zigzag tunnels corresponding to rutile and brookite polymorphs respectively. X-ray diffraction patterns of the nanosheet and nanoporous Li_xTiO_2 after recrystallization, also confirm the presence of rutile and brookite polymorphs. Lithium diffusion plots show that lithium ions diffuse well at elevated temperatures. Nanosheet and nanoporous pathways are able to accommodate more lithium ions and withstand high temperatures, hence affirming that such nano-architectures can be a good candidate for anodes of Li-Ion batteries.

241 - Characterization and Compensation of Fibre Link Dispersion in a 10 Gb/s Flexible Network

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.241) [For award: PhD]*
Primary author: BOIYO, Duncan *(Centre for Broadband Communication, Nelson Mandela Metropolitan University)*
Co-authors: *ISOE, George (Optical Fibre Research Unit,Nelson Mandela Metropolitan University); WASSIN, Shukree (NMMU); ROTICH, Enoch (Nelson Mandela Metropolitan University); GAMATHAM, Romeo Reginald Gunther (NRF, Square Kilometre Array South Africa); LEITCH, Andrew (NMMU); GIBBON, Timothy (NMMU Physics Department)*

Typical optical networks require deployment of optical fibres that minimise signal and data distortion over the length of transmission. Flexible networks involve dense-wavelength division multiplexed (DWDM) systems propagating within a single fibre or a concatenation of fibres at different bandwidths. For scalable and effective network resource utilisation, fibre impairments that lead to signal distortion should be considered during a network link design. Chromatic dispersion (CD) introduces signal broadening which in turn causes intersymbol interference in transmitted data in long-haul high speed transmissions. As a result, dispersion effects in a link should be measured, characterized and optimized for better quality of transmission (QoT). This work provides an experimental measurement of CD in a typical fibre link using the phase shift method. The performance of different fibre links has been evaluated using bit error rate (BER) measurement at 10^{-9} threshold. A 10 Gb/s signal at 1306 nm and 1550 nm has been transmitted through ITU-T G.652 and G.655 fibres. These fibres exhibit different attenuation, dispersion and polarization mode dispersion (PMD) properties and performance at different wavelengths. A G.652 fibre with 0 ps/nm.km dispersion at 1306 nm had a 1.1 dB transmission penalty for 18 km. Whereas a 1550 nm transmission on G.655 fibre with a -2 ps/nm.km dispersion had a 0.5 dB penalty for 25.49 km. Therefore, dispersion managing wavelengths and fibres should be used to minimize dispersion effects for better QoT and BER. This work is vital for network link design, topology and deployment of fibres in long-haul, metro-access and fibre to the home/building (FTTX) networks.Key words: Flexible Networks, Dispersion, Transmission, Fibre-link Networks

242 - Driven non-equilibrium systems modeled with Markov processes

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.242) [For award: PhD]*
Primary author: TSOBGNI NYAWO, Pelerine *(University of Stellenbosch)*

My talk is devoted to presented results about a study of the current fluctuation of a motion of a particle on a ring, evolving with a driving force and the potential under the influence of a stochastic force.We derived the equation of motion with and without noise and solved it for various parameters.We analyzed an analytical and numerical stationary distributions. We also derived for this model the fluctuations properties of the current observable and looked at the driven process for these fluctuations. The resulting function tells us how fluctuations arise.

243 - Advantages of Free Space Optics over Optical Fibre for Clock Tone Distribution in a 2.5 GHz Transmission Link

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.243) [For award: MSc]*
Primary author: LEBURU, Kagiso J *(Nelson Mandela Metropolitan University)*
Co-authors: *ISOE, George (Optical Fibre Research Unit,Nelson Mandela Metropolitan University); BOIYO, Duncan (Nelson Mandela Metropolitan University); LEITCH, Andrew (NMMU); GIBBON, Timothy (NMMU Physics Department)*

The Square Kilometre Array is a big data project across Africa and Australia. When fully operational, SKA will host the world's largest telescope with a combined signal collection surface area of about 1 km2, with distance up to 3000 km. The telescope rely on high clock tones to be distributed to each antenna and each clock signal is crucial for driving the digitizers, time stamping the data, and for monitoring and control functions. In addition to radio astronomy, other applications requiring high precision clock tones include banking systems, satellite navigation and metrology services. In the case of buried and aerial optical fibres, a complex interplay between numbers of factors adversely affect the stability in the light-wave clock tone as it propagates within an optical fibre. These factors include temperature fluctuations, component noise, polarisation instability, birefringence and others. Free Space Optics (FSO) presents some advantages over optical fibre – license free spectrum, quicker deployment and lower costs. However, the challenges experienced in FSO systems compared to optical fibre are atmospheric absorption and disturbances (fog, snow, rain), background light and requires line of sight. In this paper we present a detailed analysis of the advantages of FSO for clock distribution versus fibre transmission in the case of fluctuating temperature. The typical fibre has thermal coefficient of expansion of 7 ppm/°C. This means for 1 km length of fibre when the temperature changes by magnitude of 10 degree Celsius over a night/day cycle, the time of flight will change by 350 ps. This corresponds to a 19 degrees phase shift for a 2.5 GHz clock. The FSO system is far more immune to the temperature effects since the length of the medium remains unaffected.

248 - Multiparty Quantum State Sharing of an arbitrary unknown three particle state with GHZ state measurements

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.248)*
Primary author: SEKGA, COMFORT *(Botswana International University of Science and Technology)*
Co-author: MAFU, Mhlambululi *(Botswana International University of Science and Technology)*

We propose a scheme for sharing unknown three-particle state to n agents using Greenberger-Horne-Zeilinger (GHZ) states. Firstly, we introduce the five party QSTS of arbitrary three particle unknown state where Alice start by sharing four GHZ entangled states with her four agents and performs three GHZ state measurements on her particles followed by two single particle measurements on the Hadamard basis. One of the agents Bob1 performs single measurement on her particle and the three other agents each perform unitary transformation on their particle to recover the unknown state. Subsequently we propose the generalised multiparty QSTS of an arbitrary three particle state.

251 - Low cost passively Q-switched laser

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.251) [For award: MSc]*
Primary author: MADLALA, Bigboy *(Structured Light Lab, School of Physics, University of the Witwatersrand)*
Co-authors: *STEYL, Johan (AIRBUS DS OPTRONICS); FORBES, Andrew (CSIR)*

Present laser designator designs incorporate porro prisms, for alignment purposes, with a single mode as output. While this makes the design insensitive to alignment, it comes at a cost since the resonator contains many custom optical elements. Here we outline the design of a low cost passively Q-switched laser that produces a single pulse with no side lobes in the far field. We replace the porro prisms and lenses with curved mirrors, appropriately designed to produce identical optical transforms, so that the output is similar. In addition, we outline the approach to compact this configuration into a monolithic design for robust performance in a miniature package. We demonstrate the concepts experimentally and numerically, the latter using Fox-Li approach to modeling resonator modes with the Collin's integral for the system under study.

253 - Magnetic and Kondo behaviour in Ce8Pd24(Al1-xSnx)

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.253)*
Primary author: *TCHOULA TCHOKONTE, Moise Bertin (Department of Physics, University of the Western Cape)*
Co-authors: *BASHIR, Aiman (University of the Western Cape); STRYDOM, Andre Michael (University of Johannesburg); KACZOROWSKI, Dariuzs (Institute of Low Temperature and Structure Research, Polish Academiy of Sciences)*

Ce8Pd24(Al1−xSnx), (0≤ x ≤ 1) has been studied by magnetic susceptibility, ■(T), magnetization,M(μ0H), electrical resistivity, ρ(T), thermoelectric power, S(T), and thermal conductivity, λ(T), measurements. All investigated compositions crystallize in a cubic AuCu3 – type crystal structure with space group Pm–3m (No. 221). ■(T) data at high temperature follows the paramagnetic Curie – Weiss relation with negative Weiss temperatures θp and effective magnetic moments μeff close to the value of 2.54 μB expected for the free Ce3+ - ion. The low temperature dc ■(T) data indicate an antiferromagnetic (AFM) anomaly for all compositions between 0 ≤ x ≤ 1, associated with a Néel temperature ranging from TN = 4.3 K to 6.9 K between the two end compounds. Field – cooling (FC) and zero – field – cooling (ZFC) ■(T) data indicates spin – glass behaviour at Al concentrated alloys. ρ(T) data is dominated by coherent Kondo lattice scattering for alloys in the concentration range 0 ≤ x ≤ 0.5 and by crystal –electric field (CEF) effect for alloys with x ≥ 0.7. At low temperature ρ(T) data indicate a steep decrease at TN associated with magnetic phase transition also observed in the ■(T) results. Below TN, ρ(T) is described by a spin – wave dispersion relation. At low temperatures, S(T) data measurements indicate an AFM transition at TN corresponding to the ■(T) and ρ(T) results. The high temperature S(T) data is described by the phenomenological resonance model giving the Kondo temperature TK and the characteristic temperature TCEF associated with crystal - electric field effect. λ(T) increase linearly with temperatures from low T. The reduced Lorentz number, L/L0 increase upon cooling and exhibit maxima which decrease in magnitude with increase x, while the figure of merit (ZT=S2T/ρ) exhibit maxima and minima upon cooling and the magnitude at room temperature decreases with x.

254 - Africhino Quasi-Computer

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.254) [For award: Hons]*
Primary authors: *NAIDOO, Kreason Aaron (University of KwaZulu-Natal); RAMOHOEBA, Nonky (University of KwaZulu-Natal)*
Co-authors: *MARIOLA, Marco (University of kwazulu-natal); ISMAIL, Yaseera (University of KwaZulu-Natal); PETRUCCIONE, Francesco (UKZN)*

Several applications require acquisition techniques to elaborate the physical signals from the external environment as a control entity. Data handling is the main factor of concern especially with the current technological advancement of the digital world. Specifically, there is a significant necessity for the acquirement of data by utilizing scientific software to efficiently control hardware and vice versa. Current devices utilised for research are expensive and often use a proprietary software which drastically increases the cost of the device. The proposed study will be to develop a high quality and affordable compilation of electronic devices for experimental research and professional users based on the collation of numerous electronic techniques. The envisaged device is an open source software and hardware electronics design. The intended device is an inexpensive stand-alone portable laboratory apparatus for research institutions and schools. The proposed product will be based on the development of a complete compact system for experiments and controls or used as a computer. This system can act as an external device to function as a digital signal generator or perform as a controlled power supply which can be used as an apparatus for engineering and research purposes.

256 - DESIGN, MANUFACTURE AND PERFORMANCE EVALUATION OF A WASTE HEAT RECOVERY UNIT IN A GASIFICATION PLANT

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.256) [For award: PhD]*
Primary author: *NWOKOLO, Nwabunwanne (University of Fort Hare)*
Co-authors: *MAMPHWELI, Sampson (Fort Hare Institute of Tecnology); MAKAKA, Golden (University of Fort Hare)*

The term waste heat refers to unused thermal energy that is generated as a product or by-product of a process. Some waste heat sources include, hot gasification gas cooled during gas cleaning, hot combustion or flue gas dumped to the environment, hot equipment surfaces and heated products from industrial processes. The act of recovering and re-using rejected heat is known as waste heat recovery. Waste heat recovery offers a number of benefits such as reduction in the demand of primary fuel source, efficiency enhancement and reduction in CO2 emissions. Some waste heat losses are unavoidable, however much could be recovered by use of more efficient equipment or waste heat recovery unit. In this study, heat contained in syngas resulting from gasification of wood that is ordinarily wasted at the gas scrubber during syngas cleaning is recovered with the use of cyclone heat exchanger. A cyclone heat exchanger similar to a double pipe heat exchanger was designed and manufactured. The theoretical model for the heat transfer in the cyclone heat exchanger is presented. The effect of control parameters such as mass flow rates and temperatures of hot and cold fluid on the performance indicators were evaluated. More also the influence of flow configuration that is counter flow and parallel flow on performance parameters are considered. The final paper will present the obtained result.

258 - Interplay of antiferromagnetic and Kondo effect in $Ce_8Pd_{24}Al$

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.258) [For award: PhD]*
Primary author: *BASHIR, Aiman (University of the Western Cape)*
Co-authors: *TCHOULA TCHOKONTE, Moise Bertin (University of the Western Cape); STRYDOM, Andre Michael (University of Johannesburg); KACZOROWSKI, Dariusz (Institute of Low Temperature and Structure Research Polish Academy of Sciences)*

The suppression of antiferromagnetic (AFM) order and Kondo effect in $Ce_8Pd_{24}Al$ with the dilution of Ce with La is investigated by means of magnetic susceptibility, $\chi(T)$, magnetization, $M(\mu_0 H)$, electrical resistivity, $\rho(T)$, magnetoresistivity, MR, thermoelectric power, S(T), and thermal conductivity, $\lambda(T)$ measurements. X – ray diffraction studies indicate a cubic $AuCu_3$ – type crystal structure for all compositions on the alloys series $(Ce_{1-x}\ La_x)_8Pd_{24}Al$. At high temperature, $\chi(T)$ follows the paramagnetic Curie – Weiss behavior with negative paramagnetic Weiss temperatures θ_p and effective magnetic moment μ_{eff} values in close agreement with the value of 2.54 μ_B expected for free Ce^{3+} - ion. The low temperature dc $\chi(T)$ data show an AFM anomaly associated with a Néel temperature T_N which decreases almost linearly from 4.2 K for x = 0 to 2.9 K for x = 0.2 alloys. For alloys in the concentration range of $0 \le x \le 0.3$, $\rho(T)$ is characterized by a coherent Kondo lattice scattering with a well-defined $\rho(T)$ maximum at T_{max} = 9 K to 5.1 K for compositions in the range $0 \le x \le 0.3$, while incoherent single – ion Kondo scattering prevail for the $x \ge 0.4$ alloys. MR measurements on Ce diluted alloys are analyzed based on the calculations by Schlottmann for the Bethe – ansatz in the frame of the Coqblin – Schrieffer model and yields values of the Kondo temperature T_K and the effective moment of the Kondo ion μ_K. The decrease in T_K and T_{max} is described by the compressible Kondo lattice model. S(T) measurements are interpreted within the phenomenological resonance model giving values of the characteristic temperature T_{CEF} associated to crystal – electric field (CEF) effect.λ (T) data increase linearly with temperature from low temperature with T, while the reduced Lorentz number L/L_0 increase upon cooling and exhibit maxima at low temperature which decrease in magnitude with increased La content x.

259 - Characterization of Complex Spinel $LiMn_2O_4$ Nanosheet Simulated via Armorphization and Recrystalization Technique

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.259) [For award: PhD]*
Primary author: *LEDWABA, Raesibe Sylvia (Physics)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); SAYLE, Dean (University of Kent)*

Particle size reduction (mm to nm) is one of the strategies identified to shorten the electron and lithium ion diffusion paths in cathodes materials for lithium-ion batteries. Its implementation has resulted in enhanced rate capability, improved cycling stability and electrochemical performance of $LiMn_2O_4$ [1]. The armorphization and recrystallization technique is a practical tool to compliment annealing in experiments. It was previously employed to generate nano-architectures of binaries such as MnO_2 [2] and will be used in the current study on the spinel. Analysis of atomic crystal structures and microstructures of the resulting models, revealed presence of the spinel $LiMn_2O_4$ polymorph, rutile-MnO_2 and layered-$Li_2Mn\ O_3$ in the nanosheet $LiMn_2O_4$. The highly defected structures revealed vacancies and comprise substitutions of Li and Mn in different layers, which suggest possible mechanisms for Li mobility. The calculated XRD compare favourably with measured XRD providing valuable insights of the atomistic models and supporting observations in microstructural features.

261 - Analytical Results for the Tsallis Thermodynamic Variables in a Hot and Dense System

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.261)*
Primary author: *MOGLIACCI, Sylvain (UCT)*
Co-authors: *BHATTACHARYYA, Trambak (University of Cape Town); CLEYMANS, Jean (University of Cape Town)*

Based on recent findings, we analytically investigate the thermodynamic variables of a hot and dense system, in the framework of the Tsallis non-extensive statistics.After a brief review, we first recall the massless limits which then serve as benchmarks. Afterwards, we present the exact massive thermodynamic results, valid for all values of the q-parameter --- characterizing the non-extensivity of the system. Finally, we compare our results to their analogs in the so-called Boltzmann-Gibbs statistics. A special emphasis is put on the method, used in order to perform these computations, which allows to reduce cumbersome momentum integrals into ones containing simpler ones, resulting in analytic representations in terms of the Hypergeometric functions.Our analytic results, agreeing extremely well with the corresponding numerical estimates, happen to substantially simplify calculations within the Tsallis framework. The latter being extensively used in various different fields of Science, the LHC phenomenology for example, we hope to enlighten a number of possible applications.

262 - Development of Quantum Key Distribution System

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.262) [For award: MSc]*
Primary author: *UMUHIRE, Marie Louise (University of KwaZulu-Natal - Westville Campus, Durban, South Africa)*
Co-authors: *ISMAIL, Yaseera (University of Kwazulu Natal, Westville Campus, Durban, South Africa); PETRUCCIONE, Francesco (University of KwaZulu-Natal,westville Campus,Durban,South Africa)*

Quantum Key Distribution (QKD) is a process of producing and distributing the key information between groups of people or between two parties[1]. It is one of most advanced quantum information technology which uses quantum mechanics to guarantee the security of the communication. The implementation of QKD is realized by using an appropriate protocol. The sender (Alice) and the receiver (Bob) are connected by two channels. One is a quantum channel which is used for quantum transmission. In the case of sending photons this channel is generally either an optical fibre or free space. The second one is a classic channel which is used for the post – processing of the measurement bits, discarding all improper measured bits. The post – processing is performed to correct the errors obtained in shared key and erase all the information that an eavesdropper usually referred to as Eve could have obtained[2].There exist many different protocols for providing a secure key i.e. BB84 protocol which is the first and most known protocol, the B92 protocol, the E91 protocol and many more[2]. In this work, all these protocols are defined and their differences will be discussed focusing on an extensive study of the BB84 protocol. An experiment set up is constructed to reproduce this protocol using a single photon source and free space as a quantum channel. A shared key is obtained and a quantum bit error rate (QBER) is calculated to give an idea how efficient the system is. Error detection and correction is achieved using cascade protocol and privacy amplification methods are discussed.The conclusion is made according to the results obtaining during the QKD process. References1. Wiesner, S., Conjugate Coding. 1983. 15(1): p. 10.2. Nicolas Gisin, et al., Quantum cryptography. Reviews of Morden Physics, 2002. 72(1): p. 51.

263 - The Wigner distribution function in modal characterisation

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.263) [For award: MSc]*
Primary author: *MREDLANA, Prince (CSIR National laser centre)*
Co-authors: *NAIDOO, Darryl (Council for Scientific and Industrial Research); MAFUSIRE, Cosmas (University of Pretoria); KRÜGER, Tjaart (University of Pretoria); FORBES, Andrew (CSIR); DUDLEY, Angela (CSIR National Laser Centre)*

We investigate a novel approach to characterise an optical field employing a Wigner distribution function with a modal decomposition technique. Optical fields are typically characterised through their phase, beam size, far field beam divergence, beam quality and constituent modal components where a variety of measurement techniques are required to obtain the above parameters. These techniques include a modal decomposition that uses a superposition of orthogonal functions to determine constituent modal components and a knife-edge method to determine beam size by the use of a scanning slit and a detector. The use of the Wigner distribution function together with the modal decomposition is an approach to optimally obtain the various beam parameters in a single set of measurements. We demonstrate a mathematical representation of the approach and highlight the experimental procedure in modal characterisation.

264 - Deep Level Transient Spectroscopy of GaSb/GaAs Quantum Dots

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.264) [For award: MSc]*
Primary author: *VENTER, Danielle (Nelson Mandela Metropolitan University)*
Co-authors: *VENTER, André (NMMU); BOTHA, Johannes Reinhardt (NMMU); WAGENER, Magnus (NMMU)*

Self-assembled quantum dots (QDs) are interesting not only for studying charge confinement in zero dimensional systems, but also for the potential it offers towards the development of opto-electronic devices. In particular, GaSb/GaAs QD structures exhibit type-II band alignment in which the holes are strongly confined while a conduction band off-set creates a barrier to the flow of electrons. This, combined with the special separation between electrons and holes results in enhanced exciton lifetimes and reduced recombination probabilities, rendering these structures particularly suitable for long wavelength opto-electronic and memory device applications [1,2]. However, a thorough understanding of the electrical properties and carrier dynamics of these QD systems is an essential prerequisite for the development of the aforementioned mentioned devices.In this study, the electronic properties of a GaSb/GaAs QD system, grown by molecular beam epitaxy, are investigated by means of current-voltage (IV), capacitance-voltage (CV) and Laplace deep level transient spectroscopy (L-DLTS). The IV measurements show a significant rectification (~ 4 orders of magnitude) between -1V and +1V with an ideality factor of 1.75 at 300 K. The reverse bias current of roughly 7nA displays a weak bias dependence up to -3V. Three prominent defects are detected around 140 K, 300 K and 330 K using a rate window of 200 Hz. L-DLTS is used to evaluate the defects around the QDs. The respective signatures and charge carrier dynamics are presented.[1]. M. Hayne, J. Maes, S. Bersier, Appl. Phys.Lett. 82 (2003) 4355-4357.[2]. M. Geller, C Kapteyn, L. Muller-Kirsch, R. Heitz, D. Blumberg, Appl. Phys. Lett. 82 (2003), 2706-2708

265 - Surface Impedance Derived from the South African Magnetotelluric Network for the estimation of geomagnetically induced currents in the South African Power network

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.265)*
Primary author: *CILLIERS, Pierre (SANSA Space Science)*
Co-author: *MATANDIROTYA, Electdom (SANSA Space Science & CPUT)*

Geomagnetically Induced Currents (GIC) in power lines are driven by the geo-electric field that is induced between grounded points of the network by a varying geomagnetic field. The electric field is derived by the multiplication of the horizontal components of the geomagnetic field with the local surface impedance in the frequency domain. Tensor surface impedance values can be derived from the simultaneous measurement of the variations in the induced geo-electric field and the geomagnetic field by means of magneto-telluric (MT) devices. Alternatively the surface impedance can be calculated from Earth conductivity profiles based on MT surveys. This paper presents the first analysis of the surface impedances derived from the South African network of eight LEMI417 MT units deployed since April 2012 by SANSA Space Science as part of the South African Ionospheric, Geophysics and Geomagnetic Experimental Resource (SNIGGER) funded by the NRF's National Equipment Programme. The geographic variation of the surface impedance is presented and compared with surface impedances derived from 1D planar multilayer approximations of the ground conductivity profiles obtained by means of the Southern African Magneto-telluric Experiment (SAMTEX), conducted over parts of South Africa during the period 2003 to 2008. A comparison is made between the use of the complex spectral coefficients of the tensor surface impedance and the surface impedance derived from the homogeneous and isotropic Earth approximation in the calculation of GICs at selected locations in the South African power network, which has been used in several studies on GICs in the Southern African network. The results of this study demonstrate the importance of using in-situ measured values of the surface impedance for accurate estimation of GICs.

270 - Performance evaluation of a direct expansion bulk milk cooler on a dairy farm in the Eastern Cape Province of South Africa

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.270)*
Primary author: *MHUNDWA, Russel (University of Fort Hare Institute of Technology)*
Co-authors: *SIMON, Michael (FHIT); TANGWE, Stephen Loh (Fort Hare Institute of Technology, University of Fort Hare)*

This paper presents the performance evaluation of a direct expansion bulk milk cooler (BMC) used on a dairy farm in the Eastern Cape. The study was carried out on an existing dairy farm with an average of 800 cows in milking. The study focused on establishing the performance of BMC by the South African National Standards (SANS) 708:2007 for BMC's tanks. The performance evaluation of the BMC's considered morning and afternoon milking periods at an everyday collection of milk. A data acquisition system was installed to measure power consumption, the temperature of raw milk before cooling commences, the BMC room temperature, relative humidity, and ambient temperature. The volume of milk produced per every milking time was extracted from the on-farm records from fourth quadrant software. The cooling capacity of the BMC was determined for the two different milking times. The study revealed that an average of 60% of the day's milk extracted during the first milking. During this first milking, raw milk at an average temperature of 32°C attained a storage temperature of 4°C in 3 hours inclusive of the milking time. Also, after the last milking, the BMC operated for an average duration of 1.5 hours to before the raw milk attained the safe storage temperature. This short duration of cooling was owing to the slightly lower temperature lift of the stored milk from the storage temperature and also because of the volume of milk during that milking time which was lower than that of the morning milking time. The cooling capacity of the bulk milk tank was reduced due to an increased ambient temperature. Also, lower relative humidity increased the cooling capacity of the BMC and a decrease in the room temperature for the BMC lowered the cooling duration for the milk.

275 - Emission modelling of numerical hydrodynamical simulations with application to Active Galactic Nuclei jets

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.275) [For award: MSc]*
Primary author: *VAN DER WESTHUIZEN, Izak (University of the Free State)*
Co-authors: *MEINTJES, Pieter (University of the Free State); VAN SOELEN, Brian (University of the Free State)*

Active Galactic Nuclei, such as quasars and blazars, are highly variable over intra-day to year time scales. The regions that produce this variability have been the topic of many recent studies, especially in the investigation of correlation between multi-wavelength components from radio to gamma-rays. In this study a simulation is presented of an idealistic relativistic hydrodynamical jet propagating through a uniform background medium. This simulation is created with the use of the numerical code PLUTO ver 4.2 which uses high resolution shock capturing algorithms to evolve the fluid dynamic partial differential equations with time. In order to investigate possible causes of variable emission in the simulation a post processing emission code is developed to compute intensity maps of the hydrodynamic computational environment. The code is designed to model the synchrotron self-absorption spectrum in the radio regime for each cell. This emission is calculated using the emission and absorption coefficients, which are then integrated along a fixed line of sight to produce simulated intensity maps of the relativistic jet. Using the intensity maps we can investigate regions of variable emission as well as the respective time scales on which they occur. In this paper we present the initial results and intensity maps produced by the emission code as well as the planned future development of the project. The tools which are being developed for this hydrodynamic model can be applied to a range of other transient sources, such as X-ray and γ-ray binaries, to investigate the different emission components produced by such sources.

278 - Particle and gamma decay studies: an update on the K600

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.278)*
Primary author: *NEVELING, Retief (iThemba LABS)*
Co-authors: *ADSLEY, Philip (University of Stellenbosch/iThemba LABS); STEYN, Deon (iThemba LABS); SMIT, Frederick David (iThemba LABS); PAPKA, Paul (Stellenbosch University); PELLEGRI, Luna (University of Witwatersrand and iThemba LABs); TRIAMBAK, Smarajit (University of the Western Cape); PESUDO, Vicente (University of the Western Cape); MARIN LAMBARRI, Daniel (University of the Western Cape); BRUMMER, Johann Wiggert (University of Stellenbosch); LI, Kevin (Stellenbosch University, iThemba Labs)*

The K600 at iThemba LABS is a kinematically corrected QDD magnetic spectrometer for light ions. This facility, combined with the excellent beam quality from the iThemba LABS accelerators, is one of only two such facilities worldwide capable of measuring medium energy hadronic scattering and reactions at very small scattering angles, including zero degrees, with low background and high energy resolution.Medium-energy hadronic scattering and reactions at zero degrees are notoriously difficult to measure, but highly sought after due to the advantage of being very selective to excitations with low angular momentum transfer. This simplifies the analysis of the many possible contributions to the spectra due to the complex nature of the nuclear interaction. The addition of coincident particle and gamma detection to the zero degree capability enhances the selectivity of such a facility. Such a capability can open up a host of new opportunities to be explored, allowing rare events to be probed.Since the establishment of a dedicated Coincident Array of segmented detectors for K600 Experiments (CAKE) in 2014 numerous successful particle decay experiments were performed. Some results of this new facility will be presented, as well as details of the development of a gamma coincidence detection capability in the form of BAGEL, a Beautiful Array of Germaniums for Energy and L value determination.

280 - New Calibration Sources for Very Long Baseline Interferometry at 1.6 GHz

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.280) [For award: MSc]*
Primary author: *HAILEMARIAM, Mekuanint Kifle (University of Pretoria & Hartebeesthoek Radio Astronomy Observatory)*
Co-authors: *BIETENHOLZ, Michael (Hartebeesthoek Radio Astronomy Observatory); DE WITT, Aletha (Hartebeesthoek Radio Astronomy Observatory); BOOTH, Roy (University of Pretoria)*

I present new 1.6 GHz VLBI observations of calibrator sources in the Southern Hemisphere. My sample contains 43 sources known to be good calibrators at 8.4 GHz. Mygoals were firstly to establish the suitability of the selected sources as calibrators for 1.6 GHz VLBI observations, and secondly to determine, based on the selected sample, how the properties of the sources seen at 8.4 GHz are related to those seen at 1.6 GHz. I used seven telescopes; ASKAP, ATCA, Ceduna, Hobart, Mopra and Parkes from Australia, and HartRAO from South Africa.By evaluating the sources' radial extents, flux density at the central components of the sources and their brightness, I classified the sources into very good, good, intermediateand bad calibrators. Among the 43 sources, I found that 38 sources fell into the good or very good calibrator classes. Of the basis of my sample therefore, I can say that 88 percent of the good calibrators at 8.4 GHz are also safe to use at 1.6 GHz.

281 - suitability of quadratic gauge for non-perturbative QCD

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.281) [For award: PhD]*
Primary author: *RAVAL, Haresh (Indian institute of Technology Bombay)*

The confinement and the gribov ambiguity are two non-perturbative phenomena of great importance in QCD. Abelian dominance, a signature to the confinement, is mostly studied in Maximal abelian gauge which is Abelian projection. The Gribov ambiguity exists in various gauges. Algebraic gauges are more likely to be ambiguity free but are not compatible with the boundary conditions i.e.,the ambiguity continues to exist on a compact manifold. In general, algebraic gauges are not Lorentz invariant, which is their fundamental flaw. We consider a quadratic gauge, which is an algebraic gauge. It is Lorentz invariant and does not fall into the class of Abelian projection. We show that the gauge has two strong signatures of the confinement. We then provide an example of spherically symmetric gauge field and prove that with a proper boundary condition on the configuration, this gauge removes the ambiguity on a compact manifold $\mathbb{S}^3$. Thus, It is more suitable for the non-perturbative phenomena in QCD.

283 - The effect of low level laser therapy on both HIV infected and uninfected TZM-bl cells

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.283) [For award: PhD]*
Primary author: *LUGONGOLO, Masixole (Council of Scientific and Industrial Research)*
Co-authors: *MTHUNZI, Patience (CSIR - NLC); OMBINDA-LEMBOUMBA, Saturnin (CSIR- National Laser Centre); MANOTO, Sello (CSIR)*

Human immunodeficiency virus (HIV) infection still remains a major health problem despite the use of highly active antiretroviral therapy (HAART), which has greatly reduced mortality rates. Due to the unavailability of an effective vaccine or a treatment that would completely eradicate the virus from the system of the infected individuals, the quest for new therapies continues. Low level laser therapy (LLLT) involves the exposure of cells or tissues to low levels of red and near infrared light. LLLT has been widely used in different medical conditions including skin diseases, diabetes and wound healing, but not in HIV infection. This study aimed to determine the effects of LLLT on HIV uninfected and infected TZM-bl cells. Both HIV infected and uninfected TZM-bl cells were laser irradiated at a wavelength of 660 nm with different fluencies of 0, 2, 4, 6, 8 and 10 J/cm2. Changes in cellular responses were assessed using cell morphology, viability, proliferation, cytotoxicity and luciferase activity. The non-irradiated cells (0 J/cm2) and HIV uninfected cells were used as controls. TZM-bl cells irradiated in the absence of HIV showed no changes in cell morphology, viability, proliferation and cytotoxicity. However, cells irradiated in the presence of HIV infection showed changes in cell morphology, viability, proliferation and cytotoxicity. Laser irradiation reduced luciferase activity in HIV uninfected and infected cells. Laser irradiation in the absence of HIV has no inhibitory effect on cells, while in the presence of HIV infection it induces cell damage in a dose dependent manner.

286 - Optimizing the 90 degree scattering setup for determining the coordinates of the interaction points inside the iThemba LABS segmented clover detector.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.286) [For award: PhD]*
Primary author: *EASTON, Jayson (iThemba LABS)*

The new iThemba LABS segmented clover detector has 32 segments, which are electrically separated. This segmentation allows us to track gamma-rays inside the detector using pulse shape analysis of the traces. The average traces measured for various x y z points inside the detector should be compared with the simulated traces for the same x y z position. Once the measure and the simulated traces agree well a data base of simulated traces will be generated to track gamma-rays inside the detector.To measure the traces for some interaction points inside the detector, 900 Compton scattering is used. The setup includes the iThemba LABS clover detector in conjunction with a BGO detector. The iThemba LABS detector is mounted vertically on a scanning table. The scanning table is capable of positioning a collimated source in the x y plane with precision of less than a mm. The BGO detector is placed at a specific z height. Coincidence analysis between the clover and the BGO detector selects only the 900 Compton scattering events, determining the three coordinates of the gamma-ray interaction position inside the clover detector. The average trace for this interaction position is then measuredIn order to select only the 900 scattering events and reduce background events, optimization of the setup is done. This includes using specific shielding like lead blocks and using other BGO detectors as passive and active shielding. The relative distances between the detectors and the distance from the source also play a role. Optimizing the sorting codes decreases the running time for data collection in order to reduce data files sizes while collecting good events. The setup and its performance will be discussed.

289 - Quantum state sharing of an arbitrary three particle state using Einstein-Podolsky-Rosen pairs and GHZ state measurements

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.289)*
Primary author: *SEKGA, Comfort (Botswana International University of Science and Technology)*
Co-author: *MAFU, Mhlambululi (Botswana International University of Science and Technology)*

We propose a scheme in which Alice share an arbitrary three-particle unknown state with Bob1 and Bob2. Alice start by sharing Einstein-Podolosky-Rosen(EPR) pairs with her agents and then perform three joint three-particle Greenberger-Horne-Zeilinger(GHZ) state measurements on her particles. Bob1 who acts as controller performs a product measurements in the x-direction on his particles whilst Bob2 retrieves the original state by performing three unitary operations on his particles. Subsequently we propose the generalized multiparty quantum state sharing of an arbitrary three particle state. This scheme can be applied for sharing of secret information in quantum communication networks.

291 - Measurement of the surface potential of AlGaAs/GaAs heterostructures using Kelvin Probe Force Microscopy

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.291) [For award: MSc]*
Primary author: *KAMENI BOUMENOU, Christian (Nelson Mandela Metropolitan University)*
Co-authors: *NEL, Jacqueline (University of Pretoria); BOTHA, Johannes Reinhardt (NMMU); URGESSA, Zelalem N. (NMMU)*

In this study, cross-sectional potential imaging of AlGaAs/GaAs heterostructures is investigated. The measurements were performed using Amplitude Modulation Kelvin Probe Force Microscopy (AM-KPFM) in air at room temperature. The AM-KPFM measurement technique is usually carried out in two main stages: In the first stage, the sample topography is obtained using standard tapping mode atomic force microscopy (TM-AFM). In the second stage, the cantilever stays at a constant height and an external voltage in the form V_DC+ V_AC sin(w_AC t) is applied between the tip and sample (with a pre-set step size) to measure the Contact Potential Difference (CPD). It is shown that GaAs quantum wells with a few nanometer thickness, embedded in an AlGaAs matrix, can be detected using TM-AFM method. However, a flat surface potential (zero CPD) has been obtained. This result, which still needs to be optimized, can for the moment be explained by the rather low mole fraction of AlAs (0.35 in our case) contained in the AlGaAs matrix. In fact, it has been reported that the CPD between GaAs and AlGaAs increases monotonically with increasing AlAs fraction mole. CPD values around 120-180 meV have been reported for an AlAs mole fraction of 0.8, while the CPD for an AlAs mole fraction of 0.3 was almost zero. Further details of the morphology and electrical properties of cross-sections of a variety of AlGaAs/GaAs heterostructures will be presented.

293 - Sol-gel synthesis of Zn_2SiO_4:Mn^{2+} phosphors and the effect of rare-earth ions co-doping on their photoluminescence

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.293)*
Primary author: *MBULE, Pontsho Sylvia (University of South Africa)*
Co-authors: *DHLAMINI, Mokhotjwa Simon (University of South Africa); MOTHUDI, Bakang Moses (University of South Africa); NTWAEABORWA, Odireleng (University of the Free State)*

The present study reports on the synthesis, structure and optical properties of manganese (Mn2+) doped zinc silicate (Zn2SiO4). Zn2SiO4:Mn2+ phosphors with doping concentration of Mn2+ ions ranging from 0.015 to 0.09 mol% were prepared by a sol-gel method. The prepared powder phosphors were characterized using X-ray Diffractometer (XRD), Field-Emission Scanning Electron Microscopy (FESEM) coupled with Energy Dispersive spectroscopy (EDS) and Photoluminescence (PL) techniques. Samples annealed at 600 oC were amorphous and when annealed at 1000 oC showed an XRD pattern matching the α-phase structure of Zn2SiO4. A network of spherical (but faceted) agglomerated nanoparticles was observed from un-doped and Mn2+ doped Zn2SiO4 phosphors. The PL spectra recorded from as-prepared Zn2SiO4:Mn2+ phosphors showed a broad emission band at ~ 520 nm under UV excitation light. This is a typical emission of Mn2+ in Zn2SiO4 and maybe assigned to the electronic transition 4T1(4G) $\rightarrow$6A1(6S). Zn2SiO4:Mn2+ phosphors were then co-doped with Eu3+ and Dy3+ rare-earth ions and phosphors co-doped with Eu3+ showed emission peak at ~590 nm and an intense red emission at ~615 nm resulting from Eu3+ ion transitions 5D0 $\rightarrow$ 7F2 and 5D0 $\rightarrow$ 7F3, respectively. In addition, Dy3+ co-doped Zn2SiO4:Mn2+ phosphors showed a multi-peak emission with an intense emission at ~571 nm corresponding to 4F9/2 $\rightarrow$ 6H13/2 transition. Furthermore, the PL decay of Zn2SiO4:Mn2+,Eu3+,Dy3+ phosphor was analyzed and described to be bi-exponential.

294 - Preparation of organically modified Vermiculite and calculation of intercalation energies of polymers into both unmodified and organically modified Vermiculite

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.294)*
Primary author: *PHALA, Michael Feredi (University of Limpopo)*

Computer modeling studies were performed to modify vermiculite with cetyl trimethyl ammonium bromide surfactant to form organically modified vermiculite and to investigate the intercalation energies of several polymers into unmodified vermiculite and organically modified vermiculite. Forcite module within Material Studio modelling interface was used to run the calculations. The force field employed in our studies is the universal force field. This force field has been found to be effective for most clay minerals. It was found that the intercalation energies of most polymers into unmodified vermiculite is higher than into organically modified vermiculite, which agrees with previous studies of vermiculite and polymer insertion into other 2:1 clays.

295 - Molecular dynamics simulations of the interactions between water molecules and sulphide nanoparticles

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.295)*
Primary author: *MEHLAPE, Mofuti (University Of Limpopo)*
Co-author: *NGOEPE, Phuti (University of Limpopo)*

The interaction of water molecules with sulphide nanoparticles has a variety of important geological and technological processes. Nanoparticles have been the area of active research in the recent years due to their unique material properties, which distinguish them from the bulk material. Computational modelling method, molecular dynamics (MD) was performed to provide atomic or molecular level insights of the structural and dynamics of sulphides nanoparticles. MD provides an alternative to experimental approaches for analysis of the interaction between nanoparticles and water molecules. Radial distribution functions, density profiles, and phase changes were calculated to study the effect of water on the nanoparticles. We found that nanoparticles are stabilized in the presence of water, as compared to nanoparticles in vacuum, which undergoes structural changes.

301 - Zig zag of quadrupole shapes in sd-shell

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.301) [For award: PhD]*
Primary author: *ABRAHAMS, Kenzo (The University of the Western Cape)*

The work presented in this paper pertains measuring the sign and magnitude of the spectroscopic quadrupole moment for the first excited 2+ state in 36Ar. This will be done through a Coulomb excitation measurement using the reorientation effect at safe energies. The measurement will be performed using a distance of closest approach of at least 6.5 fm as proposed by Spear. This separation between the beam and target ensures that there are no nuclear excitations taking place which could obscure the results. The spectroscopic quadrupole moment was previously measured in 1971 by Nakai using a 206Pb target with a minimum safe distance of 4.3 fm. This lead to a large uncertainty in the value of Qs(2+) = 11(6) efm2 in 36Ar, which is currently the accepted value of Qs on the NNDC. The first 2+ state of 36Ar will be excited by bombarding a 1mg/cm2 194Pt target with 36Ar beams at 134(1) MeV. The reorientation effect plays a pivotal role in determining Qs because it provides information about the diagonal matrix elements. The data will be analysed using Gosia to extract the diagonal matrix elements which in turn will be used to calculate the spectroscopic quadrupole moment. An accurate measurement of Qs will help in understanding the shape evolution and deformation of nuclei in this region, in particular the zig zag of quadrupole shapes observed at the end of the sd shell.

303 - High energy electron irradiation influence on the Schottky barrier hieght and the Richardson constant on Pd/ZnO Schottky barrier diodes

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.303) [For award: PhD]*
Primary author: *MAYIMELE, Meehleketo Advice (university of Pretoria)*
Co-author: *AURET, Danie (University of Pretoria)*

The influence of high energy electron (HEE) irradiation from Sr-90 radio-nuclide on Pd/ZnO samples has been investigated over the temperature range of 80-350 K. Current-voltage (IV), capacitance-voltage (CV) and deep level transient spectroscopy (DLTS) were used characterize the devices before and after irradiation. For both devices, the IV characteristics were well described by thermionic emission (TE) in the high temperatures but deviated from TE theory at low temperatures. The current flowing through the interface at a bias of 2.0 V from pure TE to Thermionic field emission (TFE) within the depletion region with the free carrier concentration of the devices decreases after HEE irradiation. The modified Richardson constants were determine from the Gaussian distribution of the barrier height across the contacts. New defects appeared after HEE irradiation.

305 - Optimisation of spin-coating parameters for fabrication of thin film polyaniline-based nuclear radiation sensors

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.305)*
Primary author: *MOKOEAN, Jimmy (University of Pretoria)*
Co-authors: *DIALE, Mmantsae (University of Pretoria); MSIMANGA, Mandla (Tshwane University of Technology)*

The use of polymeric films in electronic device applications is becoming more commonplace due to the relatively low production and material cost of polymers when compared to conventional semiconductors. Material properties of thin polymeric films depend a lot on the structure of the films, which in turn is determined by the fabrication procedure. Current research efforts into polymer based photo-voltaic and radiation sensors are geared towards tailoring material properties of the polymers to improve their quantum efficiency to at least match that of silicon based detectors. This contribution presents results of a systematic study carried out to establish the relationship between material properties and spin parameters of conjugate polyaniline films spin-coated onto polyethylene substrates. In an effort to quantify observed relationships, empirical formulas are proposed to describe film thickness, roughness and crystallinity as functions of spin acceleration, speed and duration.

308 - Density Functional Theory on a Lattice: Self-consistence Hartree plus Exchange Approximation.

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.308) [For award: PhD]*
Primary author: *AMOUZOUVI, Kossi (University of the Witwatersrand)*
Co-author: *JOUBERT, Daniel (School of Physics, University of the Witwatersrand)*

Within an ensemble density functional theory formulation for a finite chain single band Hubbard Hamiltonian we define a ‘Hartree plus Exchange’ approximation that can be solved exactly in a self-consistent framework. In this formulation we exclude a small ‘Correlation’ term. Comparison of the results for a short Hubbard chain with the exact values show that the discontinuity in the Kohn-Sham potential is reproduced well and that the approximate total energy is a good approximation of the exact total energy. The results suggest that it is possible to find a good approximate solution for a Hubbard chain of any length and opens the way for solving interesting models such as Hubbard defect chains in a numerically simple and reliable way.

312 - Down-conversion process in Dy3+, Yb3+ co-doped TiO2 nanophosphor powder

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.312) [For award: MSc]*
Primary author: *MOKOENA, Mpho S (University of the Free State)*
Co-authors: *YAGOUB, Mubarak (University of the Free State); NTWAEABORWA, Odireleng (University of the Free State); SWART, Hendrik (University of the Free State)*

A series of TiO2 nanophosphors co-doped with two lanthanide ions (Dy3+, Yb3+) were synthesized by using a sol-gel method at room temperature. The concentration of Dy3+ ions was fixed at 0.5 mol%, while the Yb3+ concentration was varied from 0.05 to 5.0 mol%. The synthesized nanophosphor powders were characterized by X-ray diffraction (XRD), Fourier transform infrared (FT-IR), photoluminescence (PL), ultra-voilet visible spectroscopy (UV-Vis), scanning electron microscopy (SEM) and energy x-ray dispersive spectroscopy (EDS) techniques. The XRD pattern showed the formation of the tetragonal phase of TiO2 with an experimental lattice parameters a = b = 3.803Å and c = 9.534Å. The average crystallite sizes were estimated by using Debye Scherrer equation and were found to range from 9 to 15 nm. The FT-IR results confirmed the existence of different bonds in the prepared nanophosphor powder, in addition the absorption bands which were observed near 450 to 800 cm-1 revealed the vibration properties of the TiO2. The absorption bands of Dy3+ ions were observed in the visible region and also the absorption bands of Yb3+ were observed in the NIR region from the UV-Vis diffuse reflectance spectroscopy. The optical band gap energies of the synthesized nanophosphors were estimated from the Kubelka Munk function and it was clearly observed that the band gap energies decreased as the dopant ions were introduced into the TiO2 lattice. The emission in the NIR coming from the Yb3+ ion was observed by using a 325 nm He-Cd laser PL as the excitation source. The EDS technique confirmed the elements which were found in the synthesized nanophosphor. The particle morphologies of the un-doped and co-doped TiO2 nanophosphor were investigated by using the SEM.

314 - The Bottom-up synthesis and characterization of molybdenum dichalcogenide nanomaterials for applications in supercapacitors

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.314) [For award: MSc]*
Primary author: *NDALA, Zakhele (University of the Witwatersrand)*
Co-author: *GQOBA, Siziwe (University of the Witwatersrand)*

The 2D atomic crystals of molybdenum dichalcogenides such MoS2 and MoSe2 have attracted much interest in the scientific community due to their unique properties. The 2D atomic crystals or nanosheets of the molybdenum dichalcogenides have excellent electrical and optoelectronic properties that make them good candidates for use in certain applications such as energy conversion devices, chemical sensors and catalysis. Molybdenum dichalcogenide nanosheets have traditionally been synthesized using methods such as mechanical exfoliation, liquid exfoliation and chemical vapor deposition. These methods are difficult to scale up due to their high temperature requirements, tedious procedures and require complex apparatus. In this project bottom-up chemical synthetic methods are used for the production of MoS2 and MoSe2 nanomaterials. These methods have attracted a lot of interest because they provide a way of making these materials at low temperature with relatively simple procedures that can be scaled up easily and allow for the control of the size and thickness of the materials. These methods have also resulted in interesting morphologies such as nanorods and nanoflowers which are also being investigated in this project. MoS2 nanosheets have been recognized as a good candidate for use as electrodes in supercapacitors because of their high intrinsic fast ion conductivity and high surface area. Soon and Lohz have reported that the capacitance obtained when MoS2 is used as the electrode is comparable to that obtained when carbon nanotube arrays are used. Herein, synthesis using bottom-up chemical synthetic methods and characterization of molybdenum dichalcogenide nanomaterials is reported. Their properties and relevance to application in supercapacitors is discussed.

320 - Finding the needle in Galaxy Evolution: HI Stacking

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.320) [For award: MSc]*
Primary author: *HEALY, Julia (Dept of Astronomy, University of Cape Town)*
Co-authors: *BLYTH, Sarah (Dept of Astronomy, University of Cape Town); ELSON, Ed (University of Cape Town + South African Astronomical Observatory)*

Neutral atomic hydrogen (HI) is the raw fuel from which the star-forming molecular gas forms and is therefore an important tracer of galaxy evolution. Due to the intrinsic faintness of the HI emission line (observed at rest at 21cm), galaxies beyond a few hundred megaparsecs are difficult to observe directly with current radio telescopes. However, in the next year, MeerKAT and other SKA pathfinder telescopes will begin operating and enable deeper, large surveys (e.g. LADUMA) of neutral gas in galaxies. HI Stacking is an observational technique that will be highly exploited to learn about the HI content of galaxies that are not directly detected. Stacking involves combing the HI spectra of all the galaxies in a distant sample, thereby generating a high signal-to-noise measure of their total HI content. We have developed a Python-based software package that is capable of carrying out this HI stacking procedure for a set of given input HI galaxy spectra. We have applied our software to studying the non-detected HI spectra of galaxies in the Nancay Interstellar Baryons Legacy Extragalactic Survey (NIBLES). In doing so, we aim to extend by two orders of magnitude the stellar mass range probed by local Universe stacking experiments. Our future goal is for our package to be used to stack HI spectra from the LADUMA survey which aims to study the HI galaxy properties of galaxies over more than two thirds the age of the universe.

322 - Thermal stability of titanium Schottky contacts and defects introduced in epitaxial p-Si

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.322) [For award: PhD]*
Primary author: *DANGA, Helga Tariro (University of Pretoria)*
Co-authors: *AURET, F. Danie (University of Pretoria); MEYER, Walter. E (University of Pretoria)*

The electronic and thermal properties of defects introduced during electron beam deposition (EBD) and isochronal annealing of titanium (Ti) contacts on epitaxial p-Si were investigated. In this work, Ti Schottky contacts were annealed with in a temperature range of 50 °C-400 °C. Current-voltage (I-V) measurements were conducted to monitor the change in electrical characteristics with every annealing step. A barrier height of 0.57 eV was measured on the as-deposited sample. Deep level transient spectroscopy (DLTS) and Laplace-DLTS techniques were employed to identify the defects induced after electron beam deposition (EBD) and isochronal annealing of the Ti Schottky contacts. The defect level identified on the as-deposited sample was a hole trap at 0.35 eV, known as the K-centre.

325 - Structural prediction of β-MnO2 nanoclusters using global search techniques

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.325) [For award: PhD]*
Primary author: *MASOGA, Phala (University of Limpopo)*
Co-authors: *MAPHANGA, Rapela (University of Limpopo); NGOEPE, Phuti (University of Limpopo)*

The increasing demand for high energy density rechargeable batteries has fuelled the interest in the research, development and manufacturing of new battery systems capable of powering high powered machinery as well as rechargeable household appliances. Pyrolusite (β-MnO2) is the most stable and abundant polymorph of manganese dioxide and it is regarded as a potential material for rechargeable lithium-ion batteries. In this study, a combination of evolutionary algorithm techniques and density functional theory methods are employed to determine the stabilities of MnO2 nanoclusters across the energy landscape. We investigate the energetics and structural configurations for $(\beta\text{-MnO2})_{n=1\text{-}20}$ nanoclusters. The most stable nanoclusters are made of a cubic structure consisting of two manganese and two oxygen atoms for various cluster sizes. The stable structures tend to migrate to a more circular compact configuration after geometry optimisation using density functional theory. Calculated x-ray diffraction patterns for the nanoclusters revealed the most dominant and stable peaks with their respective intensities in addition the effect of temperature changes on nanocluster stability was studied. As the temperature is increased from 200K to 1300K, the change in the bond angles and bond distances is measured. An increment of the exterior angles and bonding lengths along with the decrease of the interior angles is observed. The average stable temperature was found to be approximately 300K for $(\beta\text{-MnO2})_{n=1\text{-}6}$ nanoclusters.

330 - Materiallurgy of macadamia nut shell explained using its physical properties

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.330)*
Primary author: *MULABA-BAFUBIANDI, Antoine F. (University of Johannesburg)*
Co-author: *NICLETTE, Eloko (University of Johannebsurg)*

Macadamia integrifilia and macadamia tetraphyllia nuts come from trees found in rainforest. In South- Africa, macadamia nuts are found in Limppo (Venda and Tzaneen), Mpumalanga and Kwa zulu Natal. Their seeds have many therapeutic and nutritional attributes. While essential oil is extracted from the nut seed, the hard nut shells may be used for its high calorific value 19.64 MJ/Kg. Artisanal clay bring makers in the Dididi village of the Nondoni dam (Venda) are using these nuts in conjunction with fire woods to reach the required higher temperature (around 1200 0C) for their firing of clay bricks. Although macadamia was found to have a calorific value similar to that of coal (19.44 Mj/Kg), it has a lower amount of ash. The compressive strength for untreated macadamia nut shell was found to be between 1800 and 4000 N which would make it useful as building material. The fracture force per mean shell thickness of macadamia has been found between 1000–1200 N/mm. Its micro-hardness supported by the physical activation makes it suitable in the production of activated carbon for gold extraction. The chemical activation with citric, with hydrochloric, with sulfuric acid or with sodium hydroxyl makes macadamia nut shells suitable as cations and anions–exchangers for base metals recovery from hydrometallurgical aqueous solutions or for water purification. In addition to the above, the present paper will elaborate on the adsorption isotherms using the thermodynamics, adsorption mechanisms using the physico-chemistry of the nut shell surface and the kinetics for base metals ie Cu, Co and Ni removal from aqueous solutions.

332 - Effects of precursor concentration on morphological, structure and optical properties of TiO2 synthesised via sol-gel method

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.332)*
Primary author: *SITHOLE, T M (Vaal University of Technology)*
Co-authors: *KOAO, L F (University of the Free State); DEJENE, Francis (University of the Free State)*

This study describes the synthesis and characterization of material properties of a nanometric titanium oxide nanopowder. The primary aim of the investigation was to evaluate the effect of tetra-n-butyl-orthotitanate on the stability of TiO2 nanopartic les particularly for the use of wide band gap, high temperature devices such as LEDs and a variety of other sensing devices. XRD patterns of TiO2 powder exhibit anatase phase (JCPD file No. 84-1286). The crystallite sizes estimated using (101) diffraction peaks are found to vary from 16 to 41 nm respectively with an increase of tetra-n-butyl-orthotitanate from 3 to 17ml. SEM images show that at low concentration of tetra-n-butyl-orthotitanate spherical nanoparticles were observed. As the concentrations of precursors increases the nanoparticles become more agglomerated. UV measurements show that samples exhibit absorption peak at 330 nm corresponding to the excitation of electrons from the valence to the conduction band. The synthesized TiO2 nanomaterials has band gap energy between 3.3 and 3.7 with an increase in tetra-n-butyl-orthotitanate which are larger than the value of 3.2 eV for the bulk TiO2 nanomaterials. The PL spectra of TiO2 nano powders revealed a broad intensity band centered at 460 nm with a weak band at higher wavelength (560 nm). These two emissions were assigned to photon incident lines and oxygen defect trap, respectively.

334 - Observing 5 MHONGOOSE galaxies with the KAT-7

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.334)*
Primary author: *SORGHO, Amidou (University of Cape Town)*
Co-author: *CARIGNAN, Claude (University of Cape Town)*

In preparation of the MHONGOOSE survey to be conducted with the upcoming MeerKAT telescope, we use the KAT-7 telescope to observe 5 galaxies of the survey sample. With its short baselines and high surface brightness sensitivity, the KAT-7 allowed us to observe the galaxies down to low column density levels. Using 3 different phase calibrators for each galaxy, we developed a calibration technique to be used with the MeerKAT telescope, and determined the best calibrator for each of the galaxies. Also, comparisons with single dish observations show that most of the fluxes of the galaxies are detected by the KAT-7.

336 - Qualitative comparison of advanced characterisation techniques of Photovoltaic cells

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.336) [For award: MSc]*
Primary author: *DIX-PEEK, Ross (NMMU)*
Co-authors: *VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU); CROZIER, Jacqui (NMMU); PRETORIUS, Christiaan (NMMU - Mathematics)*

Electroluminescence (EL), infrared (IR) thermography, light beam induced current (LBIC) measurements and their associated techniques provide powerful non-destructive characterisation tools for photovoltaic (PV) cells. In this study, EL, IR thermography, and LBIC are compared as to determine the interdependence of the results obtained from each technique. The combination of these techniques are used to successfully identify and characterise performance limiting defects in PV cells. The LBIC measurement technique is used to perform localized cell characterization of PV cells using a focussed light beam as probe. The technique allows the determination of local photo-response and current-voltage (I-V) characteristics of a cell, the extraction of device parameters and identification of performance degrading defects present in a solar cell. EL is essentially the reverse of the photovoltaic effect. When a PV device is forward biased, luminescence is emitted from active areas of the device. This then enables defects to be observed, with different defects reacting differently to varying bias levels. IR thermography also renders defects and low performing device areas to be observed. In the paper an LBIC system will be used to measure point-by-point photo-response and I-V characteristics. The performance and device parameter mapping across a PV cell will be correlated with EL and thermography on a point-by-point basis. All three system configurations were designed and constructed in accordance to requirements of the project. The initial results will be discussed in this paper.Key words: Electroluminescence, infrared thermography, LBIC, photovoltaic, I-V

337 - Effect of annealing temperature on the structure, morphology and optical properties of Sm^{3+} doped lanthanum phosphovanadate

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.337)*
Primary author: *MOTLOUNG, Selepe Joel (University of the Free State)*
Co-authors: *TSHABALALA, Kamohelo George (University of The Free State); SHAAT, Samy (Islamic University of Gaza Palestine)*

This work explores the influence of annealing temperature on the Sm^{3+} activated lanthanum phosphovanadate phosphor powders prepared by solution combustion method. The prepared phosphor powders were annealed at different temperatures (600–1000 °C) for 2 hours. The structure and surface morphology were investigated by X-ray diffraction (XRD) and scanning electron microscopy (SEM) respectively. The XRD analysis indicated that as the annealing temperature is increased, the crystal structure of the prepared phosphor powders changed from monoclinic to tetragonal phase. The SEM images showed different morphologies and sizes. The estimated band gap from diffuse reflectance spectra (DRS) is ~ 3 eV. The excitation spectra showed a strong broad band extending from 200 to 350 nm with maximum at λ = 273 nm.The photoluminescence result showed three emission peaks and they are attributed to $^6G_{5/2} \rightarrow {}^6H_{5/2}$, $^6G_{5/2} \rightarrow {}^6H_{7/2}$ and $^6G_{5/2} \rightarrow {}^6H_{9/2}$ transitions of Sm^{3+} ion.

343 - Theory of fast ion transport on nanoscale and computer exploration

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.343)*
Primary author: *DESPOTULI, Alexandr (IMT RAS)*
Co-author: *ANDREEVA, Alexandra (IMT RAS)*

The future integrated circuits in deep sub-voltage nanoelectronics [1] should include devices with fast ion transport (FIT). Among them, all solid state thin-film impulse supercapacitors which basic working part is a solid electrolyte (SE)/electronic conductor (EC) heterojunction. It implies the development of the FIT-theory on nanoscale. However, until now the basic FIT-theory describing nano-object response on external dynamic influence is absent. For the problem decision, for development of nanoionics [2] and interpretation of frequency-dependent impedance of SE-nanosystems we have put forward structure-dynamic approach (SDA) of nanoionics [3]. Theoretical system of SDA includes a structural layered 1D-hopping atomic model of the region with a non-uniform potential landscape, a method of “hidden” variables (excess concentrations of mobile ions induced by external influence on crystallographic planes), a physico-mathematical formalism (based on the principle of a detailed balance and the kinetic equation in the form of the particle conservation law), and a method of uniform effective field. A new notion - the Maxwell displacement current on a potential barrier and the essential definition of effective electrostatic field (corrected uniform Gauss field) [4,5] are given. The computer exploration of the ion-transport and dielectric-polarization processes of model SE/EC heterojunctions are analyzed, and such modes of solid state ionics as “near constant loss” and Johnsher’s universal dynamic response (the power law of the real part of frequency dependent conductivity) are explained. [1] A.L. Despotuli, A.V. Andreeva. International Journal of Nanoscience 8 (2009) 389. [2] A.L. Despotuli, V.I. Nikolaichik. Solid State Ionics. 60 (1993) 275.[3] A.L. Despotuli, A.V. Andreeva. Nano and Microsystem Technique. 9 (2012) 16.[4] A.L. Despotuli, A.V. Andreeva. Ionics 21 (2015) 459. [5] A.L. Despotuli, A.V. Andreeva. Ionics 22 (2016) DOI 10.1007/s11581-016-1668-3

346 - Visualizing higher order Brillouin zones with applications

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.346)*
Primary author: *ANDREW, Richard (University of Pretoria)*
Co-authors: *SALAGARAM, Trisha (University of Cape Town); CHETTY, Nithaya (University of Pretoria)*

It is common for students to use modern electronic structure codes (ESC) as black-boxes, with little conceptual understanding of the underlying theoretical and computational details of the main components involved. What is needed are simplified problems that illustrate these concepts and are easily coded by third year undergraduate students. An important concept in solid state physics is the first Brillouin zone (BZ) which uniquely determines the electronic energies and wavefunctions for electrons in a periodic potential. ESC calculate material properties using integrations over this zone. Higher order zones are also important; the BZ boundaries define Bragg planes and the constant energy Fermi surface sometimes extends into these zones. The shape of this surface is important in determining many metal properties and low energy interactions. Using a simple algorithm to sort k-points into their respective Brillouin zones, we can visualize a BZ of any order as well as deconstruct the Fermi surface for metals when it extends into the higher order zones. This is pedagogically useful as a student can write a small code, in a language of their choice, to implement the algorithm for any crystal lattice. We present results for 2D and 3D.

347 - Effect of refluxing growth time on structural, optical and luminescence properties of zinc telluride Quantum dots

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.347) [For award: MSc]*
Primary author: *KIPROTICH, Sharon (University of the Free State)*
Co-author: *DEJENE, Francis B (University of the Free State)*

Keywords: zinc telluride; quantum dots; bioimaging; photoluminescence; particle size.This paper presents the synthesis of L-cysteine capped zinc telluride quantum dots (ZnTe QDs) by a simple one-pot synthesis using zinc acetate, potassium tellurite and L-cysteine as the starting materials. The reaction was carried out in a single three necked flask in open air conditions under reflux at 100°C. Photoluminescence (PL) measurements show sharp emission peaks for all as-prepared ZnTe QDs. The PL spectra indicate a shift in emission window of the core which is accompanied by an increase in emission intensity for longer refluxing growth time. Highest intensity was observed at 30 minutes of synthesis. X-ray diffraction spectra show the formation of a hexagonal structure for all samples. Difference in absorption edges were observed due to a variation of refluxing growth time of ZnTe QDs. The position of the absorption band is observed to shift towards longer wavelengths for longer durations of synthesis. The band gap shows an inverse relation with the growth time of the as prepared ZnTe QDs. Spherical shaped QDs were formed as displayed by the HRTEM images. Owing to the flexible surface characteristics of QDs, the same surface functionalization approach can be used to conjugate QDs of any color [1-2].Reference: [1] M. Bruchez, Jr., M. Moronne, P. Gin, S. Weiss, A. P. Alivisatos, Science 1998,81, 2013.[2]X. Gao, Y. Cui, R. M. Levenson, L. W. K. Chung, S. Nie, Nat. Biotech.2004, 22, 969.

348 - A high speed OCT system developed at the CSIR National Laser Centre

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.348)*
Primary author: *SHARMA, Ameeth (CSIR National Laser Centre)*
Co-authors: *ROBERTS, Ted (CSIR National Laser Centre); SINGH, Ann (CSIR,National Laser Centre); RAMOKOLO, Rocky (CSIR, National Laser Centre); STRAUSS, Henchard (CSIR (National Laser Centre))*

Light based techniques continue to gain momentum in different spheres of diagnostic and therapeutic applications as a result of their non-invasive, non-contact properties. One such technique is Optical Coherence tomography (OCT). Since it was first reported by Huang in 1991[1], OCT has made significant strides in different fields from dermatology and ophthalmology to polymer characterisation and bio-metrics[2-4]. In South Africa, the technique is still emerging although it is being used for eye examinations by ophthalmologists. The type of OCT system employed can be a simple, cost effective solution or a complex, highly specific and fast system depending on the application.As part of a larger project, the CSIR National Laser Centre has designed and built a high speed OCT system that can image a large surface area (25 by 25 mm) to a depth of 11 mm (sample dependant). Resultant 3-D images (512 x 512 x 2048 pixels) are acquired in less than 3 seconds. The performance of the system compares adequately with many commercially available systems which usually image smaller areas [5-6].The heart of the system is a 200 kHz swept laser source and two axis galvonometer based scanner. Signal acquisition is made possible through a high speed analogue-to-digital converter capable of speeds greater than 1GS/s. This paper will give an overview of the system and elaborate on the design of the data acquisition system and the initial results that have been obtained.

350 - Physics of clayey soils to explain their geophagic, traditional pottery making and paints applications

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.350)*
Primary author: *ANTOINE F., Mulaba-Bafubiandi (University of Johannesburg)*
Co-author: *MEGNE-TIEGUM-, Adeline (University of Johannesburg)*

Clayey soils are traditionally used in construction of houses and shelters in African rural areas. In the Eastern Cape province of South Africa for instance, huts and shelters are colourfully painted (a part from industrially made and commercial paints) using traditional paints made of river bed clays and indigenous plants from the Southern African flora. These paints are also used on traditional clay pots employed in many diverse cultural applications as funerals, birth and traditional wedding rites, etc…Clayey soils are also commonly eaten by pregnant women and by youth from both genders. The present paper will present the established correlation between physical properties (particle size distribution, physical aggregate and morphology, texture, color, plasticity, etc…), mineralogical composition, mineral-chemistry of clayey soils, CEC, adsorption ability, surface adhesion property etc…and their specific applications (pottery, paints or geophagia) for clayey soils collected from Tzaneen, cameroon, Venda, Qwaqwa (Free State) Bugersdorp (Tzaneen) and Sedibeng (Tzaneen).

351 - Effect of different synthesis methods on structure, morphology and magnetic properties of CoFe2O4 nanoparticles

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.351)*
Primary author: *OSMAN, Nadir (University of KwaZulu-Natal)*
Co-author: *MOYO, Thomas (University of KwaZulu-Natal)*

Spinel structure of CoFe2O4 nanoparticles was synthesized via combustion, glycol-thermal and hydrothermal methods. The structure was studied by X-ray powder diffraction. High-resolution transmission electron microscope was used to investigate the effect of the synthesis methods on the morphology of the samples. The sample produced by combustion method show largest crystallite sizes of 22.98 nm. Smallest crystallite sizes of about 6.57 nm were obtained by hydrothermal method. Iron distribution and hyperfine interaction on the tetrahedral site and octahedral site for the samples were studied using 57Fe Mössbauer measurements at room temperature. Investigation of the magnetic behavior for the samples was carried out using vibrating sample magnetometer (VSM) in external magnetic fields of up to 14 kOe. The coercive fields obtained were 1271.1 kOe, 198.15 kOe and 165.84 kOe for the samples produced by combustion, glycol-thermal and co-precipitation respectively.

358 - Long-term monitoring of TeV Blazars with the Watcher Robotic Telescope

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.358) [For award: MSc]*
Primary author: *MARAIS, Johannes Petrus (UFS)*
Co-authors: *VAN SOELEN, Brian (University of the Free State); MEINTJES, Pieter (University of the Free State)*

Blazars are known to show large-scale multi-wavelength variability on the order of days to years. This variability often manifests as rapid flares that can show correlation over a broad wavelength range. Since flares happen suddenly rapid, follow-up observations must be scheduled if a more detailed multi-wavelength observation campaign is to be started. We report on the long term optical photometric monitoring of a selection of known and candidate TeV blazars observed with the Watcher Robotic Telescope since December 2014 in the V, R and i filters. In particular, we present results of five well known sources PKS 1510-089, AP Librae, PG 1553+113, PKS 2005-489, PKS 2155-304. A reduction pipeline is currently in development to help identify potential sources for rapid follow-up multi-wavelength observations and provide optical lightcurves to complement multi-wavelength observations. During the observation period PKS 1510-089 showed 2 outburst and a Δ(V) ~ 1.7 mag. PKS 2155-304 showed a Δ(V) 1 magnitude difference and a steady increase in magnitude. PG 1553+113 exhibits an outburst with a total magnitude change of Δ(V) ~ 0.6, while PKS 2005-489 presents one outburst (~0.5 mag) in all the filters during the middle of the campaign. No flare events were observed for AP Librae.

360 - Open Quantum System approach to spontaneous formation of prebiotic molecules in interstellar space.

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.360) [For award: MSc]*
Primary author: *ELS, Paul (NWU, Potchefstroom)*
Co-authors: *MARAIS, Adriana (UKZN); SINAYSKIY, Ilya (University of KwaZulu-Natal and National Institute for Theoretical Physics); PETRUCCIONE, Francesco (UKZN)*

The past half-century has seen much advancement in the fields of astronomy and astrochemistry, but an emerging field, known as astrobiology, now seeks to answer one of the oldest and most fundamental questions in science: What is life? Prebiotic molecules – those that are proposed to be part of the processes leading to the origin of life – and the formation of nucleobases, in different astrophysical environments, have thus far been the primary area of focus. Recently we have seen the detection of an HCN dimer ($H_2C_2N_2$) along with possible formation routes leading to Adenine ($H_5C_5N_5$), one of the nucleobases. In our work we apply an open quantum systems approach to the problem of HCN dimer formation. The temperature of the relevant environment is ~10K meaning it is quite possible that non-trivial quantum effects may be vital to the process of dimerisation. Following observational data from the Green Bank Telescope we specifically focus on the possibility of spontaneous dimerisation on the surfaces of interstellar ice grains.

363 - Ionospheric characterisation of the South Atlantic Magnetic Anomaly using a ship-based dual-frequency GISTM receiver

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.363) [For award: MSc]*
Primary author: *VERMEULEN, Annelie (UCT SpaceLab)*
Co-authors: *CILLIERS, Pierre (SANSA Space Science & UCT SpaceLab); MARTINEZ, Peter (UCT SpaceLab)*

The South Atlantic Magnetic Anomaly (SAMA) is the region in the South Atlantic Ocean where the Earth's magnetic field is weakest at comparable latitudes. It is of interest due to the precipitation of high energy particles into the ionosphere over this region during geomagnetic storms. This paper reports the novel use of a geodetic-grade, dual-frequency GPS Ionospheric Scintillation and Total Electron Content Monitor (GISTM), located on the polar research vessel SA Agulhas II, in combination with a modified algorithm to characterise the ionosphere over the SAMA during voyages through this region.Ionospheric Scintillations are rapid fluctuations in the phase and amplitude of trans-ionospheric radio signals resulting from electron density variations along the ray path. Identification of the ionospheric structures that cause these scintillations and characterising the effect they have on satellite communications requires measuring the Total Electron Content (TEC) along ray paths from GPS satellites to terrestrial receivers to determine the spatial distribution of ionospheric electrons. Traditional TEC and scintillation measurements are done using dedicated dual-frequency GPS receivers at fixed terrestrial locations. SANSA operates several receivers in Southern Africa, at Marion Island, Gough Island, and SANAE-IV in Antarctica. However, most of the SAMA lies beyond the reach of these land-based sensors. The GISTM installed on board the SA Agulhas II in 2012 has enabled for the first time the terrestrial measurement of scintillation in the SAMA. In this project, the amplitude (S4) and phase scintillation (σ_Φ) indices from 50Hz L1 signals recorded during the 2014 and 2015 voyages of the SA Agulhas II will be analysed for the first time. Mobile TEC measurements will be verified with stationary TEC measurements in intersecting areas. The SA Agulhas II is additionally equipped with vibration sensors that will be used to determine the possible coincidence of the observed scintillation events with ship-generated vibrations.

364 - Novel method to make a calibrated thoron source

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.364) [For award: PhD]*
Primary author: *ELHAG, Elmughera (University of the Western Cape)*
Co-authors: *LINDSAY, Robert (University of the Western Cape); DE MEIJER, Rob (UWC)*

Researchers around the world have recognized that radon (Rn-222) is a hazard to human health, and more recently thoron (Rn-220) has been found to be a larger problem than expected. Rn-222 is a progeny of radium in the uranium series while Rn-220 is a member of the thorium series. The recent interest for measuring Rn-220 activity in air and the following development of the corresponding measurement techniques, require the improvement of standards for the calibration and characterization of the measurements device which have often been optimized for radon measurements. In this work we describe a simple, cheap method that can provide a reasonably accurate flow of Rn-220 for checking Rn-220 detectors and to investigate Rn-220 measurements. A novel Rn-220 source has been developed using Thorium Nitrate crystals, that are dissolved in water and the Rn-220 is created by bubbling air through the solution using the continuous monitoring detector system, the RAD7. The strength of the source is found by simultaneously measuring the gamma rays from the water using a sodium iodide detector (NaI). The difference in the gamma rays that are emitted before and after the Rn-220 in the thorium decay chain give an accurate measurement of the concentration of Rn-220 that leaves the water. The measurement has to be taken over a few hours to allow for the decay of Pb-212 that has a half-life of 10.6 hours.

365 - High temperature and phase transformation studies of Pt_3Al compounds

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.365) [For award: MSc]*
Primary author: *MKHONTO, CHRESTINAH (SAIP MEMBERSHIP)*
Co-authors: *CHAUKE, Hasani (University of Limpopo); NGOEPE, Phuti (University of Limpopo)*

Platinum group alloys, particularly the Pt_3Al alloys are of importance in high temperature environment, such as aerospace and gas turbine. The Pt_3Al exist in four phases that is $L1_2$, DOc, DOc′ and tP16; the $L1_2$ is stable at high temperatures (HT) and transforms to tetragonal phases at low temperature (LT). In particular, the cubic $L1_2$ Pt_3Al is ductile but unstable, while the lower temperature (LT) phase which has the tetragonal lattice DOc′ is stable but brittle. However, the tetragonal tP16 is observed to be the ground-state structure at lower temperature. In this study, the relative phase transformation behaviour from $L1_2$ to tP16 and DOc′ has been investigated using Molecular Dynamics within the LAMMPS code. The calculated X-ray diffraction (XRD) pattern reveals a transformation trend from $L1_2$ to DOc′ and $L1_2$ to tP16 between 400K and 1300K. The observed $L1_2$ to DOc′ XRD peaks vanishes above 800K, while the $L1_2$ to tP16 peaks are observed above 1000K. This confirms that the DOc′ and $L1_2$ are stable below 800K and above 1000k, respectively. The $L1_2$ to tP16 transformation showed distinct XRD peaks above 800 K. The $L1_2$ XRD pattern are consistent with the experimental results, and also confirms that the tP16 phase is stable below 1000K.

366 - Studying the thermal history of the intergalactic medium with the redshifted 21-cm line

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.366)*
Primary author: *KLUTSE, Diana (Rhodes University)*
Co-authors: *BERNARDI, Gianni (Rhodes University); GROBLER, Trienko (Rhodes University)*

The 21-cm line is the best probe of the evolution of the intergalactic medium and the Universe reionization. We show our progress in studying the thermal history of the intergalactic medium prio reionization and to constrain the sources of heating through 21-cm observations

371 - Classical light simulations of quantum measurements

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.371) [For award: MSc]*
Primary author: *BERRY, Gareth (Structured Light Lab, School of Physics, University of the Witwatersrand)*
Co-authors: *MCLAREN, Melanie (Wits); FORBES, Andrew (CSIR)*

Quantum entanglement has been at the forefront of multiple interesting studies since the release of Einstein, Podolsky and Rosen's famous paper in 1935. Its uses have extended to fields such as cryptography, teleportation and quantum imaging. The process of creating entangled bi-photon relies on a non-linear process called spontaneous parametric down conversion (SPDC). In SPDC a single photon is split into two entangled daughter photons, a process in which both energy and momentum are conserved. While SPDC has become a standard technique in generating entangled photon pairs, alignment and measurements of single photons is not a simple procedure. As such, classical light in the visible wavelength regime is used to not only align the entanglement system, but can also be used to simulate quantum measurements. This technique is known as back-projection and relies on both the conservation laws of SPDC as well as Snell's law. This technique simplifies an otherwise complex quantum system and offers a simple experimental system for predicting quantum behaviour. We illustrate this through various quantum measurements such as a Bell inequality and a full state tomography. The validity of this classical approach is highlighted in an experimental demonstration of quantum imaging.

377 - An ab initio density functional theory study of structural, electronic, magnetic and optical properties of Niobium diphosphide (NbP2)

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.377) [For award: MSc]*
Primary author: *RUGUT, Elkana (Elkana Rugut University of the Witwatersrand, Johannesburg.)*
Co-author: *JOUBERT, Daniel (School of Physics, University of the Witwatersrand)*

One of the fascinating things about numerical simulations of properties of materials is that it helps predict and explore materials ranging from those whose properties have already been established experimentally to those that are yet to be explored. In this study, we report structural, electronic, magnetic and optical properties of Niobium diphosphide which have not been reported before. We confirm that NbP2 in the C 1 2/m 1 structure is energetically, mechanically and dynamically stable. It is a metal, but in contrast to Niobium chalcogenides it is not magnetic. Optical properties are explored at the Density Functional level of approximation aswell as at the GW and BSE approximations of many-body perturbation theory.

382 - Effects of doping ratio on structural, luminescence and transmittance properties of Ga–Doped ZnO nanoparticles by precipitation reflux method

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.382) [For award: PhD]*
Primary author: *UNGULA, Jatani (University of the Free State)*
Co-authors: *DEJENE, Francis B (University of the Free State); SWART, Henrik (University of the Free State)*

Key words: Semiconductor, Gallium, ZnO, DSSCsGa-doped ZnO (ZnO:Ga) nanoparticles were synthesized by precipitation reflux method. The effects of varying [Ga]/[Zn] doping ratios on the morphology, luminescence and optical properties of ZnO:Ga were investigated. Ga-doped ZnO transparent conducting materials have gained much interest in recent years due to their low resistivity, high transmittance, nontoxicity and resource availability [1]. X-ray diffraction (XRD) and scanning electron microscopy (SEM) analyses were performed for the nanoparticles. It was found that SEM images increased in size by increasing the [Ga]/[Zn] ratio up to 2 mol.% then reduced in size at higher doping ratios (3-5 mol.%). The diffraction patterns showed hexagonal wurtzite structure of ZnO. The crystallinity and crystallite sizes increased by increasing doping ratios to 2 mol. %, but decreased as doping ratios increased to 5%. The total reflectance spectra of ZnO:Ga samples are similar and show reflectance of 9–14% in the spectral region of 350 –700 nm. The % transmittance of ZnO:Ga in the UV region, was observed to increase with doping levels then reduce at higher % doping. Similarly, the highest excitonic peak emissions were seen at 2% [Ga]/[Zn] ratio from the PL spectra. Reference: [1] M. Netrvalova, I. Novotny, L. Prusakova, V. Tvarozek, and P. Sutta, "Influence of deposition regime on physical properties of gallium-doped zinc oxide films," Vacuum, vol. 86, no. 6, pp. 707–710, 2012.

383 - Free-space data transfer using the spatial modes of light

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.383) [For award: MSc]*
Primary author: *GAILELE, Lucas (Structured Light Lab, School of Physics, University of the Witwatersrand)*
Co-authors: *FORBES, Andrew (CSIR); DUDLEY, Angela (CSIR National Laser Centre)*

Orbital angular momentum (OAM) of light has become, over the years, the focus of intensive research worldwide. Traditional optical communication systems optimize multiplexing in polarization and the colour of the light that is transmitted to attain a high bandwidth data communication link. Yet despite these technologies, we are expected to reach a bandwidth ceiling in the near future due to nonlinear effects in fibres. We are particularly interested in the additional spatial degree of freedom that light provides for optical communication. The OAM basis has become the most common choice for free-space communication. These modes carry integer values of OAM. The idea is to assign information to each integer value of OAM where theoretically there is no limit. We have experimentally demonstrated that we can generate and detect these modes by making use of a Spatial Light Modulator (SLM) to digitally vary the phase of the light beam.OAM carrying modes were generated using a technique known as complex amplitude modulation as a way of modulating a laser beam in phase and amplitude. We also detected these modes using a technique known as modal decomposition as a way of detecting OAM carrying light beams. A 100X100 grey scale picture was sent and received with high fidelity to demonstrate these techniques. This work was done in a lab-based scheme, free from the challenges associated with atmospheric turbulence. We wish to extend this work to the mid-IR region as an attempt to mitigate the problem of atmospheric turbulence over a long distance communication link and show high bit data transfer.

389 - Influence of Hexamethylenetetramine on the Low Temperature Chemical Bath Deposited ZnO Nanorods

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.389) [For award: PhD]*
Primary author: *MWANKEMWA, Benard Saamwel (University of Pretoria)*

Nanostructured zinc oxide (ZnO) nanorods were synthesized using an easy, low cost and low temperature chemical bath deposition (CBD) technique on glass substrate. ZnO thin films were prepared using ethanol as a solvent and zinc acetate ($Zn(CH_3COO)_2$. $2H_2O$) as a solute, and then used as seed layer template for the subsequent growth of ZnO nano-rods. The growth solution consists of zinc nitrate hexahydrate ($Zn(NO_3)_2$).$6H_2O$) and hexamethylenetetramine (HMT). The influence of different concentrations of hexamethylenetetramine on the structural and morphological properties of ZnO nanorods were investigated using X-ray diffraction (XRD) and scanning electron microscope (FE-SEM), respectively. For additional characterization of the ZnO NRs, surface topography measurements were performed using Atomic Force Microscope (AFM). XRD patterns of the ZnO nanorods grown using CBD at 60°C for four hours shows a remarkably strong diffraction peak at the (002) plane indicating that all the ZnO nanorods possessed pure hexagonal wurtzite structures. SEM images revealed the changes in morphology of ZnO nanorods upon addition of different amounts of hexamethylenetetramine.

390 - A review on the benefits of Biogas Technology from the Renewable Energy, Environment and Agronomy perspectives

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.390)*
Primary author: *MANYI-LOH, cHRISTY (INSTITUTE OF TECHNOLOGY)*
Co-authors: *MAMPHWELI, SAMPSON (INSTITUTE OF TECHNOLOGY); MEYER, EDSON (INSTITUTE OF TECHNOLOGY, UNIVERSITY OF FORT HARE); OKOH, ANTHONY (DEPARTMENT OF BIOCHEMISTRY AND MICROBIOLOGY, UNIVERSITY OF FORT HARE)*

Across the globe, the conventional sources of energy including coal, oil and natural gas are non renewable and as such are faced with challenges of depletion over time as well as high cost, environmental and public health hazards. In this light, biogas technology utilizing biomass has been considered as a powerful tool to address the afore mentioned challenges presented by the use of conventional energy sources. It is the anaerobic breakdown of the organic wastes by the concerted activities of four metabolically linked microorganisms in an airtight chamber to ultimately yield methane, carbon dioxide plus others. Plants and animal wastes are often regarded as the principal substrates since they are often produced in large quantities and their supplies are not affected overtime. Microorganisms are said to be ubiquitous in nature therefore they are present in these wastes from animal origin, feeds or might be deposited into these wastes during collection of the wastes for disposal. The process of biogas production can be influenced by physicochemical, operational and microbial factors. The degradation of these organic wastes will often result in sanitization thereby causing the treated wastes to be less harmful compared to its raw status. Hence, pathogens of environmental and public health significance can be reduced to threshold levels recommended for safety. In addition, these wastes contain macro and micronutrients that become readily available to plants after microbial anaerobic degradation process. The effluent can be applied as a biofertilizer for the growth of plants and crops to improve on food security. This will help to minimize the use of synthetic chemical fertilizers that have been reported to cause damage and transformation of the natural ecosystems. Furthermore, the biogas technology often generates biogas which can be used for cooking, lighting and or harnessed to produce electricity.Keywords: Biogas technology, public health, Environment, Agronomy

391 - Calibration of a statistical method used to constrain pulsar geometries via light curve modelling

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.391) [For award: Hons]*
Primary author: *BEZUIDENHOUT, Tiaan (NWU)*
Co-authors: *SEYFFERT, Albertus (Centre for Space Research, North-West University, Potchefstroom Campus, 2520 Potchefstroom, South Africa); VENTER, Christo (North-west University, Potchefstroom Campus); HARDING, Alice K. (NASA Goddard Space Flight Center)*

Since its launch in 2008, the Fermi Large Area Telescope (LAT) has detected over 200 gamma-ray pulsars above 100 MeV. This population of pulsars is characterised by a rich diversity of light curve morphologies. Researchers have been using both the radio and gamma-ray light curves to constrain the inclination and observer angles of each of these pulsars. At first, this was done using an "eyeball" technique and later on via statistical approaches. We have also been developing a novel statistical approach that places the radio and gamma-ray data on equal footing despite their disparate flux errors. We chose a dozen pulsars from the Second Fermi Pulsar Catalog, both old and young, and applied this new technique as well as the "eyeball" technique to constrain their geometric parameters. We will present first results on our comparison of the best-fit parameters yielded by each of the aforementioned techniques. This will assist us in determining the utility of our new statistical approach, and gauge the overlap of the best-fit parameters (plus errors) from each of the different methods. This technique will provide the means for further pulsar magnetospheric model development using light curve data.

393 - Beneficial effects of Cobalt on ZrNb alloy using density functional theory and virtual crystal approximation.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.393) [For award: MSc]*
Primary author: *MALEBATI, Magoja Martinus (University of Limpopo)*
Co-author: *NGOEPE, Phuti (University of Limpopo)*

Zirconium and its alloys are presently being developed as cladding materials due to their high temperature application and corrosion resistance. Density functional theory (DFT) and Virtual Crystal Approximation (VCA) were used to investigate the influence of Co addition on the thermodynamic, electronic and mechanical properties of ZrNb alloys. Where a lesser amount of atomic percent Co has shown to have a beneficial effect on the ZrNb alloy suitable for industrial applications. This was verified through the obtained results which are reporting on the equilibrium lattice parameters, heats of formation, elastic properties and the density of states. The investigated properties are evaluated to mimic the stability trend in the competing phases of $Zr_{97}Nb_{3-x)}Co_x$, $Zr_{97.5}Nb_{(2.5-x)}Co_x$, $Zr_{98.1}Nb_{(1.9-x)}Co_x$, $Zr_{98.5}Nb_{(1.5-x)}Co_x$, $Zr_{98.8}Nb_{(1.2-x)}Co_x$, and $Zr_{99}Nb_{(1.0-x)}Co_x$ alloy composition. According to literature findings no theoretical attempts have been made on ZrNbCo alloy system thus far.

396 - Microwave-assisted method derived ZnO nanostructures with various morphologies: Effect of pH on PL, magnetic and sensing properties.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.396) [For award: MSc]*
Primary author: *SHINGANGE, Katekani (CSIR and UFS)*
Co-authors: *MHLONGO, Gugu (CSIR/UFS); MOTAUNG, David (CSIR); NTWAEABORWA, Martin (UFS)*

Zinc oxide (ZnO) nanostructures with different morphologies induced by variation of pH were successfully synthesized using the microwave-assisted hydrothermal method. Based on scanning electron microscopy (SEM), photoluminescence (PL) and electron paramagnetic resonance (EPR) studies, variation of pH have substantial effect on the morphology, surface defects, magnetic properties, and surface area of the ZnO nanostructures. The sensing performance of the ZnO nanostructures to different concentrations of methane (CH_4), and ammonia (NH_3) at 300°C was investigated.

403 - The Spectroscopy of ^{162}Hf at Low and High Spins

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.403) [For award: PhD]*
Primary authors: KHUMALO, Nontobeko *(University Of the Western Cape/iThemba LABS); SHARPEY-SCHAFER, John F (UWC); MAJOLA, Siyabonga (UCT/ iThemba Labs); NCHODU, Rudolph (iThemba LABS)*
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The main aim of this project is to comprehensively study the nuclear spectroscopy of ^{162} Hf at low and high spins and to search for triaxial superdeformed (TSD) structures.The search for TSD structures in the rare earth region of the nuclear chart has been of interest recently. These structures have been predicted to occur for over 35 years. The main aim of this project is to look for the TSD bands in the ^{162}Hf nucleus. The research is also part of an investigation into the systematic behaviour of the N=90 nuclei. Our interest is in the systematics of the positive parity excited bands in N=90 nuclei and the behaviour of the negative parity bands as the proton number Z is increased leading to a reduction in the deformation of the ground state structure. A number of high spin structures with high dynamic moments of inertia have been observed in the heavy Hafnium isotopes. Cranked Nilsson Strutinsky calculations predict that such bands are most likely associated with TSD structures originating from a positive-γ energy minimum which dominates at ultrahigh spins.Two experiments have been performed to study the nucleus of interest and they were carried out on world class multi-detector gamma-ray spectrometers namely the AFRODITE (South Africa) and JUROGAM at Jyvaskyla (Finland). The reaction used at JYFL was ^{110}Pd(^{56}Fe, 4n) reaction at a beam energy of 270 MeV and the reaction used at iThemba LABS was ^{144}Sm (^{22}Ne, 4n) at a beam energy of 110 MeV. The collected data was sorted using MTSort . Results from both data sets will be presented.

406 - Ultrahigh-energy neutrino events in current and future neutrino telescopes from nearby Gamma-Ray Bursts

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.406) [For award: PhD]*
Primary author: *KAYYUNNAPARAYIL THOMAS, JESSYMOL (UNIVERSITY OF JOHANESBURG)*
Co-authors: MOHARANA, REETANJALI *(University of Johannesburg, Auckland Park-2006); RAZZAQUE, Soebur (University of Johannesburg)*

Neutrino Astronomy has gained momentum after discovering cosmic neutrinos by the IceCube Neutrino Observatory at the south pole. A proposed upgrade of IceCube and planned future experiments will increase sensitivity to neutrino fluxes at ultrahigh energies (> PeV). We consider ultrahigh-energy neutrino flux from the Gamma Ray Bursts (GRBs) during the afterglow phase. We calculate this flux by modeling in details the observed afterglow data with standard afterglow theories for nearby long-duration GRBs within redshift 0.5. We also calculate neutrino events from these GRBs in the current and future experiments such as KM3NeT, IceCube Gen-2, Pierre Auger Observatory and JEM EUSO.

407 - Simulating Iron Oxide Nanoparticle Oscillations in different Electric Fields.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.407)*
Primary author: HARRIS, Richard *(University of the Free State)*

The surface charge on small iron oxide nanoparticles may be tuned during synthesis as a function of size (and shape) by precisely controlling the quantity (concentration) and the type of surfactant chosen to act as the capping agent. As such, these nanoparticles may possess a small amount of uncapped charge. Similarly, the positive charge on bare nanoparticles may be carefully engineered to suit a particular application. These nanoparticles with a small amount of uncapped charge behave like imperfect point charges and even dipoles in the presence of an external electric field. In this theoretical study it will be shown how these properties may be exploited to develop chemical and biological sensors. In particular hydroxyl and hydrocarbon detection are presented as case studies.

414 - The Effect of Annealing Temperature on the Sensitivity and Selectivity of TiO_2 base Gas Sensors

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.414) [For award: MSc]*
Primary author: TSHABALALA, Zamaswazi *(CSIR and UFS)*
Co-authors: *MOTAUNG, David (CSIR); MHLONGO, Gugu (CSIR/UFS); MTWAEABORWA, Martin (UFS)*

In this study we report on the effect of annealing temperature on the TiO_2 nanostructure based chemoresistive gas sensors synthesized using microwave assisted hydrothermal treatment. The sensing response, structural, optical and magnetic properties were carried out using various analytical techniques. The X-ray diffraction, Raman and transmission electron microscope displayed an increase in rutile (110) and (101) peaks at 700 °C annealing temperature. The scanning electron microscope revealed that the web of nanotubes transforms to short nanorod like structures at 700 °C. Photoluminescence analysis showed an increase in band edge and a decrease in oxygen vacancies concentration as the annealing temperature increases. The electron paramagnetic resonance displayed room temperature ferromagnetism due to the presence of Ti^{4+}- O^{2-} and Ti^{3+} radicals on the surface and lattice respectively. We observed a decrease in a sensing response as the annealing temperature increases.

418 - Fine structure of the Isoscalar Giant Monopole Resonance in ^{208}Pb, ^{90}Zr, ^{58}Ni and ^{40}Ca using medium energy Alpha-particle Scattering at Zero Degree

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.418)*
Primary author: BOTHA, Nolan *(University of the Witwatersrand)*
Co-authors: *USMAN, Iyabo (University of the Witwatersrand, Johannesburg.); CARTER, John (University of the Witwatersrand); SMIT, Frederick David (iThemba LABS); NEVELING, Retief (iThemba LABS)*

A systematic experimental investigation was performed of the phenomenon associated with the fine structure of giant resonances, with emphasis on the Isoscalar Giant Monopole Resonance (ISGMR), for ^{208}Pb, ^{90}Zr, ^{58}Ni and ^{40}Ca using a 200 MeV alpha-particle beam delivered by the Separated Sector Cyclotron of iThemba LABS. These nuclei are of special interest since they are doubly-magic, ^{208}Pb and ^{40}Ca, and proton-magic, ^{90}Zr and ^{58}Ni. Measurements were made using the state-of-the-art K = 600 magnetic spectrometer to obtain unique high energy-resolution alpha-particle inelastic scattering excitation-energy spectra in the region of ISGMR at θlab = 0° where the cross-section of the ISGMR is at a maximum. In addition, measurements were also made for all four target nuclei at θlab = 4°, where the cross-section of the Isoscalar Giant Quadrupole Resonance (ISGQR) is at a maximum. This was done in order to subtract the contribution of the ISGQR from the excitation energy spectra taken at zero degrees. Preliminary results are presented.

423 - Follow up studies on delta Schuti star: HD 75656

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.423)*
Primary authors: BUTTON, Charissa *(University of Pretoria); MEKAZI, Kamogelo (University of Pretoria); MPUTLE, Omphemetse Kelebogile (University of Pretoria);* MRWETYANA, Nosicelo *(University of Pretoria); MATSHOBA, Samuel (University of Pretoria); MOKGADI, Thapelo (University of Pretoria); MUTANGWA, Phathutshedzo (university of pretoria); MABASO, Tlhogelo (University of Pretoria); MEDUPE, Rodney (North West University, Mafikeng Campus); VENTER, Johannes (University of Pretoria)*

HD 75656 is a normal A-star. A team led by T. Medupe observed the star from Sutherland observatory in 2007. From their observations, they found that this star pulsates with an oscillation period of 2.45 hours which would suggest that it is a δ-Scuti star. We will present more data on HD 75656 in order to confirm whether it is a δ-Scuti star or not. The 40.0 cm telescope at the Mahikeng Astronomical Observatory is used to obtain more data on the star. The project will use HD75501 as a comparison star. Light curves of the star will be obtained from the data and Fourier analysis performed in order to determine the frequency at which the star pulsates and to find out whether it pulsates at more than one frequency. Possible asteroseismology will be performed on the frequency data

426 - Orientation of the Ge Crystals of the iThemba LABS Segmented Clover Detector

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.426)*
Primary author: DINOKO, Tshepo *(iThemba LABS)*
Co-authors: *LAWRIE, Elena (iThemba LABS); BUCHER, Thifhelimbilu Daphney (iThemba LABS); EASTON, Jayson (iThemba LABS and University of the Western Cape); ERASMUS, Nicholas (University of the Western Cape); NONCOLELA, Sive (UWC); SHIRINDA, OBED (iThemba LABS); MTHEMBU, Sinegugu Happiness (Student)*

By using an automated scanning table, the position sensitive response of crystals A, B, C and D, of the iThemba LABS segmented clover detector were measured using the 241Am collimated source [1]. One of the primary parameters to describe a Ge detector for pulse shape analysis is the orientation of the crystallographic axis of the cubic centered Ge crystal. The drift mobility for the electron-hole pair in the Ge depends on the orientation of the electrical field with respect to this axis and causes deviation in the collection times of up to 30% [2]. The intention is to characterize the segmented iThemba LABS Ge clover detector, for pulse shape analysis and develop a technique that determines the individual position of each energy deposition caused by the interaction of a gamma-ray in the segmented Ge crystal [3]. The T30 to T90 rise-time distributions, which refers to the time needed for the pulse to rise from 10% to 90% of its amplitude, were measured from each core at 12 mm radial distance and with a step of 10o around the core. Our results suggest that the drift velocity is position sensitive for each crystal of the detector. This necessitates a measurement of the crystal orientations of the four crystals of the detector.[1] M. Descovich, et al., Nucl. Instr. And Meth., A553, 512-521 (2005)[2] B. Bruyneel, et al., Nucl. Instr. And Meth., A569, 764 (2006)[3] C. E. Svensson, et al., Nucl. Inst. And Meth. A 540, 348-360 (2005)

428 - A comparison of neutron energy distributions unfolding codes used with a NE213 detector

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.428)*
Primary author: *HERBERT, Mark (University of the Western Cape)*
Co-author: *SHILUVANE, Thulani (University of the Westtern Cape)*

In fast neutron radiotherapy knowledge of how neutrons transfer energy into body tissue as they progress through the body is required. This knowledge is important to calculate the energy distributions of secondary charged particles, to characterize the radiation quality and absorbed dose both inside and near to the area under treatment. Experimental measurement or Monte Carlo transport codes can be used to determine neutron energy distributions.. Unfolding can be used for processing the measured data and obtaining the neutron energy distribution. The neutron energy distributions have to be unfolded from the measured pulse-height distributions, which is an ill-conditioned problem. Therefore, use of independent unfolding methods allows for comparison and interpretation of the data. This paper reports on the overall procedure of measuring and unfolding the fast neutron energy distributions with NE213 liquid scintillation detector using the unfolding codes Gravel based on the GRAVEL iterative method and MAXED based on the Maximum Entropy method. The results obtained from pulse height distributions using the different unfolding codes will be presented and discussed.

433 - Iron (III) Oxide Nanostructured Thin Films Based Selective Solar Absorber for Concentrating Solar Power Application

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.433) [For award: PhD]*
Primary author: *MBONGO, Mduduzi (University of South Africa)*
Co-authors: *KHAMLICH, Saleh (iThemba LABS); DHLAMINI, Mokhotjwa Simon (University of South Africa); MAAZA, Malik (UNISA UNESCO); MOTHUDI, Bakang Moses (University of South Africa)*

Recently, the energy sector in South Africa has attracted significant attention due to the crisis of power outage, high tariffs and a general inability to match supply and demand. To overcome these challenges, new energy resources have to be implemented. The high fossil fuel prices and the first ubiquitous signs of climate change have been enough to assist to the market a number of alternative, renewable sources of energy based on material that harvest and convert solar energy to other forms of energy (i.e. electricity and heat). Concentrating solar power technologies being one of the alternatives, use mirrors to concentrate radiation from the sun and convert it into high temperature heat, which is used to generate steam to drive a turbine that generates electrical power. New efficient material for this system are needed to lower the cost of CSP systems. Iron oxide (Fe2O3) based selective solar absorbers for high temperature conditions on stainless steel substrate are explored. Iron oxide Fe2O3 nanoparticles has the potential to be used as coating for solar absorber and it was investigated and reported once in literature due to its high thermal stability and solar absorption selectivity it was investigated once more in this work. This was done by changing parameters such as deposition time, current density, reaction temperature and solution concentration, using different deposition methods. The coating of Fe2O3 nanoparticles were deposited on the stainless steel substrate using three fabrication process/methods namely electron beam deposition, atomic layer deposition and plasma enhanced chemical vapour deposition. The effects of the thickness, substrate roughness and heat treatment on the performance of the Fe2O3 nanoparticles were analyzed using, HR-SEM, UV-VIS-NIR spectrophotometers equipped by integrating spheres, and Ellipsometry. The absorptance and the emittance were found to be closer to one and near zero respectively.

436 - Modelling and testing the effects of space radiation on space borne electronic components

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D2.436) [For award: MSc]*
Primary author: *SNELL, Holly (SpaceLab, Dept of Electrical Engineering, University of Cape Town)*

Outer space is a hazardous environment for satellites as they are continuously exposed to harsh space radiation in the form of cosmic rays and high energetic electrically charged particles (protons, electrons and alpha particles). Mission-critical electronic components are especially susceptible to space radiation as high velocity and mass/charge impact on molecular-sized circuitry can cause significant command upsets or permanent damage, compromising the satellite's functional integrity. To mitigate radiation hazard risk, electronics are carefully selected, radiation-shielded and rigorously tested prior to deployment.This project aims to describe the space radiation environment and use platforms such as SPENVIS to model radiation levels at satellite orbital altitudes. Modelled radiation values such as total dose will then be used in relevant laboratory radiation tests (iThemba Labs) of selected electronic components. Appropriateness for space use of the tested components will be evaluated by, inter alia, comparing test results with published proton cross-section profiles for selected or similar components. A report on the appropriateness and correctuse of relevant space radiation models will be given, and elementary simulation of satellite radiation shielding will be conducted.The presentation will outline the theory behind the project, as well as information about the experimental procedure that will be carried out.

437 - Spectroscopic investigation of charge and energy transfer in P3HT/GO nanocomposites

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.437) [For award: PhD]*
Primary author: *MOLEFE, Fokotsa (UNISA)*
Co-authors: *KHENFOUCH, MOHAMMED (1 UNISA Africa Chair in Nanosciences-Nanotechnology, College of Science, Engineering and technology Science Campus, Corner of Christiaan de Wet Road & Pioneer Avenue, Florida, 1709, Johannesburg, South Africa. 2 University Sidi Mohamed Ben Abdellah, Faculty of Sciences Dhar el Mahraz, Laboratory of Solid state Physics, Group of Polymers and nanomaterials, BP 1796 Atlas Fez 30 000, Morocco.); DHLAMINI, Mokhotjwa Simon (University of South Africa); MAAZA, Malik (UNISA UNESCO); MOTHUDI, Bakang Moses (University of South Africa)*

As the world demand for energy continue to increase, it is vital to improve renewable energy technologies that will replace conventional fossil fuels. Carbonaceous graphene oxide (GO) is a promising environmental friendly nanomaterial, easy to prepare and scale up to commensurate with industrial requirements. The nanocomposite was prepared by blending GO nanomaterials with poly(3-hexylthiophene) (P3HT) to form hybrid heterostructures for photovoltaic applications. The X-ray diffraction (XRD) results revealed the interaction of P3HT with GO through determination of the basal spacing and unit cells dimensions. It was clearly evident from scanning electron microscopy (SEM) that presence of P3HT in GO modified flaky structure to the formation of nano-platelets. The interaction of GO with P3HT is presented by various vibrational frequencies in Fourier Transform infrared spectroscopy (FTIR). The increased percentage absorbance and clear splitting of absorption bands was observed in UV-vis spectrum for P3HT/GO due to ionic interaction between P3HT and GO. The nanocomposites were excited using tunable photoluminescence (PL) wherein the measurements showed quenching and shifting of emission spectrum when introducing P3HT. This is due to charge-transfer and energy-transfer revealed by the time correlated single photon counting (TCSPC) measurements. The obtained nanocomposites establish the formation and existence of new energy levels upon GO incorporation in P3HT which enhances charge transport. The uniqueness of this work will be presented to show conversion mechanism.

441 - Digitally transforming high-order mode to a high brightness beam

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.441)*
Primary author: *NGCOBO, Sandile (CSIR)*
Co-author: *BELL, Teboho July (CSIR)*

In this paper we demonstrate the superresolution technique of transforming a pure high order LGpl or HGml modes into a Gaussian intensity distribution at the plane of a converging lens. The high order modes are generated by encoding a digital amplitude hologram mask that contains absorbing rings match the Laguerre polynomial p and l zeros or the Hermite polynomial m and l zeros on a spatial light modulator (SLM) that acts as end-mirror of the resonator. The transformation is achieved by encoding an annular binary diffractive optical element on a second SLM as a digital hologram with a transmittance that has +1 or -1 which coincide with the dark and bright parts of the incident beams. It is envisaged that the transformed beam at the focus of the lens will have a focal volume and a profile that is similar to a Gaussian beam.

447 - Synthesis and characterization of gold nanoparticles and their functionalization using dodecanethiol

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.447) [For award: MSc]*
Primary author: *SHUMBULA, Ndivhuwo (University of Witwatersrand)*
Co-authors: *MOLOTO, Nosipho (University of Witwatersrand); MLAMBO, Mbuso (University of Pretoria)*

Surface enhancement Raman spectroscopy (SERS) has been widely studied for decades, and has attracted many researchers in various fields due to its advantageous characteristics such as low limit of detection, easy sample preparation, non-destructive nature and high sensitivity. Recent studies have focused more on enhancing the Raman signal by manipulating various parameters of SERS. The SERS substrates (metal nanoparticles) and Raman reporters (ligands) are the main parameters which play a major role in Raman signal enhancement. Noble metallic nanostructures are the most targeted substrate since they exhibit a strong surface plasmon. Amongst all, gold nanoparticles (AuNPs) have added more advantage in various applications due to their stability, biocompatibility, and easily controllable size and shape. However the effect of gold nanoparticles sizes on Raman signal enhancement has been a question mark in various fields including biomedical and pharmaceuticals. Current studies have put more focus on evaluating the capacity of AuNPs as substrates for developing and improving analytical applications based on SERS measurements. Furthermore, functionalizing gold nanoparticles with alkanethiols improve the application of SERS, since they are Raman active and possess strong chemical affinity to gold. Therefore, the aim of this study is to synthesize and functionalize AuNPs of various sizes with Dodecanethiol and evaluate enhancement factor dependency.Herein we report on the synthesis of various sizes of gold nanoparticles and evaluate their enhancement effect on the Raman spectrum of Dodecanethiol. Key words: nanoparticles, SERS, alkanethiol

450 - Characterisation of the optical properties of silver nanoparticles (Ag NPs) for use in the enhancement of the performance of an organic photovoltaic (OPV) device.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.450) [For award: Hons]*
Primary author: BALOYI, Kenneth *(University of Venda)*
Co-authors: KIRUI, Joseph *(University of Venda)*; JHAMBA, Lordwell *(University of Venda)*

The study was performed with an aim of enhancing the overall performance of the photovoltaic device through incorporation of silver nanoparticles (Ag NPs). Starting with eight glass plates with Indium tin oxide (ITO) on one side, two of them were etched by reacting hydrochloric acid with zinc powder. ITO is one of the most widely used transparent conducting oxides endowed with desirable properties such as electrical conductivity , optical transparency and the ease with which it can be deposited as a thin film. Silver nanoparticles of varying concentrations were then deposited on the substrates using radio frequency (RF) sputtering method. Poly(3,4-ethyleredioxythiopene) polystyrene sulfonate (PEDOT:PSS), a popular a conductive polymer used for fabrication of an organic light emitting diode, was deposited onto the etched substrates using spin coating method. The optical properties were investigated using UV-Visible absorption spectroscopy where the surface plasmon peaks were recorded approximately 347 nm and 576 nm for transmittance and absorption respectively. Our results tell us that less concentration of Ag NPs will result in more light passing through and as the concentration of Ag NPs increases, the peaks shifted to the visible region. In addition, we observed that PEDOT:PSS reduces the reflective properties of glass and generate a negative absorbance which allows more light to go through to the active layer hence leading to more electron-hole pairs.

454 - Determination of thin silicon sample thicknesses using linear and nonlinear optical methods

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.454) [For award: PhD]*
Primary author: NDEBEKA, Wilfrid *(Laser Research Institute, University of Stellenbosch)*
Co-authors: *STEENKAMP, Christine (University of Stellenbosch); STAFAST, Herbert (Leibniz Institute of Photonic Technology, Albert-Einstein-Str. 9, 07745, Jena, Germany); NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); ROHWER, Erich (University of Stellenbosch)*

Silicon (Si) continues to be a prominent material in microelectronics, optoelectronic, micromechanics, solar cells, and increasingly in photonics. Delicate Si devices can be shaped and/or modified by laser technology providing many kinds of controlled methods for e.g. doping, annealing, crystallization and ablation. Proper processing requires, however, a detailed understanding of the linear and nonlinear optical phenomena in Si. Some of the nonlinear phenomena may occur simultaneously and be difficult to discriminate like coherent two-photon absorption (TPA), free carrier absorption (FCA), and thermally induced absorption enhancement (TAE). In this work, a femtosecond (fs) Ti:sapphire laser tuned at 800 nm is applied to investigate the linear and nonlinear optical behaviours of thin Si samples in the 10 μm to 30 μm range by measuring the average laser power of the fs pulse train transmitted through the membranes as a function of the incident laser power. The experimental findings help to determine the thickness of the Si samples using a linear and FCA absorption methods, respectively.

460 - Surface Brillouin Scattering studies of Transition metal nitrides thin films deposited by RF Magnetron Sputtering

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.460) [For award: PhD]*
Primary author: KURIA, Jonah *(School of Physics, University of the Witwatersrand)*
Co-authors: *WAMWANGI, Daniel (wits university); MSIMANGA, Mandla (Tshwane University of Technology); COMINS, Darrell (University of the Witwatersrand); BILLING, David (University of the Witwatersrand)*

Transitional metal nitrides thin films have been intensively investigated owing to their attractive mixture of physical, chemical and mechanical properties. Among these thin film coatings, Niobium nitride (NbN) is a promising candidate material for applications such as single photon detectors, Josephson junctions and diffusion barriers against copper migration. Tantalum nitride (TaN) thin films have also received interest in recent years because of their inherent properties such as good thermal stability and low electrical resistivity. In this work, NbN and TaN thin films have been deposited on etched (100) Si substrates using RF magnetron sputtering at working pressure of 8.5 × 10-4 mbar. Sputter powers ranging from 75W to 250W were used for NbN thin films and 150W for TaN thin films. The effect of sputter power on the microstructure and subsequently on the elastic constants of the NbN thin films is investigated. The microstructure of the thin films has been determined using a combination of grazing incidence x-ray diffraction (GIXRD) and scanning electron microscope (SEM) and correlated to deposition conditions. X-ray reflectivity (XRR) measurements have been used to study the layer mass density, and layer thickness of some select films. Atomic surface microscopy (AFM) has been used to determine the surface topography of the films for surface Brillouin measurements. A time of flight spectrometer for heavy ion detection (HI-ERD) thin film analysis has been used to establish the stoichiometry of the films. Surface Brillouin scattering spectra were gathered for the NbN and TaN samples using the 514.5 nm line from an argon-ion laser operating in a single axial mode. Theoretical modelling based on the surface Green's functions has been used to predict and compare surface Brillouin spectra with the experimental spectra for select thin films. The elastic constants of the films will be extracted using the results obtained from the SBS experiments.

461 - Digital laser mode amplification using ND: YAG amplifier

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.461) [For award: PhD]*
Primary author: BELL, Teboho *(CSIR)*
Co-authors: *NGCOBO, Sandile (CSIR); FORBES, Andrew (CSIR)*

In this we work demonstrate the output power amplification of the generated higher-order modes from a digital laser by using an extra-cavity Nd: YAG amplifier. The digital laser generates fundamental higher-order modes by encoding and displaying amplitude digital hologram mask on a phase-only spatial light modulator (SLM) that acts as an end-mirror of the laser resonator cavity. The amplifier was designed in such a manner that when higher-order modes enters the Nd:YAG amplifier they will experience higher gain which would translate to increase the power of the mode when it is transmitted through the amplifier.

466 - Physics of the artisanal mining of sandstones in a rural community

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: E.466)*
Primary author: ANTOINE F., Mulaba-Bafubiandi *(University of Johannesburg)*

Sandstone, a sedimentary rock containing either siliceous grains, or calcareous grains or ferruginous grains, is artisanal mined on the Drakensberg chain of mountains in the South African Free State province. Chisel and hammer are the main tools for the rock extraction while wheelbarrow is the usual transport means for the mined products. At a time, gravity is used to move bigger lumps from the up mountain to the bottom for an easier cutting before piece cutting or size reduction with a metallic circular steel saw run with the electricity from the grid at a static workshop. The position of the tip of the chisel, the impact force generating the required momentum of the chisel, and the grain size and mineralogical composition are elements used in this paper as it elaborates on the resulting often horizontal sliding or displacement of the aggregated bulk rock piece. This paper is a contribution to physics education as applied to earth materials.

469 - Growth and characterization of RuO_2 thin films nanostructures

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.469)*
Primary author: CHONCO, Nelisiwe *(University of Zululand)*
Co-authors: *NDWANDWE, Muzi (University of Zululand); SEFAGE, Amanda (University of Zululand)*

RuO_2 thin films were deposited from 99.999% of ruthenium target on p-type silicon substrate and also on glass substrates. Substrates were used to study other physical properties of the deposited films. Thin films of ruthenium oxide were grown by direct current (DC) unbalanced magnetron sputtering methods in argon atmosphere at a rate of 6-10sccm and oxygen rate of 2-6sccm, with varying power starting from 100W- 200W. The physical and electrical properties of RuO_2 thin films were investigated by using XRD,SEM,RBS and AFM.Keywords: RuO_2, nanostructures, temperature, sputtering

472 - Enhanced photoluminescence emission from Dy^{3+} and Tb^{3+} activated lanthanum phosphovanadate

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.472)*
Primary author: MOTLOUNG, Selepe Joel *(University of the Free State)*
Co-authors: *TSHABALALA, Kamohelo George (University of the Free State); SHAAT, Samy (Islamic University of Palestine); NTWAEABORWA, Odirileng Martin (University of the Free State)*

Dysprosium and terbium doped lanthanum phosphovanadate ($LaV_{0.25}P_{0.75}O_4$: Dy^{3+} and Tb^{3+}) phosphor powders were synthesized by the solution combustion method. X-ray diffraction (XRD) was used investigate phase formation of the prepared phosphor powder. Scanning electron microscopy (SEM) images revealed that the prepared powder consisted of different shapes and sizes. Elemental composition was examined by energy dispersive x-ray spectroscopy (EDS), while the stretching mode frequencies were determined by Fourier transform infrared spectroscopy (FTIR). The band gap was estimated from the diffuse reflectance spectra. The excitation spectra of both dysprosium and terbium doped samples showed a strong broad band extending from 200 to 350 nm with the maximum at $\lambda \approx 274$ nm. Photoluminescence emission spectra for dysprosium doped samples showed two peaks at 480 nm ($^4F_{9/2} \rightarrow {}^6H_{13/2}$) and 573 nm ($^4F_{9/2} \rightarrow {}^6H_{15/2}$) corresponding to Dy^{3+} emission while four emission peaks were observed for terbium doped samples at 490 nm ($^5D_2 \rightarrow {}^7F_5$), 544 nm ($^5D_2 \rightarrow {}^7F_5$), 586 nm ($^5D_2 \rightarrow {}^7F_2$) and 623nm ($^5D_2 \rightarrow {}^7F_5$) corresponding to transitions of Tb^{3+} ions. These photoluminescence results further revealed that the PL intensity increases with an increase in temperature.

473 - Long-term measurements of temperature of the fermenting slurry within the biogas digesters at Vele secondary school

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.473) [For award: PhD]*
Primary author: NEKHUBVI, Vhutshilo, M *(University of Venda)*
Co-author: *TINARWO, DAVID (UNIVERSITY OF VENDA)*

On the issue of biogas production, irrespective of how digesters of different designs are installed (i.e., off–ground or underground) or how different feedstock are used to feed such digester systems, researchers around the globe deepened their most focus on the influence of temperature on the production of the gas. Variation in biogas production has been correlated to the temperature of the slurry inside the digester by a number of researchers. Heating the bio-digester to a temperature of about 35oC is important for mesophilic bacteria growth and activity, in order to obtain optimum biogas production. In view of the above, an attempt has been made to study the variation of temperature within the digester and its correlation with the ambient and surround soil temperature. Three brick built biogas digesters have been partially built underground. Since these digesters are underground, the energy to heat them can only be associated with solar radiation falling to the specific locations where the systems are. Thus an incoming amount of solar radiation striking the soil surface can affect the internal temperature of the digester installed. Each individual digester is fitted with a K-Type thermocouple positioned at the center of individual digester to measure the slurry temperature, one measuring the ambient, and another in the soil at a properly selected position near the digesters. Results of this study are presented in details and answer some of the questions that have been raised by researchers. This study is also useful for biogas researcher who are intending to heat household biogas digesters. Keywords: Biogas digester, Thermocouple, Mesophilic , Bacteria

474 - Development of non-linear microscopy infrastructure

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.474) [For award: MSc]*
Primary authors: VILJOEN, Ruan *(Stellenbosch University)*; ERASMUS, Anneke *(Laser Research Institue)*; DWAPANYIN, George *(Laser Research Institue)*
Co-authors: *SPANGENBERG, Dirk-Mathys (University of Stellenbosch); NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); BOSMAN, Gurthwin (Stellenbosch University); ROHWER, Erich (University of Stellenbosch)*

The components of a versatile multimodal non-linear microscopy setup have been developed and an integrated construction has been designed. The various critical components in this setup are discussed and elements are characterised. These include for the excitation: A coherent super continuum light source generated in a photonic crystal fibre pumped by a femtosecond laser, a 4f pulse shaper with programmable spatial light modulator for dynamic pulse compression of the super continuum and pulse manipulation, the Multiphoton Intra-pulse Interference Phase Scan (MIIPS) compression algorithm; For sample management an optical tweezer and basic imaging facility; For imaging a fluorescence detection and confocal setup with scanning facility.Specific detail of the high intensity probe created through compression of the super continuum through phase correction using a spatial light modulator is presented. The characteristics of the pulses regarding spectral bandwidth and polarisation dependence on input pulse power, the phase and amplitude of the compressed pulses are presented. The MIIPS algorithm is described and evaluated. The details of the tweezer setup are presented and results from the instruments are discussed. A fluorescence microscope has been integrated into the system and the layout and functioning of this setup is also discussed. The spectral imaging facility is presented and future plans for further development of the setup are alluded to.

479 - RF Generation for Ion Trapping Experiments

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: C.479) [For award: PhD]*
Primary author: MATJELO, Naleli *(Stellenbosch University)*
Co-author: *UYS, Hermann (National Laser Centre, CSIR/Department of Physics, Stellenbosch University)*

Radio frequency (RF) Paul traps have for decades been employed to electrodynamically trap atomic ions for experiments ranging from precision spectroscopy, atomic clock physics, quantum computing and fundamentals of quantum optics. A key technical requirement for ion trapping, is the generation of a narrow band RF signal with amplitude of several hundreds of volts. A common technique for producing such high RF voltages noise-free is to use a helical resonator with sufficiently high Q-factor. However, helical resonators are not trivial to design and experimental implementations invariably require significant empirical optimization. Being geometry-dependent, the Q-factor and resonance frequency of a helical resonator are also not easily tuned once the resonator is done. Here we present the design and implementation of a 15 MHz helical resonator as an integral part of our ion trapping setup. We also propose a novel feedback-based resonator which produces a tunable Q-factor. A transformer element is used to boost the voltage gain for this feedback resonator configuration. We expect the feedback resonator to provide a viable and versatile alternative to standard helical resonators.

480 - Feasibility Study of Electron Source Production at iThemba LABS

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.480) [For award: HONS]*
Primary author: LORRAINE, Tebogo *(physics hons)*

Under certain conditions it is more favourable for an exited atomic nucleus to decay by the internal conversion (IC) process rather than by the emission of a gamma-ray. The IC process involves the emission of conversion electrons. A project was initiated to commission electron spectrometers for use in conjunction with high-resolution gamma-ray detectors at iThemba LABS, in order directly measure internal conversion electrons. In order to energy calibrate these spectrometers mono-energetic sources of electrons are required. The sources should ideally be ‘‘open”, having the active material “bare” with minimal covering material that would lead to deteriorated electron energies, from effects such as energy-straggling . In this presentation we present results from our study of the feasibility of producing such sources with methods and materials available at iThemba LABS (e.g. neutron or proton induced reactions)-Radiation Detection and Measurements 4th Edition- Glenn F. Knoll September 2012-Principle of Nuclear Radiation Detection-John W Poston 1 August 1985

483 - Structural and dynamical properties of oxygen and cerium vacancies in cerium dioxide

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: G.483)*
Primary author: MOSUANG, Thuto *(University of Limpopo)*

Structural and dynamical properties of oxygen and cerium vacancies in cerium dioxide are studied using classical molecular dynamics. The formulation uses the Buckingham potential under the NVT ensemble to study these properties. Structural properties are studied using the radial distribution and structure factor functions. The dynamical properties are studied using the time-dependent mean square displacement. Transport properties of both oxygen and cerium vacancies in cerium dioxide are discussed.

484 - Nature of forces acting on the terrestrial globe

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.484)*
Primary author: DJIEDEU, Nicodeme *(CEPAMOQ, University of Douala)*

This work is an investigation of some dynamical properties of the terrestrial globe moving on its elliptical orbit. Taking account of the ellipsoidal shape of the terrestrial globe, its kinetic and dynamic’s moment are established. Using these two quantities, we were able to deduce on the one hand, the ‘excited’ charge of the terrestrial globe and the intensities of the magnetic fields which are responsible of the revolution and the rotation of the terrestrial globe and on the other hand, we were able to deduce the nature of forces acting on the terrestrial globe. We then conclude that the terrestrial globe is moving in an electromagnetic field.

485 - Identification of a third stable state associated with E3 center in GaAs.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.485) [For award: PhD]*
Primary author: TAGHIZADEH, Fatemeh *(University of Pretoria)*
Co-authors: *AURET, Danie (University of Pretoria); OSTVAR, Kian (University of Pretoria)*

High resolution Laplace deep level transient spectroscopy was used for the study of fine structures associated with the radiation induced bi-stable E3 center in epitaxially grown GaAs. The samples were made using n-type GaAs that were doped with silicon to doping densities of 10^{15} cm^{-3} and 10^{16} cm^{-3}. To introduce the defect, the samples were subjected to MeV electrons emanating from a $_{90}Sr$ source for 113 hours at room temperature. Laplace DLTS measurements were carried out at 200 K. In addition to the two previously known states, a third stable state of the defect was also observed. It was also observed that at lower doping densities, the concentration of the third state is smaller compared to the other two but increases as the doping density is increased. From these observations, it was hypothesized that the existence of the third state could be the result of localized effects due to close proximity of the E3 and a dopant atom.

486 - Application of uniaxial stress with Laplace DLTS as a structure sensitive characterization technique.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.486) [For award: MSc]*
Primary author: OSTVAR, Kian *(University of Pretoria)*
Co-authors: *MEYER, Walter (University of Pretoria); AURET, Danie (University of Pretoria)*

This paper aims to explain the method adopted by the author for integration of uniaxial stress into the highly sensitive Laplace DLTS technique. The purpose of this integration was to provide a technique that would allow for study of defect structures based on changes in their electrical properties as a result of an external perturbation of their respective positions within the crystal lattice. The system consists of an apparatus that is capable of exerting external uniaxial stress of more than 10^9 Pa while a Laplace DLTS system records the slightest changes in the emission rate spectrum of a defect. The data obtained in this manner is then used to determine properties such as orientational degeneracy, symmetry and composition of the defect as well as its placement with relation to the primitive cell of the host semiconductor. The system can operate between 77 K to 500 K and therefore is suitable for studying a wide range of defects. Preliminary experiments on EL2 and EI2 like defects in n-type GaAs were carried out to determine the proper operation of the system and were shown to comply with previously published results.

488 - Growth and characterisation of an AlGaAs double barrier resonant tunnelling diode for use in a fast analogue to digital converter.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.488)*
Primary author: MEYER, Walter *(University of Pretoria)*
Co-authors: *JANSE VAN RENSBURG, Johan (University of Pretoria); STANDER, Tinus (University of Pretoria); GASKELL, Anthony (University of Pretoria)*

High speed analogue to digital converters are essential in many applications, including the digitization of radio frequency signals for digital processing, as would be needed by the SKA. For high speed conversion, flash converters are used, which require a huge number of comparators. Increasing the speed and efficiency of these comparators will therefore lead to significant improvements in analogue to digital conversion performance. Two double-barrier resonant tunnelling diodes in series can, with the addition of a few MOSFET transistors be used to make an exceptionally fast, low power comparator.In this presentation, we will describe the design, growth and characterisation of a GaAs-$Al_{0.3}Ga_{0.7}As$ double barrier heterostructure for use in such a comparator.

490 - Isotropic energy and luminosity correlations with spectral peak energy for five long GRBs

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.490) [For award: PhD]*
Primary authors: DIRIRSA, Feraol F. *(University of Johannesburg); RAZZAQUE, Soebur (University of Johannesburg)*

We present a time-integrated spectral analysis of five long gamma-ray bursts (GRBs) with identified redshift triggered in 2015. Two bursts (GRB150403A & GRB150314A) are detected both by the Fermi Large Area Telescope (LAT) and Gamma-Ray Burst Monitor (GBM) while the other three sources (GRB150727A, GRB151027A & GRB150301B) are detected only by GBM. We describe the observable correlations of these bursts such as the intrinsic peak energy with the isotropic-radiated energy and luminosity in the source frame, to show their consistency with the global Amati/Yonetoku relation. We investigate the possibility that Band function, Power law, Smoothly broken power law and Comptonized components may be present separately by fitting the prompt emission spectra in the keV-MeV energy range. For the Fermi-LAT bursts, we consider also unbinned likelihood analysis using the preliminary Pass 8 new event-level reconstruction to characterize the models which at the end can have impact on the measured observables. Finally, we summarize that the intrinsic peak energy is highly correlated to the radiated isotropic energy (the Amati relation) and not as significantly correlated with the peak luminosity (the Yonetoku relation).

494 - Second stage distribution of biogas to an area of application after the first stage distribution has reached the zero pressure as displayed on the gauge

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.494) [For award: PhD]*
Primary author: NEKHUBVI, vhutshilo 1st mountaineer *(UNIVERSITY OF VENDA)*
Co-author: TINARWO, DAVID *(UNIVERSITY OF VENDA)*

Every biogas digester is designed with a gas storage chamber of volume Vc. The chamber stores the gas accumulated as the result of the fermentation process within the digestion chamber until the pressure P for the specific period of time is reached. For this study a small scale 6m3 prefabricated biogas digester system has been deployed underground in order to study the possibility of distributing the gas to the appliance forcefully immediately after the initial supply has reached the zero pressure as displayed on the gauge. According to the manufacturer specification, the digester has 1.13 m3 as the maximum gas the chamber can hold. The possible upper limit of the pressure inside the chamber is 8.5 kPa. Exceeding this limit can destroy the chamber; however, a system is designed so that if the upper limit pressure is reached the gas escapes through the outlet and inlet. It was found in this study that when 0.00 kPa is displayed on the gauge, the biogas at the area application is almost reduced with no pressure making any difference to the appliance. However, when a gas detector was positioned at the end of the gas outlet pipe it detected a useful concentration level of CH4 for a reasonable period of time. This led to the second test using a meter to measure the amount of biogas that can be forcibly removed from the digester using a simple hand held vacuum pump placed at the end of the gas supplying pipe. The aim of this study was to develop a method that can be used to aid biogas digesters operators to optimise the production of biogas at low cost.Key words: biogas digester, zero pressure, vacuum pump,

496 - Crystal orientation of the iThemba LABS segmented clover detector

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.496) [For award: PhD]*
Primary author: NONCOLELA, Sive *(UWC)*
Co-authors: *BUCHER, Thifhelimbilu Daphney (iThemba LABS); LAWRIE, Elena (iThemba LABS)*

In order to characterize a segmented germanium detector for the purpose of pulse shape analysis one has to have a correct understanding and be able to model the movement of electron and hole charges inside the detector volume. The movement of the charges is defined by their drift velocity along the direction of the applied electric field. One of the parameters that can influence the drift velocity of the holes and electrons is the crystal lattice orientation. The pulse shape, particularly its rise time is a useful tool to understand the interaction position and the velocity of the moving charges. This is because the rise times are proportional to the distances the charge carriers travel from the point of interaction to their respective electrodes. The iThemba LABS segmented clover detector was irradiated by a collimated Am-241 source at different positions. Measurements were taken at a depth of 1 mm from the detector front surface and in steps of 5 mm around the four sides of the detector. Traces were then averaged for each position offline using a sorting code and then the rise times were measured at 10%, 30%, 60% and 90% fractions of the total trace amplitude. Fractional rise times at T30, T60 and T90 were calculated from the measured rise times values and then plotted for every position with respect to the angle. If the crystal axis is orientated along the diagonal of the crystal the rise times will have equal values for surface interactions at equal distances from the core. Therefore T30, T60 and T90 will be symmetric with respect to the diagonal of the crystal. If the rise times do not show symmetry with respect to the diagonal the crystallographic axis is not aligned with the crystal diagonal. The measured rise times will be presented and discussed.

497 - spectroscopy of proton unbound states in 32Cl for nuclear structure and astrophysical studies.

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: B.497) [For award: MSc]*
Primary author: KAMIL, mohamed *(university of western cape)*

This project aims to investigate the Proton unbound states in 32Cl, within two aspects, the nuclear structure aspect and the astrophysical aspect.For the nuclear structure aspect, 32Cl is a member of the A=32, T=2 isospin multiplet. This is the most precisely measured isospin multiplet. The masses of the members of an isobaric multiplet are related by a quadratic equation called the Isobaric Multiplet Mass Equation (IMME). This equation has proved to be quite successful in predicting the masses of the multiplet members. However, we aim to address recently observed unexpected break-down of the IMME for the A = 32, T = 2 quintet. We used the K600 magnetic spectrometer coupled with an array of HPGe clovers at iThemba labs to perform a high precision measurement to probe states around the T=2 state in 32Cl to look for potential sources of isospin admixtures that could cause the IMME breakdown.For the astrophysical aspect we aim to study states near the Proton separation energy in 32Cl, which are relevant for nucleosynthesis in explosive hydrogen-burning stellar environments such as novae. We have used the K600 spectrometer together with a segmented silicon detector array at backward angles and an array of HPGe clovers. Proton and gamma-ray information obtained in coincidence with the triton events at the focal plane will be used to obtain branching ratio information relevant for the 31S(p,γ)32Cl reaction rate.

499 - Photo-thermal degradation analysis of single junction amorphous silcion solar module EVA encapsulation

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.499)*
Primary author: OSAYEMWENRE, Gilbert *(Fort Hare)*
Co-authors: *MEYER, Edson (FHIT); MAMPHWELI, Sampson (FHIT)*

Ethylene vinyl acetate (EVA) encapsulation degradation affects the performance of photovoltaic (PV) module. Hot spot formation causes the EVA encapsulation to undergo photo-thermal deterioration, and molecular breakdown by ultra-violet (UV) radiation. This leads to diffusion of chemical particles from one layer to another. During outdoor deployment, the EVA encapsulation in the affected region losses its adhesive strength, when this happens the layer in the affected region undergoes rapid delamination. The presence of photo-thermal degradation is detrimental to the reliability of PV modules because it causes both optical and thermal degradation. Photo-thermal degradation makes the encapsulant in the affected region to be more susceptible to chemical substances and moisture. Scanning Probe Microscope (SPM), Energy Dispersive X-ray (EDX) and Thermogravimetric analysis were used to investigate the observed photo-thermal degradation. Why Fourier Transform Infrared Spectroscopy (FTIR) was used for the optical degradation. Our findings show high concentration of Sodium, Phosphorus and Aluminium, which originate from the glass substrate, cell emitter and back contact respectively.

501 - Astronomy for Teachers Update: Teaching the Strand Planet Earth and Beyond in Primary School Natural Science

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: E.501)*
Primary author: LEEUW, Lerothodi *(University of South Africa)*
Co-authors: *DE WITT, Aletha (Hartebeesthoek Radio Astronomy Observatory); GOUWS, eldrie (UNISA); WEST, Marion (HartRAO)*

An update will be presented on a project to assess and enhance the teaching of the strand Planet Earth and Beyond, whose goal was to learn what is needed to help improve primary school learner performance and attrition in Natural Science and implement some possible solutions. A pilot program was initiated to assist teachers to teach the strand better and improve learner performance and attrition in Natural Science and an update following that effort will be presented..

503 - The Sub-millimeter Continuum Emission of Selected Nearby Active Galaxies

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.503)*
Primary author: *LEEUW, Lerothodi (University of South Africa)*

We analyze the sub-millimeter (submm) continuum emission from selected nearby active galaxies, using data from the SCUBA Camera on the James Clerk Maxwell Telescope to the SPIRE Camera on Herschel Space Observatory. The data span over a decade of observations and provide the tightest constraints of the nature of the submm continuum emission from these nearby and similar distant active galaxies.

504 - Novel PET detector with high throughput electronics for Mineral-PET

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.504)*
Primary author: *BALLESTRERO, Sergio (CERN and University of Johannesburg)*
Co-authors: *BASSINI, Stefano (Net Instruments, Milano, Italy); BOIANO, E (Net Instruments, Milano, Italy); CONNELL, Simon (University of Johannesburg); COOK, Martin (University of Johannesburg)*

There is a need for detectors for Positron Emission Tomography (PET) to operate with increasing rate capacity, higher granularity, better spatial and timing resolution and to be more affordable, allowing essentially square meters of PET detector surface to become feasible. The higher granularity of the detecting crystal pixelisation must be matched by a corresponding increase in the replication of the analogue electronics (signal pulse processing, amplifiers, summing, integrators, comparators, discriminators) as well as the digital electronics (signal digitisation, RoI selections). To lower the primary data output stream rate and the busy-time, intelligence for event building and for defining good events must be moved up the data flow chain as close as possible to the detectors while also exhibiting a high degree of granularity. Field-Programmable Gate Arrays (FPGAs) on a per detector element basis are used. The triggering and buffering (to reduce the event randomisation) as well as compression algorithms are also implemented on a per module (group of detectors) basis. These are also based on FPGA architectures and on-chip PCs. These novel advances have been optimised for the Mineral-PET project. Mineral-PET is a revolutionary new technology for diamond bearing rock sorting which has its roots in medical-nuclear physics. The technique is able to look within rock (with size up to about 15cm) to image locked diamonds, in a run-of-mine scenario. This presentation will cover the development of the novel PET detector system and assess its performance in a dynamic PET environment. The development is applicable to Mineral-PET, Medical-PET and PEPT (Positron Emission Particle Tracking).

507 - Optical Spectra of Herschel Gravitational Lenses and their Astrophysical Implications

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: D1.507)*
Primary author: *LEEUW, Lerothodi (University of South Africa)*
Co-author: *CRAWFORD, Steven (SAAO)*

We present optical spectra of gravitational lenses that were discovered in the Herschel-ATLAS (www.h-atlas.org) maps and subsequently observed with the Southern African Large Telescope (SALT). From the spectra of the lenses and the related systems observed in the same SALT program, astrophysical parameters such as redshifts and lens masses are determined and their astrophysical implications described for the for the sample and also individual systems.

508 - MCNPX based Radiation Shielding Analysis for the Mineral-PET Kimberlite Sorting Facility

Poster Session (2) - Wednesday 06 July 2016 16:10 *(Poster Board: F.508)*
Primary author: *CHINAKA, Eric (UJ & NECSA)*
Co-authors: *VAN ROOYEN, Johann (Necsa); CONNELL, Simon (University of Johannesburg)*

Radiation shielding analysis and optimization calculations have been performed to design a shield for the mineral-PET (Positron Emission Tomography) facility. PET is a nuclear imaging technique currently used in diagnostic medicine. The technique is based on the detection of 511 keV coincident and co-linear photons produced from the annihilation of a positron (produced by a positron emitter) and a nearby electron. The technique is being developed for the run-of-mine detection of diamonds in Kimberlite rock. In the technique, a 40 MeV electron beam irradiates a bremsstrahlung target, producing a photon beam which irradiates the candidate rock to activate the naturally occurring 12C, thus producing a positron emitter 11C isotope via the photo-nuclear (γ,n) reaction. The resultant high intensity and high energy radiation (including both photons and neutrons) field requires appropriate shielding to protect personnel, equipment and the environment around the facility. Calculations to simulate the radiation field and to optimize the required shielding materials and their geometry were done using a Monte Carlo based radiation transport code, MCNPX-2.70. The optimized shield configuration as well as the associated neutron and photon dose rates on the personnel side of the shield are presented.

510 - Commissioning of a Molecular Beam Epitaxy (MBE) system for III-V semiconductor growth

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.510)*
Primary author: *THERON, Chris (University of Pretoria)*
Co-authors: *MEYER, Walter (University of Pretoria); JANSE VAN RENSBURG, Johan (University of Pretoria)*

MBE is an advanced technique used for growing epitaxial structures to almost atomic layer precision which enables the development of various new material systems. MBE is already used in industry for advanced multilayer crystal growth and has led to radically new devices including high speed transistors, microwave devices, laser diodes and detectors. This enables multi-disciplinary research in a wide range of materials with new physics covering fields such as material science, photonics, and nano-electronics.We hereby report on the commissioning of a new Riber Compact 21 Molecular Beam Epitaxy system in the Department of Physics, University of Pretoria. The system will allow the growth of III-V semiconductor materials GaAs, AlGaAs, InGaAs and their alloys with both n- and p-type doping (Si and Be respectively). The base pressure with liquid nitrogen in the cryopanels is $5x10^{-11}$ Torr. The system can process up to 3” inch wafers which can be annealed in the outgassing station to temperature up to 800 °C. The sample manipulator allows growth temperatures up to 1100 °C with continuous rotation and in situ RHEED analysis. Preliminary results from initial calibration growths and test structures will be presented. The various growth capabilities of the system will further be discussed such as quantum well superstructures, nanorods, laser heterostructures, and HEMTs. A list of various projects that are planned and already underway will also be presented.

514 - Copper nitride nanoparticles for use in optoelectronic devices

Poster Session (1) - Tuesday 05 July 2016 16:10 *(Poster Board: A.514) [For award: PhD]*
Primary author: *SITHOLE, Rudo (University of the Witwatersrand)*

Since the first reported synthesis in 1939, different reports have been given on the nature of copper nitride (Cu3N). It has been reported to be insulating, semiconducting or metallic and as a result, the reported band gaps range from 0.2-1.9 eV. Cu3N has an anti-rhenium cubic structure with voids at the centre of the body which can be occupied by either nitrogen or copper atoms resulting in differences in the reported optical properties. Films produced have been said to be unstable and Yue et al. showed that the copper nitride films decompose to copper and nitrogen at 200 0C [1]. There have been a lot of reports on the fabrication of copper nitride thin films using sputtering and vapor deposition techniques, but very little has been reported on the colloidal synthesis. We report on the colloidal synthesis of semiconducting Cu3N quantum dots which remain stable at temperatures as high as 330 0C. This was achieved by the thermolysis of a Schiff-base copper (II) complex in octadecylamine to yield Cu3N nanoparticles with a band gap of 2.48 eV. Variation in temperature and time was done to obtain the desired morphology and optical properties. The semi-conducting nature and thermal stability of the as-synthesized nanoparticles has led to the next phase of our research where application in solar cells is currently underway. As-synthesized nanoparticles in chloroform were dispensed on a clean indium-titanium oxide doped glass substrate on a spin coater. A vacuum evaporator was used to deposit aluminium metal contacts on top of the thin film and then I-V measurements were taken. Reference: 1. Yue, G. H., Yan, P. X., & Wang, J. (2005). Journal of crystal growth, 274(3), 464-468.

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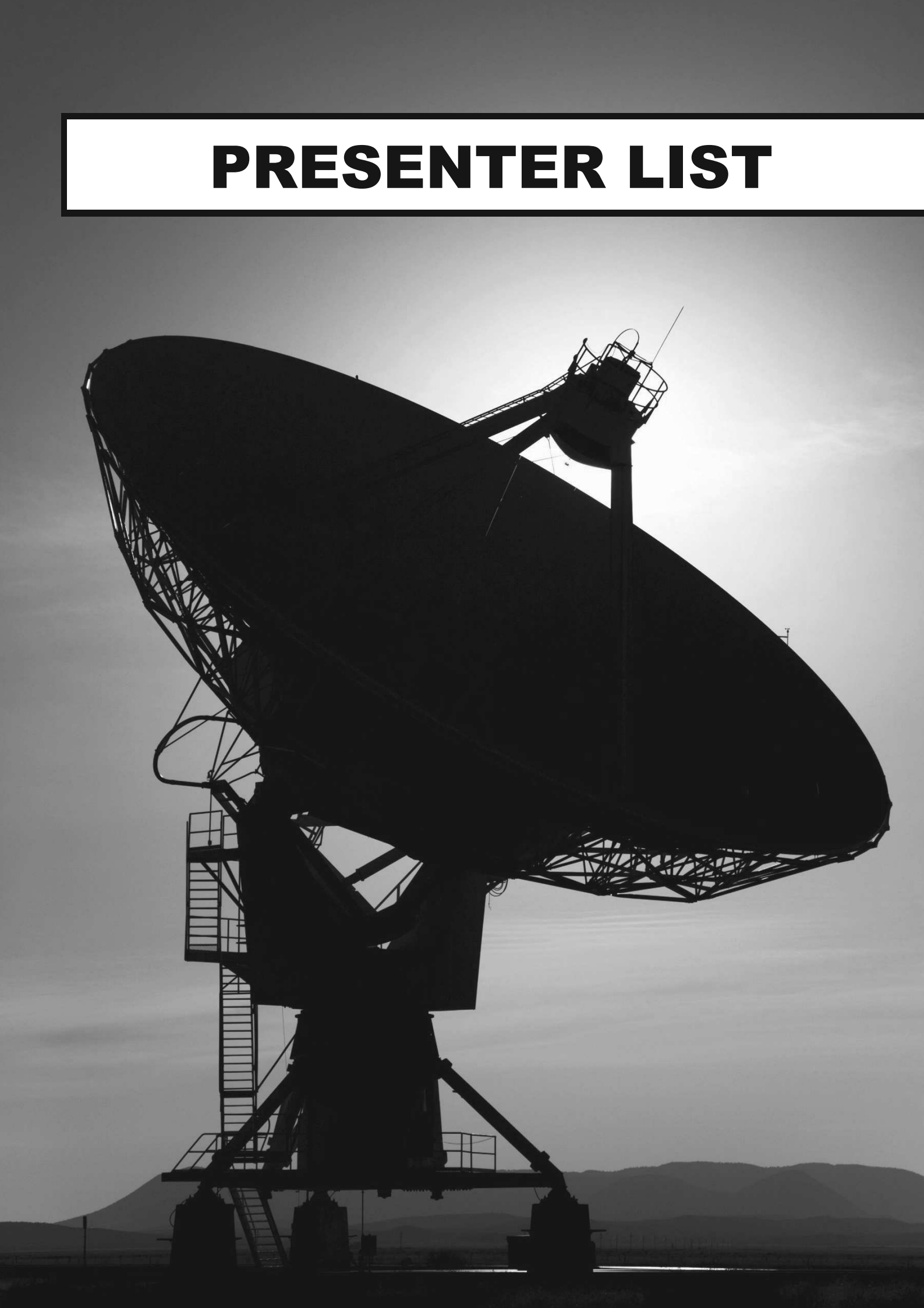

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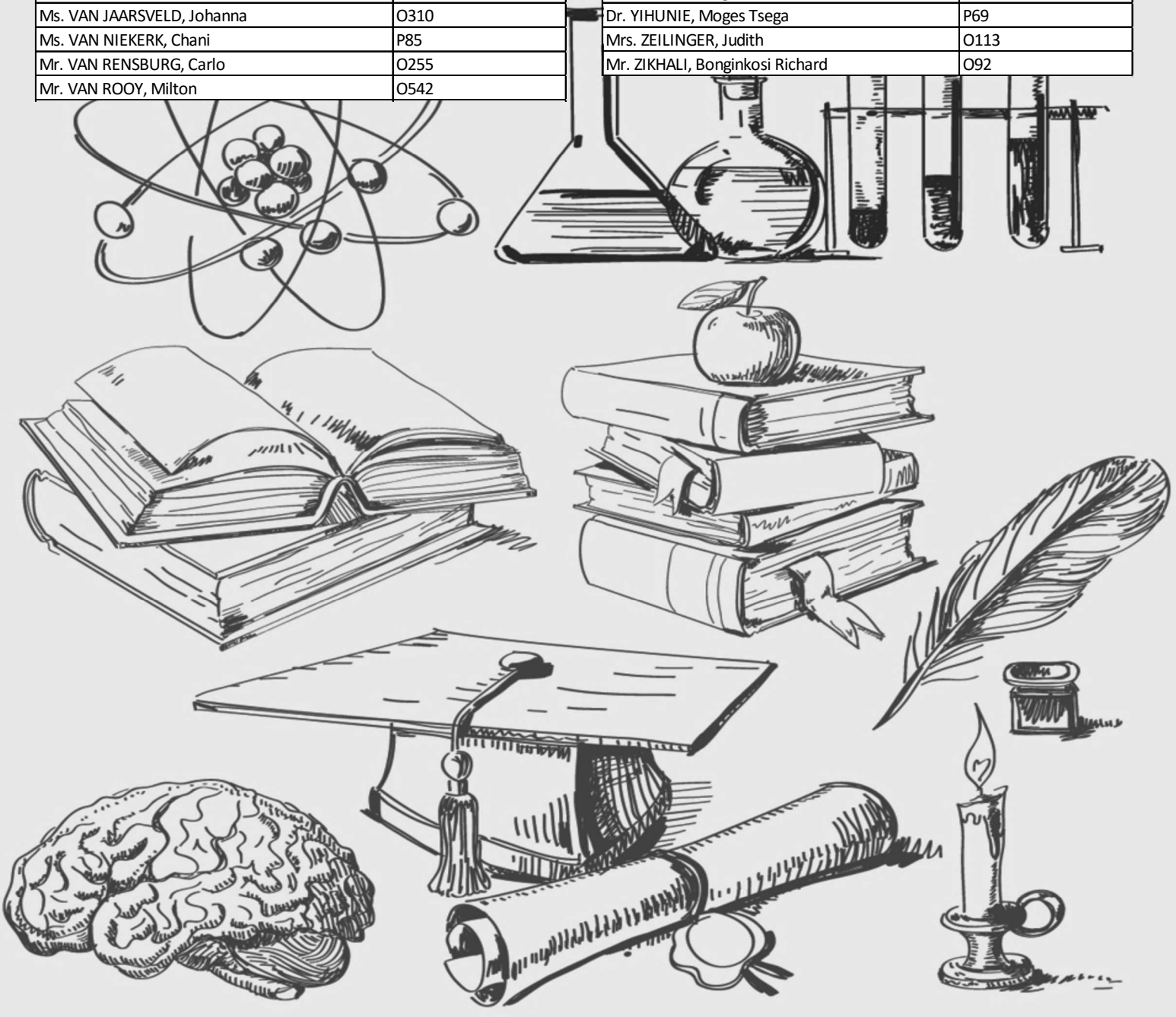

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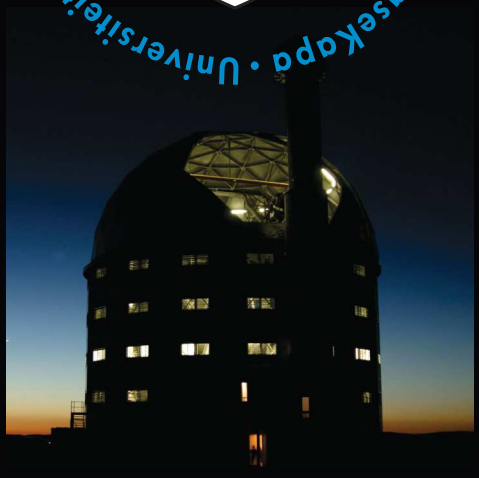

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