SOUTH AFRICAN INSTITUTE OF PHYSICS

60TH ANNUAL CONFERENCE

29 JUNE - 3 JULY 2015
BOARDWALK CONVENTION CENTRE
PORT ELIZABETH

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Nelson Mandela Metropolitan University

SOUTH AFRICAN INSTITUTE OF PHYSICS

RHODES UNIVERSITY
Where leaders learn

CRYOGENIC
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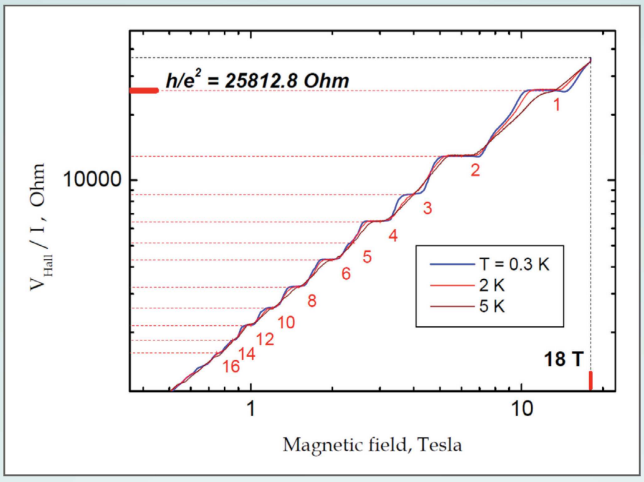
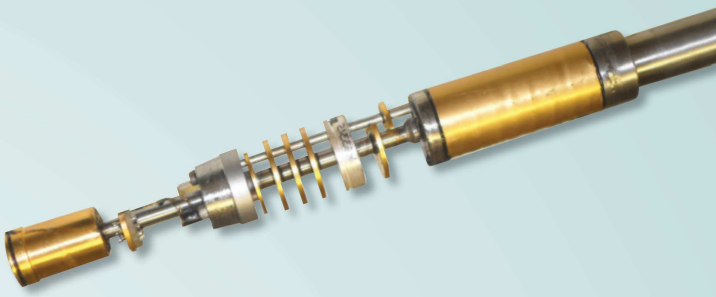
18 TESLA CRYOGEN-FREE MEASUREMENT SYSTEM

280 mK electrical transport measurements



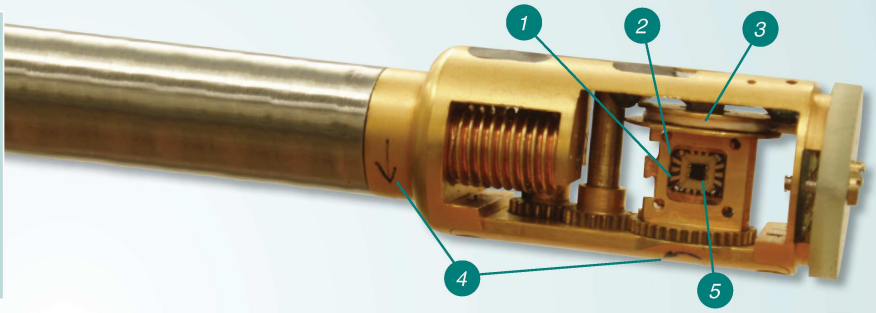


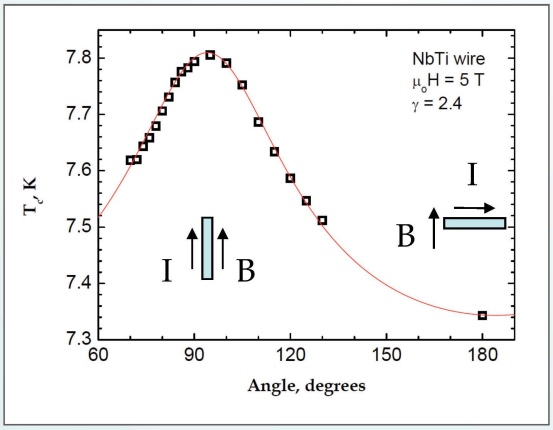
Quantum Hall Effect in GaAs-AlGaAs heterostructure

Sample rotation platform for electrical transport measurements at low temperatures

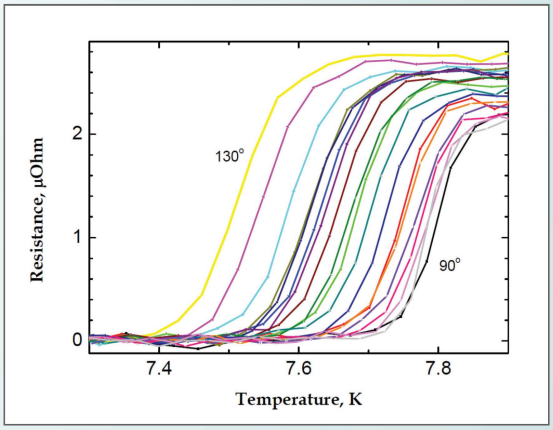
Key

1. Contact number 1
2. Sample platform
3. Cable to sample platform
4. Direction of positive rotation
5. Sample





Critical temperature as a function of the angle. Effective anisotropy factor is 2.4



Resistive transition in a short straight sample of NbTi wire, at different angles between the wire and the magnetic field

Unit 30, Acton Park Industrial Estate, The Vale, London W3 7QE, UK
Tel: +44 (0)20 8743 6049 **Fax:** +44 (0)20 8749 5315 **Email:** sales@cryogenic.co.uk
www.cryogenic.co.uk

Table of Contents

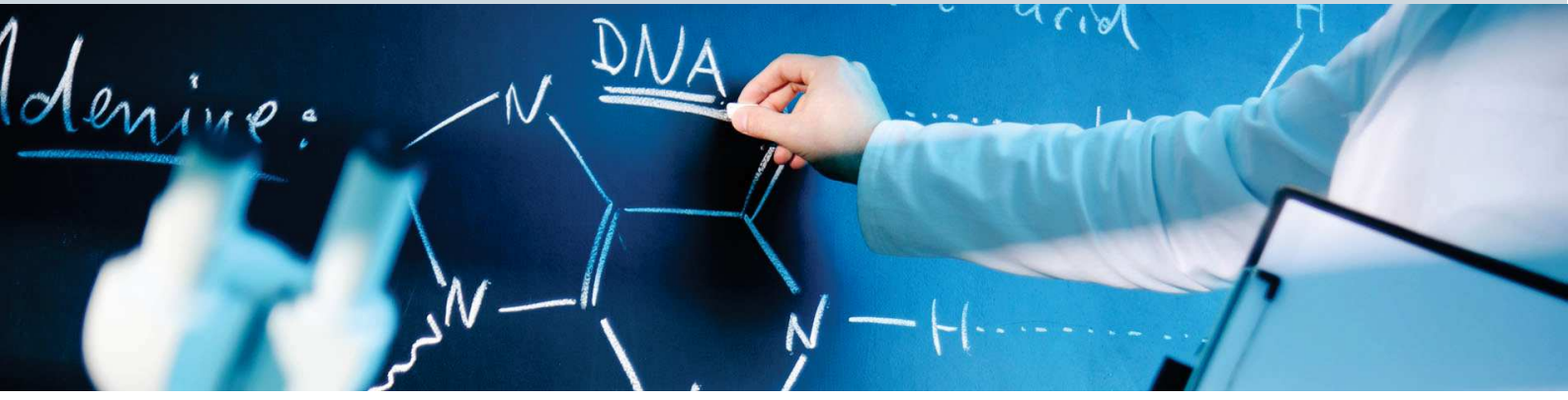
Abbreviations

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 Observatory
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

Emergency Numbers

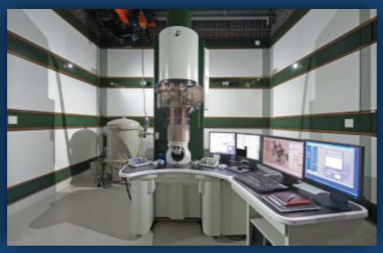
PLEASE REPORT TO THE REGISTRATION DESK OR USE ONE OF THE LISTED NUMBERS

Netcare Ambulance	**082 911**	**24 hour Poison Centre**	**021 931 6129**
St George's Hospital	**041 392 6111**	**Police Flying Squad**	**101 11**
Greenacres Hospital	**041 390 7000**	**Alpha Pharm Summerstrand Pharmacy**	**041 583 2128**
Fire & Emergency Services	**041 585 1555**	**GP : Dr André Killian**	**041 583 2121**



Centre for HRTEM






The Centre for High Resolution Transmission Electron Microscopy is a state-of-the-art electron microscopy facility focusing on the application of high resolution and analytical electron microscopy techniques in the characterisation of strategic materials in collaboration with local and international leaders in physics, materials science and engineering.

Research fields include:

- Nanoparticle catalysts
- Nuclear reactor materials
- Coal-fired power plant steels
- Semiconductor materials
- Diamond and titanium alloys
- Platinum group metals
- Nanoparticles for removal of metals from water

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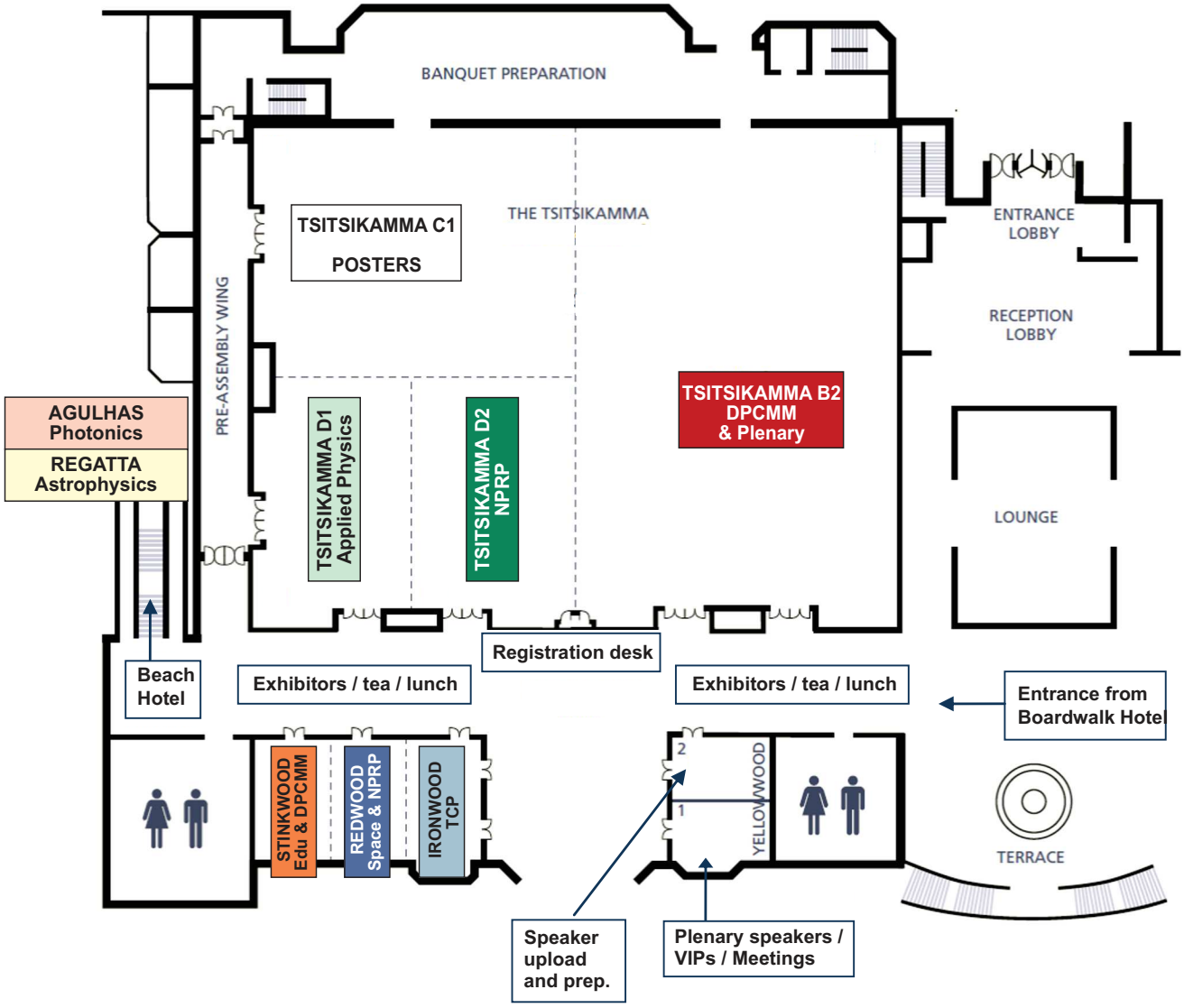
Apply NOW for NRF 2016 scholarships!

Visit our website: http://chrtem.nmmu.ac.za

Map and Venue List

Boardwalk Convention Centre & Beach Hotel



A1: Div. for Physics of Condensed Matter and Materials (Tsitsikamma B2)	A2: Div. for Physics of Condensed Matter and Materials (Stinkwood)
B1: Nuclear, Particle and Radiation Physics (Tsitsikamma D2)	B2: Nuclear, Particle and Radiation Physics (Redwood)
C: Photonics (Agulhas)	
D1: Astrophysics (Regatta)	
D2: Space Science (Redwood)	
E: Educational Physics (Stinkwood)	
F: Applied Physics (Tsitsikamma D1)	
G: Theoretical and Computational Physics (Ironwood)	


THE Art OF ACCOMPLISHMENT
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AT THE FACULTY OF SCIENCE
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INNOVATIVELY CREATING NEW KNOWLEDGE AND LEADING SCIENTISTS
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Guidelines for Speakers and Chairs

Speakers

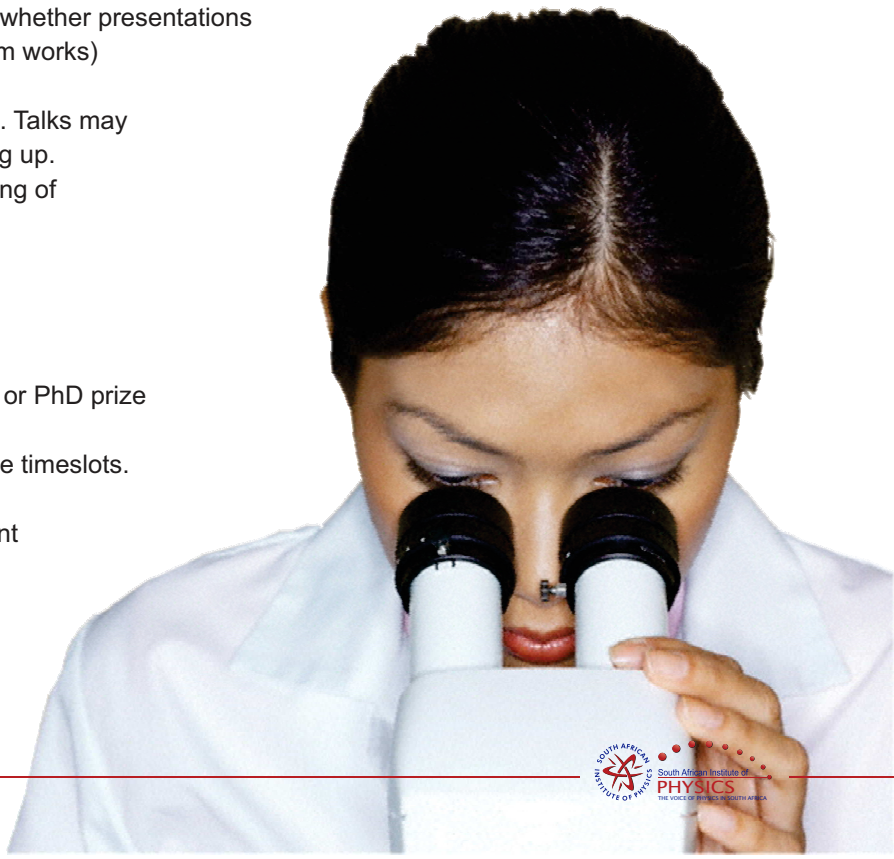
- 20 minute slots have been allocated for orals: 15 minutes for presentations and 5 minutes for questions. You will be warned of the time 13 minutes into the talk
- It is important to double check the date, time and venue for your presentation(s)
- Ensure that your presentation is UPLOADED IN THE YELLOWWOOD 1 ROOM before the start of the session
- An assistant has been assigned to each venue, please make use of them
- Be on time and report to the chair whether:
  - This is part of a group presentation.
  - You are competing for a prize.
- You are not allowed to move your presentation to any other slot
- Once the chair indicates the end of your session, you must stop your presentation immediately
- Laser pointers will be available from the session assistants

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 then 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

Chairs

- Please keep to the scheduled times
- Make it a point that you 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 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 turning up.
- Welcome delegates and speakers at the beginning of your session
- Make the following announcements:
  - All cellphones are to be switched off
  - The title and name of the speaker
  - Whether it is a group presentation
  - Whether the speaker competes for an MSc or PhD prize
- Thank all the speakers at the end of the session
- Allow questions according to time. Stay within the timeslots.
- Report shortcomings to the session assistant
- Report to the front desk if the speaker was absent



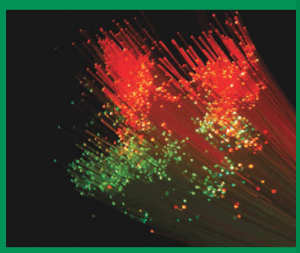
Nelson Mandela Metropolitan University

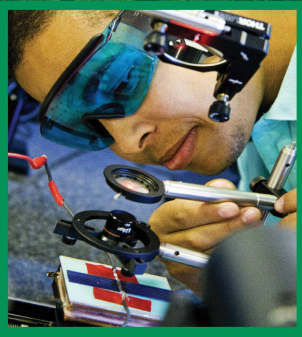
for tomorrow

Department of

Physics

Faculty of Science





RENEWABLE ENERGY

Sustainable Energy for the Future

The Centre for Energy Research is actively involved in various energy research projects, on Photovoltaics, Solar Thermal and Wind Energy. Studies include various renewable energy research projects on different technologies and the development of new characterisation techniques.

The following Applied Physics skills are acquired:

- LabView programming
- Data acquisition system design and analysis
- Computer - equipment interfacing

Future student projects include:

- Advanced PV characterisation
- Concentrator PV technology
- Solar Resource assessment
- Infrared thermography
- Electroluminescence studies
- PV module energy yield monitoring and analysis

CONTACT
Prof Ernest van Dyk
ernest.vandyk@nmmu.ac.za

OPTICAL FIBRE TELECOMMUNICATION RESEARCH

Escalating bandwidth demands fuelled by smartphones, tablet computers, social media, Big data and cloud computing makes Telecommunications an extremely challenging and rewarding field.

The Centre for Broadband Communication at NMMU has one of the best equipped research laboratories in Africa.

We offer an exciting range of MSc and PhD projects featuring:

- Fibre-to-the-home (FTTH) technologies
- Square Kilometer Array related optical fibre topics
- Dispersion measurement, compensation and emulation
- Polarization effects, wavelength division multiplexing, non-linear effects
- Modelling and simulation, OTDR, fusion splicing, bit error rate testing

Scholarship opportunities are available for good, motivated students.

CONTACT
Prof Tim Gibbon
tim.gibbon@nmmu.ac.za

www.nmmu.ac.za/physics

General Information

REGISTRATION DESK

The registration desk will operate daily in the foyer area. A message board will be situated here. Operating times:

Monday, 29 June:	07h30-19h00
Tuesday, 30 June:	07h00-17h00
Wednesday, 1 July:	08h00-17h00
Thursday, 2 July:	08h00-17h00
Friday, 3 July:	08h00-13h00

EMERGENCY NUMBERS

For any type of emergency please enquire at the registration desk. Emergency numbers:

Netcare Ambulance	082 911
St Georges Hospital	041 392 6111
Greenacres Hospital	041 390 7000
Fire & Emergency Services	041 585 1555
24 hour Poison Centre	021 931 6129
Police Flying Squad	101 11
Alpha Pharm Summerstrand Pharmacy	041 583 2128
GP - Dr André Killian	041 583 2121

NAME TAGS

Wear name tag at all times to gain access to the venue of the conference, lecture halls, social functions and lunches

POSTER SESSIONS

Posters should be put up on the poster boards on the Tsitsikamma Room, for the duration of the conference. It is important that presenters avail themselves during their allocated poster session(s) for discussions. DPCMM Posters (to be judged for awards) must be presented during both poster sessions.

LUNCHES, TEA AND REFRESHMENTS

All teas and lunches will be served in the foyer area.

PRESENTATION UPLOAD FACILITIES

Your presentation must be uploaded in the Yellowwood 2 room at least one session before the allocated timeslot. This room is operational on:

Monday, 29 June:	07h30-19h00
Tuesday, 30 June:	07h30-17h00
Wednesday, 1 July:	07h30-17h00
Thursday, 2 July:	07h30-17h00
Friday, 3 July:	07h30-13h00

TRANSPORT

Transport during the conference is for your own arrangement. For Airport Transfers, contact Ilios Travel on +27 (0)82 440 5811 / mariskadelport@ilios.co.za (Cost: R 165pp one way)

SAIP GOLF SHIRTS

Ordered shirts will be issued during registration. Additional items will be on sale throughout the duration of the conference at the registration desk.

WIFI / INTERNET

Complimentary WIFI is available, just connect and access your browser.

Organising Committee

NMMU and Rhodes University

André Venter (Chairperson) (NMMU)
Makaiko Chithambo (Chairperson) (RU)
Reinhardt Botha
Tim Gibbon
Gretta Hashe
Jano Jonker
Schadrack Nsengiyumva
Jan Neethling
Ernest van Dyk
Freddie Vorster
Magnus Wagener
Lindsay Westraadt
Dino Giovannoni

South African Institute of Physics

Brian Masara (Executive Officer)
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Juan Grey (Online System, Contribution Management)

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Rhodes University
SA Council for Natural Scientific Professions (SACNASP)
South African Institute of Physics
Stellenbosch University
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Rhodes University
South African National Space Agency (SANSA)
Vacutek
WIRSAM Scientific
Women in Physics in South Africa (WiPiSA)

CREATING OPPORTUNITIES

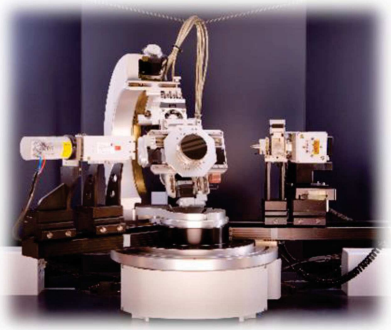
iThemba LABS is one of **seven** National Facilities administered by the National Research Foundation. The National Research Foundation (NRF) is an independent statutory body setup in accordance with the National Research Foundation Act. Its mandate is to support and promote research through funding, 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.**

For more information visit www.tlabs.ac.za or email: director@tlabs.ac.za
Tel: 021 843 1000

Message from SAIP President

Welcome to SAIP2015! It's a delight to be in the Eastern Cape. Just up the road from us in the Addo Park, the elephants will be congregating at the waterhole at the same time that we develop a thirst, just after the last lectures; it is sensible to learn from those wise animals in this respect.

It is at this annual conference that physicists gather to wrestle with their own, and each other's, ideas. In the local environment, we may be in the hottest pursuit (a typical estimate might be 8 x 10^5 K, the temperature of the fast solar wind) of the coolest ideas (probably about 3 K). Students don't come just to give their first paper, but to be heartily welcomed into an environment of critical thinkers. Speakers don't arrive to lay down the physical law, but to test each clause. We are here to let the kittens of ideas out to play, before they develop into the Big Cats of the literature.

The events in physics in the last year will be reported live at this conference. The South African Institute of Physics has had an extremely active year and has followed the strategy worked out in 2014, and as has been said, “however beautiful the strategy, you should occasionally look at the results”. We'll be reporting on these during the conference and there are many. I'd like to mention here that SAIP has been formally recognised as a Professional Body. The Voice of Physics is clear and the acoustics are good.

I extend a warm welcome to all Plenary speakers, delegates and visitors, and to all those participating in the associated meetings, Schools and workshops. Profound thanks go to the universities welcoming us today: to Prof André Venter and his team at NMMU and Prof Makaiko Chitambo and his group at Rhodes. And now, for the conference.

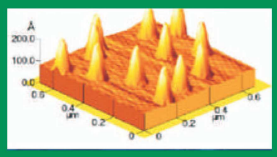
PROF. IRVY (IGLE) GLEDHILL
President
South African Institute of Physics

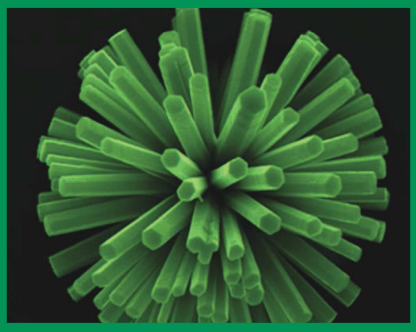
Nelson Mandela Metropolitan University

for tomorrow

Faculty of Science

Department of Physics





NANOPHYSICS RESEARCH AND CAREER OPPORTUNITIES

After successful completion of your BSc degree with physics as a subject, you can continue with physics honours and a masters/doctors degree in nanophysics which may lead to the following exciting employment opportunities:

- **Sasol** – catalysts
- **Element Six** – diamonds and other hard materials
- **NECSA** – nuclear reactor fuel materials and minerals
- **CSIR and Mintek** – materials and minerals
- **Universities** – lecturing and research
- **iThemba LABS and Eskom** – nuclear reactor materials

NMMU'S TRACK RECORD IN NANOPHYSICS AND ELECTRON MICROSCOPY

- State-of-the-art research equipment in Centre for High Resolution Electron Microscopy
  – the most advanced electron microscopes in Africa
- Specialize in all aspects of Electron Microscopy applied to nanomaterials
- Close collaboration with industries and universities in South Africa and overseas

NANOPHOTONICS

Nano-sized materials for opto-electronic devices

- Nano-science is the major driver of high tech opto-electronics
- Nano-structures provide novel ways to engineer high efficiency LEDs, laser diodes and sensors
- "Nano" is "BIG"!

The Physics Department has unique equipment for the synthesis and characterization of semiconductor nano-structures, including a state-of-the-art reactor for semiconductor crystal growth.
We have active collaborations with several local and overseas universities, including groups in Sweden, Germany and the UK.

WE CURRENTLY DEVELOP:

- InAsSb layers and nano-structures for infrared detectors
- ZnO for high efficiency white LEDs

EXCITING NEW MASTERS DEGREE IN NANOSCIENCES, PRESENTED JOINTLY BY NMMU AND THREE OTHER SA UNIVERSITIES.

CONTACT
Prof Jan Neethling
jan.neethling@nmmu.ac.za

CONTACT
Prof Reinhardt Botha
reinhardt.botha@nmmu.ac.za

www.nmmu.ac.za/physics

Message from the VC - NMMU

The Nelson Mandela Metropolitan University (NMMU) is privileged to co-host - together with Rhodes University - the 60th Annual Conference of the South African Institute of Physics (SAIP). NMMU has a keen interest in the importance of scientific and technical knowledge and its relation to development.

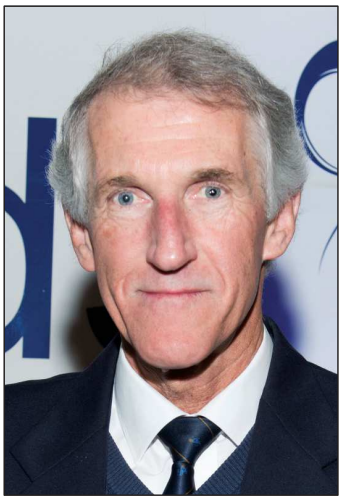
For this reason, NMMU is constantly seeking ways to create and sustain an environment that encourages, supports and rewards a vibrant research, scholarship and innovation culture, whilst positioning the university as an engaged Institution that contributes to a sustainable future through critical scholarship.

There is a deeply felt institutional conviction to be part of the social building process by uniting professional knowledge, scientific consciousness, and social commitment. This resonates with the rising voices for a radical rethink about the social (re)production of knowledge and its relevance for South Africa's transition. NMMU is an active proponent for raising the status of the science and physics disciplines and programmes across the higher education landscape, and in seeking novel ways to explore trans-disciplinarity to expand the frontiers of learning and experimentation. The research focus of the NMMU Physics Department is the development of a variety of materials, including semiconductors, metal alloys and ceramics, as well as on the characterisation of solar energy materials and devices.

The department is also actively researching optical fibre technologies for the local telecommunications industry. As a comprehensive university NMMU draws on more than a century of quality higher education, in a novel kind of university that offers a wide range of academic, professional and technological programmes at varying entrance and exit levels. NMMU warmly welcomes all Conference delegates both to the university and to Nelson Mandela Bay and wishes the SAIP Conference every success in its endeavours.

PROF. DERRICK SWARTZ
Vice-Chancellor
Nelson Mandela Metropolitan University

Message from the Dean of Science - NMMU



It is with great pleasure that we welcome you to Port Elizabeth as you attend the 2015 Conference of the South African Institute of Physics. The event is jointly hosted by the Physics Departments of Rhodes University and Nelson Mandela Metropolitan University the latter can lay claim to being the southernmost Physics Department in Africa! Physics will forever remain the foundation, along with Mathematics, for all other scientific disciplines and technologies. Its importance cannot be exaggerated, especially in this modern age. Our own country stands on the cusp of major developments such as the SKA, an expansion of nuclear power based electricity generation, growing alternative energy applications, and so on, all of which require involvement by physicists. It seems like a good time to be a physicist.

It is pleasing to see that such a wide range of themes will be addressed during this meeting, including the physics of condensed matter and materials, applied physics, nuclear, particle and radiation physics, theoretical and computational physics, astrophysics, space science, photonics, physics education and biophysics. This is indicative of a pleasingly wide range of physics activity in South Africa, although there are undoubtedly challenges in ensuring that it is sustained. One of the biggest is to ensure that talented young minds can be lifted out of a school system which in some regions is plainly dysfunctional, and on into university where they can be trained and equipped to tackle the many relevant problems in physics. So, it is encouraging to see that one of the conference themes is physics education.

We trust that you will have a fruitful meeting as you share your scientific work and interact with each other. No doubt many old acquaintances will be renewed and hopefully new ones made. Port Elizabeth prides itself as the 'Friendly City' and we hope that you will fully enjoy our hospitality at the social level too.

PROF. CW MCCLELAND
Acting Dean: Faculty of Science
Nelson Mandela Metropolitan University

Message from the Dean of Science - Rhodes University

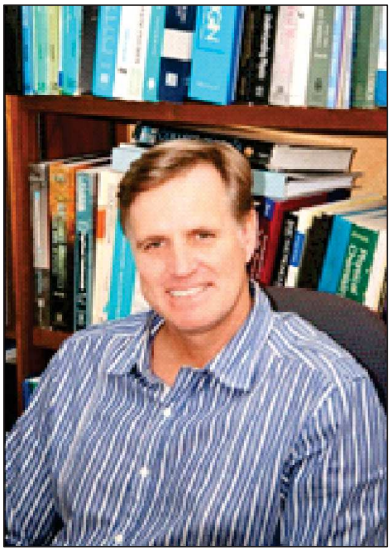
On behalf of the Faculty of Science at Rhodes University, I would like to warmly welcome you to the 2015 South African Institute of Physics conference. It is truly an honour for our Department of Physics and Electronics to co-host the event.

There have been many topical issues in Physics recently that have drawn much publicity such as the discovery of the Higgs boson, news about black holes, and many interesting results from desktop experiments. These all suggest that these are interesting times for physics within South Africa and abroad. We at Rhodes University are proud to have played a role in South Africa's successful bid for the SKA project. We now have a Chair in Radio Astronomy and have established a dedicated Radio Astronomy research group

I wish you a successful conference and hope that those of you that have some time to spare take a drive and visit our beautiful campus in Grahamstown.

PROF. TONY BOOTH
Dean: Faculty of Science
Rhodes University

Message from the HOD - NMMU



It is indeed a great pleasure and honour for me to welcome you all to the 60th South African Institute of Physics Conference in our friendly city, Port Elizabeth. I sincerely hope that you will find the conference academically stimulating, and that the beautiful surroundings, pristine beaches, and the overwhelming natural beauty of the Eastern Cape, will contribute to the SAIP 2015 Conference being engraved in your fondest memories" folder as one of those very special occasions. A special word of welcome also to our invited guests. Thank you for being willing to travel far, even across the globe for some, to share your expertise with us. This is sincerely appreciated.

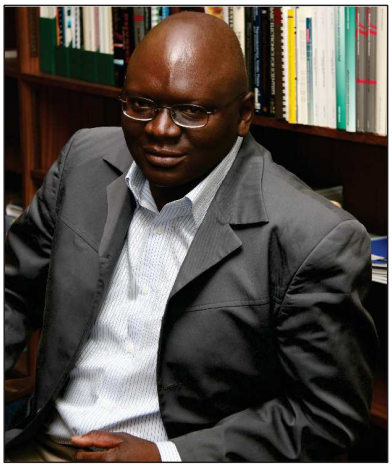
The Physics Department at the NMMU was established in 1965, the same year as the former University of Port Elizabeth (UPE). In 2005 UPE, the PE Technikon and the PE campus of Vista University merged to form a comprehensive university, named after South Africa's first democratically elected President, Nelson Mandela. The last 50 years have seen the NMMU Physics Department develop from an infant to a mature player in the physics fraternity, acknowledged for its expertise in the fields of Solid State Physics, Materials and Nano Science, Renewable Energy and Optical Fibre Characterization.

This conference allows you to engage academically, to nurture existing collaborations and/or initiate new ones and maybe even for some of us, to start life-long friendships. I sincerely hope that you will use such opportunities and that you will leave PE with a sense of fulfilment and time well spent.

Lastly, thank you to all who made this event possible: Tanya and her team from Eastern Sun Events for their diligence and commitment, the co-chairperson, Makaiko Chithambo, members of the LOC, as well as the Council and the office of the SAIP. Thank you.

PROF. ANDRÉ VENTER
Acting Head: Department of Physics - Nelson Mandela Metropolitan University
Co-Chair: SAIP2015

Message form the HOD - Rhodes University



On behalf of the Department of Physics and Electronics at Rhodes University, I am delighted to welcome all delegates to the 2015 Conference of the South African Institute of Physics.

Rhodes University has a long and proud association with physics in South Africa. The Department of Physics at this university was established in 1905 and has, over the 110 years of its existence, produced a long list of luminaries. Contemporary examples include many in key national positions. Our department has thriving research programmes in radio astronomy, solid state physics, nuclear physics and theoretical physics. It is perhaps opportune to mention that the study of radio astronomy at Rhodes University goes back to the time of Jack Gledhill, father to the current SAIP president. It is always a pleasure to hear Igle remind those who know, and inform those who don't, that she is counted among our number. We also take particular interest in high-quality education and have actively participated in the current national review of teaching and learning of physics in South Africa. Our programme is unique in offering a combination of fundamental physics and modern electronics.

As a co-host of SAIP2015, we take note that the meeting is being held in part under the auspices of generous support, financial and otherwise, from many sources. For good reason, I would like to single out the support from Rhodes University, which I acknowledge with sincere gratitude.

The conference programme has a diverse list of interesting contributions to look forward to. Outside the formalities, there are, without a doubt, old friends to catch up with and new ones to make. I wish you a worthwhile and enjoyable meeting.

PROF. MAKAIKO CHITHAMBO
Head: Department of Physics and Electronics, Rhodes University
Co-Chair: SAIP2015

Department of Physics & Electronics

POSTGRADUATE OFFERINGS

Rhodes University enjoys amongst the best pass and graduation rates in South Africa, has one of the most highly qualified academic staff complements and amongst the best research output per academic staff member. At the 2015 graduation ceremony, 46% of all graduates were awarded postgraduate degrees.

Located in the Rhodes Science Faculty, the Department of Physics and Electronics houses a SARChI Chair in Radio Astronomy and has a vibrant research group involved with the SKA project.

It is the only University Department in South Africa which offers research opportunities that combine Fundamental Physics and Modern Electronics. This hybrid offering gives students the distinct advantage of apply cutting-edge technologies to the frontiers of scientific research in a way that can enable them to contribute uniquely to big scientific projects such as the SKA.

Postgraduate research opportunities are available in the following areas:

- Radio Astronomy
- Experimental Solid State Physics
- Theoretical High Energy Physics
- Experimental Nuclear Physics
- Electronics
- Pedagogy of Physics

For more information and application details:
Contact: Prof. Makaiko Chithambo
m.chithambo@ru.ac.za
www.ru.ac.za/physicsandelectronics/

RHODES UNIVERSITY
Where leaders learn

Image courtesy of SKA South Africa

BIOPHYSICS INITIATIVE

Biophysicists study the physics of biological systems. Merging the disciplines of physics and biology provides unparalleled insight into biological phenomena and it is used to explain how biological molecules and systems work.

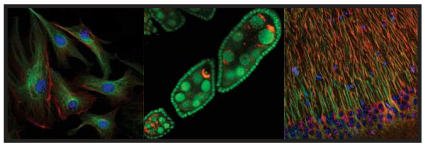
Many interesting biological phenomena occur on the scales ranging from micrometers to nanometers. These can be probed and visualised using electromagnetic radiation which can be used to obtain information about the structure, function and dynamics of the systems. The interesting properties that determine behaviour include conductivity and binding energy which can only be measured and described using physical methods. The forces that determine the properties of biological systems are often weak and this makes the systems fragile.

Much of the discipline of experimental biophysics is devoted to overcoming the problems of obtaining reliable measurements of exquisite and delicate, nanoscale, naturally occurring machines without destroying them. Two large branches of Biophysics are spectroscopy and microscopy. Both these techniques are used to study the structures and dynamics of biological samples under as near physiological conditions as possible and without damaging the sample. More recently a third approach has been introduced which is rapidly gaining importance - this is the ability to manipulate biological materials and is called optical tweezing.

Biophysics has undergone rapid advances over the past 10 years due mainly to the development of new technologies – synchrotrons, electron microscopes, lasers and computers. These technologies enable multiscale imaging ranging from cellular to atomic resolution and allow events to be recorded on ultra-fast (pico- and femto-second) time scales.

MICROSCOPY

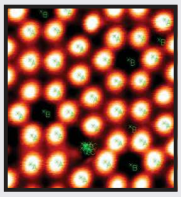
There has been a recent increase in the use of light microscopy in the study of biological systems. Optical microscopy is one of the very few techniques by which physiologically active sample can be studied giving high spatial resolution. Microscopy also enables the study of sub-surface and intra-cellular processes. Confocal microscopy is a powerful tool in biology. By changing the focus of the laser within a sample images through the tissue can be obtained and in this way it may be optically sectioned to a depth of 600µm. From these sections three dimensional images can be constructed. A limitation of confocal microscopy is that the laser energy required for optimal resolutions can damage cells. In recent years new microscopy techniques have been developed called non-linear microscopy. This includes multiphoton-excitation fluorescence (MPF), second harmonic generation (SHG) and third harmonic generation (THG).



SPECTROSCOPY

This basket of techniques is usually concerned with studying in more detail a specific sub-cellular fraction. This may be to determine more precisely the molecular structure of the sample or to follow the reaction mechanisms of the sample.

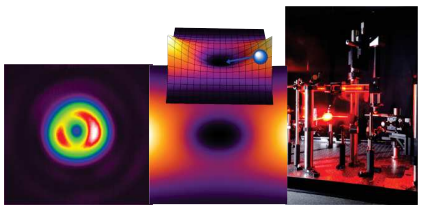
These techniques fall mainly into one of three categories of measuring light and its interaction with the sample. One is the scattering of the light from the sample for example Raman spectroscopy. This is very powerful for detecting the chemical composition of the sample. Then there is the absorption of the light by the sample and then light that is produced as a result of first being absorbed and then re-emitted at a longer wavelength which is termed fluorescence. All the above techniques can be measured in both the steady state and in a time resolved means. Steady state spectroscopy reveals information mostly about the structure and composition of the sample where as time-resolved spectroscopy provides information on the dynamics of a reaction.



OPTICAL TWEEZING

Laser light possesses momentum as outlined in the de Broglie relationship. It is possible to transfer the momentum of light onto another body and exert a force on it. This force may only be a few piconewtons but is able to trap or move a cell or nanosized particle. An optical tweezer makes use of a tightly focused light beam and differences in the refractive index of a particle and surrounding medium.

A particle with a refractive index higher than the surrounding environment is drawn into the laser focus. This technique has been used to measure biomechanical forces acting on macromolecules or cells in the order of femtonewtons. By using optical forces it is possible to manipulate cellular and sub-cellular samples without physical contact.



South African Institute of PHYSICS
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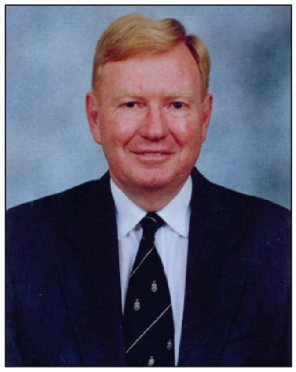
For more information about this initiative please visit http://biophysics.saip.org.za/ or email biophysics@saip.org.za

Invited Plenary Speakers



Prof. Darrell Comins
University of the Witwatersrand

Darrell Comins is an Emeritus Research Professor at Wits University. Previously he held the Chair of Solid State Physics, was Chairman of the Materials Physics Research Institute, Founding Director of the DST-NRF Centre of Excellence in Strong Materials and Director of the Raman and Luminescence Laboratory.

He is a Fellow of the Royal Society of S.A. and of the SAIP, and a Member of the Academy of Science of S.A. (ASSAF). He was awarded the Science for Society Gold Medal of the ASSAF, the De Beers Gold Medal of the SAIP, an NRF President's Award as an A-rated Scientist, and the Wits Vice-Chancellor's Research Award. He has applied optical spectroscopic techniques to materials physics leading to many international journal publications, conference papers and invited lectures. He co-Chaired the ICDIM 2000 conference, is a committee member of two international conferences and has collaborations with local scientists and those in Britain, France, Germany, USA, Japan, Austria, and Algeria.

His research on radiation damage in alkali halides using Raman spectroscopy and optical absorption established the nature of the halogen interstitial defects and their structures. Work on fluorite super-ionic compounds using high temperature Brillouin and Raman spectroscopy has provided important insights into the complex processes leading to their high ionic conductivity. Surface acoustic excitations in opaque materials in bulk or thin film form have been studied with surface Brillouin scattering (SBS) to determine their elastic constants and mechanical properties. Unique high temperature and high pressure studies have been made. Industrially relevant work includes: stress measurements in diamond using Raman spectroscopy, the determination of elastic constants of superalloys and carbides using SBS, and work on metal corrosion processes by in situ micro-Raman spectroscopy and electro-chemistry. Working with postgraduate students has been a priority and several have received awards for their achievements and attained senior positions.

ABSTRACT

Optical Techniques Applied to Materials Physics (ID: 324)

Tuesday 30 June 2015 09:00

Brillouin and Raman light scattering techniques provide powerful methods to study the properties of materials. In general, laser light interacts with the vibrating atoms of the material and a tiny fraction of the scattered light emerging from the sample is changed in frequency. Brillouin scattering concerns the coupled movement of the unit cells constituting bulk and surface waves in the GHz region. From such studies, the elastic stiffnesses of materials are established that determine the resistance of the material to deformation and depend on variables such as temperature and pressure, microstructure, composition and strain. A (3+3) pass tandem Fabry-Pérot interferometer system and a frequency-stabilised laser are used to resolve the very small changes in frequency. Surface Brillouin scattering studies of the elastic properties of near opaque bulk solids and thin supported films at both ambient and high temperatures are discussed. Determinations of the elastic stiffnesses of bulk materials such as platinum group alloys and iron pyrite, and thin supported films of tungsten carbide are described. Raman scattering refers to the atoms within the unit cells or within molecules moving with respect to one another and is used to identify the nature of a material, its state of crystalline perfection, changes of phase, the presence of inclusions, and the effects of temperature, pressure and strain. A grating spectrograph is employed to resolve the spectral features and is fitted with a Raman microscope enabling 2-and 3-dimensional mapping. Low and high temperature stages and high-pressure cells are available. Raman scattering studies include radiation-induced defects in alkali halides, recrystallisation of ion beam induced amorphised layers, stress mapping in single crystal and polycrystalline diamond, the temperature dependence of the vibrational modes of single-walled carbon nanotubes, and the passivation and pitting of iron during corrosion processes.

Prof. Michael Kosch
SANSA

Prof Mike Kosch was born and raised in Durban where he also achieved his BSc Electronic Engineering in 1984 and PhD in Space Physics in 1991 following a life-changing experience over-wintering at the SANAE Antarctic research station 1984-1986. He was based for over 2 decades in Europe, first as a postdoc and scientist at the Max-Planck Institute in Germany during the 1990s and then as a lecturer, professor of Experimental Space Science and faculty research Dean at Lancaster University in the UK. He has held research fellowships in Australia, twice Japan and twice USA as well as many research visits to Norway.

Since 2014, he is the chief scientist at the South African National Space Agency (SANSA) in Hermanus, managing the Space Research and Applications group including the Space Weather Unit. He also co-directs EnviroVision Solutions, a spin-out company with international operations. His research has focussed mainly on auroral physics and the electrodynamics of the polar upper-atmosphere, primarily using night-vision optics and incoherent scatter radar, as well as experimental plasma physics using high-power radio waves beamed into the ionosphere as a natural laboratory.

He has led many experiments at major international facilities, e.g. EISCAT in Scandinavia, HAARP in Alaska and Sura in Russia. To support the research, he owns and operates 2 optical observatories in Norway and assembles bespoke optical instruments. Successful experiments include inducing artificial auroras with high-power radio waves. He has published over 110 papers in international peer-reviewed journals.

ABSTRACT

Space Weather - why should we care? (ID:385)

Tuesday 30 June 2015 12:10

There is much talk about how potentially dangerous space weather storms are to modern society. However, mankind has survived for millennia and therefore many a solar storm long before we even knew they existed or were a problem. So just how vulnerable are we? In this presentation we review the chain of events from solar eruptions to geomagnetic storms as well as some impacts on the space environment, atmosphere, and technology. Example impacts relate to radiation hazards for spacecraft and human spaceflight, the radiative and chemical balance of the atmosphere, and power outages on the ground, respectively. How can developing countries contribute to this important science? The effective use of relatively low-cost ground-based instrumentation is introduced.

Dr. Don Mingay

Don's career has covered a large range of interests including nuclear fields of astrophysics, nuclear reaction dynamics, technology applications and techno-transfer management, reactor technology and fundamental and applied research. He holds a doctorate in Nuclear Physics and is an author of well over 100 International publications. He maintained a base at Wits on accelerator based research for 20 years ending as Professor of Experimental Nuclear Physics in 1976. Inter-linked with these years was extensive International research and development at several laboratories overseas. (Harwell, Cal Tech, Yale University, Bell Tel. Research Labs.).

The following 20 years were spent at Pelindaba ending as Senior General Manager of Applied Radiation Technology in charge of Safari I Research Reactor, the Hot Cell Complex, Tokoloshe Tokomak and in-house accelerators as well as all associated radiation technologies. He initiated the Radioisotope Business based on SAFARI 1 where NTP spin-off is now the third biggest supplier of radioisotopes (fission "moly-99)" in the world servicing over 56 countries with an annual turnover of well over 1 billion Rand. He Chaired AFRA, an Inter-Governmental Agreement on Nuclear Technology between 23 African countries under the aegis of the IAEA (International Atomic Energy Agency) and served as a S. A. representative on the World Energy Council.

In 1996 he retired formally, followed by 6 years as an International Expert Consultant for the IAEA in Vienna serving a wide range of nuclear technology applications in reactors, medicine, energy, industry, agriculture and the environment as well as writing 5 year strategic plans for 5 developing countries in Europe. His final work was specifically on nuclear techniques for humanitarian de-mining. Since terminating this position in 2003, he retired to the Cape and has maintained an active involvement in both the Global and National energy debate. In addition he has long kept a forefront involvement in the aberrations and realities of Climate Change.

ABSTRACT

PUBLIC LECTURE
Conflict in climate change (ID: 386)
Tuesday 30 June 2015 19:00

Climate Change is a critically important issue with respect to both humankind and key Governmental planning. There pervades an unequivocal statement by the IPCC that CO2 is the dominant driver of global warming. With this comes the further alarmist warning that anthropogenic release of carbon dioxide must be reduced to avoid dangerous warming of the planet. This dogma has become a political religion and dogma having strong vested interests while attempting to silence the growingly powerful so-called denialist arguments as to why this is not so. The counter argument is based on a long stated and established role of Solar sun spot variability in addition to Mankowic sun-earth cycles which affect cosmic ray impacts on cloud formation as being the true drivers of Climate Change over aeons. This is gaining ground in credibility and provides evidence that we could well be entering a period associated with Global Cooling, rather than Global Warming! There is no clear total understanding of Climate Change but it is necessary that sanity prevails ultimately in terms of the correct and complete exploration of and conclusions drawn from the scientific data available.

Prof. Rositsa Yakimova
Linkoping University

Rositsa Yakimova is professor emerita in material science, Linköping University. She is an internationally recognized expert in the field of semiconductor crystal and nanostructure growth of SiC, AlN, ZnO and graphene.

Yakimova is a consultant for the Japanese company ELSEED on sublimation growth of SiC. Yakimova has pioneered a novel method for fabrication of large area uniform graphene and since 2008 she is leading the research of graphene on SiC in Sweden. Currently, she is focused on graphene-like novel materials and heterostructures - development of growth platform and design of growth equipment. Yakimova is a founder of the company Graphensic AB.

ABSTRACT

Growth and physical properties of graphene mediated structures (ID: 56)
Wednesday 01 July 2015 08:40

Graphene grown on SiC substrates may facilitate formation of novel heterostructures by enabling unique compositional diversity. In this talk we will focus on two material systems: graphene-ZnO and graphene-SiC, and will show new properties that are induced by the interaction of 2D graphene and wide bandgap semiconductors. Graphene was grown on SiC substrates by high temperature sublimation method.We report a key effect of graphene as a substrate on the light emission properties of thin ZnO films that are grown via quasi Van der Waals epitaxy. Unusually high UV PL was observed at r. t. from the ZnO/Gr/4H-SiC heterostructures in comparison to similar samples without graphene. The luminescence enhancement depends nonlinearly on the thickness of the ZnO, reaching its maximum - 360% for the film as thin as ~150 nm. The effect may be most probably related to exciton plasmon coupling at the ZnO/Gr interface. The reported phenomenon demonstrates the perspective of two-dimensional materials integration with wide band gap semiconductors and is important for the design of future light emitting devices.In the second graphene mediated structure we revealed quantum wells and quantum well levels. We showed that the structure in the valence band density of states near the Fermi level is described by the quantum well states whose number and energy position coincide with the calculated ones. This property may be an attribute not only of graphene (or few-layer graphene) on a wide-bandgap semiconductor substrate but also of graphene on dielectric and of suspended graphene. The QW state formation becomes possible in such a narrow quantum well due to the large electron/hole mass in the direction perpendicular to the graphene plane.

Invited Plenary Speakers

Prof. Liesel Folks
University at Buffalo

Liesl Folks is dean of the School of Engineering and Applied Sciences at the University at Buffalo. She holds a BSc (Hons) and a PhD, both in Physics, from The University of Western Australia, as well as an MBA from Cornell. Prior to joining UB in 2012, she spent 16 years in R & D in the magnetic data storage industry in silicon valley, working for IBM, Hitachi and Western Digital.

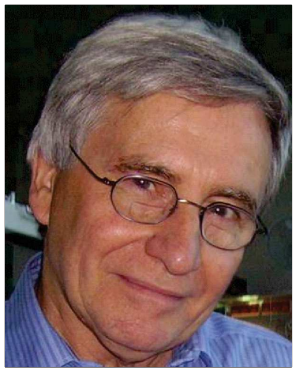
Her research is in the fields of magnetic materials and devices, nanoscale metrology, and spin-electronic devices. She was the President of the IEEE Magnetics Society for 2013 - 2014.

ABSTRACT

Status of Women in STEM in the US (ID: 472)

Wednesday 01 July 2015 12:10

Despite decades of effort to encourage and support the advancement of women and other under-represented groups in science, technology, engineering and math (STEM) disciplines in the USA, the pace of change has been frustratingly slow in many fields. The STEM workforce is largely white and male, despite widespread encouragement by business and government leaders for broader demographic participation. There have been local success stories that we can point to, but not the national shifts that would signal a sea change across STEM. In this presentation, I will present recent data on trends, along with commentary from experts who study demographic changes in the workforce. I will discuss the challenges we face in changing the cultural dialogue around gender and other diversity axes, and make recommendations for what we can aim to achieve collectively to redress the imbalances we observe.



Prof. Walter Kutschera
University of Vienna

In 1965, Walter Kutschera gained a Ph.D. in Experimental Physics from the University of Graz, Austria. From 1966-1993 he spent 27 years away from Austria working in basic and applied nuclear physics at various institutions, mainly in connection with tandem accelerators including the Max-Planck-Institute for Nuclear Physics in Heidelberg in Germany, the Physics Department of the Technical University of Munich, Garching also in Germany, the Physics Department of the University of Tokyo in Japan and 14 years at the Physics Division of Argonne National Laboratory in Chicago, USA.

From 1999-2000 he was President of the Austrian Physical Society, and was awarded the Großes Silbernes Ehrenzeichen für Verdienste um die Republik Österreich in 2006, the Erwin Schrödinger Prize of the Austrian Academy of Sciences in 2010 and became a Fellow of the American Association for the Advancement of Science in 2011. He is presently Emeritus Professor of Physics at the University of Vienna, a position he has held since 2008. Prior to this, he was Dean (2004-2006), and then Vice Dean (2006-2007) of the Faculty of Physics. From 1993-2007 he was Professor of Physics at the University of Vienna, and Head of the Institute of Isotope Research and Nuclear Physics under which the Vienna Environmental Research Accelerator (VERA), a universal facility for Accelerator Mass Spectrometry (AMS), was established. VERA is based on a 3-MV Pelletron tandem accelerator and has been operating since 1996, including an upgrade in 2001 to allow for AMS experiments of "all" isotopes throughout the periodic table. In 2007 a second injector with a 40-sample Cs-beam sputter source was added to allow for a more versatile use of the AMS system.

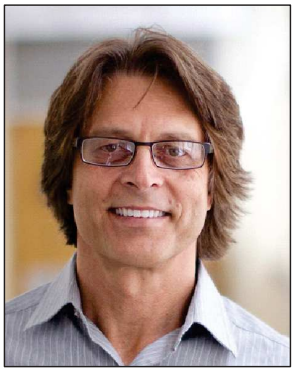
His most recent research interests have focused on (1) Search for Superheavy Elements in Nature with AMS, (2) Efforts to solve the puzzle of dating the Minoan Eruption of Santorini, (3) 14C bomb peak dating of Human DNA, (4) Measuring stable Pt isotopes in pre-solar nanodiamonds, (5) Developing radiometric dating of ancient ice with the 26Al/10Be chronometer, (6) Testing the new Rehydroxilation (RHX) dating method of ceramics.

ABSTRACT

Exploring the World with Accelerator Mass Spectrometry (ID: 393)

Thursday 02 July 2015 08:40

Accelerator Mass Spectrometry (AMS) is a method to measure minute traces of long-lived cosmogenic and anthropogenic radioisotopes in all domains of our environment at large: atmosphere, hydrosphere, biosphere, cryosphere, lithosphere, cosmosphere, and technosphere [1]. In the context of AMS, a long-lived radioisotope is one whose detection by atom counting is much more efficient than counting radioactive decays. For example, from the 60 million C-14 atoms in one milligram of carbon, only one decays per hour, whereas it is possible to detect one million C-14 atoms in an hour by direct atom counting. AMS is almost exclusively performed with tandem accelerators, because the use of negative ions and the terminal stripping process provides an efficient suppression of background from stable isotopes, which allows one to measure radioisotope-to-stable isotope ratios in the range from 10-12 to 10-16. Although AMS started originally at accelerators used for nuclear physics experiments – and are still performed at such facilities – a variety of dedicated AMS facilities were developed [2]. Currently, there are about 100 AMS facilities world-wide, with the first one in Africa now operational at the iThemba Labs in Johannesburg. Due to its presence in organic matter and its attractive half-life (5700 yr) for dating, C-14 is by far the most-used radioisotope in AMS. However, there are a number of other radioisotopes such as Be-10, Al-26, Cl-36, Ca-41, I-129, U-236 which are also frequently used with AMS. Here, a few selected examples from archaeology, astrophysics, geophysics, and biology will be discussed.[1] W. Kutschera, Int. J. Mass Spectr. 349-350 (2013) 203[2] H.-A. Synal, Int. J. Mass Spectr. 349-350 (2013) 192



Dr. Jakob van Zyl
Jet Propulsion Laboratory,
Cal. Inst. of Technology

Dr. Jakob van Zyl is the Associate Director at the Jet Propulsion Laboratory responsible for Project Formulation and Strategy. He has more than 20 years of research experience in various aspects of satellite remote sensing.

He received the Hons. B. Eng. degree cum laude in electronics engineering from the University of Stellenbosch, Stellenbosch, South Africa, in 1979, and the M.S. and Ph.D. degrees in electrical engineering from the California Institute of Technology, Pasadena, in 1983 and 1986, respectively.

He was elected Fellow of the IEEE Geoscience and Remote Sensing Society in 1998. Dr. van Zyl has co-authored two textbooks on the physics and techniques of remote sensing, contributed to another thirteen books on remote sensing, and published more than a hundred papers in peer-reviewed journals and conference proceedings. He has delivered a number of keynote addresses at major international conferences. Dr. van Zyl is a Senior Faculty Associate at the California Institute of Technology, where he teaches the course "Introduction to the Physics and Techniques of Remote Sensing." He is also an Extraordinary Professor at the University of Stellenbosch in South Africa.

ABSTRACT

Exploring the Solar System and Beyond: Some Recent Results (ID: 470)

Thursday 02 July 2015 12:10

Are we alone? For centuries humans have looked up at the night sky and wondered if there was another world like our planet out there. The sixteenth century Italian philosopher Giordano Bruno speculated that there could be multiple worlds like our own. But it was not until the first discovery in 1992 of two exoplanets orbiting a pulsar that we had definitive evidence of planets outside of our own solar system. In 1995 the first exoplanets orbiting a main sequence star, 51 Pegasi, were announced providing further evidence of planets orbiting stars outside of our own solar system. Finding planets outside of our own solar system, especially those orbiting within the so-called habitable zone of their parent star, raises the intriguing possibility that life may have evolved elsewhere. Recent developments in the study of our own solar system raises important questions about our model of where life may have evolved, with tantalizing evidence of liquid water and organic molecules present on some of the moons of Jupiter and Saturn.This talk will detail some of the recent results in our quest for understanding how planetary systems form and evolve, including where one might look for signs of life, both within our solar system and beyond.

PUBLIC LECTURE
Exploring the Universe - The Search for Signs of Life (ID: 471)

Thursday 02 July 2015 19:00

Prof. Andrew Forbes
University of the
Witwatersrand

Andrew received his PhD (1998) from the University of Natal (South Africa), and subsequently spent several years working as an applied laser physicist, first for the South African Atomic Energy Corporation and then later in a private laser company where he was Technical Director. In 2004 he joined the CSIR National Laser Centre where he was Chief Researcher and Research Group Leader.

In March 2015 Andrew joined the U. Witwatersrand on the distinguished professor programme. Andrew chairs SPIE's international conference on Laser Beam Shaping, serves on many SPIE, OSA and conference committees, and serves on the editorial board of two optics journals. He is active in promoting photonics in South Africa, is a Steering Committee member of the Photonics Initiative of South Africa and a member of the Academy of Science of South Africa.

His research interests include laser beams and resonators, digital holography, orbital angular momentum and quantum optics.

ABSTRACT

1,2,3 ... infinity: high-dimensional quantum entanglement with patterns of light (ID: 459)

Friday 03 July 2015 08:40

Photons can be described in terms of their spatial modes - the patterns of light. As there are an infinite number of spatial modes, entanglement in this degree of freedom offers the opportunity to realise high-dimensional quantum states. In this talk I will review the recent progress in quantum entanglement of photons in their spatial degree of freedom. I will explain how to create high-dimensional quantum states in the laboratory, how to measure them, and what the present state of the art is in terms of applications. In particular, I will outline the advantages and disadvantages of using such entangled states as a means to encode information for secure quantum communication channels, and will consider the preservation of entanglement through noisy channels, e.g., a turbulent atmosphere. Finally I will outline some ideas on mimicking quantum entanglement behaviour with classical light.

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Physics
at Stellenbosch University

The Department of Physics at Stellenbosch University has a proud history, producing outstanding research and many excellent graduates since 1903.

Our graduates are well-rounded physicists with the technical and specific scientific skills required to make a unique contribution to the research and development environment.

Theoretical Physics

Our research activities focus on quantum field theory, quantum mechanics, statistical and computational physics with applications to condensed matter theory, high energy physics and other complex many-body systems.

Members also work in collaboration with the National Institute for Theoretical Physics.

Learn more about the Institute for Theoretical Physics at

http://www.physics.sun.ac.za/theory

Laser Physics

Our research makes use of a variety of laser spectroscopy techniques, with the main focus on the application of lasers in atomic, molecular and condensed matter physics and photo-chemistry.

Our infrastructure includes modern femtosecond laser systems and associated ultrafast diagnostic techniques. We are closely aligned with the national facilities such as the CSIR National Laser Centre.

Learn more about the Institute for Laser Research at

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Nuclear Physics

We have expertise of international standard in experimental and theoretical nuclear physics as well as applied radiation physics.

We are closely aligned with iThemba LABS, which provide the facilities for basic and applied research using particle beams, particle radiotherapy for the treatment of cancer and the supply of accelerator-produced radioactive isotopes for nuclear medicine and research.

Learn more about the Nuclear Physics research group at

http://www.physics.sun.ac.za/gamma5/

Contact us Department of Physics

Tel 021 808 3391 | **E-mail** physoffice@sun.ac.za | **http://www.sun.ac.za/english/faculty/science/physics**

UNIVERSITEIT STELLENBOSCH UNIVERSITY

SAIP Divisions and Meetings

DIVISION		E-MAIL	MEETING
Division for Physics of Condensed Matter and Materials	Prof. Japie Engelbrecht	dcmpm@saip.org.za	Thursday 2 July @ 11:10
Nuclear, Particle and Radiation Physics	Dr. Simon Mullins	nuclear@saip.org.za	Thursday 2 July @ 16:10
Photonics	Prof. Erich Rohwer	photonics@saip.org.za	Thursday 2 July @ 11:30
Astrophysics and Space Science	Dr. Chris Engelbrecht (Astro) Dr. John Bosco Habarulema (Space)	astro@saip.org.za space@saip.org.za	Thursday 2 July @ 14:40
Physics Education	Dr. Sam Ramaila	education@saip.org.za	Thursday 2 July @ 14:00
Applied Physics Forum	Prof. Ernest van Dyk	applied@saip.org.za	Wednesday 1 July @ 09:40
Theoretical and Computational Physics	Prof. Kristian Müller-Nedebock	theoretical@saip.org.za	Thursday 2 July @ 11:10

Meeting list

MEETING	TIMESLOT	VENUE
CSIR Rental Pool Meeting	Sunday 28 and Monday 29 June	Stinkwood
SAIP Council Meeting - Outgoing Council	Monday 29 June 10:00 - 16:00	Yellowwood 2
SAIP Council Meeting - Incoming Council	Monday 29 June 16:00 - 17:30	Yellowwood 2
Inaugural NASSP Consortium Meeting	Tuesday 30 June @ 14:00 - 15:40	Regatta Room
WiPiSA Lunch	Wednesday 1 July 13:10 - 14:00	Foyer
Plenary speakers and students lunch	Thursday 2 July 13:10 - 14:00	Foyer
SAIP Council Meeting with HODs	Wednesday 1 July 17:30 - 20:00	Yellowwood 2
SAIP Council Meeting with Division Heads	Thursday 2 July 17:10 - 18:10	Yellowwood 2
SAIP Annual General Meeting	Friday 3 July 14:00 - 15:30	Tsitsikamma B2

Non Specialists Lectures

TRACK	PRESENTER	CONTRB.	TITLE	TIMESLOT
DPCMM	Prof. VENTER, Andrew	368	Neutron diffraction facilities MPISI and PITSI at SAFARI-1	Thursday 2 July @ 15:00
Photonics	Prof. FORBES, Andrew	458	Accelerating light	Wednesday 1 July @ 11:30
Astrophysics	Prof. VENTER, Christo	243	Cosmic rays from binary millisecond pulsars	Wednesday 1 July @ 14:00
Education	Dr. LOUW, Wynand	395	South Africa and the International Measurement System: Billion or Trillion?	Thursday 2 July @ 09:40
Applied	Mr. DE BEER, Frikkie	313	Penetrating Radiation: The Power of Tomography as an Analytic Research Tool	Tuesday 30 June @ 14:00
Applied	Dr. JOHANNES, Manfred	384	Non-destructive Testing of wind power generators	Thursday 2 July @ 14:00
Theoretical	Prof. CORNELL, Alan	53	Hyperbolic extra-dimensions in particle physics and beyond	Thursday 2 July @ 14:00

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Winter School : International year of light

The International Year of Light Photonics Winter School
Venue : Ironwood Room

		PRESENTER	TOPIC
MONDAY 29 JULY 2015	08:15	Prof. EG Rohwer	Welcome & Introduction
	08:30	Dr. H Uys	Trapping and cooling of single ionized atoms
	09:45	Dr. P Neethling	THz spectroscopy
	10:30	Tea & Coffee break	
	11:00	Prof. A Forbes	Light manipulation
	12:45	Dr. G Bosman	Ultrafast spectroscopy
	13:00	Lunch	
	14:00	Prof. H Swart	Luminescent materials
	14:45	Dr. T Kruger	Photosynthesis
	15:30	Tea & Coffee break	
	16:00	Student chapters	Light demonstrations

Opening Ceremony

Boardwalk Convention Centre, Monday 29 June 2015
Dress code: Smart Casual
Cash Bar available

18h00 Arrival

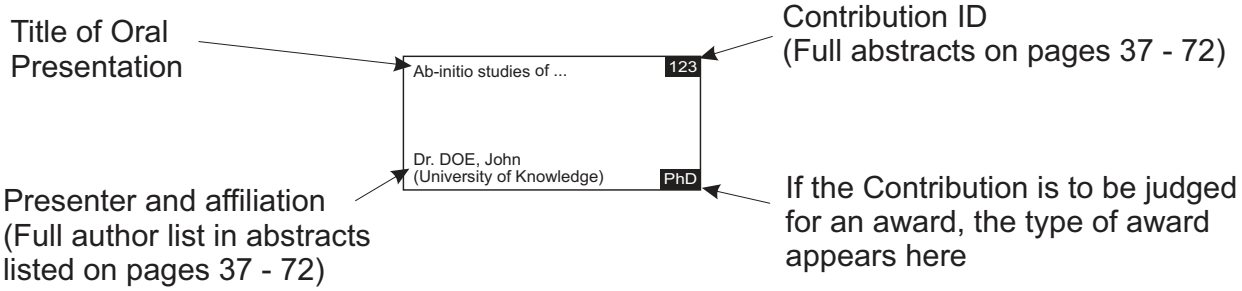
18h30 Welcoming address
SAIP2015 Chair(s)

18h35 Message from the Dean

18h45 Message from the SAIP President
Prof. Igle Gledhill

19h00 Cocktail function

Timetable Legend



TUESDAY 30 JUNE 2015

08:30 - 09:00	**Welcome Address**				
09:00 - 10:00	**PLENARY: Prof. COMINS, Darrell** **Optical Techniques Applied to Materials Physics (ID: 324)**				
TRACK	**A1: Div. for Physics of Condensed Matter and Materials (TsitsikammaB2)**	**A2: Div. for Condensed Matter Physics and Materials (Stinkwood)**	**B1: Nuclear, Particle and Radiation Physics (Tsitsikamma D2)**	**C: Photonics (Agulhas)**	
Theme Chair	**PhD for award** **Dr. Kumar, Vinod**	**MSc for award** **Dr. Kumar, Vinjay**	**-** **Dr. Mullins, Simon**		
10:00 - 10:20	52 Why MnO_2 is used as a catalyst in Li-air batteries and not TiO_2 Ms. MAENETJA, Khomotso (University Of Limpopo) PhD	8 Electrodeposited Ni Nanowires-Track Etched P.E.T. Composites as Selective Solar Absorbers Mr. LUKHWA, Rendani (University of Western Cape) MSc	138 Test for traditional vibrational wisdom in 110,112Cd by two proton stripping Mr. MAQABUKA, Bongani (University of the Western Cape) PhD		
10:20 - 10:40	60 Study of the interdiffusion in Ni/Cu multilayer thin films by Auger electron spectroscopy depth profiling Mr. YAN, XinLiang (University of the Free State) PhD	27 Evolutionary algorithm simulation study of Manganese dioxide nanoclusters Mr. MASOGA, Wesley (University of Limpopo) MSc	90 Nuclear structure studies in the A=136 mass region using transfer reactions Ms. REBEIRO, Bernadette (University of the Western Cape) PhD		
10:40 - 11:10	**Tea & Coffee Break**				
Theme Chair	**PhD for award** **Dr. Kumar, Vinod**	**Msc for award** **Dr. Kumar, Vinjay**	**-** **Prof. Karataglidis, Steven**	**Medical Photonics** **Dr. Naidoo, Darryl**	
11:10 - 11:30	64 Selenization dependence of morphological, structural and electrical properties of $Cu_2ZnSn(S,Se)_4$ thin ilms deposited by one-step sputtering Dr. YIHUNIE, Moges Tsega (University of The Free State) PhD	40 Computational Modelling Studies of Platinum Telluride Minerals Mr. SELOWA, Phatholo (University of Limpopo) MSc	140 Statistical properties of Zirconium-91 Mr. ZIKHALI, Bonginkosi Richard (Zikhali) MSc	77 Gene Expression Changes in Diabetic Wound Healing as Induced by Photobiostimulation in vitro Ms. AYUK, Sandra, M. (University of Johannesburg) PhD	
11:30 - 11:50	85 Exciton energies of chalcopyrites AgAlX2 (X=S,Se,Te) from GW and BSE calculations Mr. DONGHO NGUIMDO, Guy Moise (University of the Witwatersrand) PhD	55 Synthesis, structural and optical characterisation of cobalt (Co) and indium (In) co-doped ZnO nanoparticles Mr. MASWANGANYE, Mpho (Universtity of Limpopo) MSc	168 Second-order Coulomb excitation effects from the GDR Prof. ORCE, Nico (University of the Western Cape) -	155 Irradiation of in vitro melanoma cells with low intensity laser in the presence of hypericin and aluminium (III) phthalocyanine chloride tetrasulphonate for use in photodynamic diagnosis Ms. NDHUNDHUMA, Ivy (University of Johannesburg) -	
11:50 - 12:10	98 Structural and magnetic properties of $NiFe_2O_4$/NiFe bi-magnet and NiFe nano-alloy synthesized from thermal reduction of $NiFe_2O_4$ Mr. EZEKIEL, Itegbeyogene (UKZN) PhD	84 Comparison of optical and luminescence properties of as prepared and annealed ZnO nanoparticles synthesized using sol-gel method Mr. UNGULA, Jatani (University of the Free State) MSc		219 Ability of Gold Nanoparticles in mediating cellular damage in human breast cancer cells (MCF-7) using laser irradiation Mr. MFOUO TYNGA, Ivan (Laser Research Centre) PhD	
12:10 - 13:10	**PLENARY: Prof. KOSCH, Michael** **Space Weather - why should we care? (ID: 385)**				
13:10 - 14:00	**Lunch Break**				
Theme Chair	**PhD for award** **Dr. Diale, Mmantsae**	**MSc for award** **Prof. Meyer, Walter**	**-** **Prof. Connell, Simon**	**Fibre Photonics** **Dr. McLaren, Melanie**	
14:00 - 14:20	103 Ab-initio studies of Tm^{3+} interstitial defects in Germanium (Ge) using Hybrid Functional HSE06 Mr. IGUMBOR, Emmanuel (University of Pretoria) PhD	108 Hydrogenation of Ti6Al4V alloy and Commercially Pure (CP) Ti Ms. MAZWI, Sive (University of the Western Cape/ iThemba LABS) MSc	93 Search for a Neutral MSSM Higgs bosons in the tau-tau final state in early Run II collision data at ATLAS Mr. HAMITY, Guillermo (Honours Physics Student) PhD	74 Fibre Bragg grating sensor to measure shrinkage in a concrete overlay Mr. GROBLER, Michael (University of Johannesburg) -	
14:20 - 14:40	113 Electronic and Optical Properties of monolayer MX 2 M= Zr, Hf; X=S, Se from first principles calculations Mr. ABDULSALAM, Mahmud (Wits University) PhD	154 First principle study of Xanthate and Diethyldithiophosphate adsorption on PtS Ms. MASENYA, Mamogo (University of Limpopo) MSc	61 Jet substructure: a discovery tool at the LHC KAR, Deepak (University of Witwatersrand) -	75 Fibre Optic Temperature Measurement Sensors for a Robotic Hand Mr. MOORCROFT, Ronald (University of Johannesburg) -	
14:40 - 15:00	146 Formation of chemical compound layer due to reaction-diffusion process Mr. AKINTUNDE, Samuel (University of Pretoria) -	182 Phosphorescence of hototransferred thermoluminescence in annealed synthetic quartz Mrs. KOMBE, Elizabeth Fende Midiki nee Atang (Rhodes University) MSc	151 Multiple Bremsstrahlung Using MHV Technique Mr. RASOANAIVO, Andriniaina Narindra (UCT) PhD	110 A Nonlinear Optical loop Mirror enhanced three wavelengths Erbium doped fiber laser Mr. QHUMAYO, Siyanda (student) MSc	
15:00 - 15:20	176 Computer simulation study of water adsorption on {110} surface of nickel-rich pentlandite ($Fe_4Ni_5S_8$) mineral Mr. MKHONTO, Peace (University of Limpopo) PhD	233 Multi-Dimensional Analysis of Precipitates in a 12% Cr Steel Ms. DEYZEL, Genevéve (NMMU) MSc	43 Probing new physics in the Higgs sector with effective field theories at the Large Hadron Collider Prof. MELLADO, Bruce (University of Wisconsin - Madison) -	365 Development of Single Mode 2076.4 nm Holmium-doped Fibre Laser Dr. WU, Lorinda (CSIR-NLC) -	
15:20 - 15:40	183 Ferromagnetism in Chromium-doped Rutile, Anatase and Brookite phases of Titanium dioxid Ms. MULWA, Winfred Mueni (University of the Free State) PhD	278 Surface Brillouin Scattering Characterization of Bismuth Ferrite Thin Films Mr. AYELE, Fekadu (University of the Witwatersrand) MSc	42 Status of the measurements of Higgs boson properties with the ATLAS detector Prof. MELLADO, Bruce (University of Wisconsin - Madison) -		
15:40 - 16:10	**Tea & Coffee Break**				
16:10 - 18:00	**POSTER SESSION 1: DPCMM** **Refer to p32 - 33 for poster list**				

TUESDAY 30 JUNE 2015

Welcome Address				08:30 - 09:00
PLENARY: Prof. COMINS, Darrell Optical Techniques Applied to Materials Physics (ID: 324)				09:00 - 10:00
D1: Astrophysics (Regatta)	**F: Applied Physics (Tsitsikamma D1)**	**G: Theoretical and Computational Physics (Ironwood)**		**TRACK**
Theoretical Models **Dr. Engelbrecht, Christian**	**-** **Prof. van Dyk, Ernest**			Theme Chair
Stellar Streams: Modelling and Methodology 418 Dr. DEG, Nathan (UCT) -	Reconfigurable Wavelength Selective Switching for 10 Gbps Optical Fibre Ring Networks 345 Mr. BOIYO, Duncan (Nelson Mandela Metropolitan University) PhD			10:00 - 10:20
Beyond Mixing-Length Theory: an advanced approach to treating convective energy transfer in stars 272 Mr. MOONSAMY, Sashin (University of the Witwatersrand) PhD	Performance Comparison between the Traditional Intensity Modulation Direct Detection and Coherent Detection in a High Speed Optical Fibre Communication System 351 Mr. CHABATA, Tichakunda Valentine (NMMU) PhD			10:20 - 10:40
Tea & Coffee Break				10:40 - 11:10
Radio Astronomy **Dr. Moin, Aquib**	**-** **Prof. Winkler, Hartmut**	**-** **Prof. Botha, André**		Theme Chair
Modeling antenna primary beams using characteristic basis function patterns 421 Mr. IHEANETU, Kelachukwu (Rhodes University) PhD		Firewall Argument for Acoustic Black Holes 173 Mr. PONTIGGIA, Luca (University of the Witwatersrand) -		11:10 - 11:30
Intensity Mapping Techniques for Radio Observation 288 Mr. ANSAH-NARH, Theophilus (Rhodes University) -	Portable QKD Device Using the COW Protocol 169 Ms. PILLAY, Sharmini (University of KwaZulu-Natal) PhD	The Simplest Gauge-String Duality 17 Mr. NKUMANE, Lwazi (University of witwaterstrand) MSc		11:30 - 11:50
A Study Of Potential Calibrators Using The KAT-7 Telescope 406 Mr. KASSAYE, Ermias (Rhodes University) PhD	Electronic tracking system for quantum cryptography and radio telecommunication 306 Dr. MARIOLA, Marco (UKZN) -	Relativistic Quantum Mechanics On Non-commutative Space 76 Mr. WILLIAMS, Paul Henry (Stellenbosch University) MSc		11:50 - 12:10
PLENARY: Prof. KOSCH, Michael Space Weather - why should we care? (ID: 385)				12:10 - 13:10
Lunch Break				13:10 - 14:00
- **Prof. Chetty, Nithaya**	**-** **Dr. Hayes, Michael**	**-** **Prof. Muronga, Azwinndini**		Theme Chair
457 Inaugural NASSP Consortium Meeting	**NON-SPECIALIST LECTURE:** 313 Penetrating Radiation: The Power of Tomography as an Analytic Research Tool Mr. DE BEER, Frikkie (Necsa) -	Large N Conformal Field Theory from Gauge Theory/ Gravity Dualityan Analytic Research Tool 25 Mr. HASINA TAHIRIDIMBISOA, Nirina Maurice (University of the Witwatersrand) PhD		14:00 - 14:20
		Integrability in Giant Graviton Dynamics 28 Mr. MAHU, Augustine Larweh (University of the Witwatersrand) PhD		14:20 - 14:40
	Simulation of radiography beam collimation using ray tracing method 321 Mr. NSHIMIRIMANA, Robert (NECSA) PhD	Double Coset Magnons 247 Prof. DE MELLO KOCH, Robert (University of the Witwatersrand) -		14:40 - 15:00
	Spatial resolution evaluation of digital neutron radiography and tomography facilities 376 Mr. RADEBE, Mabuti Jacob Radebe (Necsa) PhD	Prodding QGP in N=4 SYM with Stringy Yo-yos 192 Mr. MOERMAN, Robert (University of Cape Town) Hons		15:00 - 15:20
	X-ray diffraction and Raman spectroscopy based residual stress measurements for assessment of fatigue in leached polycrystalline diamond tool bits 291 Mr. VHARETA, Maxwell (University of the Witwatersrand) PhD	Non-Fermi Liquid Fixed Point in a Wilsonian Theory of Quantum Critical Metals 111 Mr. RABAMBI, Teflon (Wits university) MSc		15:20 - 15:40
Tea & Coffee Break				15:40 - 16:10
POSTER SESSION 1: DPCMM **Refer to p32 - 33 for poster list**				16:10 - 18:00

WEDNESDAY 1 JULY 2015

08:40 - 09:40	**PLENARY: Prof. YAKIMOVA, Rositsa** Growth and physical properties of graphene mediated structures (ID: 56)			
TRACK	**A1: Div. for Physics of Condensed Matter and Materials (TsitsikammaB2)**	**B1: Nuclear, Particle and Radiation Physics (Tsitsikamma D2)**	**C: Photonics (Agulhas)**	**D1: Astrophysics (Regatta)**
Theme Chair	**MSc for award** **Prof. Neethling, Johannes**	**-** **Dr. Mira, Joel**	**Beamshaping** **Dr. Neethling, Pieter**	**Large-Scale Structure and Cosmology** **Dr. Leeuw, Lerothodi**
09:40 - 10:00	297 Armorphization and Recrystallization of spinel $LiMn_2O_4$ nano-architectures Ms. LEDWABA, Raesibe Sylvia (University of Limpopo) MSc	26 Monte Carlo simulations to obtain the weak magnetism term for ^{22}Na beta decay Mr. PHUTHU, Lutendo (University of the Western Cape) MSc	7 Measuring the "vectorness" of a vector vortex beam Dr. MCLAREN, Melanie (University of the Witwatersrand) -	292 Studying Stellar Populations of Luminous Red Galaxies to probe the Hubble Parameter H(z) Dr. RATSIMBAZAFY, Ando (North-West University) -
10:00 - 10:20	314 Thermodynamic and mechanical stability studies of Zr-Nb(Co) alloys Mr. MALEBATI, Magoja Martinus (student) MSc	6 Variation of dose distribution with depth and incident energy using EGSnrc Monte Carlo simulation method Mr. ODERINDE, Oluwaseyi Michael (University of the Free State) PhD	145 Angular Accelerating White Light Dr. DUDLEY, Angela (CSIR National Laser Centre) -	405 A PAPER-32 Stokes I Sky Catalogue Mr. PHILIP, Liju (Rhodes University) MSc
10:20 - 10:40	353 Density functional theory study of methane dissociation over Pd nanoclusters Ms. CHUMA, Moyahabo Hellen (University of Limpopo) MSc	360 Generation and validation of Monte Carlo signal events for the H->ZdZd->4l Analysis Mr. UNWUCHOLA, Doomnull Attah (University of Johannnesburg) PhD	422 Wigner distribution function and the complex curvature applied to Laguerre-Gaussian modes propagating through first order systems Dr. MAFUSIRE, Cosmas (University of Pretoria) -	442 Dynamical mass estimates of Sunyaev-Zel'dovich effect selected galaxy clusters in the Millennium Gas simulations Mr. MTHEMBU, Nhlakanipho Kwaz (Student) MSc
10:40 - 11:10	**Tea & Coffee Break**			
Theme Chair	**MSc for award** **Prof. Neethling, Johannes**	**-** **Prof. Connell, Simon**	**-** **Prof. Rohwer, Erich**	**Large-Scale Structure and Cosmology** **Dr. Leeuw, Lerothodi**
11:10 - 11:30	441 Investigation of the annealing behaviour of the donor-vacancy complex in alpha-particle irradiated Ge Mr. BARNARD, Willem (University of Pretoria) MSc	271 Measurement of single muon vs charged particle multiplicity at the LHC – an outlook study Ms. MHLANGA, Sibaliso (Post Graduate) MSc	452 The Fundamentals of Single Molecule Microscopy Dr. BOSMAN, Gurthwin (Stellenbosch University) -	400 The Vela Supercluster - does it provide the missing link to explain the local flow fields Mr. ELAGALI, Ahmed (Cape Town University) MSc
11:30 - 11:50		207 Performance of missing transverse momentum reconstruction in ATLAS Ms. LIAO, Shell-may (University of the Witwatersrand) -	458 **NON-SPECIALIST LECTURE:** Accelerating light	124 From darkness comes multi-frequency emission: dark matter after PLANCK Mr. BECK, Geoff (University of Witwatersrand) PhD
11:50 - 12:10			Prof. FORBES, Andrew (U. Witwatersrand)	
12:10 - 13:10	**PLENARY: Prof. FOLKS, Liesl** Status of Women in STEM in the US (ID: 472)			
13:10 - 14:00	**Lunch Break**			
Theme Chair	**PhD for award** **Dr. Hayes, Michael**	**-** **Mulaba-Bafubiandi, Antoine**	**-** **Dr. Steenkamp, Christine**	**Pulsars** **Dr. Engelbrecht, Christian**
14:00 - 14:20	188 Simultaneous substitution of Ba, Mn and Co into Fe_3O_4 spinel structure: Magnetic and electrochemical sensing properties of the synthesized nanoparticles Mr. OSMAN, Nadir (University of KwaZulu-Natal) PhD	216 The Impact of Re-homogenisation for Nodal Cross-section Corrections in OSCAR-4 as Applied to SAFARI-1 Research Reactor Mr. CHINAKA, Eric (North-west University & NECSA) MSc	191 Terahertz Time-Domain Ellipsometry Mr. SMITH, Shane (Physics Post Graduate Student) PhD	243 **NON-SPECIALIST LECTURE:** Cosmic rays from binary millisecond pulsars
14:20 - 14:40	223 Dependence of the photo-ionization cross-section of a-Al2O3:C on the measurement tempera Mr. NYIRENDA, Angel (Rhodes University) PhD	177 The development of a neutron converter for the production of radioactive beams at iThemba LABS Mr. NGCOBO, Zipho (iThemba Labs) PhD	197 Surface Enhanced Raman Spectroscopy (SERS) of bio-molecules Ms. PFUKWA, Cathrine (Stellenbosch University) MSc	Prof. VENTER, Christo (North-west University, Potchefstroom Campus)
14:40 - 15:00	239 Computational Study on Advanced Lithium – Sulphur Battery for Future Portable Energy Storage Mr. MASEDI, Cliffton (UL/ CSIR) PhD	48 An analysis and quantification of typical errors in the deterministic calculational path for research reactor modelling Mr. GINA, Thembelani (University of Johannesburg, Necsa) MSc	201 Supercontinuum pulse compression Mr. VILJOEN, Ruan (Stellenbosch University) MSc	218 Very-high-energy emission from pulsars Ms. BREED, Monica (North-West University) -
15:00 - 15:20	261 Magnetic and Structural Properties of Mn0.2Cr1.8-xFexO3 Nanoparticles Mr. MBELA, Kalengay (UKZN) PhD	337 Fast Neutron Radiography at an RFQ Accelerator System Mr. DANIELS, Graham (Necsa) -	214 Fluorescence spectra of carbon monoxide isotopomers upon vacuum ultraviolet excitation Mr. DE BRUYN, Andre (Stellenbosch University) MSc	24 A Timing Noise Analysis Pipeline for HartRAO pulsars Mr. JACQUES, Maritz (UFS) PhD
15:20 - 15:40		212 Data processing at the Necsa neutron diffraction facility Mr. MARAIS, Deon (Necsa) PhD	408 Development of kHz applied optical remote sensing for atmospheric insect monitoring applications Mr. GEBRU, Alem (Stellenbosch University & Lund University) PhD	312 Optical spectroscopy of PSR B1259-63 around the 2014 periastron passage Dr. VAN SOELEN, Brian (University of the Free State) -
15:40 - 16:10	**Tea & Coffee Break**			
16:10 - 18:00	**POSTER SESSION 2: DPCMM (for award), NPRP, Photonics, Astro, Edu, Applied, TCP** **Refer to p32 - 36 for poster lists**			

WEDNESDAY 1 JULY 2015

PLENARY: Prof. YAKIMOVA, Rositsa
Growth and physical properties of graphene mediated structures (ID: 56)

08:40 - 09:40

D2: Space Science (Redwood)	E: Educational Physics (Stinkwood)	F: Applied Physics (Tsitsikamma D1)	G: Theoretical and Computational Physics (Ironwood)	TRACK
Ionospheric TEC modelling **Dr. Maharaj, Shimul Kumar**	**-** **Dr. Reddy, Leelakrishna**	**-** **Prof. van Dyk, Ernest**	**-** **Prof. de Mello Koch, Robert**	Theme Chair
189 Data assimilation into a climatological model Dr. HABARULEMA, John Bosco (South African National Space Agency) -	294 Why we need a Physics Olympiadinel $LiMn_2O_4$ nano-architectures Mr. RIJSDIJK, Case (ASSA/SAIP) -	468	346 Biological filament interacting with molecular motors Mr. MEYLAHN, Janusz (Stellenbosch University) MSc	09:40 - 10:00
121 A comparison of measured TEC data with results based on the IRI and NeQuick 2 ionospheric models over a chain of mid latitude stations near the geographic meridian of 28° situated in the Southern hemisphere Mr. SICHONE, Gift L. (Department of Physics, University of Zambia) -	23 University physics students' views about scientific inquiry Dr. RAMAILA, Sam (University of Johannesburg) -	**DIVISION MEETING**	215 A model describing two-exciton effects in photosynthetic light-harvesting systems Mr. NÖTHLING, Johan (University of Pretoria) MSc	10:00 - 10:20
69 Single station TEC modelling during storm conditions Mr. UWAMAHORO, Jean Claude (SANSA) MSc	273 Using classroom response systems to promote active learning Dr. HERBERT, Mark (University of the Western Cape) -		256 One and two dimentional models of dye adsorption for application in dye sensitized solar cells Dr. MALUTA, Nnditshedzeni Eric (University of Venda) -	10:20 - 10:40
Tea & Coffee Break				10:40 - 11:10
Theoretical Space Plasma Physics **Dr. Habarulema, John Bosco**	**-** **Mr. Rijsdijk, Case**	**-** **Mr. De Beer, Frikkie**	**-** **Prof. de Mello Koch, Robert**	Theme Chair
184 Forbidden gap regions in ion-acoustic solitons Dr. MAHARAJ, Shimul Kumar (SANSA) -	206 Why Do Students Distinguish Between Net Force and Total Force? Mr. SOUTHEY, Philip (UCT) PhD	92 Rutherford Backscattering Analysis using lithium ions Prof. DERRY, Trevor (University of the Witwatersrand) -	33 Simulating mechanical annealing of atomic-sized gold surfaces via classical molecular dynamics and density functional theory transport calculations Mr. DEDNAM, Wynand (UNISA) MSc	11:10 - 11:30
126 Large amplitude slow and fast electron-acoustic solitons and supersolitons in three-electron temperature space plasmas Mr. MBULI, Lifa (SANSA) PhD	430 Student difficulties with DC circuits: misconceptions or sense making? Mr. JOHN, Ignatius (CPUT) -	274 Unfolding the fast neutron fluence energy distribution of a NE230 deuterated liquid scintillator detector using the MAXED code Dr. HERBERT, Mark (University of the Western Cape) -	86 Structural, electronic and thermal properties of Sn clathrates Mr. EGBELE, Peter (University of the Witwaterrand) MSc	11:30 - 11:50
221 The effect of an ion beam on ion-acoustic supersolitons Dr. OLIVIER, Carel (SANSA) -		293 In-situ neutron powder diffraction temperature capabilities at SAFARI-1 Dr. HAYES, Michael (Necsa) -		11:50 - 12:10
PLENARY: Prof. FOLKS, Liesl Status of Women in STEM in the US (ID: 472)				12:10 - 13:10
Lunch Break				13:10 - 14:00
GICs, pulsations, ionospheric irregularities and electrodynamics. Kosch & Mtumela	**-** **Dr. Herbert, Mark**	**-** **Dr. Vorster, Frederik**	**-** **Prof. Konrad, Thomas**	Theme Chair
13 Modelling ground conductivity for computing the electric field associated with geomagnetically induced currents (A mid latitude case study) Mrs. MATANDIROTYA, Electdom (CPUT & SANSA) PhD	229 Exploring teachers' baseline knowledge of mechanics Dr. RAMAILA, Sam (University of Johannesburg) -	204 Solar radiometry and forecasting research at UKZN Dr. MATTHEWS, Alan (UKZN) -	383 The numerical investigation of the stochastic Schroedinger equation with memory Mrs. IULIIA, Semina (UKZN) -	14:00 - 14:20
11 Investigation of Pc5 pulsation events using Sanae radar and ground-based magnetometer data during northward interplanetary magnetic field (IMF) interval Dr. MTUMELA, Zolile (SANSA) -	58 The light bulb effect: University students' problem solving cognitive processes in a physics problem solving skills test Dr. ALBERS, Claudia (WITS University) -	158 Monte Carlo based estimation of the effect of different aerosol classes on solar irradiance in African atmospheric conditions Ms. CYULINYANA, MARIE CHANTAL (University of Johannesburg) PhD	265 Process tomography within the hybrid formalism Ms. BASSA, Humairah (UKZN and NLC, CSIR) PhD	14:20 - 14:40
94 Characterization of the Multipath Environment of Ionospheric Scintillation Receivers Ms. ATILAW, Tsige (SANSA & UCT) MSc	397 Teaching of the Strand Planet Earth and Beyond in Primary School Natural Science Prof. LEEUW, Lerothodi (University of South Africa) -	320 Is solar PV generated electricity cheap in South Africa? Dr. RORO, Kittessa (CSIR) -	170 Projection operators in the theory of open quantum systems Dr. SEMIN, Vitalii (UKZN) -	14:40 - 15:00
54 Estimating plasma drift velocities in the low latitude regions within the African sector Mr. DUBAZANE, Makhosonke (SANSA) -		367 Energy yield monitoring of photovoltaic technologies Mr. SCHULTZ, Ross (NMMU) -		15:00 - 15:20
88 Ionospheric pre-geomagnetic disturbance enhancements over African equatorial and midlatitude regions Ms. ORFORD, Nicola (SANSA) PhD		390 Characterization of torrefied sugarcane bagasse for gasification in a downdraft biomass gasifier system Mr. ANUKAM, Anthony (University of Fort Hare) PhD		15:20 - 15:40
Tea & Coffee Break				15:40 - 16:10
POSTER SESSION 2: DPCMM (for award), NPRP, Photonics, Astro, Edu, Applied, TCP **Refer to p32 - 36 for poster lists**				16:10 - 18:00

THURSDAY 2 JULY 2015

08:40 - 09:40	**PLENARY: Prof. KUTSCHERA, Walter** **Exploring the World with Accelerator Mass Spectrometry (ID: 393)**				
TRACK	**A1: Div. for Physics of Condensed Matter and Materials (TsitsikammaB2)**	**B1: Nuclear, Particle and Radiation Physics (Tsitsikamma D2)**	**C: Photonics (Agulhas)**	**D1: Astrophysics (Regatta)**	
Theme Chair	**- Dr. Venter, Andrew**	**- Dr. Masiteng, Paulus**	**- Dr. Bosman, Gurthwin**	**Computational Techniques Mr. Moonsamy, Sashin**	
09:40 - 10:00	Embedding of noble metal nanoparticles and study of optical and photoluminescence properties induced by ion irradiation Dr. PRAKASH, Jai (UFS) -	152	Alpha particle scattering within the MCAS approach Prof. KARATAGLIDIS, Steven (University of Johannesburg) -	67	A Near Infrared Femtosecond Laser Source for Observation of Charge Transfer Processes in Semiconductors Ms. AHMED, Essraa (MSc student) MSc	285	A 'road test' of ANOVA versus DFT and LS as a period-finding algorithm Dr. ENGELBRECHT, Christian (University of Johannesburg) -	332
10:00 - 10:20	Investigation of nuclear reactor materials using modern electron microscopy techniques Prof. NEETHLING, Johannes (NMMU) -	210	Developing the high data-throughput ADC daughter board of the PROMETEO test-bench for the upgrade of the ATLAS Tile Calorimeter Mr. SPOOR, Matthew (WITS) MSc	107	Ultrafast photochromism in metal-organic complexes Mr. VON STEIN, Xavier (Stellenbosch University) MSc	370	Fast Scheme for Approximating an Off Set PSF Response Mr. ATEMKENG, Marcellin (Rhodes University) PhD	364
10:20 - 10:40	The PITSI neutron powder diffractometer at the SAFARI-1 Research Reactor Ms. SENTSHO, zeldah (Necsa) -	70	GPU-based Computation of Energy & Time for the Upgrade of the Tile Calorimeter of the ATLAS Detector" Mr. SACKS, Marc (University of the Witwatersrand) MSc	78	Novel zincate phosphors: A new red-emitting phosphors for LED applications Dr. KUMAR, Vijay (University of the Free State) -	31		
10:40 - 11:10	**Tea & Coffee Break**				
Theme Chair	**- Prof. Swart, Hendrik**	**- Dr. Kar, Deepak**	**- Prof. Rohwer, Erich**	**Gamma A Dr. Moharana, Reetanjali**	
11:10 - 11:30		463	Exploring the Dark Sector extension to the Standard Model via the Higgs Portal Prof. CONNELL, Simon (University of Johannesburg) -	153	Ultrafast mapping of crystallic structural changes in organic radical salts Mr. SMIT, Bart (MSc Student) PhD	409	Synchrotron Modelling of the gamma-ray to optical afterglow of GRB 130427A and expected neutrino flux Mrs. KAYYUNNAPARAYIL THOMAS, Jessymol (UJ) PhD	39
11:30 - 11:50	**DIVISION MEETING**		Dark matter production in association with Higgs bosons through heavy scalar resonance at the LHC Mr. VON BUDDENBROCK, Stefan (University of the Witwatersrand) MSc	159	**DIVISION MEETING**	465	Radio Observations Of GRB 100418a: Test Of An Energy Injection Model Explaining Long-Lasting GRB Afterglows Dr. MOIN, Aquib (UJ) -	230
11:50 - 12:10			Search for the Higgs boson in the di-photon decay in association with intermediate missing energy with the ATLAS detector Ms. LIAO, Shell-may (WITS) MSc	44			Implementation of a goodness-of-fit test for finding optimal concurrent radio & gamma-ray pulsar light curves Mr. SEYFFERT, Albertus (North-West University) PhD	263
12:10 - 13:10	**PLENARY: Dr. VAN ZYL, Jakob** **Exploring the Solar System and Beyond: Some Recent Results (ID: 470)**				
13:10 - 14:00	**Lunch Break**				
Theme Chair	**- Prof. Swart, Hendrik**	**- Dr. Winkler, Stephan**	**- Prof. Forbes, Andrew**	**Gamma B Dr. Moin, Aquib**	
14:00 - 14:20	Effects of Cd2+ concentration on the structure, optical and luminescent properties of MgAl2O4:x% Cd2+ phosphor prepared by sol-gel method Mr. MOTLOUNG, Setumo Victor (University of the Free State) -	242	Radioelement results which was obtained with a self-developed measuring method of a new in situ gamma ray detection system Dr. BEZUIDENHOUT, Jacques (Stellenboch University) -	416	Hong-Ou-Mandel interference for the orbital angular momentum Bell States - a high dimensional analysis Dr. ZHANG, Yingwen (CSIR) -	132	H.E.S.S. observations of radio galaxies Mr. DAVIDS, Isak Delberth (North West University) PhD	371
14:20 - 14:40	Magnetic properties of Ni-substituted Co-nanoferrites Mr. NDLOVU, Bongani (UKZN) -	250	A calibration facility for in-situ gamma-ray detector efficiency Mr. SEHONE, Alfred (Stellenboch University) MSc	449	Implementing the Deutsch Algorithm with classical light Mr. PEREZ-GARCIA, Benjamin (University of the Witwatersrand) -	220	Possible extragalactic astrophysical counterparts of IceCube neutrino events Dr. MOHARANA, Reetanjali (UJ) -	141
14:40 - 15:00	Role of defects in the emission of undoped and doped ZnO thin film prepared by pulsed laser deposition Dr. KUMAR, Vinod (University of the Free state) -	29	Plasma diagnostics on the GTS-ECRIS at iThemba Labs Mr. SAKILDIEN, Muneer (iThemba LABS) -	287	Communication through fibres using cylindrical vector vortex modes. Mr. NDAGANO, Bienvenu (University of the Witwatersrand) MSc	80	**DIVISION MEETING**	466
15:00 - 15:20	**NON-SPECIALIST LECTURE:** Neutron diffraction facilities MPISI and PITSI at SAFARI-1	368	Ion Sources used to produce different beams at iThemba LABS Dr. MIRA, Joele (iThemba LABS) -	317	Fundamental Laguerre-Gaussian (LGp0) mode with lower output power threshold Mr. BELL, July (CSIR) PhD	257		
15:20 - 15:40	Prof. VENTER, Andrew (NECSA)		Investigating prompt gamma cross-section data using a Geant4-simulated AFRODITE detector system Ms. RAMANATHAN, Vijitha (University of Cape Town) PhD	238	Controlled injection of higher-order modes into an optical fiber from a solid state digital laser Mr. NGCOBO, Sandile (CSIR) -	366		
15:40 - 16:10	**Tea & Coffee Break**				
Theme Chair	**- Prof. Dejene, Francis**	**- Dr. Mullins, Simon**		**Galaxy Rotation Curves Prof. Venter, Christo**	
16:10 - 16:30	Characterisation of traditional ceramic materials used in the Sotho culture (South-Africa) for clay pot making Ms. HLEKANE, Phindile (University of Johannesburg) -	381		464			Solving the puzzle of galaxy rotation with a gravitomagnetic form of Newton's Law Prof. WAGENER, Pieter (University of Fort Hare) -	2
16:30 - 16:50	SBS observation of higher order resonances in annealed, carbon implanted CVD Dr. MATHE, Bhekumusa (University of the Witwatersrand) -	300	**DIVISION MEETING**				Rotation Curves and Bars: Accounting for non-circular motions in barred spiral galaxies Mr. RANDRIAMAMPANDRY, Toky (University of Cape Town) PhD	399
16:50 - 17:10	An ab-initio study of the metastability of the boron-vacancy (B-V) complex in silicon Dr. MEYER, Walter (University of Pretoria) -	440						

THURSDAY 2 JULY 2015

PLENARY: Prof. KUTSCHERA, Walter
Exploring the World with Accelerator Mass Spectrometry (ID: 393)

08:40 - 09:40

D2: Space Science (Redwood)	E: Educational Physics (Stinkwood)	F: Applied Physics (Tsitsikamma D1)	G: Theoretical and Computational Physics (Ironwood)	TRACK
Heliospheric Physics Dr. Olivier, Carel	- Dr. Ramaila, Sam	- Dr. Kibirige, Betty		Theme Chair
443 A new approach to modeling the heliospheric current sheet Mr. RAATH, Jan-Louis (North-West University) PhD	395 **NON-SPECIALIST LECTURE:** South Africa and the International Measurement System: Billion or Trillion? Dr. WYNAND, Louw (NMISA)	51 Determining the effect of the solar cell band gap on power yield in southern African irradiance conditions Mr. WEBBER, Graham (University of Johannesburg) MSc		09:40 - 10:00
410 The Solar-Cycle Dependence of the Heliospheric Diffusion Tensor Ms. NEL, Amoré (North-West University, SANSA) MSc		259 Enhancing light absorption and life-time stability of organic solar cells using pentacene encapsulation Mr. OTIENO, Francis (University of Witwatersrand) MSc		10:00 - 10:20
95 Acceleration of galactic electrons at the solar wind termination shock and their journey beyond Mr. PRINSLOO, Phillip (North-West University) MSc		244 Analysis of homogeneity in thin film photovoltaic modules using large area light beam induced current (LA-LBIC) measurements Mr. OKULLO, Michael (NMMU) PhD		10:20 - 10:40
Tea & Coffee Break				10:40 - 11:10
Different aspects of Space Physics Dr. Habarulema, John Bosco	- Dr. Albers, Claudia	- Dr. Matthews, Alan	- Müller-Nedebock, Kristian	Theme Chair
50 Analysis of ionospheric response during geomagnetic storms for mid and low latitudes Mrs. MATAMBA, Tshimangadzo Merline (SANSA) PhD		253 Qualitative assessment of Photovoltaic modules using Electroluminescence Ms. CROZIER, Jacqui (NMMU) -	469 **DIVISION MEETING**	11:10 - 11:30
308 The study on the short term planetary wave activity in the MLT region over Southern Hemisphere using SuperDARN HF radar Mr. NGWANE, Ntlakanipho (Student) MSc	326 Effect of guided inquiry laboratory activities on first-year physics students' views on the nature of science Mr. BALOYI, Vonani Michael (University of Pretoria) PhD	277 Estimation of energy production decrease due to shading for the Nampower rooftop system Ms. DOBREVA, Petja (NMMU) -		11:30 - 11:50
96 An Integrated Software Based Analytical Model for the Signal Path Efficiency of the HartRAO Lunar Laser Ranger Optical System Mr. NDLOVU, Sphumelele (HartRAO) PhD	396 Perceptions of Professional Academic Development: Barriers and bridges between physics lecturers and physics education researchers Dr. LOMBARD, Elsa (NMMU) -	282 On the effect of optical configuration on the performance of different multijunction cells used in H-CPV systems Mr. SCHULTZ, Ross (NMMU) PhD		11:50 - 12:10

PLENARY: Dr. VAN ZYL, Jakob
Exploring the Solar System and Beyond: Some Recent Results (ID: 470)

12:10 - 13:10

Lunch Break 13:10 - 14:00

Division Meeting (with Astro) Dr. Habarulema, John Bosco	- Dr. Ramaila, Sam	- Prof. Derry, Trevor	- Dr. Semin, Vitalii	Theme Chair
	467 **DIVISION MEETING**	384 **NON-SPECIALIST LECTURE:** Non-destructive Testing of wind power generatorsr the Nampower rooftop system Dr. JOHANNES, Manfred (CSIR)	53 **NON-SPECIALIST LECTURE:** Hyperbolic extra-dimensions in particle physics and beyond Prof. CORNELL, Alan (NITheP)	14:00 - 14:20 14:20 - 14:40
466 **DIVISION MEETING in Astrophysics Venue (Regatta)**		429 Optimizing low Reynolds number wind turbine blades Mr. POOLE, Sean (NMMU) PhD	112 Quasi-Normal Modes for Spin-3/2 Fields Mr. HARMSEN, Gerhard (University of Witswaters Rand) MSc	14:40 - 15:00
		262 Hot Mirrors for Parabolic Trough Solar Receivers Dr. FERRER, Phil (WITS) -	161 Hypothesising the effects of Higgs portal dark matter in particle colliders Mr. VON BUDDENBROCK, Stefan (University of the Witwatersrand) MSc	15:00 - 15:20
		290 Efficiency Increase in a Cold Sprayed Hot Mirror Parabolic Trough Solar Collector Mr. KALUBA, Victor (WITS) PhD	260 Thermoluminescence from semiconductor quantum dots Prof. DEJENE, Francis (UFS) MSc	15:20 - 15:40
Tea & Coffee Break				15:40 - 16:10
		- Dr. Roro, Kittessa	- Dr. Semin, Vitalii	Theme Chair
		32 Gum ghatti-based poly (acrylic acid-aniline) IPN hydrogel: Characterization and release properties Dr. SHARMA, Kashma (University of the Free State) -	49 The Influence of Increased Temp on the Miscibility and Mechanical Properties of poly(2,5-benzimidazole) and polytetrafluoroethylene Mrs. SQUARE, Lynndle (UWC) PhD	16:10 - 16:30
		115 A comparison of solid state reaction, electrical performance & failure mechanism of ruthenium Schottky contacts on 6H-SiC and 4H-SiC after air annealing Mr. MUNTHALI, Kinnock Vundawaka (UP and University of Namibia) PhD	267 Fano-like scattering in nanocomposites Mr. LETA T. JULE, Leta T. Jule (Addis Ababa University) -	16:30 - 16:50
		100 Synthesis of porous carbon nanosheets for use in high rate capability and long cycle life supercapacitors Dr. DANGBEGNON, Kouadio Julien (University of Pretoria) -	343 Theoretical studies of mutual neutralization in collisions of He + + H- and Li+ + F- Mr. NKAMBULE, Sifiso (Stockholm Univeristy) -	16:50 - 17:10

	F: Applied Physics (Tsitsikamma3)
17:10 - 17:30	123 Structural and optical properties of silicon nanowires Prof. ARENDSE, Christopher (UWC) -
17:30 - 17:50	199 X-ray Reflectivity Study of Si Nanowires Grown by Ag Nanoparticle Etching Prof. MICELI, Paul F. (University of Missouri) -

FRIDAY 3 JULY 2015

08:40 - 09:40	**PLENARY: Prof. FORBES, Andrew** **1,2,3 …. infinity: high-dimensional quantum entanglement with patterns of light (ID: 459)**			
TRACK	**A1: Div. for Physics of Condensed Matter and Materials (TsitsikammaB2)**	**B1: Nuclear, Particle and Radiation Physics (Tsitsikamma D2)**	**B2: Nuclear, Particle and Radiation Physics (Redwood)**	**C: Photonics (Agulhas)**
Theme Chair	- **Prof. Connell, Simon**	- **Dr. Mullins, Simon**	- **Dr. Mbele, Vela**	**Biophysics** **Dr. Krüger, Tjaart**
09:40 - 10:00	114 Effect of pH on ZnO nanostructures prepared by chemical bath method Dr. KOAO, Lehlohonolo (UFS (Qwa Qwa)) -	335 A multiplet of chiral bands in 194Tl: DSAM lifetime measurements Dr. LAWRIE, Elena (iThemba LABS) -	148 An Integration Framework Tool for ATCAs in the ATLAS Detector Control System Mr. REED, Robert (University of Witwatersrand) PhD	87 Investigating the excited electronic states of carotenoids in the main plant light-harvesting complex (LHCII) via femtosecond pump-probe spectroscopy Ms. SINGH, Asmita (University of Pretoria) MSc
10:00 - 10:20	125 Developing Iron Oxide Nanoparticle Biosensors through Simulation and Modelling Mr. HARRIS, Richard (UFS / Mintek) -	315 Multiple chiral bands in 193Tl Mr. NDAYISHIMYE, Joram (Stellenbosch University) PhD	147 A di-Higgs Search in the ggbb Decay Channel Using the ATLAS Detector Mr. REED, Robert (University of Witwatersrand) PhD	198 Femtosecond pump-probe spectroscopy on wild-type and mutant antenna complexes from Arabidopsis thaliana Mr. PARADZAH, Alexander (University of Pretoria) PhD
10:20 - 10:40	162 Optimization of a small-angle neutron scattering instrument using the VITESS model Mr. TJEBANE, Tjatji (Necsa) -	174 The design and simulation of a new experimental set up for measuring short nuclear level lifetimes Mr. SINGH, Bhivek (University of the Western Cape) MSc	66 A Portable ReadOut ModulE for Tilecal ElectrOnics (PROMETEO) test-bench for the certification of the Tile Calorimeter of the ATLAS detector Dr. KUREBA, Chamunorwa Oscar (University of the Witwatersrand) -	228 Using single-molecule spectroscopy methods to investigate the environmental dependencies of photoprotection in the main plant light harvesting complex. Mr. BOTHA, Joshua (University of Pretoria) MSc
10:40 - 11:10	**Tea & Coffee Break**			
Theme Chair	- **Prof. Prinsloo, Aletta**	- **Dr. Ntshangase, Sifiso**	- **Dr. Jones, Pete**	**Biophysics** **Dr. Krüger, Tjaart**
11:10 - 11:30	15 Collective Electronic Excitations in Ferromagnetic Metals Dr. NOLTING, Volkmar (Vaal University of Technology) -	358 Fine structure of the isovector Giant Dipole Resonance in neutron-rich calcium isotopes using the (p,p') reaction at 200 MeV Mr. LATIF, Mouftahou (University of the Witwatersrand) PhD	336 Crosstalk correction for the iThemba LABS segmented clover detector Mr. NONCOLELA, Sive (UWC, iThemba LABS) PhD	237 Ultrafast energy transfer and photoprotection in the light-harvesting complexes of the diatom Cyclotella meneghiniana Mr. ELNOUR, Huzifa (University of Pretoria) PhD
11:30 - 11:50	16 Study of Electrical Conductivity of Pr^{3+} Containing Lithium Borate Glasses by Impedance Spectroscopy Dr. RAMTEKE, Durgaprasad (University of the Free State -	119 A study of the Isovector Giant Dipole Resonance across the neodymium and samarium isotope chains Ms. DONALDSON, Lindsay (University of the Witwatersrand) PhD	99 Comparative study of proton induced radiation damage in plastic scintillators for the Tile Calorimeter of ATLAS Ms. JIVAN, Harshna (University of the Witwatersrand) MSc	258 Using single molecule spectroscopy to study the role of low-energy fluorescence bands in the photoprotection of the major plant light harvesting complex Mr. STOLTZ, Herman (University of Pretoria) MSc
11:50 - 12:10	252 Scanning probe microscopy in material science and biology Dr. URGESSA, Zelalem N. (NMMU) -	149 Search for scissor resonance in 182Ta Mr. BRITS, C.P. (University of Stellenbosch) MSc	327 Generation of Time-Stamps by a Digital Data Acquisition System Mr. ERASMUS, Nicholas (University of the Western Cape) PhD	
12:10 - 12:30		240 Extraction of statistical properties in 181Ta to investigate nucleo-synthesis of 180Ta Mr. MALATJI, Kgashane (UWC) MSc	136 Online energy reconstruction on ARM for the ATLAS TileCal sROD co-processing unit Mr. COX, Mitchell (University of the Witwatersrand) MSc	
12:30 - 12:50		83 Characterisation of potential cluster states in 16O Mr. LI, Kevin (Stellenbosch University, iThemba Labs) MSc	414 Developing a sorting code for Coulomb-excitation studies at iThemba LABS Mr. MEHL, Craig (University of the Western Cape) MSc	
12:50 - 13:10		420 The Design and Construction of an Active Target Detector for the Study of the 20Ne(a,a')20Ne* Reaction Mr. BRUMMER, Johann Wiggert (Stellenbosch University) MSc	45 A study of radiation damage in plastic scintillators using magnetic resonance techniques for the upgrade of the ATLAS detector Mr. PELWAN, Chad (University of Witwatersrand) MSc	
13:10 - 14:00	**Lunch Break**			
14:00 - 15:30	**ANNUAL GENERAL MEETING**			
18:30	**2015 SILVER JUBILEE BANQUET**			

FRIDAY 3 JULY 2015

PLENARY: Prof. FORBES, Andrew 1,2,3 …. infinity: high-dimensional quantum entanglement with patterns of light (ID: 459)				08:40 - 09:40
D1: Astrophysics (Regatta)	**F: Applied Physics (Tsitsikamma D1)**	**G: Theoretical and Computational Physics (Ironwood)**		**TRACK**
Different Perspectives Mr. van Soelen, Brian	**- Dr. Ferrer, Phil**	**- Prof. de Mello Koch, Robert**		**Theme Chair**
Optical Observations of the Be/X-ray Binary A0538-66 187 Dr. RAJOELIMANANA, Andry Fitiavana (University of the Free State) -	From single nano-wire nano-electronics through gas FETs to deployable portable industrial sensing devices 171 Dr. MWAKIKUNGA, Bonex (CSIR National Laser Centre) -	CHPC Introduction to Linux and Python Course: A capacity building tool for High Performance Computing 415 Dr. MOEKETSI, Daniel Mojalefa (CSIR Meraka Institute (CHPC)) -		09:40 - 10:00
Search for Extreme Metal-Poor Stars in the Edinburgh-Cape Blue Object Survey 444 Mr. XABANISA, Sivuyile (University of the Western Cape) MSc	Open-Source electronic board designed in South-Africa, for Africa 432 Dr. MARIOLA, Marco (University of kwazulu-natal) -	Non-universality of a constrained period doubling route to chaos for Rössler's system 38 Prof. BOTHA, André (Unisa) -		10:00 - 10:20
	Comparative analysis of the performance of integrated and split type air source heat pump water heaters by diagnostic characterization 10 Mr. TANGWE, Stephen (University of Fort Hare) PhD	Progress in Relativistic Electro-Magneto-Fluid Dynamics of Polarized Media 378 Prof. MURONGA, Azwinndini (University of Johannesburg) -		10:20 - 10:40
Tea & Coffee Break				10:40 - 11:10
Active Galactic Nuclei Dr. Engelbrecht, Christian	**- Prof. Arendse, Christopher**			**Theme Chair**
The Sub-millimeter Continuum Emission of Cygnus A 208 Prof. LEEUW, Lerothodi (University of South Africa) -	Acceleration parameters for fluid physics with accelerating bodies 338 Prof. GLEDHILL, Irvy (Igle) (CSIR) -			11:10 - 11:30
A quasi-periodicity in the optical polarization of the blazar PKS 2155-304? 234 Ms. PEKEUR, Nikki (UCT) PhD	Characteristics and function of the South African national measuring standard for force 47 Mr. DLAMINI, Sipho (National Metrology Institute of SA) -			11:30 - 11:50
Optical spectroscopic observations of unclassified Active Galactic Nuclei in the Fermi-2LAC catalogue 225 Ms. KLINDT, Lizelke (University of the Free State) MSc	BLAZE-DEM: A GPU based large scale 3D discrete element particle transport framework 104 Mr. GOVENDER, nicolin (CSIR,UP) -			11:50 - 12:10
	Resonant absorption of electro-magnetic radiation by building materials 222 Mr. MTHOMBENI, Godman (University of Johannesburg) -			12:10 - 12:30
	Time of crossing (TOC) in Pulsed Eddy Current Signals 190 Dr. KIBIRIGE, Betty (University of Zululand) -			12:30 - 12:50
	Progress with the Colliding Shock Lens 375 Mr. MAHLASE, Conrad (SAIP) -			12:50 - 13:10
Lunch Break				13:10 - 14:00
ANNUAL GENERAL MEETING				14:00 - 15:30
2015 SILVER JUBILEE BANQUET				18:30

Boardwalk Convention Centre, 3 July 2015

Dress code: Semi-formal / Smart-casual
Cash Bar available

18:30	**Arrival**
19:00	Welcoming address
19:10	Message from the VC
19:30	**Starter is served**
19:45	Awarding of Student Prizes (SAIP President & Specialist Group Chairs)
20:15	**Dinner is served**
20:45	Silver Jubilee Medal Award
21:00	SAIP Presidency handover
21:15	**Desert is served**
21:30	Vote of Thanks and handover to SAIP2016 Organisers
21:35	Final Remarks - Plenary speaker representative
21:45	**Coffee** & Entertainment

Poster Session 1: Tue. 30 June 16:10 - 18:00

DPCMM - Chair: Prof. Swart, Hendrik

Board	Presenter	Title *[For Award - Also judged during Poster session 2 on Wednesday 1 July]*
A.030	NGQOLODA, Siphelo	Vertically aligned silicon nanowires synthesized by metal-assisted chemical etching for photovoltaic applications [For award: MSc]
A.034	SEPHTON, Bereneice	Determination of the band gap of AlGaN epilayers by FTIR reflectance spectroscopy
A.057	PELWAN, Chad	A density functional theory and magnetic resonance studies of radiation damage in plastic scintillators [For award: MSc]
A.059	YAN, XinLiang	A quantification evaluation of the depth resolution of AES depth profiling data of Cu/Ni multilayer thin films using the MRI model [For award: PhD]
A.062	MOFOKENG, Jabulani	Characterization of Palladium (Pd) coated Titanium alloy (Ti6Al4V) [For award: MSc]
A.063	KORE, Bhushan	Thermoluminescence investigations in K3Ca2(SO4)3F:Dy phosphor [For award: PhD]
A.073	WAKO, ALI HALAKE	Influence of alkaline earth metal cations; Ca^{2+}, Sr^{2+} and Ba^{2+} on the structural and optical properties of MAl_2O_4: Eu^{2+}, Nd^{3+} phosphors. [For award: PhD]
A.082	JILI, Thulani	Calculation of the contribution of core states in CdF2 to the electron-positron annihilation momentum density using generalized gradient approximation.
A.097	SHAI, Moshibudi	XRD and AFM studies of graphene and single-walled carbon nano tube
A.101	REDDY, Leelakrishna	Isolation and characterization of carbon nanoballs and nanofibers from an internal combustion (I.C) engine
A.105	MBIOMBI, WILFRED	Diamond -like carbon (DLC) thin films:Synthesis and investigation [For award: PhD]
A.106	TANKIO DJIOKAP, Stive Roussel	Influence of a buffer layer on the electrical properties of ZnO/Si heterojunction [For award: PhD]
A.122	OMOTOSO, Ezekiel	Effect of temperature annealing on 4H-SiC Schottky barrier diodes after alpha-particle irradiation at high fluences
A.127	MBULANGA, Crispin	Surface characterisation of ZnO nanorods grown by Chemical Bath Deposition on Si substrate [For award: MSc]
A.128	HASABELDAIM, Emad	Effect of Background gas and substrate temperature on ZnO:Zn thin films [For award: MSc]
A.129	NUBI, Olatunbosun	Calibrating the 8000M Ball Miller Using Anatase and Rutile Titania Nanoparticles
A.131	BASHIR, Aiman	Thermodynamic properties of NdCu4Au [For award: PhD]
A.134	THABETHE, Thabsile	The surface structure and interfacial reaction analysis of W in 6H-SiC
A.143	RIKHOTSO, Blessing	Computational modelling studies of recrystallised nano-architectured TiO2 structures at different lithium concentration and temperatures for energy storage applications. [For award: MSc]
A.160	NGEMA, Nokwanda MSOMI, Justice MOYO, Thomas	Synthesis and magnetic properties of Sn-doped CoFe2O4 nanoferrites [For award: MSc]
A.166	THETHWAYO, Charles Thulani	Structural and optical properties of TiN coatings produced by reactive magnetron sputtering at different substrate temperatures [For award: MSc]
A.167	MAPASHA, Edwin	The effects of Li adatoms on defected graphane: A first-principles study
A.172	NYENGE, Raphael Lavu	The influence of the number of pulses and post annealing on the morphology and photoluminescence properties of CaS: Eu^{2+} pulsed laser deposited thin films [For award: PhD]
A.175	ABBASS, Abd Ellateef	White luminescence from sol-gel silica doped with silver [For award: PhD]
A.178	MULLER, Theo	Catalyst-free thermal evaporation of Zn powder at atmospheric pressure
A.179	AHIA, Chinedu Christian	Investigation of MOVPE-InSb Quantum Dots grown using TMIn and TDMASb [For award: PhD]
A.180	TILE, Ngcali	MOCVD growth of GaSb/GaAs quantum dots [For award: PhD]
A.185	MANAMELA, MF RAMMUTLA, Erasmus	Synthesis and characterisation of mechano-chemically synthesised Zinc Oxide nanoparticles using ball milling
A.211	DIALE, Mmantsae	Electrical Characterization of MeV Alpha-particle Irradiated Ni/4H-SiC Diodes and their Recovery by Annealing Treatment
A.213	THEBE, Mohapi	Electrical characterization of undoped and niobium-doped n-silicon diodes [For award: MSc]
A.217	CHITHAMBO, Makaiko	The influence of annealing on radioluminescence and thermally stimulated luminescence in natural quartz
A.227	PRINSLOO, Aletta	Physical properties of $Cr_{78}Al_{22}$ thin films

A.231	TSHWANE, David Magolego	Computer simulation as a strategy for generating manganese dioxide nanotubes [For award: MSc]
A.232	MASHAMAITE, Mordecai	Computaional Modelling of Ti_{50-x} Pt_{50} Zr_x SMAs [For award: MSc]
A.241	MUDAU, patience	The magnetic properties of Cr + 1 at.% Al thin films [For award: MSc]
A.254	JACOBS, Bincy Susan	Electronic and magnetic properties of the $(Cr_{84}$ $Re_{16})_{100-x}$ Mn_x alloy system
A.276	CHONCO, Nelisiwe Princess	Synthesis and characterization of diamond like carbon (DLC) thin films for gas sensing applications [For award:MSc]
A.281	MSOMI, Justice	Mössbauer and magnetic study of Co(Ti,Sn)xFe2-xO4 nanoferrites
A.283	DOBSON, Stephen	High resolution X-ray diffraction and photoluminescence of $InAs_{1-x}$ Sb_x/GaSb
A.284	MAYIMELE, Meehleketo Advice	Electrical characterization of introduced in bulk grown ZnO during electron beam exposure [For award:MSc]
A.301	NCUBE, Siphephile	Multiwalled nanotube-rare earth magnet (MWNT-Gd) based spin valve design and characterization. [For award:PhD]
A.302	DANGA, Helga	Deep level defects in alpha-particle irradiated epitaxially grown silicon [For award: MSc]
A.304	MAHAFA, Tshepo	Microstructural analysis of proton irradiated zircaloy-4[For award: MSc]
A.305	MTHWESI, zuko	Thermoluminescence of annealed synthetic quartz [For award: MSc]
A.307	MOTLOUNG, Selepe	Structural and photoluminescence properties of LaV_{1-x} P_x O_4 :1 mol % Dy^{3+} phosphor powder prepared by solution combustion method
A.311	NSENGIYUMVA, Schadrack	Phototransferred thermoluminescence in argon implanted synthetic quartz
A.318	FOURIE, Antonie	CZTS solar cell: A green energy source produced in a green way. [For award: MSc]
A.322	NTSOANE, Tshepo	Time-evolution studies of thermal sprayed hydroxyapatite coatings
A.325	NETSIANDA, Makondelele	Prediction of Structures and Energy stabilities of VO_2 nanoparticles.
A.329	DEJENE, Francis	Effect of Pb doping and annealing temperature on the structural and optical properties ZnO nanoparticles synthesized by sol-gel method
A.331	MASIKHWA, Tshifhiwa Moureen	Preparation and electrochemical investigation of the cobalt hydroxide carbonate/activated carbon nanocomposite for supercapacitor applications [For award: PhD]
A.334	NETHAVHANANI, Takalani	Synthesis of ZnO nanoparticles by Green process and investigation of their growth mechanism [For award:MSc]
A.341	TUNHUMA, Shandirai	Electrical characterization of 5.4 MeV alpha particle irradiated, low doped n-type Gallium Arsenide. [For award:MSc]
A.361	SEFAGE, Amanda	Fabrication and Characterisation of CdO-CNS hybrid for LPG Sensing
A.374	MULAUDZI, Masilu Godfrey	Density functional theory calculation of surface properties of pyrite (100) and depression of pyrite using TGA. [For award:PhD]
A.377	NAMBALA, Fred Joe	Electrical characteristics of Pd Schottky contacts on ZnO and AZO nanoparticles
A.382	MULABA-BAFUBIANDI, Antoine-Floribert	Iron bearing minerals characterised with Mossbauer spectroscopy at the Mineral Processing and Technology Research Centre , University of Johannesburg, South Africa
A.411	ALI, Abdub	Energy transfer mechanisms and material properties of Y2O3: Eu3+:Ho3+ nanophosphors synthesized by sol- combustion method.
A.417	BHEBHE, NKOSIPHILE ANDILE	Laser excitation studies and crystal-field analysis of ZnO:Tb^{3+} and ZnO:Eu^{3+} powders[For award: MSc]
A.423	MEHLAPE, Mofuti	The modified interatomic potentials of FeS_2 in atomistic simulations
A.426	FOKA, Emily	Synthesis and Characterization of LaVO4:Ln (Ln=Eu, Li) by Combustion method [For award: PhD]
A.427	VENTER, Danielle	Electrical characterization of bulk 4H-SiC [For award: Hons]
A.431	MAPHANGA, R. Regina	Structure Prediction of Manganese Dioxide Nanoclusters Using Computer Simulation Techniques
A.435	MASINA, Bathusile	Synthesis of vanadium oxide (VxOy) using CO2 Laser Pyrolysis
A.447	COLEN, Manaka	Synthesis, photoluminescence and thermoluminescence of the BaAl2O4:Dy3+ phosphor[For award: MSc]
A.448	MURAPE, Davison Munyaradzi	Interface state density distribution in sulphur treated bulk Au/n-GaSb Schottky barrier diodes
A.450	MAABONG, Kelebogile	Thermal and compositional defects in dip-coated iron oxide (α-Fe_2O_3) thin film photoanodes: Effects on film properties
A.451	CONNELL, Simon	Ultra smooth surface of diamonds, towards Å scale roughness for the (111) orientation

Poster Session 2: Wed. 1 July 16:10 - 18:00

DPCMM (for award), NPRP, Photonics, Astro, Edu, Applied, TCP
Chair2: Prof. Swart, Hendrik, Dr. Mullins, Simon; Prof. Rohwer, Erich; Dr. Engelbrecht, Christian; Dr. Ramaila, Sam; Prof. van Dyk, Ernest; Prof. Muller-Nedebock, Kristian

Board	Presenter	Title [For Award]
B.012	GBAORUN, Frederick	Investigation of the Energy Spectra of Even-Even Nuclei in the Lower Half of the sd-Shell
B.035	KWETANA, Musa Lonwabo	Synthesis, Production and Tc-99m-DISIDA (N-2,6-diisopropylphenylcarbamoylmethyliminodiacetic) acid Scan [For award: Hons]
B.041	LIAO, Shell-may	Radiation hardness tests on different plastic scintillator grades for the upgrade of the Tile Calorimeter of the ATLAS detector [For award: MSc]
B.046	NTSHANGASE, Sifiso Senzo	Reaction mechanisms studied using the iThemba LABS recoil detector
B.091	MANTENGU, Nkanyiso Robert	Radiation Shielding Calculation using FLUKA transport code for Radiactive-ion Beam Facility at iThemba LABS. [For award: MSc]
B.102	LAMULA, Thobeka	Reaction rates determination using Monte Carlo simulations for the Bi target at 90 MeV neutron energy. [For award: MSc]
B.118	TLOU, Sijiye	Impact of dose rate on radiation damage of plastics scintillators for the Tile Calorimeter of ATLAS. [For award: 3rd]
B.120	O'CONNELL, Sheena	Viability of map-reduce algorithms for the measurement of Higgs boson properties with the ATLAS detector at the LHC [For award: MSc]
B.135	MOLUPE, Tshidiso	Understanding double Higgs boson production with vector boson fusion with the ATLAS detector at the LHC [For award: Hons]
B.165	OHENE-KWOFIE, Daniel	Efficient processing of physics quantities for the Processing Unit for the upgrade of the Tile Calorimeter of ATLAS [For award: PhD]
B.195	ADAMIAK, Daniel	High-Momentum Particle Production at RHIC, Fermilab, and LHC[For award: Hons]
B.196	WENTZEL, Farrel Sidney	Radon exhilation of building materials
B.203	DAMMALAPATI, U.	Ambient gamma dose rate measurements at Manyoni uranium mines, Singida, Tanzania
B.248	KUREBA, Chamunorwa Oscar	The search for Dark Matter in association with the Higgs boson with the di-photon decay
B.264	MABIKA, Phumzile	A precise measurement of the $½^+$ to $½^+$ ft value in ^{19}Ne beta decay [For award: MSc]
B.295	MOKGOLOBOTHO, Makabata Jeremia	Determining the spectroscopic quadrupole moment (Q_s) of the first 2^+ state in ^{40}Ar [For award: MSc]
B.296	SHIRINDA, OBED	Multiple chiral bands associated with the same strongly asymmetric many-particle nucleon configuration
B.298	GOSSMAN, David	Sensitivity to New Physics via the study of the Higgs boson transverse momentum at the ATLAS detector [For award: Hons]
B.309	NEMULODI, Fhumulani	Beam experiments with the Grenoble Test Electron Cyclotron Resonance Ion Source at iThemba LABS
B.330	DINOKO, Tshepo	Orientation of the Ge crystals of the iThemba LABS segmented clover detector
B.357	DINDIKAZI, Nomvelo	Single muon pT distributions from heavy quark decay in pp collisions at 7 TeV with ALICE [For award: MSc]
B.453	CONNELL, Simon	Channelling radiation of electrons in high-quality HPHT diamond single crystals
C.014	PANDEY, Anurag	Fluorescence behaviour of europium doped Gd2O3 nanosheets
C.081	NDAGANO, Bienvenu	Propagation of cylindrical vector beams through fibres[For award: MSc]
C.186	NDEBEKA, Wilfrid	Investigating charge carrier effects in silicon membranes using fs laser. [For award: PhD]
C.200	VILJOEN, Ruan	Demonstration of a new ultrafast pulse reconstruction modality – PIRANA [For award: MSc]
C.224	PEREZ-GARCIA, Benjamin	Implementing the Deutsch-Jozsa Algorithm with classical light

C.266	HASINJATOVO MANDANIRINA, Nambinintsoa Romeoh	Wavelength-modulated spectroscopy of the sub-band gap response of solar cell devices [For award: MSc]
C.323	BELL, July	Optimization of losses introduced by p absorbing mask in a Digital Laser (for award PhD]
C.348	MAWEZA, Loyiso	Creating and Measuring 2 μm Light Using a Spatial Light Modulator [For award: PhD]
C.425	NAIDOO, Darryl	Intra-cavity metamorphosis of a Gaussian beam to flat-top distribution
C.445	MQADI, Wonder Mhlakubuswa	Determination of the Origin of a High Frequency Signal Superimposed on the Light Emission detected from a Detonating Explosive in a Free Environment [For award: MSc]
D1.003	WINKLER, Hartmut	The unusually strong coronal emission lines of SDSS J1055+5637
D1.037	DIRIRSA, Feraol	Spectral studies of flaring quasar PKS 1424-418 above 100 MeV with Fermi-LAT [For award: PhD]
D1.156	VAN DER WESTHUIZEN, Izak	Numerical modelling of hydrodynamical astrophysical outflows [For award: MSc]
D1.340	AKOTO-DANSO, Alexander	Fringe Fitting Calibration of VLBI Data
D1.344	SEBOKOLODI, Makhuduga	New Minimization Techniques, Solvers and Calibration Algorithms [For award: MSc]
D1.404	MBOU SOB, Ulrich Armel	Investigating the Variability of Sources in the Data from the Karoo Array Telescope. U. Mbou Sob, S.K.Sirothia, T. Glober, O. Smirnov [For award: MSc]
D1.437	LEEUW, Lerothodi	Optical Spectra of Herschel Gravitational Lenses and their Astrophysical Implications
E.018	REDDY, Leelakrishna	Does proficiency in units and measurements contribute towards success in first year university physics?
E.019	RAMAILA, Sam	Exploring teaching-learning activity in large class groups
E.020	REDDY, Leelakrishna	Assessment of Physics practicals using a software-embedded and improvisation based scientifically efficient system
E.021	RAMAILA, Sam	Quality vs Quantity: the National Senior Certificate - a case study
E.022	RAMAILA, Sam	Global competitiveness as a barometer of scientific endeavor
E.079	TANCI, Sinovuyo	An overview of the mainstream mechanics first year module at the University of the Western Cape and students experiences of the module [For award: MSc]
E.398	REDDY, Leelakrishna	Soweto Science Centre as a community engagement initiative at the University of Johannesburg
E.419	REDDY, Leelakrishna	Expository vs Problem-based approach to Physics practicals at the University of Johannesburg-A case study
E.455	RAMAILA, Sam	A Comparative Study of the Preparedness for Undergraduate Studies of Students entering the University with South African Matriculation Examination results and Zimbabwe ZIMSEC Examination results.
F.005	MHUNDWA, Russel	Low cost empirical modelling to determine milk production in a dairy plant: A case study of Fort Hare Dairy Trust [For award: PhD]
F.065	TYALIMPI, Vumile	Metrology of Ultrasound and Underwater Acoustics at the National Metrology Institute of South Africa
F.071	SHILUVANE, Thulani	Determination of a neutron beam fluence energy distribution using multichannel unfolding code MAXED [For award: MSc]
F.072	NENGUDZA, Azwidovhiwi Emmanuel	Simulation of quasi-mono-energetic neutron beam fluence energy distributions at the iThemba LABS time-of-flight facility [For award: MSc]
F.089	KIPROTICH, Sharon	Thermoluminescence (TL) study ofβ-stimulated $BaAl_2O_4:Eu^{2+},Dy^{3+}$ phosphor [For award: PhD]
F.130	KROON, Ted	Experimental evaluation of emission models from a thermal evaporation source
F.139	NDLOVU, Nothando	Evaluation of an empirical model for a flat plate solar collector[For award: MSc]
F.205	SENEKANE, Makhamisa	A quantum walk-based MPPT optimization algorithm for a stand-alone PV system

F.209	DIX-PEEK, Ross	Measurement of diffusion capacitance of mono-crystalline and poly-crystalline photovoltaic cells using LBIC [For award: Hons]
F.226	ODUTEMOWO, opeyemi	Investigating the structural changes in strontium implanted glassy carbon using Multiwavelength Raman Spectroscopy [For award: PhD]
F.249	RADEMEYER, Yvette	Evaluation of photovoltaic modules using standard electrical power measurements and imaging techniques [For award: Hons]
F.251	ERASMUS, Lucas	Measuring the optical thermometry properties of a phosphor [For award: MSc]
F.310	MAXWELL, Christopher	Development of an in-house high precision experimental entanglement source [For award:Hons]
F.333	SHABALALA, Lizwi	Quantum Key Distribution Using Entangled Source [For award: Hons]
F.342	ISOE, George	Fibre-to-the-Hut Technology: A Solution to Cheap Access for High-Speed Optical Network in South Africa [For award: PhD]
F.349	MALUTA, Nnditshedzeni Eric	Analysis of temperature models for the computation of global solar radiation in the climatic conditions of Western Cape province of South Africa [For award: PhD]
F.350	DLAMINI, Phumla	Phase noise analysis for 1.7-14.5 GHz clock signal transmission over 12km telescope network optical fibre [For award: MSc]
F.362	QWABE, Henry Simphiwe	FPGA- based implementation of cascade error correction protocol for QKD applications [For award: MSc]
F.363	WASSIN, Shukree	Active phase correction using a VCSEL for clock tones transmitted along a 24 km optical fibre link [For award: PhD]
F.372	NGUBELANGA, Nolitha	Characterisation of municipal organic waste for microwave plasma gasification [For award: MSc]
F.391	MOMODU, Damilola	Simonkolleite-graphene foam composites and their superior electrochemical performance [For award: PhD]
F.394	KULA, Mpumezo	Morphological and elemental properties of sugarcane bagasse for gasification purposes [For award: MSc]
F.401	ARADI, Emily	Cross-section Electron Microscopy studies of Boron Implanted Hexagonal Boron Nitride
F.402	HLONGWANE, Senzo	Quantum State Tomography [For award: Hons]
F.413	NWOKOLO, Nwabunwanne	The design of a waste heat system capable of harnessing energy from the surface of a cyclone dust collector attached to a downdraft biomass gasifier [For award: PhD]
F.439	SIKAKANA, Ike	The Generation of Surface Acoustic Waves using a Normal Transducer and Perspex Wedges
G.004	KOLBE, Isobel	pQCD Short Path Length correction to Energy loss formulae [For award: MSc]
G.137	KOSSI, Amouzouvi	Density Functional Theory on a Lattice: Particle Number Dependence of the Exchange-Correlation Potential.[For award: PhD]
G.202	MOSUANG, Thuto	Molecular dynamics studies of Schottky and Frenkel defects in cerium dioxide
G.236	RAZZAQUE, Soebur	Neutrino mass hierarchy and CP phase measurement using atmospheric neutrino flux
G.245	NGOMANE, Alex Otavia MALUTA, Eric DE MELLO KOCH, Robert	Minimum Norm Estimates for the Bioelectromagnetic Inverse Problem
G.246	PHALA, Feredi	Computer modeling studies of the adsorption energies of heavy metals onto vermiculite surface
G.279	MAFU, Mhlambululi	Security of quantum key distribution
G.280	SENEKANE, Makhamisa	Higher dimensional quantum key distribution in the presence of quantum noise [For award: PhD]
G.359	CHIRWA, Max	A circular current's bi-Cartesian magnetic dipolar model and the bias in
G.373	MEIRING, Ben	The full spacetime description of jet evolution in the weakly coupled regime [For award: MSc]
G.380	MULAUDZI, Sophie	A comparative study of the three empirical solar models in North West, South Africa. [For award: PhD]

Book of Abstracts

ORAL PRESENTATIONS

2 - Solving the puzzle of galaxy rotation with a gravitomagnetic form of Newton's Law.

Astro - Thursday 02 July 2015 16:10

Primary author: *WAGENER, Pieter (University of Fort Hare)*

For the past two decades dark matter has been hypothesized to solve the puzzle of the orbital velocities of galaxies. We derive a form of Newton's law of gravitation similar to the Lorentz force of electromagnetism, i.e. a gravitomagnetic form. This form gives the observed curve of the orbital velocity of a galaxy against its distance from its centre.

7 - Measuring the “vectorness” of a vector vortex beam

Photonics - Wednesday 01 July 2015 09:40

Primary author: *MCLAREN, Melanie (University of the Witwatersrand)*
Co-authors: *KONRAD, Thomas (UKZN); FORBES, Andrew (CSIR)*

Vector beams are defined by spatially inhomogeneous states of polarization, that is, the spatial distribution and polarization state of the beam are non-separable. A variety of optical fields such as interferometry and optical tweezing have made use of the tighter focal spots produced by vector beams. It is therefore important to determine the degree to which these beams are non-separable or to determine the “vectorness” of such beams. We show that the non-separability of vector beams is analogous to that of entangled quantum states and as such, we use traditionally quantum techniques such as a Bell inequality, to determine the vectorness of our generated vector vortex beams.

8 - Electrodeposited Ni Nanowires-Track Etched P.E.T. Composites As Selective Solar Absorbers

DPCMM - Tuesday 30 June 2015 10:00 *[For award: MSc]*

Primary author: *LUKHWA, Rendani (University of Western Cape)*
Co-authors: *MADJOE, Reginaldt (University of the Western Cape); MAAZA, Malik (iThemba LABS); KOTSEDI, Lebowang (iThemba LABS); NKOSI, Mulungisi (iThemba LABS); SONE, Bertrand T. (University of the Western Cape)*

This contribution reports on the fabrication and characterization of flexible nano-structured selective solar absorber composites for low-temperature solar-thermal applications. The active material in this system consists of electrodeposited Ni nano-cylinders embedded in track etched polyethylene tetraphthalate host membrane. The tubular and metallic structure of the Ni nano-cylinders within the insulator polymeric host forms a typical ceramic-metal nano-composite “Cermet”. The optical properties of such Ni-polyethylene tetraphthalate nano-cermets were optimized following various structural, morphological and optical investigations.

10 - Comparative analysis of the performance of integrated and split type air source heat pump water heaters by diagnostic characterization

Applied - Friday 03 July 2015 10:20 *[For award: PhD]*

Primary author: *TANGWE, Stephen (Fort Hare Institute of Technology, University of Fort Hare)*
Co-authors: *SIMON, Michael (Fort Hare Institute of Technology, University of Fort Hare); MEYER, Edson (Fort Hare Institute of Technology, University of Fort Hare)*

Air source heat pump water heater generates sanitary hot water by harnessing the aero-thermal energy during the process of vapor compression refrigerant cycles. The study focuses on identification of critical parameters (volume of hot water drawn off, ambient temperature and relative humidity) as well as deterministic quantities (time used, power consumption and the coefficient of performance) as the indicators to benchmark the efficiencies of the both systems. The analyses were performed based on two predominant scenarios (first hour heating rating and heating up cycle due to hot water drawn off) whereby both the integrated and split type ASHP water heaters were undergoing VCRC. The both types of ASHP water heater were of 200 L tank capacity with the auxiliary heating element disabled. The results analyses were presented for the two systems with their hot water set point temperature at 55o C. Multiple contour simulation plots were developed and built in Matlab to simulate the COP of the systems using the critical parameters as predictors. The multiple contour simulation plots showed the variation of the COP of the systems and the desired predictor with the others invariant. Conclusively, it was demonstrated that the integrated type ASHP water heater demonstrated performed better than the split type system.keywords: integrated ASHP water heater, Split type ASHP water heater, vapor compression refrigerant cycles, predictors, multiple contour simulation plots, coefficient of performance.

11 - Investigation of Pc5 pulsation events using Sanae radar and ground-based magnetometer data during northward interplanetary magnetic field (IMF) interval

Space - Wednesday 01 July 2015 14:20

Primary author: *MTUMELA, Zolile (SANSA)*
Co-authors: *KOSCH, Michael (SANSA); STEPHENSON, Judy (UKZN)*

The Pc5 pulsation events presented here were monitored in the high-latitude ionosphere by Sanae radar and ground-based magnetometer arrays in Greenland and CARISMA stations that are in the same range of magnetic latitude, when the interplanetary magnetic field of the solar wind is northward. These two instrument types complement each other. The line-of-sight Doppler velocities from the radar can be used to measure ULF oscillations in the F-region plasma flow associated with Pc5 field line resonance. Ultra low frequency (ULF) pulsations have been observed for many years in magnetometer data and are endemic within the magnetosphere. Spectral analysis of the Pc5 pulsations from Sanae radar and magnetometers has been performed. This will help in determining the characteristic features of pulsations during northward interplanetary magnetic field interval.

13 - Modelling ground conductivity for computing the electric field associated with geomagnetically induced currents (A mid latitude case study)

Space - Wednesday 01 July 2015 14:00 *[For award: PhD]*

Primary author: *MATANDIROTYA, Electdom (CPUT and SANSA Space Science)*
Co-authors: *CILLIERS, Pierre (SANSA Space Science); VAN ZYL, Robert Ryk (French South African Institute of Technology (FSATI))*

The study of geomagnetically induced currents (GIC) in technological systems connected to the Earth such as power lines and pipelines during adverse space weather conditions requires the computation of the electric field induced in the Earth. These computations can be achieved through solving Maxwell’s equations with appropriate boundary conditions. COMSOL Multiphysics, a finite element method (FEM) simulation package is used to compute the electric field induced by measured geomagnetic field in a layered Earth model. The study is based on the calculation of the GIC in a transformer at an electrical substation in South Africa where a ground conductivity profile was derived from GIC and magnetic field measurements. The investigation aims at studying the effects of varying the number, thickness and conductivity of layers when computing the electric field associated with GIC, thus, enhancing the understanding of the distribution of the induced horizontal electric field within the various layers of the Earth during a geomagnetic storm. The measured GIC and the modelled GIC are compared to determine the best representation of the Earth. This kind of study is important in understanding the layers which matter most in the effective modelling of GIC for this particular substation. The results based on this case study indicates that for a layered Earth model where the top layers have a low conductivity compared to the underlying layers the deeper high conductivity layers have a significant influence on the accuracy of the modelled GIC.

15 - Collective Electronic Excitations in Ferromagnetic Metals

DPCMM - Friday 03 July 2015 11:10

Primary author: *NOLTING, Volkmar (Vaal University of Technology)*

Collective electronic excitations in the system of interacting conduction electrons of ferromagnetic metals (Fe, Co, Ni) are investigated. These conduction electrons stem from relatively narrow d-type bands and a suitable model to describe them is the Hubbard model. Treating the Thomas-Fermi screening as a dynamic phenomenon yields oscillations in the electron density. These charge density waves (plasmons) are determined from the poles of the dielectric function $\varepsilon(q,E)$ that is approximately evaluated within the random phase approximation RPA. On the other hand, spin wave energies (magnons) are identical to the poles of the transverse susceptibility. Magnetizations m(T,n) , Curie temperatures T_C (n), and the temperature dependent exchange splitting ΔE_{ex} are calculated within reasonable agreement with experimental results.

16 - Study of Electrical Conductivity of Pr^{3+} Containing Lithium Borate Glasses by Impedance Spectroscopy

DPCMM - Friday 03 July 2015 11:30

Primary author: *RAMTEKE, Durgaprasad (University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); GEDAM, Rupesh (Visvesvaraya National Institute of Technology, India)*

Lithium borate glasses are very interesting to study because of their technological applications in various field. The complexity and functionality of these glasses are defined by boron anomalies and the concentration of the Li ions. Impedance spectroscopy plays a vital role in characterization of these glasses for solid electrolyte applications. An impedance study provides multidimensional electrical and structural information about the conducting glasses. Though lithium borate glasses offer good conductivity, their conductivity performance under the influence of rare earth ions is less known. In the current trend rare earth (RE) oxides are used for a variety of optical applications due to their interesting *4f* and *5d* orbitals. Among the RE ions, the Pr ion is of a particular interest, because it gives rise to a number of energy levels. The intention behind the present work is to understand the conductivity behavior of glasses in the presence of Pr^{3+}. In order to comprehend the conduction properties, the glass series was prepared with the general formula $27.5Li_2O\text{-}(72.5\text{-}X)B_2O_3\text{-}XPr_6O_{11}$ (X= 0.5, 1, 1.5 and 2) by a melt quench technique. The prepared glasses were analyzed by using the impedance spectroscopy technique. The conductivity of prepared glasses decreases and activation energy increases with increase in Pr^{3+}. The decrease in conductivity is mainly due to the higher molecular weight of Pr^{3+}. To understand the conduction mechanism of these glasses, scaling were performed. The overlapping of the data on the single master curve reveals that the conduction mechanism is compositional dependent. This study demonstrate the role of Pr^{3+} ions on the conducting properties glasses.

17 - The Simplest Gauge-String Duality

TCP - Tuesday 30 June 2015 11:30 *[For award: MSc]*

Primary author: *NKUMANE, Lwazi (University of witwaterstrand)*
Co-author: *DE MELLO KOCH, Robert (University of Witwatersrand)*

We consider an instructive toy model of the gauge-string dualities which exist between quantum field theory and theories of quantum gravity. In this example we study the Gaussian matrix model as our gauge theory and the topological A-model string theory on **P** ^1 as our theory of quantum gravity.We propose operators in the matrix model that are dual to the gravitational descendants of the puncture operators of the topological string theory. We test our proposal by showing that matrix model correlators obtained from the recursion relations that follows from a systematic 1/N expansionof well chosen Schwinger-Dyson equations are in complete agreement with correlators in the dualtopological string theory, up to contact terms.

23 - University physics students' views about scientific inquiry

Edu - Wednesday 01 July 2015 10:00

Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-author: *RAMNARAIN, Umesh (University of Johanneburg)*

The development of informed views about scientific inquiry forms an integral part of a key endeavour geared towards meaningful enhancement of scientific literacy. Within the realm of curriculum innovation, there is an added imperative for scientific inquiry to underpin curriculum reform efforts. In this regard, the Views About Scientific Inquiry (VASI) questionnaire was utilized to establish university physics students' baseline knowledge about scientific inquiry as an essential tenet in science education. Analysis of responses revealed fragmented and incoherent views about the nature of scientific inquiry with the concomitant implication that students appeared not to hold informed views about scientific inquiry itself.

24 - A Timing Noise Analysis Pipeline for HartRAO pulsars

Astro - Wednesday 01 July 2015 15:00 *[For award: PhD]*

Primary authors: *JACQUES, Maritz (UFS); PIETER, Meintjes (UFS)*
Co-authors: *SARAH, Buchner (SKA); NATALIA, Lewandowska (HartRAO)*

Timing noise in long-term pulsar timing residuals is a challenge to our understanding of present pulsar models. The quest to shed light on the emission mechanisms of radio pulsars, has led to various key science projects ranging from the search for gravitational waves to the development of next-generation instruments for pulsar astronomy. Timing noise studies present an essential cornerstone in these projects. One possible explanation for the existence of timing noise is mode switching in the magnetosphere of the pulsar. In a long-term study we have investigated the timing noise phenomena seen in PSR J1326-5859. It was observed with the 26 m radio telescope of the Hartebeesthoek Radio Observatory (HartRAO) for several decades and provides a large variety of timing noise characteristics. In this presentation we review the timing noise analysis pipeline used for PSR J1326-5859 which can be also used for other southern hemisphere pulsars observed with HartRAO.

25 - Large N Conformal Field Theory from Gauge Theory/ Gravity Duality

TCP - Tuesday 30 June 2015 14:00 *[For award: PhD]*

Primary author: *HASINA TAHIRIDIMBISOA, Nirina Maurice (University of the Witwatersrand)*
Co-author: *DE MELLO KOCH, Robert (University of the Witwatersrand)*

We consider operators in the su(2) sector of N = 4 super-Yang-Mills theory, that have a classical dimension of order N. The correlation functions of these operators receive corrections at large N from non-planar diagrams. We compute the spectrum of anomalous dimensions by enforcing the global su(2) symmetry algebra of the theory. The computation entails computing the exact form of the su(2) generators. Our results provide further support for integrability inlarge N but non-planar limits of the theory.

26 - Monte Carlo simulations to obtain the weak magnetism term for ^{22}Na beta decay

NPRP - Wednesday 01 July 2015 09:40 *[For award: MSc]*

Primary author: *PHUTHU, Lutendo (University of the Western Cape)*
Co-authors: *SMARAJIT, Triambak (University of the Western Cape); ORCE, Nico (University of the Western Cape); GARCIA, Alejandro (University of Washington); DIAZ VARELA, Alejandra (University of Guelph); DUNLOP, Ryan (University of Guelph); JAMIESON, Drew (University of Guelph); WREDE, Christopher (Michigan State University)*

The study of ^{22}Na beta decay offers an opportunity to test the Standard Model via measurements of the β-γ angular correlation. A previous measurement of this correlation yielded a non-zero value, indicating the need for a higher-order correlation to the decay, beyond the allowed V-A approximation. On assuming the Conserved Vector Current (CVC) hypothesis for weak interactions and using the magnetic dipole M1 width of the analog 2_1^+ state in ^{22}Na, one obtains an unexpectedly large "second-class" form factor that is in disagreement with the Standard Model predictionThis talk describes an analysis of data obtained from a prior ^{21}Ne(p,γ) experiment to obtain the M1 width of the 2_1^+ state of interest in ^{22}Na. We aim to use the M1 width and an independent measurement of the β-γ angular correlation to obtain a higher order Standard-Model-allowed weak magnetism term, in an attempt to explain the observed discrepancy mentioned above. I will also describe some Monte Carlo simulations performed to extract E2/M1 mixing ratio from these data.

27 - Evolutionary algorithm simulation study of Manganese dioxide nanoclusters

DPCMM - Tuesday 30 June 2015 10:20 *[For award: MSc]*

Primary author: *MASOGA, Wesley (University of Limpopo)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); MAPHANGA, Rapela (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 house hold appliances. Manganese dioxide is one of the promising materials that are studied as potential cathode materials for rechargeable lithium-ion batteries. Pyrolusite is chosen for this study as it is the most stable polymorph of manganese dioxide. This study aims to show that pyrolusite when refined nano-structurally can be used to improve the current state of the cathode when used in secondary/rechargeable batteries. Evolutionary algorithm techniques and energy minimisation methodologies are used to generate Manganese dioxide nanoclusters. A combination of global search techniques and density functional theory methods are employed to determine the stabilities of Manganese dioxide nanoclusters across the energy landscape. We investigate the energetics, structural and thermodynamic properties of manganese dioxide nanoclusters. Structural stabilities of the nanoclusters correlate with those for isostructural Silica and Titanuim dioxide clusters from previous studies. Compact ring structures are the most stable for the nanoclusters from n=1 to n=6 atoms. The most stable nanoclusters are made of a cubic diamond consisting of two manganese and two oxygen atoms. The stable structures tend to migrate to a more circular compact configuration after optimisation. X-Ray Diffraction patterns for the nanoclusters indicated the (0 1 -1) peak as the most dominant and stable with its intensity always in the range between 100 and 110. Temperature changes on nanocluster stability was also studied. Total energies are given through 200K to 1600K temperature range to determine the temperature at which the nanoclusters converge and stabilise. Increase in temperature results in increase of bonding distances between the atoms. The higher the temperature the less stable the nanoclusters become.

28 - Integrability in Giant Graviton Dynamics

TCP - Tuesday 30 June 2015 14:20 *[For award: PhD]*

Primary author: *MAHU, Augustine Larweh (University of The Witwatersrand)*

In this talk the large N limit of the anomalous dimensions of operators in N = 4 SYM theory, described by restricted Schur polynomials, is considered. We consider operators with a classical dimension of order N that belong to the SU(2) sector. They are constructed using m˜O(N)Y and n˜O(N)Z fields where m<<n. Non-planar diagrams contribute already at the leading order in N and the planar and large N limits are distinct. Integrability in the non-planar limit is explored, with an emphasis on terms of size m/n, needed to establish integrability in N = 4 SYM in large N but non-planar limits.

29 - Role of defects in the emission of undoped and doped ZnO thin film prepared by pulsed laser deposition

DPCMM - Thursday 02 July 2015 14:40

Primary author: *KUMAR, Vinod (Department of Physics, University of the Free state, Bloemfontein, ZA-9300)*
Co-authors: *NTWAEABORWA, Odireleng (University of the Free State); SWART, Hendrik (University of the Free State)*

Undoped and doped zinc oxide (ZnO) thin films were grown by the pulsed laser deposition (PLD) technique on silicon (Si) substrate at different growth conditions. According to the x-ray diffraction patterns, all the ZnO films were oriented along the (002) plane. This is in line with the characteristics of the hexagonal wurtzite ZnO structure where the c-axis is perpendicular to the substrate plane. Generally, ZnO have two emissions, the near-band edge emission and the deep level emission. The strong near-band edge emission at room temperature is due to free exciton recombination while the visible light emission is ascribed to the structural defects such as zinc vacancy (Vzn), oxygen vacancy (Vo), interstitial zinc (Zni), interstitial oxygen (Oi) and antisite oxygen (Ozn). The photoluminescence spectra of terbium doped ZnO (ZnO:Tb3+) thin films were characterized by three different types of transitions, the one was due to exciton recombination emission, the second was due to defect level emission and the third was due to the Tb3+ f-f transitions. The formation of different kind of defects in the ZnO was confirmed by X-ray photoelectron spectroscopy results. For the emission due to the Tb3+ ions, a major green emission peak at 543 nm and a few minor peaks at 489 and 622 nm were detected. These peaks represent the 5D4-7F5, 5D4-7F6, and 5D4-7F3 transitions of Tb3+, respectively. These ZnO thin films can be used as a suitable future light emitting material applications.

31 - Novel zincate phosphors: A new red-emitting phosphors for LED applications

Photonics - Thursday 02 July 2015 10:20

Primary author: *KUMAR, Vijay (Department of Physics, University of the Free State Bloemfontein 9300)*
Co-authors: *KUMAR, Vinod (University of the Free State); SOM, Sudipta (University of the Free State); SWART, Hendrik (University of the Free State)*

A series of lanthanum calcium zincate (La_2CaZnO_5) phosphors doped with Eu^{3+} have been synthesized by the solid state reaction method at different temperatures (700-1300 ^oC). The reaction temperatures had a significant effect on the surface morphology and luminescent properties of the resultant phosphors. Powder diffraction results showed the formation of a single-phase orthorhombic structure and that the dopant ions do not affect the crystal structure. The scanning and transmission electron microscopic images revealed the irregular morphology of the prepared phosphors consisting out of μm sized diameter particles. The Eu^{3+} doped phosphors illuminated with ultraviolet light showed the characteristic red luminescence corresponding to the $^5D_0 \rightarrow {}^7F_J$ transitions of Eu^{3+}. The phenomenon of concentration quenching is explained on the basis of ion-ion interaction, electron-phonon coupling and defect to ion energy transfer. Furthermore, the spectral characteristics and the Eu-O ligand behaviour were determined using the Judd-Offelt theory from the spectra. The CIE parameters were calculated using the spectral energy distribution functions and McCamy's empirical formula. Photometric characterization indicated the suitability of this phosphor for pure red emission in light emitting diode applications.

32 - Gum ghatti-based poly(acrylic acid-aniline) IPN hydrogel: Characterization and release properties

Applied - Thursday 02 July 2015 16:10

Primary author: SHARMA, Kashma *(University of the Free State)*
Co-authors: *KAITH, B.S. (NIT, Jalandhar, India); SWART, Hendrik (University of the Free State)*

In this work, the development of a biodegradable hydrogel based on interpenetrating network was carried out as a result of radical polymerization of aniline in a hydrogel matrix based on the Gum ghatti (Gg) and acrylic acid (AA). The graft copolymer based on Gg and AA was synthesized by grafting of poly(AA) chains onto Gg backbone using N,N'-methylene-bis-acrylamide and potassium persulphate as a crosslinker-initiator system. The characterization of the crosslinked hydrogels has been carried out by Time of flight secondary ion mass spectroscopy, Fourier transform infrared, X-ray diffraction and thermogravimetric analysis. The biodegradation of the crosslinked hydrogels was analysed using the composting soil method for a period of two months. The initial and final weight of the crosslinked hydrogels were compared as well as the percentage degradation was calculated. The ability of the synthesized hydrogels to be used as a colon-specific drug delivery system was performed at various pH using amoxicillin trihydrate as a model drug. The crosslinked hydrogel with the maximum percentage swelling was found to exhibit maximum drug absorption. Release of amoxicillin trihydrate from synthesized hydrogels was studied and evaluated kinetically.

33 - Simulating mechanical annealing of atomic-sized gold surfaces via classical molecular dynamics and density functional theory transport calculations

TCP - Wednesday 01 July 2015 11:10 *[For award: MSc]*

Primary author: DEDNAM, Wynand *(Physics department, University of South Africa)*
Co-authors: *SABATER, Carlos (Leiden University); FERNANDEZ, Miguel Angel (Universidad de Alicante); UNTIEDT, Carlos (Universidad de Alicante); PALACIOS, Juan Jose (Universidad Autonoma de Madrid); CATURLA, Maria Jose (Universidad de Alicante)*

The ability to probe interactions at the atomic level via scanning tunneling microscopy and other techniques has led to great interest in contact formation between atomic-sized metal electrodes [Agrait N et al. 2003 Phys. Rep. **377** 81]. For example, achieving ever smaller electronic circuit sizes is still a very important practical goal of nanotechnology [Lu Y et al. 2010 Nature Nanotechnology **5** 218]. In the present work, it is demonstrated by two complementary simulation techniques that atomic-sized gold surfaces can be sharpened reproducibly, or mechanically annealed, until they are stable and no longer change. Experimentally, stable sharp gold tips may be achieved by repeatedly indenting into a surface with the tip of a scanning tunneling microscope. Such a process can be simulated by classical molecular dynamics (CMD), which describes the dynamics of the gold atoms as the two atomic-sized surfaces make and break contact [Sabater C et al. 2012 Phys. Rev. Lett. **108** 205502]. To account for the interactions between the atoms in simulations, semi-empirical potentials fitted to various material parameters of the metals are used. The second simulation method, density functional theory (DFT) transport calculations [Palacios J J et al. 2002 Phys. Rev. B **66** 035322], serves to obtain the electronic properties of the CMD-simulated system, such as the transmission across the electrodes when they first make contact. This paper presents the CMD results of the repeated indentation of a gold tip into a flat gold surface, with and without adatoms on the surface beneath the tip. The quantized conductances of a large number of CMD snapshot configurations of these surfaces, at various points during the process of contact formation, are also presented. These results permit a better understanding and interpretation of the experimental observations.

38 - Non-universality of a constrained period doubling route to chaos for Rössler's system

TCP - Friday 03 July 2015 10:00

Primary author: BOTHA, André *(Unisa)*
Co-author: *THOMPSON, Craig (Unisa)*

Recently Botha and Dednam [1] demonstrated that periodic orbits exist through practically any point in the phase space of the well-known 3-dimensional Rössler system [2]. In some cases two or more distinct sets of the optimized parameters (which produce a particular periodic orbit) were found. These sets corresponded to two or more periodic orbits passing through a specific point in the phase space. Moreover, such sets could be ordered, in terms of their shortest period T, into an increasing sequence T, $2T$, $4T$, etc. At first glance the latter sequence appears to be an instance of the well known period doubling route to chaos. However, the fact that it is constrained (each periodic orbit in the sequence is constrained to pass through a precise point common to the whole sequence), raises the important question about whether or not the sequence obeys Feigenbaum's universal scaling laws [3,4]. Usually, in the Feigenbaum scenario, the variation of only one system parameter at a time is considered. In the present case, however, we found a period doubling route which followed a very tortuous path in the 3-dimensional parameter space of the system. For such paths the self-similarity and scaling laws of the Feigenbuam scenario were indeed violated, contrary to expectation. By using Poincaré sections, for example, we showed that the expected universal sequence of periodic windows could be fundamentally altered.

References

[1] Botha A E and Dednam W 2014 Proc. 59th Annual Conf. SAIP
[2] Rössler O E 1976 Phys. Lett. A **57**397
[3] Feigenbaum M J 1978 J. Stat. Phys. **19**25
[4] Feigenbaum M J 1979 J. Stat. Phys. **21**669

39 - Synchrotron Modelling of the gamma-ray to optical afterglow of GRB 130427A and expected neutrino flux

Astro - Thursday 02 July 2015 11:10 *[For award: PhD]*

Primary author: KAYYUNNAPARAYIL THOMAS, JESSYMOL *(UNIVERSITY OF JOHANNESBURG)*
Co-authors: *MOHRANA, Reetanjali (University of Johannesburg); RAZZAQUE, Soebur (University of johannesburg)*

GRB 130427A at redshift 0.34 is one of the brightest and most energetic long duration gamma-ray bursts ever detected. A 95 GeV photon, the highest energy ever detected from a GRB, has also been reported by the Large Area Telescope (LAT) on board the Fermi Gamma-ray Space Telescope. Simultaneous observations in the gamma-ray to X-ray to ultraviolet and optical frequencies make this GRB one of the most well-studied in history. We have modelled temporal evolution of flux in different frequencies and broadband spectral energy distribution at different time intervals by using optically thin synchrotron radiation from a relativistic blast wave expanding in a constant density interstellar medium and in a wind-type medium with density gradient. We find that the afterglow of GRB 130427A is better described in case of a wind-type medium. We also calculate expected neutrino flux from this GRB, if protons are accelerated to ultrahigh energies in the blast wave and interact with afterglow photons. Neutrino telescopes which are currently operating and are being planned for future will be able to detect this flux or constrain ultrahigh-energy cosmic-ray acceleration in GRBs.

40 - Computational Modelling Studies of Platinum Telluride Minerals

DPCMM - Tuesday 30 June 2015 11:10 *[For award: MSc]*

Primary author: SELOWA, Phatholo *(University of Limpopo)*
Co-author: *NGOEPE, Phuti (University of Limpopo)*

Besides being the important carriers of precious metals, telluride minerals are minor constituents in an ore deposits from a wide diversity of geological environments. In spite of the fact that these telluride minerals are of significant economic importance, not much has been done on their recovery. In this work density functional theory (DFT) method was employed to study the structural, energetic, electronic and mechanical properties of the $PtTe_2$ structure. In addition, the low Miller index {100}, {110} and {111} for $PtTe_2$ mineral were investigated. The calculated lattice constants of $PtTe_2$ structure are in a good agreement with the experimental data. The elastic properties satisfied all necessary conditions for mechanical stability. The surface {100} was found to be stable since it gave the lowest positive surface energy.

42 - Status of the measurements of Higgs boson properties with the ATLAS detector

NPRP - Tuesday 30 June 2015 15:20

Primary author: MELLADO, Bruce *(University of Wisconsin - Madison)*

The observation of a new particle consistent with a Higgs boson by the ATLAS and CMS experiments at the Large Hadron Collider (LHC) is now well established. With the approaching of the Run II data taking the analysis of Run I data is coming to a close. Measurements of Higgs boson properties with the ATLAS detector using Run I data are reviewed. This includes the measurement of the mass, compatibility of couplings and Spin/CP quantum numbers with the Standard Model, and the measurement of differential cross-sections. Long-term prospects of these measurements with the High-Luminosity LHC are also discussed. Prospects for Run II data taking are inferred.

43 - Probing new physics in the Higgs sector with effective field theories at the Large Hadron Collider

NPRP - Tuesday 30 June 2015 15:00

Primary author: MELLADO, Bruce *(University of Wisconsin - Madison)*
Co-authors: *RUAN, XIFENG (WITS); MARCH, Luis (University of the Witwatersrand)*

With the discovery of a particle consistent with a Higgs boson a new window of opportunity for searches for new physics opens up. These can be performed via precision physics or direct searches. The ATLAS and CMS experiments study the Higgs boson couplings to other particles assuming that their structure is the same as that predicted in the Standard Model. With the addition of new physics via higher dimensional operators, in the framework of an effective field theory, the structure of these couplings changes. The implications on the Higgs boson production rates and the differential cross-sections are discussed. Prospects for the sensitivity of the ATLAS and CMS experiments to these higher dimensional operators are also discussed. This includes measurements both at the level of decay and production. Direct searches for new physics in the Higgs sector includes searches for new bosons and signatures in association with the newly discovered boson. The search for the Higgs boson decaying into or produced in association with Dark Matter is particularly relevant. The significance of Run I results and prospects for Run II with regards to direct searches are also discussed.

44 - Search for the Higgs boson in the di-photon decay in association with intermediate missing energy with the ATLAS detector

NPRP - Thursday 02 July 2015 11:50 *[For award: MSc]*

Primary author: *LIAO, Shell-may (University of the Witwatersrand, School of Physics, 1 Jan Smuts Avenue, Braamfontein, Johannesburg, 2000, South Africa")*
Co-authors: *VON BUDDENBROCK, Stefan (University of the Witwatersrand); KAR, Deepak (University of the Witwatersrand); MELLADO, Bruce (University of Wisconsin - Madison); REED, Robert (University of Witwatersrand); RUAN, XIFENG (WITS); TOMIWA, Kehinde (University Of Ilorin); MARCH, Luis (University of the Witwatersrand)*

The ATLAS detector is a particle detector at the Large Hadron Collider (LHC) at CERN which is used to understand the Standard Model and to search for new physics. This is made possible through the production of highly energetic proton-proton collisions provided by the LHC. In Run I ATLAS reported the discovery of a "Higgs-like" particle through the detection of its decay products. The Higgs Boson plays a crucial role in the Standard Model, as it explains why elementary particles have mass. From the Run I data, the Higgs Boson transverse momentum spectrum does not seem to be completely consistent with the prediction from the Standard Model. This could be a hint of the production of a Higgs Boson in association with Missing Transverse Energy (MET). Missing energy is used to infer the presence of non-detectable particles such as the SM neutrino and Dark matter particles. For the upcoming Run II, the data will be analyzed using an improved MET definition. This new definition will be put in place to better fight the High Pileup and pave way for new physics discoveries. The status of the analysis for the search of the Higgs boson in association with intermediate MET using the di-photon decay is presented.

45 - A study of radiation damage in plastic scintillators using magnetic resonance techniques for the upgrade of the ATLAS detector

NPRP - Friday 03 July 2015 12:50 *[For award: MSc]*

Primary author: *PELWAN, Chad (University of Witwatersrand)*
Co-authors: *KEARTLAND, Jonathan (University of the Witwatersrand); LIAO, Shell-may (University of the Witwatersrand, School of Physics, 1 Jan Smuts Avenue, Braamfontein, Johannesburg, 2000, South Africa"); JIVAN, Harshna (University of the Witwatersrand); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); MADHUKU, Morgan (iThemba LABS); SEKONYA, Kamela (iThemba LABS (Gauteng)); MELLADO, Bruce (University of Wisconsin - Madison); JOUBERT, Daniel (School of Physics, University of the Witwatersrand)*

During the phase two upgrade of the Large Hadron Collider (LHC), various components of the accelerator and ATLAS detector are due to be replaced or upgraded to withstand the increase in instantaneous luminosity. The minimum bias trigger scintillator (MBTS) plastics located at $2.09 \leq |\eta| \leq 3.84$ on the EndCaps of the Tile Calorimeter (TileCal) in the ATLAS detector were subjected to ionizing radiation that allows them to track the trajectories and measure the energies of energetic particles. However, it is this interaction that causes structural damage within the polystyrene based MBTS plastics. The 6 MeV proton tandem accelerator at iThemba LABS, Gauteng is used to replicate the damage that the MBTS plastics are subjected to in the ATLAS detector in order to find a plastic scintillator type that could replace the one currently used. In order to understand structural damage, electron paramagnetic resonance (EPR) and nuclear magnetic resonance (NMR) are employed to detect structural defects in two grades of polystyrene based plastic scintillators and three grades of polyvinyl based plastic scintillators. A replication of the spectra seen by both magnetic resonance techniques will be attempted using a computational ab-intio approach. This should offer insight into the electronic structure of the plastic scintillators and how ionizing radiation causes structural damage to them.

47 - Characteristics and function of the South African national measuring standard for force.

Applied - Friday 03 July 2015 11:30

Primary author: *DLAMINI, Sipho (National Metrology Institute of South Africa)*

This paper describes the force comparator machine by which a national measuring standard for force is established. The design of the machine is described focusing on the mechanical structure of the force comparator. High-precision strain gauge load cells are at the heart of the force comparator machine. Characteristics of these force measuring devices are discussed. The process of calibration of load cells for industry using the comparator machine is explained and it is shown that it can be carried out to uncertainties as low as 0.03%.

48 - An analysis and quantification of typical errors in the deterministic calculational path for research reactor modelling

NPRP - Wednesday 01 July 2015 14:40 *[For award: MSc]*

Primary author: *GINA, Thembelani (University of Johannesburg, Necsa)*
Co-authors: *CONNELL, Simon (University of Johannesburg); GROENEWALD, Suzanne (Necsa); JOUBERT, Wessel (Necsa)*

The objective of this work is to analyse and quantify modelling errors introduced by approximations made in the deterministic calculational path. These approximations are introduced in order to make a model practically solvable with a diffusion code, and they are classified as follows: spatial homogenization, energy (spectral) condensation, diffusion approximation and environmental dependency. In this work, a two-node model consisting of a SAFARI-1 reactor fuel assembly next to a water node is modeled, because it is a typically encountered configuration and fairly sensitive to spatial and spectral approximations. The analysis and quantification of modelling errors introduced in the calculational path was performed. Errors introduced by the four approximations in the calculational path are quantified by investigating the effective multiplication factor (k-eff) and leakages as an integral measure of difference between two models. All calculations were performed with the transport codes NEWT and HEADE and the diffusion code MGRAC. This error analysis will help understand where to focus on improving the modelling accuracy for the deterministic approach to reactor modelling. Preliminary results indicated that for the fuel-water model, environmental dependency error and the diffusion approximation are the largest contributors to the total calculational error.

49 - The Influence of Increased Temperature on the Miscibility and Mechanical Properties of poly(2,5-benzimidazole) and polytetrafluoroethylene

TCP - Thursday 02 July 2015 16:10 *[For award: PhD]*

Primary author: *SQUARE, Lynndle (UWC)*
Co-authors: *MULLER, Theophillus (UWC); ARENDSE, Christopher (UWC)*

In this work molecular dynamics was used to study the effects of temperature on the miscibility and mechanical properties of two polymers found within the membrane electrode assembly (MEA) of a high temperature polymer electrolyte fuel cell. The polymers, poly(2.5-benzimidazole), (ABPBI), and polytetrafluoroethylene, (PTFE), are respectively, used as constituents of the membrane and ionomeric layers of the membrane electrode assembly. The temperature range considered is 298K to 383K. Of the two polymers, PTFE has the lower solubility parameter, which from the results, decreases by 6% as temperature increases. ABPBI solubility parameter decreases by 1% as temperature increases. The greater difference between these two values indicates that at elevated temperatures these two polymers are even more unlikely to mix. For the mechanical properties calculation, the molecular dynamics approach implements a constant strain algorithm. Polymers are subjected to a stress up to and including 2.0 GPa. The significance of this work is that it gives insight on the mechanical robustness of materials found within the MEA and confirms that unfavourable changes, such as miscibility, is unlikely to occur as temperature increases. The effect of elevated temperature on either property for ABPBI, using molecular dynamics, has not been reported before.

50 - Analysis of ionospheric response during geomagnetic storms for mid and low latitudes

Space - Thursday 02 July 2015 11:10 *[For award: PhD]*

Primary author: *MATAMBA, Tshimangadzo Merline (South African National Space Agency (SANSA) Space Science. And Rhodes University)*
Co-author: *HABARULEMA, John Bosco (South African National Space Agency (SANSA) Space Science. And Rhodes University)*

The ionosphere suffer major perturbations during geomagnetic storms called ionospheric storms. Ionospheric storms represent an extreme form of space weather which can have major effects on space-borne and ground based technological systems. Adverse conditions in the space environment can cause a disruption of satellite operations, communications, navigation, and electric power distribution grids leading to a variety of socio- economic losses. This research aims at performing a long term statistical analysis of ionospheric response during geomagnetic storms over the African mid and low latitudes. The statistical results will then be used in the classification or establish the physical mechanisms driving ionospheric dynamics over different latitude regions during disturbed conditions. The Disturbance storm time (Dst) index with a storm criterion of (Dst <= −50 nT) will be used to identify the geomagnetically disturbed conditions. A combination of ionosondes and GPS will provide the ionospheric data needed for the analysis. In addition, in this study we will investigate the statistics of ionospheric storm effects during geomagnetic storms as well as the physical mechanisms of the ionospheric storm effects. The study will also investigate the diurnal, seasonal and solar cycle dependence of the ionospheric storm effects. In addition, this study aims at investigating the contribution of the equatorial ionization anomaly (EIA) and the E×B drifts in determining ionospheric storm effects at different latitudes.

51 - Determining the effect of the solar cell band gap on power yield in southern African irradiance conditions

Applied - Thursday 02 July 2015 09:40 *[For award: MSc]*

Primary author: *WEBBER, Graham (University of Johannesburg)*
Co-author: *WINKLER, Hartmut (Dept. Physics, University of Johannesburg)*

Solar panel yield is determined both by the local available solar irradiance and the detector characteristics. The Shockley-Queisser limit is the theoretical limit of maximum efficiency of any single junction solar cell. It is based on the maximum possible yield for the band gap of the junction in question and not on any practical or manufacturing limits. To a first approximation this limit is calculated for the irradiance at the top of the atmosphere. A more accurate calculation requires considerations of the solar ray attenuation at the specific site of measurement. The contributions to the irradiance are not proportionally the same on the surface of the earth as at the top of the atmosphere, as different wavelengths of incident light are scattered and absorbed differently. As such the optimal band gap on the surface of the Earth will slightly differ from that obtained from the first order approximation. Due to the variability of atmospheric conditions with time and geographical position, this optimal band gap will also vary with time, location and orientation. This paper calculates the optimum band gap for site specific parameters, such as latitude, altitude and aerosol types, descriptive of southern African sites identified for solar power generation. The paper highlights the key factors that influence the band gap optimisation, which would assist in the research and development of more efficient solar cells, under southern African atmospheric conditions and allow for more accurate predictions to be made for local solar power yield.

52 - Why MnO_2 is used as a catalyst in Li-air batteries and not TiO_2

DPCMM - Tuesday 30 June 2015 10:00 *[For award: PhD]*

Primary author: *MAENETJA, Khomotso (University Of Limpopo)*

The Li-air batteries, also known as Li-O_2, promise to transform energy use this century as lightweight methods for storing electricity. Such batteries could be used to fuel electric automobiles and store the electricity generated by solar panels and wind turbines. A catalyst play an important role here; it has been shown that nanostructured MnO_2 in different polymorphic states are able to catalyse the formation and decomposition of Li_2O_2 in the cathode, thus decreasing the overpotentials required for the operation of the Li–air cell. The adsorption and co-adsorption of lithium and oxygen at the surface of rutile-like manganese dioxide (β-MnO_2) and (β-TiO_2) which are important in the context of Li–air batteries are investigated using density functional theory. In the absence of lithium, the most stable surface of β-MnO_2 and β-TiO_2, the (110), adsorbs oxygen in the form of peroxo groups bridging and mononuclear respectively. Conversely, in the absence of excess oxygen, lithium atoms adsorb on the (110) surface at two different sites, which are both tri-coordinated to surface oxygen anions. Surface (110) β-MnO_2 is energetically more stable than β-TiO_2 looking at surface free energy.

53 - NON-SPECIALIST LECTURE: Hyperbolic extra-dimensions in particle physics and beyond

TCP - Thursday 02 July 2015 14:00

Primary author: CORNELL, Alan (NITheP)

The nature of space-time at high energy is an open question and the link between extra-dimensional theories with the physics of the Standard Model can not be established in a unique way. The compactification path is not unique and supersymmetry breaking can be done in different ways. My talk shall try to tackle this problem the other way round starting from what is known from theory and experiment: the Standard Model contains chiral fermions, the dark matter content of the universe and the difference between the electroweak and Planck scale should be explained. Compactifications based on hyperbolic orbifolds gather a large number of properties that are useful for these problems, like a Dirac spectrum chiral zero modes, a mass gap with the Kaluza-Klein modes, discrete residual symmetries for the stability of dark matter, and interesting cosmological constructions.

54 - Estimating plasma drift velocities in the low latitude regions within the African sector.

Space - Wednesday 01 July 2015 15:00

Primary author: DUBAZANE, Makhosonke (SANSA Space Science)
Co-author: HABARULEMA, John Bosco (SANSA and Rhodes University)

Estimating plasma drift velocities in the low latitude regions within the African sector.M.B. Dubazane1, 2 and J.B. Habarulema1, 21. South African National Space Agency, P.O. Box 32, Hermanus, 7200, South Africa2. Department of Physics and Electronics, Rhodes University, P. O. Box 94, Grahamstown, South AfricaThe day-to-day variation of ionospheric wind dynamo current near magnetic equator has been known, from solar quiet current Sq studies, to be closely associated with variation of magnitude of horizontal geomagnetic field. In this study E x B plasma drift velocity is estimated from the horizontal magnetic field (H) measurements using a pair of low latitude magnetometers. The daytime phenomenon, equatorial electrojet current, is considered as the main driving mechanism responsible for variation of the inferred E x B plasma drift velocity. Based on the differential magnetometer approach, formulation of mathematical functions with potential to predict the E x B plasma drift velocity at different locations is presented and compared with other sources.

55 - Synthesis, structural and optical characterisation of cobalt (Co) and indium (In) co-doped ZnO nanoparticles

DPCMM - Tuesday 30 June 2015 11:30 *[For award: MSc]*

Primary author: MASWANGANYE, Mpho (Universtity of Limpopo)
Co-authors: RAMMUTLA, Erasmus (University of LImpopo); MOSUANG, Thuto (University of Limpopo); MAAZA, malik (Materials Research Department, iThemba labs); BERTRAND, Sone (Materials Research Department, iThemba labs); MWAKIKUNGA, Bonex (DST/CSIR National Centre for Nano - Structured Materials)

Co and In co-doped nanopowders of ZnO as well as In and Co singly doped ZnO were successfully prepared using sol-gel method. The synthesized samples were characterised using x-ray diffraction (XRD), UV-vis spectroscopy, Raman spectroscopy (RS), Transmission Electron Microscopy and EDS. The effects of Co and In co-doping on the structural and optical properties were investigated. XRD results showed no peaks associated with In3+ or Co2+ ions indicating that In3+ and Co2+ ions substituted for Zn2+ ions in the ZnO wurtzite structure. This was corroborated by the EDS results. Doping ZnO nanoparticles with In and Co significantly reduced the grain sizes whereas the lattice parameters were not significantly affected. TEM results confirmed that the nanoparticles were spherically shaped. Raman spectroscopy also confirmed that the ZnO nanoparticles were of a wurtzite hexagonal structure. Single doping reduced the energy band gaps and co-doping reduced them even further.

56 - PLENARY: Growth and physical properties of graphene mediated structures

Plenary - Wednesday 01 July 2015 08:40

Primary author: YAKIMOVA, Rositsa (Linkoping University)
Co-authors: KHRANOVSKYY, Volodymyr (Linkoping University); IAKIMOV, Tihomir (Linkoping University); MIKOUSHKIN, Valerii (Ioffe Institute); LEBEDEV, Alexandre (Ioffe Institute)

Graphene grown on SiC substrates may facilitate formation of novel heterostructures by enabling unique compositional diversity. In this talk we will focus on two material systems: graphene-ZnO and graphene-SiC, and will show new properties that are induced by the interaction of 2D graphene and wide bandgap semiconductors. Graphene was grown on SiC substrates by high temperature sublimation method.We report a key effect of graphene as a substrate on the light emission properties of thin ZnO films that are grown via quasi Van der Waals epitaxy. Unusually high UV PL was observed at r. t. from the ZnO/Gr/4H-SiC heterostructures in comparison to similar samples without graphene. The luminescence enhancement depends nonlinearly on the thickness of the ZnO, reaching its maximum - 360% for the film as thin as ~150 nm. The effect may be most probably related to exciton plasmon coupling at the ZnO/Gr interface. The reported phenomenon demonstrates the perspective of two-dimensional materials integration with wide band gap semiconductors and is important for the design of future light emitting devices.In the second graphene mediated structure we revealed quantum wells and quantum well levels. We showed that the structure in the valence band density of states near the Fermi level is described by the quantum well states whose number and energy position coincide with the calculated ones. This property may be an attribute not only of graphene (or few-layer graphene) on a wide-bandgap semiconductor substrate but also of graphene on dielectric and of suspended graphene. The QW state formation becomes possible in such a narrow quantum well due to the large electron/hole mass in the direction perpendicular to the graphene plane.

58 - The light bulb effect: University students' problem solving cognitive processes in a physics problem solving skills test

Edu - Wednesday 01 July 2015 14:20

Primary author: ALBERS, Claudia (WITS university)
Co-authors: CLERK, Douglas (University of the Witwatersrand); NAIDOO, Deena (University of the Witwatersrand)

The light bulb effect is a new physics problem solving cognitive process diagrammatic representation. This new representation was designed for the purpose of probing the question of what makes a problem difficult. It is used in this study, for the first time, as a way to analyse students' problem solving skills on entering a first year Physics major course, at the University of the Witwatersrand. Analysis of student written answers to a test designed to probe some essential problem solving skills revealed that students had difficulty with the algebraic manipulation of equations, understanding displacement and taking logical steps that are unfamiliar or not immediately obvious. In this representation, these are called 'light bulbs'. The more linked 'light bulbs' are required in reaching a solution to a problem, the more difficulty the students have with solving that problem. This diagrammatical representation thus suggests a way of determining the level of difficulty of any physics problem, through the determination of the number of cognitive skill links and the number of not obvious logical steps, required to solve a specific problem.

60 - Study of the interdiffusion in Ni/Cu multilayer thin films by Auger electron spectroscopy depth profiling

DPCMM - Tuesday 30 June 2015 10:20 *[For award: PhD]*

Primary author: YAN, XinLiang (University of the Free State)
Co-authors: LIU, Yi (Shantou University,China); SWART, Hendrik (University of the Free State); WANG, Jiang-Yong (Shantou University,China); TERBLANS, JJ (Koos) (UFS)

Multilayer thin films have been increasingly used in both basic research and applications because of their special physical properties that differ from those of the bulk materials and single-layer thin films.[1] Interdiffusion at the interfaces is one of the most important processes influencing the properties of a thin-film system. [2] Auger electron spectroscopy (AES) in combination with ion sputtering could be one of the most powerful methods for the determination of the interdiffusion coefficient for thin films. Recently, based on the so-called Maxing-Roughness-Information depth (MRI) model, a new method that fits a calculated AES depth profile to the entire measured AES depth has been proposed for extracting the interdiffusion parameters.[3] The interdiffusion upon annealing Cu/Ni multilayer structures at 325 ºC, 350 ºC and 375 ºC for 30 min has been studied by AES depth profiling. The Cu/Ni multilayer structures were deposited on a SiO2 substrate by means of electron beam evaporation in vacuum. After deposition the multilayer structures were annealed in vacuum. The measured AES depth profiles of the unannealed and annealed samples are quantitatively fitted by the MRI model and the interdiffusion parameters, pre-exponential factor D0 and activation energy Ea, have been extracted. The depth-dependence of the interdiffusion coefficient in the Cu/Ni multilayer structures is characterized. References:[1] I.J. Jeon, J.H. Hong, Y.P. Lee, J. Appl. Phys. 75 (1994) 7825.[2] R. Pretorius, T.K. Marais, C.C. Theron, Mater. Sci. Eng. Rep.10 (1993) 1 [3] J.Y. Wang, A. Zalar, Y.H. Zhao, E.J. Mittemeijer, Thin Solid Films 433 (2003) 92.

61 - Jet substructure: a discovery tool at the LHC

NPRP - Tuesday 30 June 2015 14:20

Primary author: KAR, Deepak (University of Witwatersrand)

Jets are the collimated bunches of hadrons measured in our detectors,created at high energy particle collisions. As we go to higher energies at the Large Hadron Collider (LHC), Higgs bosons, or yet undiscovered heavy particles are produced with very high energy and the decay products from these "boosted" particles tend to be contained in large radius jets. The internal structure of these jets is exploited to identify the original objects.In this talk, I will motivate the use of substructure techniques for probing new physics at the LHC. I will then discuss the recent ATLAS results onsubstructure measurements, including a very new and promising methodcalled "shower deconstruction".

64 - Selenization dependence of morphological, structural and electrical properties of Cu2ZnSn(S,Se)4 thin films deposited by one-step sputtering

DPCMM - Tuesday 30 June 2015 11:10 *[For award: PhD]*

Primary author: YIHUNIE, Moges Tsega (University of The Free State)
Co-author: DEJENE, F.B (University of The Free State)

Cu2ZnSn(S,Se)4(CZTSSe), a promising absorber material in solar cells, was prepared on Mo/glass substrate by using an environmental friendly and cost-effective process from a self-prepared single ceramic target. Successive selenization for the as-deposited film by radio frequency (RF) magnetron sputtering at a substrate temperature of 200 oC was performed at various temperatures between 400 °C and 600 °C for 1 h without using polluting chemicals or toxic gas. Hall measurements indicated that the as-doposited and selenized films were p-type semiconductor behavior. An improved grain size and crystal quality obtained for CZTSSe film annealed at 600 °C. The hole concentration increased from 1.06 to 2.4 × 1017 cm−3; the hole mobility increased from 2.82 to 6. 9 cm2V-1s-1; and resistivity decreased from 20.92 to 3.7 Ωcm as the precursor film selenized to 600 oC. Both variations can be ascribed to the larger grains with better crystallinity and decreased grain boundary density in the annealed film at 600 °C. An enhanced hole mobility is also important for the cell performance.

66 - A Portable ReadOut ModulE for Tilecal ElectrOnics (PROMETEO) test-bench for the certification of the Tile Calorimeter of the ATLAS detector

NPRP - Friday 03 July 2015 10:20

Primary author: *KUREBA, Chamunorwa Oscar (University of the Witwatersrand)*
Co-authors: *MELLADO, Bruce (University of the Witwatersrand); RUAN, XIFENG (University of the Witwatersrand); SPOOR, Matthew (University of the Witwatersrand); SANDROCK, Charles (University of the Witwatersrand); HOFSAJER, Ivan (University of the Witwatersrand); GOVENDER, Muruga (University of the Witwatersrand)*

The instantaneous luminosity of the Large Hadron Collider (LHC) is envisaged to be increased by up to 5-7 times after its upgrade in the year 2022. The High Luminosity LHC, also referred to as the upgrade Phase-II, will bring with it a mandatory complete re-design of the read-out electronics in the Tile Calorimeter (TileCal) of the A Toroidal LHC Apparatus (ATLAS) detect or. Here, the new read-out architecture is expected to have the front-end electronics transmit fully digitized information of the detector to the back-end electronics system. Fully digitized signals will allow more sophisticated reconstruction algorithms which will contribute to the required improved triggers at high pile-up. In Phase II, the current Mobile Drawer Integrity CheckKing (MobiDICK) test-bench will be replaced by the next generation test-bench for the TileCal superdrawers, the new PROMETEO (A Portable ReadOut ModulE for Tilecal ElectrOnics). Prometeo is a portable, high-throughput electronic system for full certification of the front-end electronics of the ATLAS TileCal. It is designed to interface to the fast links and perform a series of tests on the data to assess the certification of the electronics. The PROMETEO's prototype is being assembled by the University of the Witwatersrand and installed at CERN for further developing, tuning and tests. A presentation will be made on the overall design of the new PROMETEO, and how it fits into the TileCal electronics upgrade.

67 - Alpha particle scattering within the MCAS approach

NPRP - Thursday 02 July 2015 09:40

Primary author: *KARATAGLIDIS, Steven (University of Johannesburg)*
Co-authors: *SVENNE, J. P. (University of Manitoba, Canada); AMOS, Ken (university of Melbourne); CANTON, L. (INFN Senzione di Padova); FRASER, P. R. (Curtin University, Perth, Australia); PISENT, G. (University of Padova, Italy); VAN DER KNIJFF, D. (University o f Melbourne)*

One of the more effective tools for studying low-energy nucleon-nucleus scattering has been the Multi-Channel Algebraic Scattering (MCAS) method, which solves the coupled Lippmann-Schwinger equations in momentum space. A key aspect of the MCAS approach has been the consistent description of both bound (sub-threshold) and scattering states of the compound system, with a proper handling of the Pauli Principle. The method is not limited to the scattering of nucleons off nuclei, however. We have extended the approach to now include alpha-scattering, which is important in the understanding of nuclear reactions of astrophysical interest. We have also extended the formalism to include heavier mass (sd-shell) targets. Results will be presented for nucleon scattering from 18O and 22Ne, as well as alpha scattering from light targets, eliciting structure information for 20Ne.

69 - Single station TEC modelling during storm conditions

Space - Wednesday 01 July 2015 10:20 *[For award: MSc]*

Primary author: *UWAMAHORO, Jean Claude (SANSA Space Science and Rhodes University)*
Co-author: *HABARULEMA, John Bosco (SANSA Space Science and Rhodes University)*

It has been shown in ionospheric research that modelling total electron content (TEC) during storm conditions is a big challenge. In this work, we established mathematical equations to estimate TEC over Sutherland (32.38° S, 20.81° E), during storm conditions, using the Empirical Orthogonal Function (EOF) analysis method, combined with regression analysis. TEC was derived from GPS observations and the geomagnetic storm occurrence was defined for Dst ≤ -50 nT. The inputs for the model were chosen based on the factors that influence TEC variations such as diurnal, seasonal, solar and geomagnetic activity variations, and these were represented by hour of the day, day number of the year, F10.7 and A index respectively, during modelling. The model was developed using GPS TEC data from 1999-2013 and tested on different storms based on storm intensity. Before building the model, TEC values for storms on which the model was tested were removed from the dataset used to construct the model in order to make the model validation independent on data. Comparing the modelled TEC with the observed TEC, it was noticed that the model works well for storms with non significant ionospheric TEC response. High correlation coefficients between the observed and modelled TEC were obtained showing that the model covers most of the information contained in the observed TEC. Furthermore, it has been shown that the EOF model constructed over Sutherland can be used to model TEC variations from the closest GPS receiver stations. This is an important result as it reduces the data dimensionality problem for computational purposes. It may therefore not be necessary to compute TEC data for all the closest receiver stations for regional storm-time TEC modelling since most needed information can be extracted from measurements from one location.

70 - The PITSI neutron powder diffractometer at the SAFARI-1 Research Reactor

DPCMM - Thursday 02 July 2015 10:20

Primary author: *SENTSHO, zeldah (necsa)*
Co-authors: *HAYES, Michael (necsa); MARAIS, Deon (necsa); RAATHS, Christo (necsa); VAN HEERDEN, Rudolph (necsa); VENTER, Andrew (Necsa Limited)*

A new neutron powder diffractometer, named Powder Instrument for Transition in Structure Investigations (PITSI), has recently been built and commissioned at the SAFARI-1 Research Reactor. SAFARI-1 is a 20 MW light-water moderated tank-in-pool materials testing steady-state reactor that has an in-core flux of 4 ■ 10^14 neutrons cm^-2s^-1. Notwithstanding the growing demand to study an ever increasing mix of interesting materials with neutron powder diffraction, PITSI is the only such instrument available to the African neutron scattering community. PITSI has been developed as a medium resolution multipurpose instrument offering various wavelength options, with special attention paid towards maximising the available useful thermal neutron flux and having both high intensity and high resolution settings in one instrument. The latter is achieved by having a large double focused monochromator in conjunction with a large area detector and variable sample-to-detector distance. Special care was taken throughout to minimise the neutron background. This renders good peak-to-background ratio over the complete accessible two-theta range. The monochromatic flux at the sample position is 10^6 neutrons cm^-2s^-1. Data reduction is done with an in-house developed program ScanManipulator.Rietveld refinements of measured data from Si and Al2O3 standard powder using Topas 4.2 used for instrument calibration rendered a maximal resolution ∆d/d≈ 0.3 %. Quantification studies of chemical phase content have been completed for a number of multi-phase samples to complement X-ray powder diffraction (XRPD) studies. In these cases the neutron results provided substantial additional information largely owing to its ability for bulk analyses and not suffering the form factor fall off of XRPD. Incorporating the ancillaries, a number of in-situ temperature dependent studies have been completed.PITSI can add significant value to different scientific disciplines.

74 - Fibre Bragg grating sensor to measure shrinkage in a concrete overlay.

Photonics - Tuesday 30 June 2015 14:00

Primary author: *VAN ECK, Shaun (University of Johannesburg)*
Co-authors: *COETZEE, Werner (University of Johannesburg); GROBLER, Michael (University of Johannesburg); VANNUCCI, Megan (University of Johannesburg); MARTINEZ MANUEL, Rodolfo (University of Johannesburg); BESTER, Jannes (University of Johannesburg)*

Concrete shrinkage of large flat surfaces, such as concrete overlays in parking lots or warehouse flooring, leads to costly rework, repairs and safety hazards. Shrinkage affects the structural performance, causing cracking and curling, which is not only aesthetically undesirable but also provides ingress points for water and other chemicals that can deteriorate the overlay. It is necessary to quantify the shrinkage so that preventive and corrective measures can be taken to ensure quality overlays.Concrete shrinkage is conventionally measured using electrical resistance strain gauges and mechanical strain gauges. In this study, embedded Fibre Bragg Gratings (FBG's) used as optical sensors, were investigated as an alternative to conventional measuring methods.FBG's used as strain and temperature sensors were embedded into a square concrete overlay. The strain FBG sensors were pre-stressed to accommodate for shrinkage of the concrete. Steps were taken to compensate for the effects of temperature on the FBGs. Three specimens were produced to record data over a 10 day period and the results were compared with a conventional strain gauge (CSG). It was found that the FBG's were more sensitive than the CSG over the first 6 days but converged to the same total shrinkage at the end of the measuring period, thus demonstrating the feasibility of using FBGs to measure shrinkage in concrete overlays.

75 - Fibre Optic Temperature Measurement Sensors for a Robotic Hand

Photonics - Tuesday 30 June 2015 14:20

Primary author: *MOORCROFT, Ronald (University of Johannesburg)*
Co-authors: *VANNUCCI, Megan (University of Johannesburg); GROBLER, Michael (University of Johannesburg); MARTINEZ MANUEL, Rodolfo (University of Johannesburg)*

Robotic applications are found in both commercial and everyday environments. The Photonics Research Group at the University of Johannesburg is currently researching the use of optical sensors in robotics. In this paper optical temperature sensors are developed for use in a robotic arm. Optical sensors have many benefits including immunity to electromagnetic noise, high sensitivity, low propagating losses, small size and the possibility of multiplexing many sensors in a single fibre. A Fibre Bragg Grating (FBG) was chosen to perform the temperature sensing. For each degree Celsius of temperature change, there was a wavelength shift of 9.2pm in the reflected Bragg wavelength. To increase the sensitivity of the sensor the fibre was glued to a thin copper strip. The expansion coefficient of the copper and of the glue used was higher than that of the germanium doped silica core of the optical fibre, thus causing a greater shift in the Bragg wavelength as the temperature increased. When the fibre was glued to a piece of copper, the sensitivity of the FBG intensified and for each degree Celsius change there was an average 92pm shift in the Bragg wavelength. This thus increased the sensitivity of the FBG temperature sensor by 10 times, providing results sufficiently accurate for temperature measurement. The sensor was tested in a temperature range of -15 °C to 85 °C and provided real time results.

76 - Relativistic Quantum Mechanics On Non-commutative Space

TCP - Tuesday 30 June 2015 11:50 *[For award: MSc]*

Primary authors: *WILLIAMS, Paul Henry (Stellenbosch University); SCHOLTZ, Frederik (National Institute for Theoretical Physics)*

The Hilbert-Schmidt operator formulation of non-relativistic, non-commutative quantum mechanics is generalized to the relativistic setting of 4-dimensional non-commutative space-time. The generators of Lorentz transformations are derived in this formalism and compared with the commutative case. It is shown that the non-interacting, non-commutative Dirac equation is Lorentz invariant. Lorentz invariance can be maintained when electromagnetic interactions are included provided that the gauge and Dirac fields are composed through an appropriate star product. The non-commutative C, P, T symmetries of the interacting Dirac equation are investigated. The free Dirac equation and the interacting Dirac equation for the case of a constant background magnetic field are studied. Systems confined to a specific space-time volume, and the associated boundary conditions, are studied using appropriate projection operators. As a specific example the Dirac equation in an infinitely long cylinder is considered. An operator valued action, which yields the interacting Dirac equation as the equation of motion, is derived and evaluated in a coherent state basis. This establishes the link to the standard star product formulation of non-commutative quantum field theories.

77 - Gene Expression Changes in Diabetic Wound Healing as Induced by Photobiostimulation *in vitro*

Photonics - Tuesday 30 June 2015 11:10 *[For award: PhD]*

Primary author: *AYUK, Sandra, M. (University of Johannesburg)*
Co-authors: *ABRAHAMSE, Heidi (University of Johannesburg); HOURELD, Nicollette N (University of Johannesburg)*

Diabetes Mellitus (DM) is a complex metabolic disorder resulting in hyperglycaemia. Impaired wound healing and eventual foot amputation is one of serious complications of diabetes, and is a severe public health problem. Photobiostimulation, Phototherapy or Low intensity laser irradiation (LILI) is a non-invasive form of treatment known to enhance healing of such wounds using lasers at low energy. This study aimed to evaluate the role of photobiostimulation at 830 nm on diabetic wounded fibroblast cells *in vitro* and extracellular matrix (ECM) gene expression. **Method** : Normal (N-unstressed), normal wounded (NW-stressed) and diabetic wounded (DW-stressed) fibroblasts were incubated for 48 h after irradiation using a continuous wave diode laser at a wavelength of 830 nm with 5 J/cm ^{2}. Non-irradiated (0 J/cm ^{2}) N and DW-cells were used as controls. The gene expression profile (84 genes) was assessed using an ECM real-time reverse transcription polymerase chain reaction with the appropriate controls included. **Results**: Sixty one genes were significantly regulated (55 up-regulated and 6 down-regulated) in N-cells; 40 genes (20 up-regulated, and 20 down regulated) in NW-cells and 42 genes (9 up-regulated and 33 down-regulated) in DW-cells. Several genes were down-regulated in DW cells as compared to N and NW. **Conclusion** : Photobiostimulation modulated the expression of important genes in wound healing including cell adhesion molecules, integrins, ECM proteins, proteases, and inhibitors involved in the ECM. An in depth comprehension of the molecular and biological aspect may create an improved therapeutic protocol for diabetic wounds.

78 - GPU-based Computation of Energy and Time for the Upgrade of the Tile Calorimeter of the ATLAS Detector"

NPRP - Thursday 02 July 2015 10:20 *[For award: MSc]*

Primary author: *SACKS, Marc (University of the Witwatersrand)*
Co-author: *MELLADO, Bruce (University of Wisconsin - Madison)*

After the 2022 upgrade of the Large Hadron Collider, increased running luminosity will necessitate the redesign of the front-end and back-end detector electronics. The Tile Calorimeter (TileCal) is a hadronic sub-detector, forming part of the larger general-purpose ATLAS detector. TileCal will be generating 40 Tbps of raw data which will be read by super read-out drive (sROD) modules. The sRODs are responsible for some preliminary processing of data with an optimal filtering algorithm. This includes energy computation, time reconstruction (and associated quantities), as well as distributing this data downstream. To increase the processing capabilities of the sROD, to relieve it of certain computational burdens, and to allow for a more accessible coding platform; an ARM-based co-processing unit (PU) is being developed at the University of the Witwatersrand. This project involves identifying how the use of massively parallel computing with GPUs can be integrated into the PU to facilitate its goals with regard to the sROD, for instance implementing the optimal filtering algorithm on a GPU platform. An ARM-GPU based PU could find further application in other high-volume scientific computing environments.

80 - Communication through fibres using cylindrical vector vortex modes.

Photonics - Thursday 02 July 2015 14:40 *[For award: MSc]*

Primary author: *NDAGANO, Bienvenu (University of the Witwatersrand)*
Co-authors: *MCLAREN, Melanie (University of the Witwatersrand); FORBES, Andrew (CSIR)*

Optical fibres have become, over the years, widely used in telecommunications because of their low loss and high bandwidth. In this study we explore ways in which to increase the bandwidth that are not currently used in fibre communication. Our work demonstrates that using the natural spatial modes of optical fibres, we can effectively encode and decode digital information. This is made possible by using the quantised orbital angular momentum (OAM) density of the fibre modes. The OAM density spans an infinite dimensional Hilbert space allowing, in theory, for an infinite amount of information to be communicated. We demonstrate the generation and detection of both scalar and vector vortex modes. These cylindrical vector vortex modes are close approximations to the natural fibre modes and exhibit non-separability between azimuthally symmetric polarisation and the spatial mode distribution. Further, we show that these modes are more robust in carrying information through fibres as they maintain their polarisation state and OAM density.

83 - Characterisation of potential cluster states in 16O

NPRP - Friday 03 July 2015 12:30 *[For award: MSc]*

Primary authors: *LI, Kevin (Stellenbosch University, iThemba Labs); PAPKA, Paul (Stellenbosch University); NEVELING, Retief (iThemba LABS); ADSLEY, Phillip (Stellenbosch University, iThemba Labs)*
Co-author: *SMIT, Frederick David (iThemba LABS)*

A notable candidate for alpha clustering is the 15.097 MeV 0+ state in 16O, observed above the 4-■■α threshold at 14.437 MeV. This state is predicted using several theoretical formalisms such as the OCM (Orthogonality Condition Model) and TSHR (Tohsaki-Horiuchi-Schuck-Röpke) approaches. The decay path of this state has been characterised using inelastically scallered α-particles at zero-degrees with a silicon detector array at backward angles.

84 - Comparison of optical and luminescence properties of as prepared and annealed ZnO nanoparticles synthesized using sol-gel method.

DPCMM - Tuesday 30 June 2015 11:50 *[For award: MSc]*

Primary author: *UNGULA, Jatani (University of the Free State)*
Co-author: *DEJENE, Francis (University of the Free State)*

ZnO nanoparticles were synthesized using sol-gel method. The influence of the annealing temperature on the structural, morphological and optical properties of ZnO nanoparticles is studied. The properties were investigated using X-ray diffraction (XRD), scanning electron microscopy (SEM), photoluminescence (PL), Uv-Vis spectroscopy and EDS. XRD analysis demonstrates that the crystallinity of ZnO is improved with annealing for all growth temperatures as indicated by narrower and more intensified diffraction intensities of the annealed ZnO compared to that of the as prepared particles. The average crystallite sizes of the ZnO particles increased from 29.9 nm to 33.3 nm with annealing for the selected growth temperatures indicating the tendency of large grain growth in the nanoparticles due to annealing. SEM micrographs showed that annealed ZnO nanoparticles aggregated and became larger in diameter compared to its as prepared counterparts. The EDS analyses, for as prepared and annealed samples indicate the purity of all the synthesized samples with no peaks other than Zn and O. Annealing at 600 oC quenches the blue defect level emission but enhances the excitonic peak emission. The photoluminescence peak intensity ratios of ultraviolet to that of visible emission (UvPL/ VisPL) are found to increase on annealing. The UvPL/ VisPL intensities ratio range between 0.9-2.4 for the as prepared samples and 5.0-7.1 for annealed samples. Quenching of visible emission on annealing is known to be responsible for this. The red shift in both the visible and UV emission with increasing particle size due to annealing closely follows the red shift in the band edge emission, indicating that the two complement each other. The average band gap is observed to decrease from 3.25 eV to 3.22 eV with the increase in crystallite sizes occasioned by annealing.

85 - Exciton energies of chalcopyrites AgAlX2 (X=S,Se,Te) from GW and BSE calculations

DPCMM - Tuesday 30 June 2015 11:30 *[For award: PhD]*

Primary author: *DONGHO NGUIMDO, Guy Moise (University of the Witwatersrand)*
Co-authors: *JOUBERT, Daniel P. (University of the Witwatersrand); ABDULSALAM, Mahmud (University of Witwatersrand)*

Using state-of-the-art Density Functional and Many Body Perturbation Theories, we study electronic and optical properties of the chalcopyrites AgAlX 2 (X=S,Se,Te). The Kohn-Sham Density Functional Theory (DFT) underestimates the fundamental and the optical gaps as a result of theparticle number dependant discontinuity in the exchange-correlation potential. Accurate estimates of fundamental gaps were obtained using post DFT Many Body Perturbation Theory at the GW level. Optical absorption spectra and optical gaps were determined from solutions of the Bethe- Selpeter Equation (BSE) in the Tamm-Damcoff approximation. Comparison of the BSE and the GW results were used to obtain exciton energies. The GW-level calculated bandgaps are in good agreement with experimental values. Exciton energies were estimated for the first time but we couldn't find any theoretical or experimental results for comparison .

86 - Structural, electronic and thermal properties of Sn clathrates

TCP - Wednesday 01 July 2015 11:30 *[For award: MSc]*

Primary author: *EGBELE, Peter (University of the Witwaterrand, Johannesburg. South Africa)*
Co-authors: *SHOKO, Elvis (PSE Division, King Abdullah University of Science & Technology, Thuwal 23955-6900, Kingdom of Saudi Arabia); JOUBERT, Daniel (University fo the Witwatersrand, Johannesburg, South Africa)*

Sn clathrates are promising "phonon glass, electron crystal" materials[1], in which the phonon free paths are short and the electron free paths are long. We analysed the relaxed structure of Sn clathrates using four different Density Funtional Exchange-Correlation functionals. The phonon structures were investigated as a first in the effort to determine the phonon contribution to the thermal conductivity. We determined the Seebeck coefficient and electrical conductivity of the clathrate compound and the Thermo Electric figure of merit. A peep into the dynamics of the system for the evaluation of the thermoelectric and electronic properties is presented.[1]Slack, G.A. , 1995, in CRC Handbook of Thermoelectrics, edited by D.M. Rowe (CRC Press, Boca Raton, FL), pp. 407-440

87 - Investigating the excited electronic states of carotenoids in the main plant light-harvesting complex (LHCII) via femtosecond pump-probe spectroscopy

Photonics - Friday 03 July 2015 09:40 *[For award: MSc]*

Primary author: SINGH, Asmita *(University of Pretoria)*
Co-author: *KRÜGER, Tjaart (University of Pretoria)*

Natural photosynthesis is the chief energy storing process on earth. The photosynthetic light-harvesting apparatus of a plant switches rapidly between a highly efficient light-harvesting function and a very efficient photoprotective state. The natural photosynthetic apparatus consists of a complex network of membrane-bound pigment-protein complexes. In the main plant light-harvesting complex (LHCII), the protein-bound pigments (viz. chlorophylls and carotenoids) capture the solar photons and transfer the electronic excitation energy (on an ultrafast timescale) to neighbouring complexes and eventually to the reaction centre, where a charge separation is initiated. These ultrafast processes form the basis of the high efficiency of light harvesting and temporal storage of the harvested energy. Plants are self-protected against the adverse effects of over-illumination by activating a number of processes that collectively give rise to non-photochemical quenching (NPQ). The role of carotenoids in NPQ is not fully understood. Investigations of the excited-state dynamics of LHCII carotenoids in spinach leaves were conducted upon intensity-dependent, selective carotenoid excitation at 489 nm (primarily Lutein1 and Neoxanthin) and 506 nm (mainly Lutein2 and Violaxanthin), using femtosecond transient absorption (TA) pump-probe spectroscopy. A robust analysis technique, known as Global and Target Analysis, was applied on the TA spectra to resolve the transfer rates and decay lifetimes of the various transiently induced photoproducts. Differences in the excitation kinetics due to experimental variations (i.e. different pump wavelengths and intensities) will be discussed in the context of the carotenoids' involvement with NPQ.

88 - Ionospheric pre-geomagnetic disturbance enhancements over African equatorial and midlatitude regions

Space - Wednesday 01 July 2015 15:20 *[For award: PhD]*

Primary author: ORFORD, Nicola *(South African National Space Agency)*
Co-author: *KATAMZI, Zama Thobeka (South African National Space Agency)*

The ionosphere is used to reflect high frequency radio signals. In addition, the behaviour of the ionosphere can affect satellites and power grids. The behaviour of both the ionosphere and the magnetosphere as well as the interaction of these two regions is strongly affected by solar activity. The response of the ionosphere to geomagnetic disturbances has been widely studied. A phenomenon which sometimes accompanies ionospheric storms is known as a pre-storm enhancement and this reaction of the ionosphere has not been as deeply studied as ionospheric storms themselves.Studies over European latitudes have revealed that pre-storm enhancements accompany approximately 20% of strong storms and occur during both day and night times - with occurrences seen more frequently in winter months. The mechanism behind these pre-storm enhancements remains unknown. We are exploring this phenomenon over African equatorial and mid-latitude regions in an effort to further understand this phenomenon and to explore its potential in predicting strong ionospheric storms. In particular, we explore three storm periods, namely 11-17 May 2005, 27 September – 3 October 2012 and 14-19 March 2013, using both GPS and ionosonde data.

90 - Nuclear structure studies in the A=136 mass region using transfer reactions.

NPRP - Tuesday 30 June 2015 10:20 *[For award: PhD]*

Primary author: REBEIRO, Bernadette *(University of the Western Cape)*
Co-authors: *TRIAMBAK, Smarajit (University of the Western Cape); HERTENBERGER, Ralf (Technische Universität München); WIRTH, Hans (Technische Universität München); GARRETT, P. E. (University of Guelph); BALL, Gordon (TRIUMF); RAND, Evan (University of Guelp h); BILDSTEIN, Vinzenz (University of Guelph); BURBADGE, Christina (University of Guelph); VARELA, Alejandra (University of Guelph); RADICH, Allison (University of Guelph); FAESTERMANN, Thomas (Technische Universität München)*

Presently there is a great deal of interest to experimentally observe neutrinoless double beta (0νββ) decays. This exotic decay mode can only be observed in a few isotopes over the nuclear chart. An observation of 0νββ decay would signify physics beyond the standard model and the decay rate can be used to determine the absolute scale of neutrino masses. A major difficulty in extracting the effective neutrino mass from the decay lifetime arises from the uncertainties associated with the matrix element calculated for the decay. One of the most promising candidate for observing this decay mode is the decay of ^{136}Xe to ^{136}Ba. There are several experiments planned world-wide to observe the 0νββ in ^{136}Xe. In this talk I present preliminary results from the ^{138}Ba(d,a) reaction used to study low lying excited states in ^{136}Cs, which is the intermediate nucleus in ^{136}Xe 0νββ decay. I will also discuss future plans to study neutron pairing in the daughter ^{136}Ba nucleus via the ^{138}Ba(p,t) reaction using the same approach. Our results will provide useful spectroscopic information for the matrix element calculations in this mass region.

92 - Rutherford Backscattering Analysis using lithium ions.

Applied - Wednesday 01 July 2015 11:10

Primary authors: DERRY, Trevor *(University of the Witwatersrand); MADHUKU, Morgan (iThemba LABS)*
Co-author: *MILLER, Tony (iThemba LABS (Gauteng))*

In the absence of beams of the more usual helium ions or alpha-particles, lithium-7 ions of a few MeV are being used on the Tandem accelerator at iThemba LABS (Gauteng) for carrying out Rutherford backscattering analyses. Their extra mass and charge are found to make very little difference in terms of target mass and depth resolution. A series of experiments to calibrate the implantation doses delivered by the "new" ion implanter, is described.

93 - Search for a Neutral MSSM Higgs bosons in the tau-tau final state in early Run II collision data at ATLAS

NPRP - Tuesday 30 June 2015 14:00 *[For award: PhD]*

Primary author: HAMITY, Guillermo *(Honours Physics Student)*

In it's scheduled Run-II phase the LHC will run at unprecedented centre of mass energies. High energy pp collisions will offer competitive sensitivity even at low integrated luminosities, motivating many searches to produce results early on in Run-II. Due to very different conditions from Run-I adapting analysis strategies from Run-I to Run-II is non-trivial. The progress/results of a search for the neutral Higgs bosons of the Minimal Supersymmetric Standard Model (MSSM) decaying to tau leptons is reported. The analysis is based the early sample of proton-proton collisions in Run-II

94 - Characterization of the Multipath Environment of Ionospheric Scintillation Receivers

Space - Wednesday 01 July 2015 14:40 *[For award: MSc]*

Primary author: ATILAW, Tsige *(SANSA and University of Cape Town)*
Co-authors: *CILLIERS, Pierre (SANSA); MARTINEZ, Peter (University of Cape Town)*

Global Navigation Satellite Systems (GNSS) are used to provide information on position, time and velocity all over the world at any time of the day. Accuracy of the output or even the availability of the system depends on the current condition of space weather, which can contribute to the random fluctuation of the received signal's phase and amplitude called scintillation. Severe ionospheric scintillation due to multipath effect can lead to cycle slip and loss of lock on the satellite or degradation in the accuracy of position determination. Interference of GNSS signals that are scattered and diffracted by stationary objects on the ground, with signals that travel along a direct path via the ionosphere to the antenna, will contribute to the errors in the measured amplitudes and phase. These are known as multipath errors. Higher elevation cut off angles used for filtering GNSS signals, usually 15-30°, can eliminate non-ionospheric related interference especially multipath errors that are coming from the horizon. At the same time, a fixed elevation threshold can result in significant loss of valuable data since this method does not take into consideration the surrounding environment of each GPS station. In this project we studied the multipath environment of Gough Island GISTM receiver antenna installed by SANSA (South African National Space Agency) by plotting azimuth-elevation maps of scintillation indexes averaged over one year. This was used to identify objects that regularly scatter signals and cause high scintillation resulting from multipath effects. After identifying the multipath area from the azimuth-elevation map, an azimuth dependent elevation threshold was developed using MATLAB curve fitting tool. Using this method we are able to reduce the multipath errors without losing important data. The azimuth dependence elevation threshold typically gives 19 % more useful data than by using 20° fixed elevation threshold.

95 - Acceleration of galactic electrons at the solar wind termination shock and their journey beyond

Space - Thursday 02 July 2015 10:20 *[For award: MSc]*

Primary author: PRINSLOO, Phillip *(North-West University)*
Co-authors: *POTGIETER, Marius (North-West University); STRAUSS, Du Toit (North-West University); WEBBER, Bill (New Mexico State University)*

Prior to traversing the heliosheath and finally crossing the threshold at the heliopause into the local interstellar medium, Voyager 1 detected spurious dual-peaked increases in low-energy (2.5-14 MeV) electron intensities in the vicinity of the solar wind termination shock. Since the termination shock is a known site for diffusive shock acceleration, it is considered likely that it is the mechanism responsible for creating the aforementioned intensity features. To explore this notion, a numerical cosmic-ray modulation model accounting for the effects of diffusive shock acceleration is implemented. The model is equipped with a new heliopause spectrum, constructed from observations from both Voyager 1 and satellite-borne detectors, such as PAMELA, and employs diffusion coefficients that are able to account for the remarkable decline of electron intensities inward across the heliosheath. The spectral features of diffusive shock acceleration are studied and the dependence of this mechanism on the shock compression ratio, electron drifts, and diffusion is illustrated. The features of re-accelerated galactic electrons exhibit that diffusive shock acceleration may easily account for the magnitude of the spurious intensity increases observed by Voyager 1, while their narrow spatial extent may be reproduced by simulating turbulent, low-diffusion conditions at the termination shock. The global progression of electron intensities, and their distribution with energy, is recreated along the complete Voyager 1 trajectory in the outer heliosphere.

96 - An Integrated Software Based Analytical Model for the Signal Path Efficiency of the HartRAO Lunar Laser Ranger Optical System

Space - Thursday 02 July 2015 11:50 *[For award: PhD]*

Primary author: *NDLOVU, Sphumelele (Hartebeesthoek Radio Astronomy Observatory, University of KwaZulu-Natal)*
Co-authors: *COMBRINCK, Ludwig (Hartebeesthoek Radio Astronomy Observatory, University of KwaZulu-Natal, University of Pretoria); NKOSI, Nokwazi (Hartebeesthoek Radio Astronomy Observatory, University of KwaZulu-Natal); BOTHA, Roelof (Hartebeesthoek Radio Astronomy Observatory)*

The Lunar Laser Ranger (LLR) system under development at HartRAO will accurately measure the Earth-Moon distance by the use of laser pulses. We would like to ensure that the transmitted pulses reaches the retro-reflectors located on the Moon and a signal is returned to the Earth-fixed receiving telescope. We start by discussing the hardware components and software used in HartRAO's LLR system to achieve optimal signal path efficiency. This includes thorough descriptions of the laser source, optical components used throughout the coudé path, atmospheric transmission efficiency and retro-reflector's optimal reflectance value. The use of the link budget equation in this work estimates the number of photons that are expected to be received; this result has a direct relationship with total system efficiency. An integrated model for HartRAO's LLR is an essential tool to enable optimal signal path (optical and electrical) efficiency and is useful in estimating the expected number of photon returns for given observational parameters. An improved system will reduce adverse effects (beam divergence) on the transmitted laser beam that result from atmospheric thermal and density fluctuations. Adverse effects cannot be easily minimised, therefore the software based analytical model for HartRAO's LLR will enable evaluation of specific portions of the receive and transmit path, as well as certain atmospheric parameters. This will lead to an understanding of the effects of the numerous variables on the total system efficiency.

98 - Structural and magnetic properties of $NiFe_2O_4$/NiFe bi-magnet and NiFe nano-alloy synthesized from thermal reduction of $NiFe_2O_4$

DPCMM - Tuesday 30 June 2015 11:50 *[For award: PhD]*

Primary author: *EZEKIEL, ITEGBEYOGENE (UKZN)*
Co-authors: *THOMAS, Moyo (ukzn); ABDALLAH, Hafiz (ukzn)*

Bi-magnetic $NiFe_2O_4$/NiFe nanocomposites and NiFe nano-alloy were synthesized by reduction of $NiFe_2O_4$ nano-ferrite with activated charcoal (*nc*) in flowing high purity Ar gas atmosphere at 900 °C for 3 hours. The parent $NiFe_2O_4$ nano-ferrite was synthesized by a glycol-thermal method at 200 °C. Partial and complete reduction yielded $NiFe_2O_4$/NiFe nanocomposites and NiFe nano-alloy respectively. NiFe was formed at an optimum amount of *nc* = 5. Phase identification, morphology and magnetic properties of the samples were performed by XRD, HRSEM, HRTEM, ^{57}Fe Mössbauer spectroscope and a mini cryogenic-free system. The parent sample has an average crystallite size of about 10 nm, an XRD density of about 5.3 g/cm^3 and an average lattice parameter of (*a*) = 8·362±0·007Å. The NiFe nano-alloy exhibited the martensite bcc (α-Fe) and austenite fcc (γ-Fe) phases in coexistence. Fitted Mössbauer analysis for *nc* = 5 and 6 show high hyperfine magnetic fields associated with the bcc phase while the lower field component is associated with the fcc phase of NiFe nano-alloy. The saturation magnetization increased significantly from 57 emu/g to 141 emu/g at room temperature. The saturation magnetization is enhanced at low temperatures with a maximum of 161 emu/g at ≥ 30 K. However, the coercivity showed no significant increase at low temperatures. Keywords: Nano-ferrite; Nano-alloy; Nanocomposites; Activated charcoal; martensite; austenite; Reduction reaction

99 - Comparative study of proton induced radiation damage in plastic scintillators for the Tile Calorimeter of ATLAS

NPRP - Friday 03 July 2015 11:30 *[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); LIAO, Shell-may (University of the Witwatersrand); MADHUKU, Morgan (iThemba LABS); SOLOVYANOV, Oleg (European Organization for Nuclear Research (CERN)); SEKONYA, Kamela (iThemba LABS (Gauteng))*

The Tile Calorimeter of the ATLAS detector, is a hadronic calorimeter responsible for detecting hadrons as well as accommodating for the missing transverse energy that result from the p-p collisions within the LHC. Plastic scintillators form an integral component of this calorimeter due to their ability to undergo prompt fluorescence when exposed to ionising particles. The scintillators employed are specifically chosen for their properties of high optical transmission and fast rise and decay times which enable efficient data capture since fast signal pulses can be generated. The main draw-back of plastic scintillators however is their susceptibility to radiation damage. The damage caused by radiation exposure reduces the scintillation light yield and introduces an error into the time-of flight data acquired. During Run 1 of the LHC data taking period, cryostat scintillators in the GAP region of the Tile Calorimeter were exposed to a radiation environment of up to 10 kGy/year. With operational beam energy and luminosity set to increase in successive data taking periods to come, these scintillators will be exposed to a much harsher radiation environment. Hence these scintillators will be replaced during the 2018 detector upgrade. A comparative study was therefore conducted into the radiation hardness of several PVT and PS based plastic scintillators available on the market. In this talk, we present an analysis of the damage undergone after subjecting 350 µm thick samples to 6 MeV proton irradiation using the tandem accelerator of iThemba LABS, Gauteng. The degradation in scintillation light yield and light transmission is assessed for doses ranging between 800 kGy to 80 MGy, and a Raman characterisation of the change to bonding structure is presented. The effect of irradiation dose rate to damage is also presented.

100 - Synthesis of porous carbon nanosheets for use in high rate capability and long cycle life supercapacitors

Applied - Thursday 02 July 2015 16:50

Primary author: *DANGBEGNON, Kouadio Julien (University of Pretoria)*
Co-authors: *BELLO, Hakeem (University of Pretoria); MOMODU, Damilola (University of Pretoria); BARZEGAR, Farshad (University of Pretoria); MASIKHWA, Tshifhiwa (University of Pretoria); TAGHIZADEH, Fatimeh (University of Pretoria); MADITO, Jack (University of Pretoria); MANYALA, Ncholu (University of Pretoria)*

Carbon-based supercapacitors are known to suffer from electrode kinetic problems that are related to the limitation of electrolyte ions penetrating the inner pores of an electrode, which should in principle improve the rate capacity in such supercapacitors. This issue still remains an ongoing challenge [1]. In this work we report a simple method to fabricate porous carbon nanosheets by carbonization of poly(vinyl alcohol) (PVA) mixed with different mass of nickel chloride hexahydrate (NiCl2.6H2O). The final product of this simple method was carbon nanosheets decorated with few layers graphene. Specific surface area above 1000 m2g-1 was obtained when 5 ml of 10% wt of PVA solution was mixed with 20 g of NiCl2.6H2O. The shape of cyclic voltammetry (CV) curves, in the 2-electrode configuration and 6M KOH aqueous electrolyte, remains rectangular-like even at high scan rate (3000 mV.s-1), in a large potential window of 1.9 V. No significant ohmic drop at current density of 10 Ag-1 was observed. These results indicate successful double layer electrochemical capacitor behaviour with low ion transport resistance and short diffusion length during charge-discharge process. No capacitance loss after 10,000 cycles at current density of 5 Ag-1 was observed, highlighting a good suitability for high rate operation. These outstanding performances of this material as an electrode for supercapacitors show great potential for high performance energy-related applications.

103 - *Ab-initio* studies of Tm^{3+} interstitial defects in Germanium (Ge) using Hybrid Functional HSE06

DPCMM - Tuesday 30 June 2015 14:00 *[For award: PhD]*

Primary author: *IGUMBOR, Emmanuel (University of Pretoria)*
Co-authors: *MEYER, Walter (University of Pretoria); WEBB, Geoffrey (University of Pretoria)*

In this work we present *ab-initio* calculations results of Tm^{3+} interstitial defects in Germanium (Ge) in the frame work of density functional theory (DFT) using hybrid (HSE06) exchange correlation functional. We calculate the formation and transition levels energy of different configurations and their charge states of -2, -1, 0, +1 and +2. In all the configurations, our result shows that the formation energies are relatively low and stable, revealing the T configuration to be the most stable. While the T configuration did not have a positive-U the H exhibit some properties of positive-U . We found transition levels that behave as deep and shallow donor and deep acceptor. The transition levels of (0/-1) and (+1/0) lies at the mid region of the band-gap which give rise to small optical peak, while the transition level of (+1/+2) lies close to the valence band maximum.

104 - BLAZE-DEM: A GPU based large scale 3D discrete element particle transport framework

Applied - Friday 03 July 2015 11:50

Primary author: *GOVENDER, nicolin (CSIR,UP)*
Co-authors: *KOK, Schalk (University of Pretoria); WILKE, Daniel Nicolas (University of Pretoria)*

Understanding the dynamical behavior of particulate materials is extremely important to many industrial processes, with typical applications that range from hopper flows in agriculture to tumbling mills in the mining industry. Simulation offers valuable insight into the dynamical behavior of particles and better a understanding of the industrial processes that allows for the optimization of these processes. The discrete element method (DEM) has become the defacto standard to simulate particulate materials. The DEM is a computationally intensive numerical approach that is limited to a moderate amount (thousands) of particles.The most common approach to represent particle shape is by using a cluster of spheres to approximate the shape of a particle. This approach is computationally intensive as multiple spherical particles are required to represent a single nonspherical particle. In addition spherical particles poorly approximate sharp edges, which may result in inaccurate bulk transport predictions when it is essential to resolve the edges accurately. Alternatively, polyhedra represent the geometry of most convex particulate materials well and when combined with appropriate contact models predicts realistic mechanical behavior to that of the actual system. However, detecting collisions between polyhedra is computationally expensive often limiting simulations to only hundreds of thousands of particles. Driven by the demand for real-time graphics, the Graphical Processor Unit (GPU) offers cluster type performance at a fraction of the computational cost. We recently introduced the BLAZE-DEM framework for the GPU architecture that can model (i) tens of millions of spherical particles and (ii) millions of polyhedral particles in a realistic time frame on a desktop computer using a single GPU. In this work we demonstrate the different types of simulations currently possible with the code.

107 - Developing the high data-throughput ADC daughter board of the PROMETEO test-bench for the upgrade of the ATLAS Tile Calorimeter

NPRP - Thursday 02 July 2015 10:00 *[For award: MSc]*

Primary author: *SPOOR, Matthew (WITS)*
Co-authors: *KUREBA, Chamunorwa Oscar (University of the Witwatersrand); MELLADO, Bruce (University of the Witwatersrand); CARRIO, Fernando (University of Valencia)*

The Large Hadron Collider (LHC) is preparing for the Phase-II upgrade that is scheduled for 2022. The ATLAS Tile hadron Calorimeter (TileCal) will have both its front- and back-end electronics systems completely redesigned. The PROMETEO (A Portable ReadOut ModulE for Tilecal ElectrOnics) standalone test-bench system is being developed for full certification and quality checks of the new TileCal Front-end electronics. PROMETEO is designed to read in digitised samples from 16 channels coming from the front-end electronics at the bunch crossing frequency. The data quality of these samples needs to be assessed in real-time using FPGAs. The PROMETEO uses a Xilinx VC707 evaluation board with a dual QSFP+ FMC module for the read-out and control of the frond-end. Several other functions of the test-bench are provided by a High voltage board, LED board and a FMC ADC daughter board. The ADC board digitises differential analog trigger signals from the front-end adder boards. The board uses two ASC571 ADC chips to sample 16 analog data channels at 40 Mega Samples Per Second (MSPS) leading to a data flow of 7860 Mbps. This paper relates to the development and testing of the FMC ADC board that is being developed for the PROMETEO test-bench.

108 - Hydrogenation of Ti6Al4V alloy and Commercially Pure (CP) Ti

DPCMM - Tuesday 30 June 2015 14:00 *[For award: MSc]*

Primary author: *MAZWI, Sive (University of the Western Cape/ iThemba LABS)*

Hydrogen is considered as an ideal energy carrier for future, it is one of the most abundant elements on earth. Hydrogen storage in metal hydrides is of research interest because metal hydrides often have high hydrogen energy density and safe as compared to liquid hydrogen and hydrogen gas [1]. Recently, an increase in understanding of titanium metallurgy has demonstrated that introduction of hydrogen as a temporary alloying element improves manufacturing, changes the micro structure [2]. Titanium and its alloys are considered as potential hydrogen storage material because they have high hydrogen affinity. In this work CP-Ti and Ti6Al4V alloy were hydrogenated at different temperatures using vacuum furnace at atmospheric pressure. Elastic recoil detection analysis was used to determine the concentration and depth profiling of hydrogen. X-rays diffraction technique (XRD) was used for phase analysis. Optical microscope was used investigate the effect of hydrogen on the microstructure of Ti and Ti6Al4V alloy. It was observed from XRD analysis that Titanium hydrides were formed from temperatures of 550■. Concentration of hydrogen obtained by elastic recoil detection analysis shows that absorption of hydrogen increases with increasing temperature.References1. I.P. Jain, Y.K. Vijay, L.K. Malhotra and K.S. Uppadhyay.,13 (1988) 15-23.2. B. G. Yuan, H. P. Yu, C. F. Li, D. L. Sun; Int J of Hydrogen Energy.,35 (2010) 1829-1838.

110 - A Nonlinear Optical loop Mirror enhanced three wavelengths Erbium doped fiber laser

Photonics - Tuesday 30 June 2015 14:40 *[For award: MSc]*

Primary author: *QHUMAYO, Siyanda (student)*
Co-author: *MARTINEZ, Rodolfo (Researcher)*

A three wavelengths Erbium doped fiber laser source is developed. The configuration is a unidirectional ring cavity with a 2.5 meter of Erbium doped fiber as a gain medium. The emission wavelength selective components are Bragg gratings printed in photosensitive fiber. Erbium doped fiber is a homogeneously broadened gain medium at room temperature, as a result, simultaneous wavelength oscillation affects the wavelength and power stability of the laser, due to cross gain saturation that causes wavelength competition such that one wavelength oscillation at a time can be supported. This has a detrimental effect in Wavelength Division Multiplexing systems in which multi-wavelengths Erbium doped fiber lasers are predominantly applicable. To suppress the wavelength competition thereby enhancing the laser wavelength stability, a Nonlinear Optical Loop Mirror is incorporated in the laser cavity. A series of experiments to determine the optimum length of the Loop Mirror at which the stabi lity for the three wavelengths laser is at maximum have been performed. The experimental characterization has shown that at 2.5 km Loop length, the stability of both the wavelengths and output power of the laser is achieved. The laser has emission at 1540nm, 1547 nm and 1555 nm with an average of 1 mW of optical power level in each oscillation wavelength.

111 - Non-Fermi Liquid Fixed Point in a Wilsonian Theory of Quantum Critical Metals

TCP - Tuesday 30 June 2015 15:20 *[For award: MSc]*

Primary author: *RABAMBI, Teflon (Wits university)*

Recently there has been significant interest in new types of metals which cannot be described by Fermi liquid theory. One of the paradigm to understand these metals is by the use of the Wilsonian renormalization group (RG) to study a theoretical model consisting of fermions coupled to a gap less order parameter. In this way low energy fixed points which cannot be described using Landau Fermi theory, but are still perturbative , can be constructed. We will describe these fixed points with a particular emphasis on the renormalization of finite density systems.

112 - Quasi-Normal Modes for Spin-3/2 Fields

TCP - Thursday 02 July 2015 14:40 *[For award: MSc]*

Primary author: *HARMSEN, Gerhard (University of Witswaters Rand)*

The study of quasinormal modes (QNMs) in various black hole backgrounds has been done for spin-0, 1/2, 1, 2 particles. In this talk we will investigate the possible QNMs for spin-3/2 particles in Schwarzchild and Reissner-Nordstrom backgrounds, focusing on N-dimensional Schwarszchild black holes. We will use both the Asymmetric Iterative Method (AIM) and the Wentzel-Kramers-Brillouin (WKB) approximation in order to calculate these allowed QNMs.

113 - Electronic and Optical Properties of monolayer MX 2 M= Zr, Hf; X= S, Se from first principles calculations

DPCMM - Tuesday 30 June 2015 14:20 *[For award: PhD]*

Primary author: *ABDULSALAM, Mahmud (Wits University)*
Co-authors: *JOUBERT, Daniel (Wits University); DONGHO NGUIMDO, Guy Moise (Wits University)*

Transition metal di-chalcogenide (TMDC) monolayer have potential applicationsin electronic and optical devices. Work on these atomically thin semiconductors is an excitingemerging field of research. In this research the electronic, photo-emission and photo-absorptionproperties of monolayer ZrS 2 , ZrSe 2 , HfS 2 and HfSe 2 have been investigated using densityfunctional theory (DFT) and many body perturbation theory at the level of the partiallyself consistent GW 0 approximation. Solution of the Bethe-Salpeter equation (BSE) in theTamm-Dancoff approximation was used to investigate the optical properties of these monolayerTMDCs. The structures were found to be semiconductor with band gaps within the visiblerange of the spectrum. Exciton binding energies were estimated from a comparison of the GWand BSE results.

114 - Effect of pH on ZnO nanostructures prepared by chemical bath method

DPCMM - Friday 03 July 2015 09:40

Primary author: *KOAO, Lehlohonolo (UFS (Qwa Qwa)*
Co-authors: *DEJENE, Birhanu (UFS (Qwa Qwa)); SWART, Hendrik (UFS (Bloemfontein))*

ZnO powders were prepared by chemical bath method varying the pH using ammonia solution. The effect of pH of the precursor on the structure, morphology, optical and luminescence properties of ZnO nanostructures were investigated. The X-ray diffraction (XRD) patterns of the ZnO nanostructures correspond to the various planes of a single hexagonal ZnO phase. It was observed that the diffraction peaks increase in intensity with an increase in pH. The estimated average grain sizes calculated using the XRD spectra were found to be in the order of 38 ± 1 nm. It was observed that the estimated average grain sizes increases slightly with an increase in pH. The surface morphology study revealed that the grains are flakes-likes at low pH (< 6) but flower-like at high pH (12). The UV-Vis spectra showed a red shift with an increase in pH. The band gap energy of ZnO was found to decrease but the luminescence intensities increase with an increase in pH values. The maximum luminescence intensity was found at pH of 12.

115 - A comparison of solid state reaction, electrical performance and failure mechanism of ruthenium Schottky contacts on 6H-SiC and 4H-SiC after air annealing.

Applied - Thursday 02 July 2015 16:30 *[For award: PhD]*

Primary author: *MUNTHALI, Kinnock Vundawaka (University of Pretoria and University of Namibia)*
Co-authors: *THERON, Chris (University of Pretoria); AURET, Danie (University of Pretoria); PRINSLOO, Linda (University of Pretoria); COELHO, Sergio (UP)*

Thin films of ruthenium (Ru) on 6-hexagonal silicon carbide (6H-SiC) and 4-hexagonal silicon carbide (4H-SiC) were analysed by Rutherford backscattering spectroscopy (RBS) at various annealing temperatures. Some thin film samples were also analysed by Raman spectroscopy and x-ray diffraction (XRD) technique. RBS analysis indicated ruthenium oxidation at a temperature of 400 C and commencement of diffusion of Ru into SiC at a temperature of 500 C for both Ru-4H-SiC and Ru-6H-SiC. X-ray diffraction analysis of samples annealed in air at 600 C showed evidence of formation of ruthenium silicide in both 4H and 6H-SiC but this was not corroborated by RBS analysis. Silicide formation in 4H-SiC and Ru oxidation in 6H-SiC were also confirmed by Raman analysis. The fabricated Ru-6H-SiC and Ru-4H-SiC Schottky barrier diodes (SBD) with nickel ohmic contacts showed excellent rectification behaviour and linear capacitance-voltage characteristics up to an annealing temperature of 600oC for 6H-SiC and 300 C for 4H-SiC . The Ru-6H-SiC and Ru-4H-SiC SBDs degraded after annealing at 700 oC and 400 C respectively as evidenced by the appearance of infinite series resistance. The degradation of Ru-6H-SiC is attributed to the inter-diffusion of Ru and Si at the Schottky-substrate interface, while the oxidation of Ru which led to the formation of of non-conducting and gaseous oxide compounds is the cause of Ru-4H-SiC SBDs device failure.

119 - A study of the Isovector Giant Dipole Resonance across the neodymium and samarium isotope chains

NPRP - Friday 03 July 2015 11:30 *[For award: PhD]*

Primary author: *DONALDSON, Lindsay (University of the Witwatersrand)*
Co-authors: *CARTER, John (University of the Witwatersrand); USMAN, Iyabo (University of the Witwatersrand, Johannesburg.); NEVELING, Retief (iThemba LABS)*

The decay of giant resonances in nuclei is a prime example of how a well-ordered collective excitation dissolves into a disordered motion of internal degrees of freedom in fermionic quantum many-body systems. Fine structure in the excitation energy region of the Isovector Giant Dipole Resonance (IVGDR) in a range of neodymium isotopes ($^{142, 144, 146, 148, 150}$Nd) has been observed in high energy-resolution proton inelastic scattering experiments at zero degrees using the K600 magnetic spectrometer of iThemba LABS. This study was extended to include experiments on ^{150}Sm and ^{152}Sm, which were performed in December 2014. The analysis of both the neodymium and samarium isotope chains will yield insight into the transition from spherical to deformed nuclei and provide information about the dominant damping mechanisms. It is important to note that for nuclei with $88 < N < 92$, a detailed study of the IVGDR is of specific interest since this is the nuclear region in which a transition from spherical to permanently deformed nuclei occurs. Studying the samarium isotopes in conjunction with the neodymium isotope chain will also allow for the influence of the proton number, Z, on the fine structure of the IVGDR as function of nuclear deformation to be studied. An extensive data analysis procedure, which included cross-section extraction for comparison with existing photo-absorption data and theoretical predictions as well as a wavelet analysis was performed on the data for each of the above-mentioned isotopes. These results will be presented and conclusions to the study will be drawn.

121 - A comparison of measured TEC data with results based on the IRI and NeQuick 2 ionospheric models over a chain of mid latitude stations near the geographic meridian of 28° situated in the Southern hemisphere.

Space - Wednesday 01 July 2015 10:00

Primary author: *MWIINGA, Nchimunya (Department of Physics, University of Zambia)*
Co-authors: *SICHONE, Gift L. (Department of Physics, University of Zambia); SIBANDA, Patrick (Department of Physics, 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 28° 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 behavior in this region.

123 - Structural and optical properties of silicon nanowires

Applied - Thursday 02 July 2015 17:10

Primary author: *ARENDSE, Christopher (UWC)*
Co-authors: *MICELI, Paul (University of Missouri); GUHA, Suchismita (University of Missouri); CUMMINGS, Franscious (UWC); KREMENAK, Jesse (University of Missouri); MULLER, Theophillus (UWC); CHEN, Yiyao (University of Missouri)*

Silicon nanowires (Si NWs) find application in radial solar cells, mainly due to its excellent anti-reflective properties and improved conductivity. An additional advantage of Si NWs is that the superior material-quality requirement for efficient solar cells can be relaxed, since the required transport length of the minority charge carriers are greatly reduced. In this contribution, we report on the top-down growth of Si NWs by metal-assisted chemical etching with the emphasis on the effect of etching time on its structural and optical properties. A controlled density and diameter of the Si NWs are achievable with this technique, as confirmed with scanning electron microscopy. Changes in the symmetry and position of crystalline silicon transverse optical peak are observed in its vibrational spectra, which find its origin in the evolution of the structural properties. The Si NWs also show an appreciable reduction in its reflectivity as compared to planar Si (100).Support is gratefully acknowledged from the National Science Foundation - DGE-1069091, the National Research Foundation (RSA) - TTK14052167658, 76568 and 92520; and the University of Missouri / University of the Western Cape Linkage Program.

124 - From darkness comes multi-frequency emission: dark matter after PLANCK

Astro - Wednesday 01 July 2015 11:30 *[For award: PhD]*

Primary authors: *BECK, Geoff (University of Witwatersrand); COLAFRANCESCO, Sergio (University of the Witwatersrand); MARCHEGIANI, Paolo (University of the Witwatersrand)*

Pair-annihilation of the supersymmetric neutralino has observational consequences across the frequency spectrum, from radio synchrotron radiation 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 a range of neutralino models in dwarf galaxies, galaxies and galaxy clusters. We pay special attention to models chosen to represent those compatible with FERMI observations of the galactic centre as well as those consistent with the AMS-2/Pamela anti-proton excess, all of which remain consistent with PLANCK. We also examine the consequences for these models 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, in all the studied environments, and identify characteristics of the spectra which contain information about the neutralino mass and annihilation channel. This means that 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.

125 - Developing Iron Oxide Nanoparticle Biosensors through Simulation and Modelling

DPCMM - Friday 03 July 2015 10:00

Primary author: *HARRIS, Richard (UFS/Mintek)*
Co-authors: *SHUMBULA, Poslet (Mintek); VAN DER WALT, Hendriette (Mintek)*

It is well known that iron oxide nanoparticles exhibit magnetic and superparamagnetic properties at small sizes. These properties in magnetite in particular (Fe3O4) has been exploited for various applications ranging from memory storage and cell separation to theranostics including hyperthermia treatment of tumorous cancer cells, contrast agent in magnetic resonance imaging, cellular imaging and drug carrier in targeted drug delivery system. Forced oscillation of spherical iron oxide magnetic nanoparticles (MNPs) via low-power and low-frequency alternating magnetic field (AMF) is currently being used to kill cancer cells in vitro.Small iron oxide nanoparticles may also possess a small amount of uncapped charge, whereas the positive charge on bare nanoparticles may be carefully engineered to suit a particular application. This leads to nanoparticles behaving as imperfect point charges and even dipoles in an external electric field. In this study it will be shown how these properties may be exploited to develop chemical and biological sensors. In particular molecules with a carboxyl functional group and hydroxyls are presented as case studies. Designing such a system through experimental trial-and-error methods alone will be quit daunting without any prior knowledge of how such a system might behave under variable nanoparticle sizes and shapes, nanoparticle capping ratios, electric-field strengths and directions as well as electric field oscillating frequencies. Therefore modelling and simulation techniques prove very useful in tailoring this system.

126 - Large amplitude slow and fast electron-acoustic solitons and supersolitons in three-electron temperature space plasmas

Space - Wednesday 01 July 2015 11:30 *[For award: PhD]*

Primary author: *MBULI, Lifa (SANSA Space Science)*
Co-authors: *MAHARAJ, Shimul (SANSA Space Science); BHARUTHRAM, Ramesh (University of the Western Cape); SINGH, Satyavir (Indian Institute of Geomagnetism, India); LAKHINA, Gurbax (Indian Institute of Geomagnetism, India)*

Arbitrary amplitude slow and fast electron-acoustic solitons are investigated in a four-component unmagnetised plasma model consisting of cool, warm and hot electrons, and ions. In addition to modelling all species as adiabatic fluids, the effect of neglecting inertia and treating the warm and hot electrons, respectively, as Boltzmann distributed and non-thermal species are also examined. The admissible slow and fast electron-acoustic soliton existence regions are obtained by considering both the lower and upper Mach number limits. The possibility of obtaining supersolitons is also investigated.

132 - Hong-Ou-Mandel interference for the orbital angular momentum Bell States - a high dimensional analysis

Photonics - Thursday 02 July 2015 14:00

Primary author: *ZHANG, Yingwen (CSIR)*
Co-authors: *FORBES, Andrew (WITS); ROUX, Filippus (CSIR National Laser Centre); KONRAD, Thomas (UKZN); LEACH, Jonathan (IPaQS, SUPA, Heriot-Watt, United Kingdom); AGNEW, Megan (IPaQS, SUPA, Heriot-Watt, United Kingdom)*

Hong-Ou-Mandel (HOM) interference is a fundamental component in many quantum information protocols and one of the defining features of quantum science. Traditional HOM measurements are implemented in two-dimensional Hilbert spaces and are used to filter antisymmetric components from an input state. Here, we extend the concept of HOM interference to photons entangled in high dimensions, implementing a HOM measurement for orbital angular momentum (OAM) states. In this manner, we are able to filter the antisymmetric components from a high-dimensional entangled field. We use Dove prisms to control the precise form of the high-dimensional two-photon state and reveal state-specific constructive and destructive quantum interference. This work paves the way for high-dimensional processing of multi-photon quantum states, for example, in teleportation beyond qubits.

136 - Online energy reconstruction on ARM for the ATLAS TileCal sROD co-processing unit

NPRP - Friday 03 July 2015 12:10 *[For award: MSc]*

Primary author: *COX, Mitchell (University of the Witwatersrand)*

Modern Big Science projects such as the Large Hadron Collider at CERN generate enormous amounts of raw data which presents a serious computing challenge. After planned upgrades in 2022, the data output from the ATLAS Hadronic Tile Calorimeter (TileCal) will increase by 200 times to over 40 Tb/s. This increase requires more advanced processing on the raw data in order to harness a larger quantity of good quality physics data. An algorithm called optimal filtering is currently used in the TileCal front-end for online energy reconstruction of the digitised photo-multiplier tube signals and is currently implemented on Digital Signal Processors (DSPs) and Field Programmable Gate Arrays (FPGAs) which are difficult to program and expensive. It is proposed that a cost-effective, high data throughput and general purpose Processing Unit (PU) can be developed by using several commodity ARM processors while maintaining minimal software design difficulty for the end-user. This PU could be used for a variety of high-level algorithms other than optimal filtering on the high data throughput raw data to combat the issue of out of time pile-up and for online data quality testing. Optimal filtering and histogram algorithms have been implemented in C++ and several ARM platforms have been tested and shown to have good CPU to external I/O balance.

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

NPRP - Tuesday 30 June 2015 10:00 *[For award: PhD]*

Primary author: *MAQABUKA, Bongani (University of the Western Cape)*

The cadmium nuclei have been 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 0+ levels are key to vibrational models.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(pi) = 0+, 2+, 4+ at approximately twice the energy of the one-phonon(2+) state. A further quintuplet of three-phonon levels with I(pi) = 0+, 2+, 3+, 4+, 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, exhibit serious disagreement with expected multi-phonon patterns of low energy excitation.Details of the decay, candidate intruders, and branching ratios for the two- and three-phonon levels are being investigated using 108,110Pd(3He, n)110,112Cd, the two proton stripping reaction. The experimenta l technique involves operating AFRODITE in-coincidence with a wall containing 12 large plastic scintillators to detect the fast neutrons from direct reaction.

140 - Statistical properties of Zirconium-91

NPRP - Tuesday 30 June 2015 11:10 *[For award: MSc]*

Primary author: *ZIKHALI, Bonginkosi Richard (Zikhali)*
Co-authors: *GUTTORMSEN, Magne (University of Oslo); HADYNSKA-KLEK, Kasia (University of Oslo); WIEDIKENG, Mathis (iThemba LABS); NTSHANGASE, Sifiso Senzo (University of Zululand); KHESWA, Bonginkosi Vincent (iThemba LABS); BELLO GARROTE, Frank Leonel (University of Oslo); BLEUEL, Darren L. (Lawrence Livermore National Laboratory); GIACOPPO, Francesca (University of Oslo); GÖRGEN, Andreas (University of Oslo); HAGEN, Trine Wiborg (University of Oslo); KLINTEFJORD, Malin (Universityof Oslo); LARSEN, Ann-Cecilie (University of Oslo); RENSTRØM, Therese (University of Oslo); SAHIN, Eda (University of Oslo); SIEM, Sunniva (University of Oslo); TVETEN, Gry (University of Oslo); ROSE, Sunniva (University of Oslo)*

The gamma-ray strength function is defined as a measure of the average reduced gamma 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 [1]. The evidence of an enhancement in the gamma-ray strength function for energies less than 4 MeV has been discovered in several fp-shell nuclei over the years e.g ref [2]. Recently, a strong enhancement of M1 transitions in ^{90}Zr has been predicted for gamma-ray energies below 2 MeV in shell model calculations [3]. In this work we explore the existence of the low-energy enhancement in ^{91}Zr. The experiment ^{90}Zr(d,p)^{91}Zr was conducted at the Oslo Cyclotron Laboratory (OCL). The SiRi (silicon ring) array was used to detect charged ejectiles from the reaction. The CACTUS NaI(Tl) array was utilized to detect gamma rays in coincidence with charged particles. The nuclear level density and gamma-ray strength function were extracted with the Oslo method. In this presentation the preliminary results of the statistical properties of ^{91}Zr will discussed.

141 - Possible extragalactic astrophysical counterparts of IceCube neutrino events.

Astro - Thursday 02 July 2015 14:20

Primary author: *MOHARANA, Reetanjali (UJ)*
Co-authors: *RAZZAQUE, Soebur (University of Johannesburg); BRITTO, Richard (uj)*

Sources of the 35 very high-energy (VHE) neutrinos detected by IceCube Neutrino Observatory is now an open question in astronomy and astrophysics. The dominated shower-type neutrino events have large errors in measuring their directions, hence it is difficult to identify their astrophysical sources. These neutrinos can have counterparts in non-thermal X-rays and gamma rays. So a cross-correlation study of IceCube neutrino events with extragalactic candidate sources using X-ray and gamma-ray selected source catalogues such as Swift-BAT, 3LAC and TeV-Cat, will help in identifying sources of the neutrino events. In order to sea rch for the most possible candidates we apply cuts on X-ray and gamma-ray fluxes of the sources in those catalogues, and then we study the statistical significance of correlation by using invariant statistics and Monte Carlo simulations for different classes of sources. Furthermore we study the physical scenario in which VHE neutrinos can be produced in those correlated sources.

145 - Angular Accelerating White Light

Photonics - Wednesday 01 July 2015 10:00

Primary author: *DUDLEY, Angela (CSIR National Laser Centre)*
Co-authors: *VETTER, Christian (Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität, Jena, Germany); SZAMEIT, Alexander (Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität, Jena, Germany); FORBES, Andrew (CSIR)*

Significant interest has been devoted to tailoring optical fields that transversely accelerate during propagation in the form of Airy, Weber and Mathieu beams. In this work, we introduce a new type of optical field that exhibits controlled angular acceleration during propagation which is achieved by superpositions of Bessel beams with non-canonical phase functions. We demonstrate these angular accelerating fields by modulating the phase and amplitude of a supercontinuum source with the use of a phase-only spatial light modulator (SLM). We illustrate that by considering only the first diffraction order when the SLM is encoded with a blazed grating, the SLM is capable of tailoring the spatial profile of broadband sources without any wavelength dependence. By digitally simulating free-space propagation on the SLM, we compare the effects of real and digital propagation on the angular rotation rates of the resulting optical fields for various wavelengths. The development of controlled angular accelerating optical fields will be useful in areas such as particle manipulation, plasma control, material processing and non-linear optics.

146 - Formation of chemical compound layer due to reaction-diffusion process

DPCMM - Tuesday 30 June 2015 14:40

Primary author: *AKINTUNDE, Samuel (University of Pretoria)*

We developed a model that describes the growth of AB-chemical compound layer at the interfaces of two insoluble solid layers A and B.The growth of AB compound occurs in two stages: the first stage is controlled by interfacial reaction at one interface and diffusion at the other and the second stage by diffusion at both interfaces. During each of these stages, the reaction between A and B atoms occurs only at the interfaces and the growth of AB-compound takes place concurrently at both interfaces of the solid layers. The total growth of AB compound arises from the sum of AB compound formed at both interfaces during the two stages.The critical thickness of AB compound with its corresponding critical time, at the transition point between the interfacial and parabolic growth, is determined during the first stage of the growth.Based on the result of the model, we determine the critical thickness of palladium silicide (Pd2Si) and our estimation agree fairly well with experimental result. We further use the model to investigate the moving species during the growth of Pd2Si taken into accounts three possibilities: when palladium is the dominant species, silicon dominating during the silicide growth, and finally both palladium and silicon atoms diffusing simultaneously during the silicide growth. The result obtains show that silicon is the most likely dominant species during the growth of Pd2Si layer and it is consistent with experimental reports.

147 - A di-Higgs Search in the γγbb Decay Channel Using the ATLAS Detector

NPRP - Friday 03 July 2015 10:00 *[For award: PhD]*

Primary author: *REED, Robert (University of Witwatersrand)*

The Higgs boson was discovered on July 4th 2012. The data taken in the 2012 run was compared to Monte Carlo generated using the Standard Model and a weak limit was found for the invariant mass of the four objects, at 300 GeV, in the Higgs to γγbb channel. The confidence level at 300 GeV was calculated at approximately 3 sigma which was reduced to 2.1 sigma after the look elsewhere affect was applied. This limit is of interest as it can be tested relatively soon in the data taking period making the γγbb channel an early analysis for 2015. The structure and strategy of the analysis will be discussed and optimisations shown.

148 - An Integration Framework Tool for ATCAs in the ATLAS Detector Control System

NPRP - Friday 03 July 2015 09:40 *[For award: PhD]*

Primary author: *REED, Robert (University of Witwatersrand)*

In the year 2022 the Large Hadron Collider at CERN is scheduled to undergo a major upgrade. A large proportion of the current front-end electronics, on the Tile Calorimeter sub-detector, will be upgraded and relocated to the back-end. A demonstrator pro gram has been established as a proof of principle. A new system will be required to house, manage and connect this new hardware. The proposed solution is an Advanced Telecommunication Computing Architecture (ATCA) which will not only house but also allow advanced management features and control at a hardware level by integrating the ATCA chassis into the Detector Control System. A framework tool has been developed to automate and facilitate this integration effort.

149 - Search for scissor resonance in 182Ta

NPRP - Friday 03 July 2015 11:50 *[For award: MSc]*

Primary author: *BRITS, C.P. (University of Stellenbosch)*
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Relatively small changes to the overall shape of the photon strength function such as the scissors or pygme resonances can have significant impact on reaction rates which are important for modelling processes that take place in astrophysical environments and reactors. Recent results from the University of Oslo indicate the existence of a significant amount of scissor resonance strength in the photon strength function for nuclei in the actinide region [1]. In order to investigate the extent and persistance of the scissor resonance strength towards lighter nuclei, an experiment was performed utilizing the NaI gamma-ray detector array (CACTUS) and silicon particle telescopes (SiRi) at the cyclotron laboratory at the University of Oslo to measure the nuclear level density and photon strength function of 182Ta. In this talk I will present and discuss preliminary data from the 181Ta(d,p)182Ta reaction.[1] M. Guttormsen et al. Phys. Rev. Lett. 109, 162503 (2012)This work is based on the research supported in part by the National Research Foundation of South Africa Grant Number 92600.

151 - Multiple Bremsstrahlung Using MHV Technique

NPRP - Tuesday 30 June 2015 14:40 *[For award: PhD]*

Primary author: *RASOANAIVO, Andriniaina Narindra (University of Cape Town)*

To study the multiple bremsstrahlung emission in gauge theories at high energies, we compute scattering amplitudes with a large number of gauge particles, photons or gluons. I explain why the standard way of QFT using Feynman diagram techniques is not efficient to compute such scattering amplitudes. I give an introduction to the on-shell methods, also known as MHV techniques, and show how simple the computation of scattering amplitudes using this methods. Using the new technique I state some results on the bremsstrahlung emission in QED and QCD.

152 - Embedding of noble metal nanoparticles and study of optical and photoluminescence properties induced by ion irradiation

DPCMM - Thursday 02 July 2015 09:40

Primary author: PRAKASH, Jai (Department of Physics, University of the Free State, (UFS), Bloemfontein, ZA 9300, South Africa)
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Recent advances in nanotechnology resulted in a new class of nanomaterials with optical as well as luminescence properties called noble metal fluorescent nanoparticles. These noble metal nanoparticles have shown potential applications in many fields like optical memory, catalysis and sensor technologies [1]. The present work reports on 150 keV Ar ion beam irradiation of thin Au film on polymer substrates including dewetting in thin film and subsequent formation of spherical Au nanoparticles that at a proper fluence eventually become embedded into the substrate [2]. Au nanoparticles embedded in and located on the surface were characterised and studied by scanning electron microscopy (SEM), atomic force microscopy (AFM), transmission electron microscopy (TEM) and Rutherford backscattering spectrometry (RBS) [3]. These Au nanoparticles exhibit the presence of absorption peaks in the visible regions due to the surface plasmon resonance (SPR) oscillations as investigated by UV-Vis spectroscopy. Photoluminescence study using the 325 nm He-Cd laser excitation will also be discussed.References:1. Li-Yi Chen, Chia-Wei Wang, Zhiqin Yuan, and Huan-Tsung Chang, Analytical Chemistry, 87 (2015) 216.2. Jai Prakash, A. Tripathi, S. Gautam, K. H. Chae, V. Rigato, J. Tripathi, K. Asokan, Mat. Chem. Phys. 147 (2014) 9203. Jai Prakash, A. Tripathi, V. Rigato, J.C.Pivin , Jalaj Tripathi, K.H.Chae, S.Gautam, P.Kumar, K. Asokan, D.K.Avasthi, , J. Phys.D: Appl. Phys. 44 (2011) 125302.Acknowledgement: Author (JP) acknowledges the help and scientific discussions from Dr. D. K.Avasthi, Dr. A. Tripathi, and Dr. Pravin Kumar for providing LEIBF facility at IUAC, New Delhi.

153 - Exploring the Dark Sector extension to the Standard Model via the Higgs Portal

NPRP - Thursday 02 July 2015 11:10

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, κ. 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. A promising avenue is to exploit the production of the dark force boson Z_d via the Higgs Portal and the search for its decay back to SM leptons: $H \rightarrow h_d \rightarrow Z_d Z_d \rightarrow 4l$. The detailed design and results of this search are presented.

154 - First principle study of Xanthate and Diethyldithiophosphate adsorption on PtS (010) surface

DPCMM - Tuesday 30 June 2015 14:20 *[For award: MSc]*

Primary author: MASENYA, Mamogo (University of Limpopo)

Platinum surface has been studied extensively in recent years to improve the fundamental understanding of the mechanism of oxidation reaction on metal surfaces. These surfaces have a wide scientific and technological interest, particularly because of their catalytic properties. Density functional theory (DFT) method has been employed to study the surface properties of Platinum sulphide mineral PtS (010) and their interaction with xanthate and diethyldithiophosphate. It was noted that the adsorption energy of SEX is more exothermic compared to EX and IBX is more exothermic compared to SIBX. Furthermore, the adsorption energy of DEDTP shows that it is high in selectivity.

155 - Irradiation of in vitro melanoma cells with low intensity laser in the presence of hypericin and aluminium (III) phthalocyanine chloride tetrasulphonate for use in photodynamic diagnosis

Photonics - Tuesday 30 June 2015 11:30

Primary author: NDHUNDHUMA, Ivy (University of Johannesburg)
Co-author: ABRAHAMSE, Hedi (University of Johannesburg)

Introduction: Irradiation of certain photosensitizers with light leads to emission of a brick-red fluorescence. This principle may be used as a diagnostic procedure termed photodynamic diagnosis (PDD). Increasing incidence of malignant melanoma poses a threat to modern society and economy therefore requires considerable interventions for early diagnosis. The aim of the study was to determine the optimal combination of photosensitizer (Ps) and low intensity laser irradiation (LILI) to be used for PDD of melanoma cells. Materials and Methods: Melanoma cells (A375) were treated with various concentrations of Ps, (Hypericin (Hyp) or aluminium (III) phthalocyanine chloride tetrasulphonate (AlPcS4Cl)), for 1; 2; 4 and 24 h; varying LILI doses by itself or optimal concentrations of Ps combined with different laser light doses of suitable wavelength. Cell viability and cell morphology changes were determined after treatment of cells with either Ps or LILI by itself and when Ps was combined with LILI. Results: Both Hypericin and AlPcS4Cl accumulate in melanoma A375 cell line. No significant loss of cell viability or change in morphology was observed when cells were treated with Ps or LILI alone but when the cells were incubated with Hyp and AlPcS4Cl and irradiated with LILI at 532 nm and 682nm respectively, a time dependant decrease in cell survival was observed. With Hyp, a significant loss of cell survival was observed as early as 1hr after incubating cells with Hyp followed LILI at 532 nm. AlPcS4Cl therefore shows to be an ideal Ps to be used for PDD since it causes minimal photodynamic effects at short incubation periods.

158 - Monte Carlo based estimation of the effect of different aerosol classes on solar irradiance in African atmospheric conditions

Applied - Wednesday 01 July 2015 14:20 *[For award: PhD]*

Primary author: CYULINYANA, MARIE CHANTAL (department of physics, University of johannesburg)
Co-author: WINKLER, Hartmut (University of Johannesburg)

Aerosols influence ground level solar irradiance through their scattering and absorption of the solar light. The degree of direct solar beam attenuation, as well as the angular and wavelength dependence of the diffuse (scattered sunlight) sky brightness strongly depends on the concentration, size distribution and nature of the aerosol class. Aerosols common in the atmosphere in African conditions, such as biomass burning-generated smoke, wind-generated dust and salt crystal-based marine haze all influence incoming sunlight in different ways. In this paper, a Monte Carlo approach is employed to track the movement of photons from the top of the atmosphere to the Earth's surface for a variety of atmospheric compositions characteristic of typical African localities. The results show that the variations in aerosol types not only change the amount of direct solar radiation reaching a ground based detector or solar panel, but also the angular distribution and color of the detected diffuse light. We compare the ground-level solar energy yield for the cases investigated and briefly discuss the consequences for solar energy generation in typical African conditions.

159 - Dark matter production in association with Higgs bosons through heavy scalar resonance at the LHC

NPRP - Thursday 02 July 2015 11:30 *[For award: MSc]*

Primary author: VON BUDDENBROCK, Stefan (University of the Witwatersrand)
Co-authors: LIAO, Shell-may (University of the Witwatersrand, School of Physics, 1 Jan Smuts Avenue, Braamfontein, Johannesburg, 2000, South Africa"); KAR, Deepak (University of Witwatersrand); MELLADO, Bruce (University of Wisconsin - Madison); REED, Robert (University of Witwatersrand); RUAN, XIFENG (WITS); TOMIWA, Kehinde (University Of Ilorin); MARCH RUIZ, Luis (University of the Witwatersrand); CORNELL, Alan (NITheP); KUMAR, Mukesh (University of the Witwatersrand)

The Standard Model of particle physics has, so far, been successful in explaining the electroweak and strong interactions in the matter which we are well acquainted with. However, cosmological observations indicate that there is a large component of mass in the universe which does not interact electromagnetically. This component is known as dark matter. After the analysis of Run 1 LHC data, there is reason to believe that we can study dark matter through interactions with the Higgs boson. In particular, we note from the Run 1 Higgs p_T spectra that the data presents a different structure than that of Standard Model predictions. A simple extension to the Standard Model is considered in which we introduce a heavy scalar H and a non-interacting scalar dark matter particle χ. The consequences of this model are considered and refined according to LHC results. Monte Carlo simulations are done on the process $gg\to H\to h\chi\chi$, and the effects of this process are compared to Run 1 ATLAS results. The tuning of the model's couplings are refined using experimental results such that the χ particle can be proposed as a dark matter particle, ready to be tested against LHC Run 2 results.

161 - Hypothesising the effects of Higgs portal dark matter in particle colliders

TCP - Thursday 02 July 2015 15:00 *[For award: MSc]*

Primary author: *VON BUDDENBROCK, Stefan (University of the Witwatersrand)*
Co-authors: *CORNELL, Alan (NITheP); MELLADO, Bruce (University of Wisconsin - Madison); KUMAR, Mukesh (University of the Witwatersrand)*

The Higgs field mass term in the Standard Model is exceptionally unique. While all of the other interaction terms in the Standard Model are associated with strictly renormalisable dimension 4 operators (and therefore having marginal couplings), the Higgs field mass term has a coupling of dimension 2. This allows us to explore the possibility of the Higgs boson having decay channels consisting of particles being $SU(3)\times SU(2)\times U(1)$ singlets, meaning that they do not interact with any Standard Model particles apart from the Higgs. We could treat these particles as candidates in a field of study which is now being known as Higgs portal dark matter. In order to test this possibility, a model independent theory has been developed in the form of a Lagrangian consisting of extensions to the Standard Model: a heavy Scalar H and a non-interacting dark matter scalar chi, along with associated trilinear and quartic couplings. The implications of this model are considered where a Monte Carlo study has been performed on the process $gg\to H\to h\chi\chi$, in order to obtain results which can be directly linked to experimental observations.

162 - Optimization of a small-angle neutron scattering instrument using the VITESS model

DPCMM - Friday 03 July 2015 10:20

Primary author: *TJEBANE, Tiatji (Necsa)*
Co-author: *FRANKLYN, chris (necsa)*

A small-angle neutron scattering (SANS) instrument is a facility that uses sub-thermal energy (<25meV) neutrons extracted from a reactor or spallation source to study materials at mesoscopic levels. Putting such an instrument in place requires specialised equipment so as to achieve a clean narrow neutron beam spot (<5mm) at considerable distances (>30 m) from the primary source. A neutron beam is channelled from the source through collimators and guides. These components should be chosen such that these stringent conditions are achieved; a process Necsa is currently involved in installing a low-background SANS instrument at its SAFARI-1 research reactor.VITESS is a tool for simulating neutron scattering instruments at pulsed and continuous sources. It is supported by a graphical user interface which generates and controls command lines according to a given input. A simulation comprises one or more modules co-working sequentially. Each module passes its neutron data to the following one. VITESS is currently being used to model neutron scattering beam lines to be installed at European Spallation Source (ESS) Project under construction in Sweden. Most of the recently installed SANS beam lines (e.g. BILBY at ANSTO), V16 at HZB) were built guided by this tool, as every component to be installed can be virtually defined and inspected to reflect the real component, thereby making it an indispensable tool for neutron scattering instrument installations.SANS instrument at Necsa is being upgraded using curved neutron guides, variable collimation lengths, variable aperture diameters as well as long sample-to-detector distances (>10 m). The expected intensities at sample position will be presented according to the model. Recommendations of components and different configurations concluded from the model will be discussed. Some results obtained from such instruments will also be summarized.

168 - Second-order Coulomb excitation effects from the GDR

NPRP - Tuesday 30 June 2015 11:10

Primary author: *ORCE, Nico (University of the Western Cape)*

A new empirical formula for the (-2) moment of the photo-absorption cross section, sigma-2, has been determined from the 1988 compilation of Dietrich and Berman. A new fit to the data yields a new empirical formula which is in better agreement with Migdal's original calculation, and approximately yields a 30% decrease in the polarization potential generated by virtual electric-dipole excitations of states around the giant dipole resonance. The effect of a mass-dependent symmetry energy provides an explanation for deviations from the hydrodynamic model.

169 - Portable QKD Device Using the COW Protocol

Applied - Tuesday 30 June 2015 11:30 *[For award: PhD]*

Primary author: *PILLAY, Sharmini (University of KwaZulu-Natal)*
Co-authors: *MARIOLA, Marco (University of KwaZulu-Natal); MIRZA, Abdul (University of KwaZulu-Natal); PETRUCCIONE, Francesco (University of KwaZulu-Natal)*

Quantum Key Distribution (QKD) is an emerging field of information security. To date, this technology has been implemented for large scale financial and voting purposes, but QKD is a versatile solution which can also be utilised to secure personal transactions. The development of low cost, portable QKD devices can further promote the use of quantum encryption in commercial security systems. Research has been done to design hand-held QKD devices for personal use with ATMs. These devices use a short-range free space channel to produce a secret key using the polarisation of single photons as qubits. Free space applications of QKD usually utilise polarisation encoding of single photons since the polarisation states do not deteriorate in the turbulent atmosphere. The proposed device uses the Coherent One Way (COW) protocol to exchange a secret key between the two authenticated parties. The COW protocol is a simple, practical protocol which uses the time of arrival of consecutive weak coherent pulses as the bit encoding. The security of this protocol lies in the coherence between consecutive laser pulses. Should decoherence be observed in the monitoring line, the presence of an eavesdropper is inferred. An advantage of using the COW protocol is the small size and low cost of the setup. This is ideal for a hand-held device used for short-range QKD. The COW protocol is not traditionally used for a free space channel due to the fragility of coherence in a turbulent medium. Since this is a short-range device which will not encounter any turbulence, the coherence of the laser beam is not compromised. It is therefore suitable to use the COW protocol under these conditions. The design of the system in a free space channel and the synchronisation of the system will be discussed.

170 - Projection operators in the theory of open quantum systems

TCP - Wednesday 01 July 2015 14:40

Primary author: *SEMIN, Vitalii (Quantum Research Group, School of Chemistry and Physics, University of Kwazulu-Natal)*
Co-author: *PETRUCCIONE, Francesco (UKZN)*

We study different forms of projection operators and their application to open quantum systems. In particular, we show that applying a special class of projection operators to open systems may lead to non-linear dynamical equations, while other projection operators always lead to linear equations. We discuss general features of linear and non-linear dynamical equations and connections between them. All the features of different projectors are illustrated by examples of a qubit in a thermal bath and two interacting qubits in a common environment.

171 - From single nano-wire nano-electronics through gas FETs to deployable portable industrial sensing devices

Applied - Friday 03 July 2015 09:40

Primary author: *MWAKIKUNGA, Bonex (CSIR National Laser Centre)*

From single nano-wire nano-electronics through gas FETs to deployable portable industrial sensing devicesBonex W MwakikungaDST/CSIR National Centre for Nano-Structured Materials, PO Box 395, Pretoria 0001, South AfricaThis presentation outlines the progress made since 2011 when the projects of building nano sensors at the CSIR in Pretoria started up to the present time (2015). The time line starts with our attempts to establish electrical contacts to single WO3 nanowires by focussed ion beam coating in Carl Zeiss SEM equipped with nano-manipulators [1]. Next are the attempts for on-chip growth SnO2 nanowires on Au patterned alumina substrates [2] and lastly the Au/Ti contacts to individual SnO2 nanowires by electron-beam lithography protocols [3]. All these approaches led to harnessing the nanowire devices into a micro-nano chip which became the first CSIR technology demonstration in 2013. This demo has since been packaged into a complete breath analyser device which is now being tested in clinics where it is being calibrated to non-invasively monitor glucose levels in diabetic patients [4-6], formaldehyde and ammonia levels in renal failure patients as well as toluene levels in lung cancer patients; all this by simply analysing the patients' breath for the listed biomarkers.[1] B W Mwakikunga, A micro-nano-chip platform for contacting nano-structures electronically for diverse applications[2] Bonex W Mwakikunga, A field effect transistor and a gas detector including a plurality of field effect transistors, PA158013/P [3] B W Mwakikunga, A field effect transistor and a gas detector including a plurality of field effect transistors, PCT/IB2014/061713 (revised edition re-submitted)

173 - Firewall Argument for Acoustic Black Holes

TCP - Tuesday 30 June 2015 11:10

Primary author: *PONTIGGIA, Luca (University of the Witwatersrand)*

We investigate the firewall paradox proposed by AMPS \cite{AMPS} by first explaining the Information Paradox together with Hawking's derivation of the thermal radiation emitted from a evaporating black hole \cite{Hawking}. We then ask if one can apply arguments similar to that of Hawking and AMPS in the regime of fluid mechanics, which was first considered by Unruh \cite{Unruh}. We assume that a black hole, with a geometry conformal to the Schwarzschild metric, can be formed in a fluid. The sonic hole or ``dumb" hole, which is characterized by an acoustic event horizon, is the locus of points at which the background fluid is traveling at the local speed of sound. Since sound disturbances are coupled to the background fluid and travel at the speed of sound, the acoustic event horizon affects sound disturbances in a manner analogous to how gravitational black holes affect light \cite{Visser}. Like a gravitational black hole, which evaporates by emitting Hawking radiation, we check if an acoustic black hole will emit in a similar kind of radiation in the form of phonons. This is done by constructing a massless scalar field describing phonon propagation and treating the acoustic black hole just like a gravitational black hole. We apply the arguments put forth by Hawking and AMPS and see if there is any validity to an ``acoustic firewall" as this would require certain physical phenomena emerging from sub-atomic scales.

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

NPRP - Friday 03 July 2015 10:20 *[For award: MSc]*

Primary author: *SINGH, Bhivek (University of the Western Cape)*
Co-authors: *MCALLISTER, Rob (iThemba LABS); TRIAMBAK, Smarajit (University of the Western Cape); ORCE, Nico (University of the Western Cape); CONRADIE, Lowry (Member); BROODRYK, Johannes (iThemba LABS)*

Nuclear level lifetime measurements provide information important both for nuclear astrophysics and nuclear structure studies. The lifetime of a state provides its width as well as transition strengths to other states. The widths of the relevant states are directly related to capture reactions in stars, as the energy distribution of the resonance directly influences the nuclear reaction rates, while the transition strengths provide a measure of the matrix elements connecting the states. The latter offers useful complementary information to Coulomb Excitation (CoulEx) experiments for investigations of nuclear shapes. In this talk I describe the design and simulation of a new experimental set up to be used at iThemba LABS for lifetime measurements using inverse-kinematics and a Doppler shift method. The design was made using the Solid Edge ST6 software package for computer-aided design (CAD), with particular emphasis on providing a clean environment in which the reactions can take place. I will briefly discuss the practical considerations of the design and a Monte Carlo code to generate gamma-ray line shapes expected from particular experiments. This code aims to better understand the sensitivity of our set up and potential systematic effects.

176 - Computer simulation study of water adsorption on {110} surface of nickel-rich pentlandite ($Fe_4Ni_5S_8$) mineral

DPCMM - Tuesday 30 June 2015 15:00 *[For award: PhD]*

Primary author: MKHONTO, Peace *(University of Limpopo)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); CHAUKE, Hasani (University of Limpopo)*

Pentlandite $(Co,Fe,Ni)_9S_8$ is the most abundant iron-nickel sulphide ore containing mineral and has a wide range of applications in industries. The mineral is of commercial importance and can be extracted using floatation processes. Ab-initio density functional theory was employed to investigate the interaction of water on the nickel-rich pentlandite ($Fe_4Ni_5S_8$) {110} surface, to understand the adsorption behaviour on the ore mineral surface during ore grinding and during flotation. We considered three adsorption trajectories, i.e. Ni-top, Fe-top and complete surface coverage. It was observed that the hydration on iron-nickel surface termination shows a strong interaction of the water molecule with the iron atom. We found adsorption energy of -0.117 eV for Ni-top site adsorption and -0.320 eV for Fe-top site adsorption, while the complete surface coverage showed adsorption energy of -0.212 eV. This suggested that physisorption behaviour is favourable confirming a domination of Van Der Waal interactions. Furthermore, the PDOS plot projected onto the O s- and p-orbitals; and H s-orbitals for the H_2O molecule adsorbed on Ni and Fe atoms, show water orbitals shift to lower energy compared to the isolated water molecule. This energy shift is an indication of strong interactions with the surface Ni3b and Fe1 atoms. As such an electron gain on the oxygen atoms of the water molecule is noted. The charge transfer from the Fe/Ni atoms to the oxygen molecule of the water molecule is described using Bader analysis and charge density difference which showed a poor charge transfer of the Fe and Ni atoms.

177 - The development of a neutron converter for the production of radioactive beams at iThemba LABS

NPRP - Wednesday 01 July 2015 14:20 *[For award: PhD]*

Primary author: NGCOBO, Zipho *(iThemba Labs)*
Co-authors: *BARK, Robert (iThemba LABS); JONES, Pete (iThemba LABS); GEDULD, Dieter (University of Cape Town); BUFFLER, Andy (University of Cape Town); SMIT, Frederick David (iThemba LABS); PAPKA, Paul (Stellenbosch University); NTSHANGASE, Sifiso Senz o (University of Zululand); MALEKA, Peane (iThemba LABS); CAMRIE, Angus (University of Cape Town); MAKHATHINI, Lucky (iThemba LAB S)*

iThemba LABS proposes a 70 MeV proton accelerator which has the capability of extracting two H^- ion beams simultaneously. This allows the simultaneous production of radioactive ion beams and of medical radioisotopes. This accelerator will release the separated-sector cyclotron completely from medical radioisotope production for more physics experiments with stable beams. From literature, neutron induced fission gives enhanced production of neutron-rich fission fragments compared to proton induced fission, thus there is a need to find efficient ways of producing neutrons from protons. Beryllium targets have been suggested, but increasing proton beam current to achieve higher fission rates could lead to cooling problems. Cooling might be achieved in a natural way by using enriched H218O water as 16O is a poor neutron converter. With no data available for 18O above 25 MeV, this necessitated the measurement of neutron yields from the 18O(p,xn) reactions in the proton energy region of interest of 66 MeV. Quasi-monoenergetic neutron spectra were thus measured at proton energies of 66; 54; 42 and 30 MeV hitting on 1 mm thick H218O water target using the time of flight (ToF) technique. Neutron production from a 7Li (3 mm thick) target was also measured at the same energies to validate H218O measurements at 0 and 16 degrees. The spectra deduced at these measured energies were used to interpolate neutron spectra in MeV steps to simulate neutron spectra of 18O thicker targets. For comparison the 18O thick target of 40 mm was also measured using the proton beam of 62 MeV at 0 and 16 degrees. Experimental results are compared to theoretical calculations performed using MCNPX v2.6.0 which uses existing evaluated data from Lawrence Livermore National Lab (ENDL92) or Los Alamos National Lab (ENDF/B-VII).

182 - Phosphorescence of phototransferred thermoluminescence in annealed synthetic quartz

DPCMM - Tuesday 30 June 2015 14:40 *[For award: MSc]*

Primary author: KOMBE, Elizabeth Fende Midiki nee Atang *(Rhodes University)*
Co-author: *CHITHAMBO, Makaiko (Rhodes University)*

Phosphorescence measurements carried out on the phototransferred peak of single crystalline synthetic quartz samples annealed at 500oC for 10 minutes is reported. The samples were exposed to beta irradiation and illuminated by 470nm blue LED light. The glow curves, recorded with a linear heating rate of 1oC/s, show a phototransferred main peak. Kinetic parameters such as activation energy (E), frequency factor (s) and order of kinetics (b) are found using analysis of the phosphorescence signal observed. This observation indicates that the behaviour of this phototransferred peak is consistent with first-order kinetics and has activation energy of about 0.65eV with a frequency factor in the order of 10^7 Hz. The dependence of the PTTL intensity of this main peak on illumination time (time the sample is exposed to 470nm blue light) gives rise to a peak.

183 - Ferromagnetism in Chromium-doped Rutile, Anatase and Brookite phases of Titanium dioxide

DPCMM - Tuesday 30 June 2015 15:20 *[For award: PhD]*

Primary author: MULWA, Winfred Mueni *(University of the Free State-Qwaqwa campus, Department of physics, Private Bag x13, Phuthaditjhaba, 9866, SOUTH AFRICA)*
Co-author: *OUMA, CECIL N.M (University of Pretoria, Department of Physics, Private Bag x20, Hatfield, Pretoria, 0028, SOUTH AFRICA.)*

TiO2 doped with Cr has been investigated using density functional theory with the Hubbard term (DFT+U), In addition to electronic properties, we have also investigated the magnetic properties Cr-doped TiO2. Among the crystal structure investigated includes rutile, anatase and brookite TiO2. From the study we observed that, between 0-5% Cr doping, the systems displayed a paramagnetic behavior while between 6-8% the systems exhibit ferromagnetic characteristics. The magnetic moment was found to increase with the increase in doping percentage upto 6%, above 6% the magnetic moment remained constant (~2μB) indicating magnetic saturation. The anatase structures highly favors Cr doping than rutile and brookite.

184 - Forbidden gap regions in ion-acoustic solitons

Space - Wednesday 01 July 2015 11:10

Primary author: MAHARAJ, Shimul Kumar *(South African National Space Agency (SANSA), Space Science Directorate)*
Co-author: *BHARUTHRAM, Ramesh (University of the Western Cape)*

Plasma models composed of one and/or two (different mass) species of inertial ions and one and/or two (different temperature) species of (inertialess) electrons (isothermal and/or non-thermal) will be considered to investigateforbidden gap regions (stopbands) in velocity space where ion-acoustic solitons do not propagate. It has been previously found [1] that these forbidden gap regions in velocity space occur between two passband regions which support the propagation of ion-acoustic solitons. The focus of the study will be to establish which plasma models favour the existence of stopband regions but also to determine how the sizes of the stopband regions are a function of the plasma parameters.[1] Stopbands in the existence domains of acoustic solitons, F. Nsengiyumva, M. A. Hellberg, F. Verheest and R. L. Mace. Phys. Plasmas 21 , 102301 (2014).

187 - Optical Observations of the Be/X-ray Binary A0538-66

Astro - Friday 03 July 2015 09:40

Primary author: RAJOELIMANANA, Andry Fitiavana *(University of the Free State)*
Co-author: *CHARLES, Phil (University of Southampton)*

The Magellanic Clouds, particularly the SMC, host a large number of high-mass X-ray binaries (HMXBs) when compared to our Galaxy. The majority of these HMXBs are Be/X-ray binaries (BeX) in which a neutron star orbits a rapidly rotating Be star in a very wide (P ~ 20-200 d) and eccentric orbit. Our study of the long-term superorbital variability in these systems using archival light curves from the MACHO and OGLE database had revealed 200-2000 days variations in almost all of them. These variations are likely to be related to the formation and dissipation of the Be star circumstellar disk, however the physical mechanisms controlling the evolution of these disks are poorly understood. I will present our recent results on the long-term spectroscopic observations of the prototype LMC BeX system A0538-66, using both broad-band (wide wavelength coverage) as well as high resolution optical spectra obtained from the Southern African Large Telescope (SALT). These observations enable us to probe both the evolution of the Be star envelope and the details of its interaction with the neutron star in its presumed highly eccentric (e~0.7) orbit. The high resolution spectra allow us to derive its orbital parameters, spectral classification, and rotational velocity. In addition, we derived a refined orbital period and ephemeris from the recent OGLE-IV light curves.

188 - Simultaneous substitution of Ba, Mn and Co into Fe_3O_4 spinel structure: Magnetic and electrochemical sensing properties of the synthesized nanoparticles

DPCMM - Wednesday 01 July 2015 14:00 *[For award: PhD]*

Primary author: OSMAN, Nadir *(University of KwaZulu-Natal)*
Co-authors: *THAPLIYAL, Neeta (ukzn); MOYO, Thomas (University of KwaZulu-Natal); KARPOORMATH, Rajshekhar (ukzn)*

Simultaneous substitution of Ba, Mn and Co was successfully achieved by glycol thermal route. The phase formation was confirmed by X-ray powder diffraction technique. The microstrain is investigated based on the Williamson-Hall plot. Crystallinity, shape and size of the nanoparticles were investigated by high resolution transmission electron microscopy and high resolution scanning electron microscopy. Brunauer-Emmet-Teller measurements revealed that the sample has high surface area of 116 m^2/g. The sample displays mesoporous character based on the Barrett-Joyner-Halenda test. The magnetic properties as a function of temperature were performed on mini-cryogen free VTI system in the temperature range 4 K to 300 K. The magnetization increased from 66.5 ± 0.3 emu/g to 84.4 ± 0.5 emu/g from 300 K to 4 K respectively. The sample was found to become magnetically harder at low temperature since the coercivity increases from 0.009 ± 0.003 T to 1.01 ± 0.004 T for the temperatures 300 K and 4 K respectively. The temperature dependence of the coercive field followed Kneller's law, whilst a modified Bloch's law was suitable in describing the magnetization as a function of measuring temperature. The electrochemical properties of $Ba_{1/3}Mn_{1/3}Co_{1/3}Fe_2O_4$ nanoparticles were also investigated. Cyclic voltammograms of ferricyanide oxidation showed that the synthesized nanoparticles modified electrode exhibited improved electrochemical activity as compared to the bare electrode. These high-performance electrodes are expected to lead to the development of a novel group of electrochemical sensors.

189 - Data assimilation into a climatological model

Space - Wednesday 01 July 2015 09:40

Primary author: HABARULEMA, John Bosco *(South African National Space Agency)*
Co-author: *SSESSANGA, Nicholas (Space Science laboratory, Chungnam National University (CNU) Daejeon 305-764 South Korea)*

This work reports on the progress of assimilating observational data into an empirical climatological model (International Reference Ionosphere, IRI 2012) to improve modelling/predictions. The basis is in adjusting the major input parameters of the climatological model to enable its predictions match the actual electron content measurements. The outputs including electron density profiles are compared with independent data sources (ionosonde, radio occultation). It is observed that a significant improvement is achieved by assimilating total electron content (TEC) data into the IRI especially over areas that were originally under-represented during the model's development

190 - Time of crossing (TOC) in Pulsed Eddy Current Signals

Applied - Friday 03 July 2015 12:30

Primary author: KIBIRIGE, Betty *(University of Zululand)*

Signals picked up from pulsed eddy current systems used to evaluate aluminium specimen exhibit interesting trends. The locus received in the presence of a specimen always reaches steady state conditions at a later time than that received in the absence of a specimen. This study investigated the trends observed in the pulsed eddy current signals picked up in the absence of a specimen in relation to those picked up in the presence of aluminium specimens of different thickness. The study was carried out at specimen temperature of 30 °C with specimen thicknesses varied from 0.5 mm to 3 mm in steps of 0.5 mm. A time of crossing (TOC) between the locus of the signal received in the presence of each specimen and that received in the absence of a specimen was observed for the different thicknesses. The relationship between the TOC and the specimen thickness was a nonlinear forth-order polynomial. Linearizing this relationship for small changes about a nominal thickness could be used to gauge differences in thickness of up to 4 µm at a nominal thickness of 2 mm in thin aluminium sheets.

191 - Terahertz Time-Domain Ellipsometry

Photonics - Wednesday 01 July 2015 14:00 *[For award: PhD]*

Primary author: SMITH, Shane *(Physics Post Graduate Student)*

Terahertz time-domain spectroscopy (THz-TDS) is a useful tool for material characterization. The most common THz-TDS setups are transmission based, but these setups are severely limited in application by water absorption, especially when investigating biological samples. In these cases it would be preferable to work in reflection rather than in transmission. Setting up a reflection geometry terahertz spectroscopy setup is challenging due to stringent alignment tolerances and the small size of the emitter and detector. By performing ellipsometry measurements, the need for reference measurements is removed. This simplifies the alignment somewhat.We propose a terahertz time-domain ellipsometry setup based around photoconductive antennae. The background theory on terahertz generation and detection via photoconductive antennae, as well as ellipsometry will be discussed. Lastly, methods via which optical parameters can be extracted from terahertz time-domain ellipsometry data will be discussed.

192 - Prodding QGP in N=4 SYM with Stringy Yo-yos

TCP - Tuesday 30 June 2015 15:00 *[For award: Hons]*

Primary author: MOERMAN, Robert *(University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

In the last decade, significant strides have been taken by the high-energy physics community towards understanding the early evolution of the universe – namely the recent experimental production of quark-gluon-plasma (QGP), the deconfined state of QCD matter, which is hypothesized to have existed about a microsecond after the big bang. The properties of this partonic soup are not well understood because QGP is in the strongly coupled regime of QCD. However, using the framework of the anti-de-Sitter/conformal field theory (AdS/CFT) conjecture we are able to probe QGP in N=4 Super Yang Mills (SYM) at strong coupling through classical gravity calculations at weak coupling. In particular, we consider the thermalization of a “massless” quark which is dual to a string falling in a five-dimensional AdS-Schwarzchild background. Our modified “yo-yo” solution is constructed by fixing an end-point of a string (which is initially straight, fully-extended and later collapses to a single point) to a D0-brane situated at the horizon of the black hole in our five-dimensional geometry. This calculation is performed in the hope that it provides insight into the deviation of the computed jet nuclear modification factor at high transverse momenta (which has be previously calculated using AdS/CFT) from recent Large Hadron Collider (LHC) data.

197 - Surface Enhanced Raman Spectroscopy (SERS) of bio-molecules.

Photonics - Wednesday 01 July 2015 14:20 *[For award: MSc]*

Primary author: PFUKWA, Cathrine *(Stellenbosch University)*

Surface Enhanced Raman Spectroscopy (SERS) is a powerful vibrational spectroscopy tool as it provides detailed fingerprint information on samples due to its high sensitivity. In this study we investigate the suitability of SERS for bio-molecules (proteins and carbohydrates). The specific degree of enhancement will be looked at. For the detection of proteins, three types of Ag nanoparticles shall be employed. These are the hydroxyl-amine reduced, PEG-coated and the iodide coated nanoparticles. By utilising these types of nanoparticles we look at and compare how the Raman signals from specific proteins are enhanced. This shall be studied with an existing setup using a 532nm Nd:YAG laser as well as 785 nm diode laser in-order to investigate the wavelength dependency of the signal enhancement. Eventually, concentration studies can be carried out in order to establish the detection limit together with the optimum sample concentration for effective signal enhancement using the most effective type of nanoparticle and laser system.

198 - Femtosecond pump-probe spectroscopy on wild-type and mutant antenna complexes from Arabidopsis thaliana

Photonics - Friday 03 July 2015 10:00 *[For award: PhD]*

Primary author: PARADZAH, Alexander *(University of Pretoria)*
Co-author: *KRUGER, Tjaart (University of Pretoria)*

When exposed to high levels of solar radiation, plants and other oxygenic photosynthetic organisms have to dissipate excess absorbed photoenergy which would otherwise lead to the formation of reactive oxygen species and subsequently damage the light harvesting apparatus. The process by which excess excitation energy is harmlessly dissipated from the pigment-protein light harvesting complexes in the form of heat is known as qE and constitutes the major and fastest component of a complex feedback mechanism generally known as non-photochemical quenching (NPQ). Different models have been suggested to explain the molecular mechanism behind qE in the light harvesting complexes of higher plants. The role of specific carotenoid pigments in the process is still not entirely understood. We have tested the involvement of the carotenoid neoxanthin in the process of qE by carrying out femtosecond pump-probe spectroscopy on wild-type and NPQ2 mutant LHC II complexes. NPQ2 mutants do not contain neoxanthin; hence analysis of the data from the different samples should help shed light on the eventual involvement of this carotenoid in quenching activation. The pump pulse energy in the measurements was set at 5 nJ to avoid both singlet-singlet and singlet-triplet annihilation. We applied global and target analysis to the data to determine the excitation energy transfer that occurs between the different pigments that constitute LHC II. Here I will present the results obtained after using pump excitations at 488 and 509 nm (i.e. carotenoid-specific excitations) on the two different samples in the solubilized state. Our preliminary results indicate the involvement of neoxanthin in actively transferring excitation energy to chlorophyll b molecules.

199 - X-ray Reflectivity Study of Si Nanowires Grown by Ag Nanoparticle Etching

Applied - Thursday 02 July 2015 17:30

Primary author: MICELI, Paul F. *(University of Missouri)*
Co-authors: *KREMENAK, Jesse W. (University of Missouri); CHEN, Yiyao (University of Missouri); ARENDSE, Christopher (Physics Dept., UWC); CUMMINGS, Franscious (University of the Western Cape)*

The results of x-ray reflectivity measurements on Si(100) substrates upon which Si nanowires were produced by Ag nanoparticle etching will be discussed. Using HF and H2O2, the Ag etches into the Si substrate to produce the nanowires, which generate optically rough surfaces that are of interest for anti-reflection in photovoltaic applications. The reflection of x-rays from an interface provides a sensitive tool for determining interfacial structure on an atomic length scale. Because of the high electron density of Ag, x-ray reflectivity can investigate the evolution of the Ag nanoparticles during etching. A brief overview of the technique, its advantages and its limitations will be given. In particular, the highly rough surfaces that are generated introduce challenges for the technique. Measurements were performed on a series of samples prepared for different etch times. Both Bragg diffraction and x-ray reflectivity indicate a similar Ag nanoparticle size of ~27 nm. The depth of the Ag nanoparticles relative to the position of the Si surface was determined by x-ray reflectivity as a function of etching time. The results will be compared and corroborated with electron microscopy and optical measurements performed on companion samples. Support is gratefully acknowledged from the National Science Foundation (USA) - DGE1069091, the National Research Foundation (RSA) - TTK14052167658, 76568 and 92520; and the University of Missouri/University of Western Cape Linkage Program.

201 - Supercontinuum pulse compression

Photonics - Wednesday 01 July 2015 14:40 *[For award: MSc]*

Primary author: VILJOEN, Ruan *(Stellenbosch University)*
Co-authors: *SPANGENBERG, Dirk-Mathys (University of Stellenbosch); BARICHOLO, Peter (National University of Science and Technology, Stellenbosch University); NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); ROHWER, Erich (University of Stellenbosch); HEIDT, Alexander Heidt (Laser Research Institute, Physics Department, University of Stellenbosch)*

Using the supercontinuum (white light) output from of an all-normal dispersion photonic crystal fibre (PCF) provides the platform to create ultrashort pulses around the order of a few fs. Due to extreme dispersion of the pulse in the PCF, chirp compensation is required to create such an ultra short pulse. This is realised experimentally by having the white light propagate through a 4f-shaper setup combined with a computer controlled one dimensional spatial light modulator in order to determine the amplitude and phase of the pulse. To calculate the phase of the dispersed pulse we apply an iterative procedure called multiphoton intrapulse interference phase scan (also known as MIIPS). We can use the 1D SLM to correct for this pulse dispersion using the determined phase and in so doing compress our pulse to produce bandwidth limited output pulses. This presentation will focus on the experimental realisation of compressing the pulse using a 4f-shaper-1D SLM setup, specifically how the phase correction is applied to our stretched pulses. White light generation and the MIIPS procedure will be briefly discussed in order to provide a general understanding of this pulse compressor.

204 - Solar radiometry and forecasting research at UKZN

Applied - Wednesday 01 July 2015 14:00

Primary author: MATTHEWS, Alan *(UKZN)*
Co-authors: *GOVENDER, Paulene (UKZN); GANYA, Elson (UKZN); SIVAKUMAR, Venkataraman (University of KwaZulu Natal); BROOKS, Michael (UKZN)*

At the UKZN Westville and Howard College campuses there are radiometers (on both campuses) that provide measurements of direct and diffuse irradiance, and a Total Sky Imager (TSI) that produces images of cloud patterns throughout the day. The radiometers are members of SAURAN (Southern African Universities Radiometry Network). Current research is focused on classification of irradiance profiles and solar forecasting using the TSI and other data sources (P. Govender, PhD project), as well as the relationship between irradiance and cloud cover (E. Ganya, MSc project), working together with the other co-authors on this paper. Research thus far has involved performing clustering analysis on irradiance profiles and on analysing TSI images. This paper describes the research plan and reports on current progress.

206 - Why Do Students Distinguish Between Net Force and Total Force?

Edu - Wednesday 01 July 2015 11:10 *[For award: PhD]*

Primary author: SOUTHEY, Philip *(UCT)*
Co-author: *ALLIE, Saalih (UCT)*

In previous research we have shown that novice physics students distinguish between the concept of a net vector quantity and the concept of a total vector quantity. Introductory physics textbooks variably use the terms “net”, “total” or “resultant” when referring to a vector sum, with some textbooks using these terms interchangeably. In particular, we have shown that students distinguish between the concepts of net force and total force, and the concepts of net momentum and total momentum. Phase two of this research has been to analyse the reasons students give for making these distinctions. Using an approach suggested by Grounded Theory, free responses from 400 first year students have been analyzed and broad trends of reasoning have been identified. These trends are contrasted with foundational representational schemas posited by the cognitive sciences, such as “changing position versus changing state”, and “interior viewpoint versus exterior viewpoint”.

207 - Performance of missing transverse momentum reconstruction in ATLAS

NPRP - Wednesday 01 July 2015 11:30

Primary author: *LUIS, March (University of the Witwatersrand)*
Co-authors: LIAO, Shell-may *(University of the Witwatersrand, School of Physics, 1 Jan Smuts Avenue, Braamfontein, Johannesburg, 2000, South Africa"); TOMIWA, Kehinde (University Of Ilorin)*

The missing transverse energy plays a really important role in reconstructing events produced at hadron colliders.Undetectable particles, such as neutrinos, pass through the matter with a negligible probability of interaction.Hence, no direct evidence of them can be measured in a general purpose detector, as ATLAS. However, the total momenta in the transverse plane to the beam axis has to be conserved and computed. In particular, it is used in searches for the Standard Model Higgs boson channels, such as: H -> WW, H -> ZZ and H -> ττ for Run-I data-taking.The benefit of using this conservation law is that an energy imbalance may signal the presence of such undetectable particles. Therefore, it becomes also a powerful tool for new physics searches at the Large Hadron Collider, such as Supersymmetry and Extra Dimensions, for Run-II data-taking period.The missing transverse energy measurement is significantly affected by the contributions of additional proton-proton collisions superimposed on the hard physics process, so new methods have been developed to suppress such contributions for Run-II data-taking.The performance of the missing transverse momentum reconstruction in the ATLAS detector using data collected in Run-I and studies of the expected Run-II performance are presented.

208 - The Sub-millimeter Continuum Emission of Cygnus A

Astro - Friday 03 July 2015 11:10

Primary author: LEEUW, Lerothodi *(University of South Africa)*

We analyze the sub-millimeter (submm) continuum emission from the radio galaxy Cygnus A, 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 this and similar galaxies.

210 - Investigation of nuclear reactor materials using modern electron microscopy techniques

DPCMM - Thursday 02 July 2015 10:00

Primary author: NEETHLING, Johannes *(Nelson Mandela Metropolitan University)*
Co-authors: *OLIVIER, Jaco (NMMU); O'CONNELL, Jacques (NMMU); GOOSEN, William (NMMU); JANSE VAN VUUREN, Arno (NMMU)*

Electron microscopy is an essential characterization and research tool for nuclear materials science, which includes materials used for the nuclear power plant, fuel cycle and waste immobilization. The research investigations carried out in the Centre for HRTEM focuses on fission product transport in silicon carbide (SiC), the joining of SiC, radiation damage in SiC, zirconium nitride (ZrN), zirconium titanium nitride (ZrTiN) and Oxide Dispersion Strengthened steel. The structural properties and radiation resistance of nanocrystalline ZrTiN coatings on zircaloy are being investigated as part of an international accident tolerant LWR fuel cladding programme. The experimental techniques used for the materials research include scanning electron microscopy (SEM), energy dispersive x-ray spectrometry, electron backscatter diffraction, transmission Kikuchi diffraction, focused ion beam SEM, high resolution transmission electron microscopy (TEM) and electron energy loss spectroscopy. The modern ion mills and focused ion beam used for TEM specimen preparation have created the enabling technology for the preparation of excellent TEM specimens of materials that presented serious challenges in the past. Site specific TEM specimens from soft to ultra-hard materials as well as TEM specimens from ceramic and other nano-size powders can now be prepared employing these fast and reliable methods. The application of these techniques to the characterization of the materials mentioned above will be discussed and a number of important results on metallic fission product transport in silicon carbide will be presented.

212 - Data processing at the Necsa neutron diffraction facility

NPRP - Wednesday 01 July 2015 15:20 *[For award: PhD]*

Primary author: MARAIS, Deon *(The South African Nuclear Energy Corporation (Necsa))*
Co-authors: *VENTER, Andrew (Necsa Limited); MARKGRAAFF, Johan (North West University, Potchefstroom Campus)*

The South African Nuclear Energy Corporation SOC Ltd. (Necsa) recently completed major instrument upgrades to the Neutron Diffraction Facility (NDIFF) at the SAFARI-1 research reactor. With this, a method was needed to facilitate data processing of both the Powder Instrument for Transition in Structure Investigations (PITSI) and the Materials Probe for Internal Strain Investigations (MPISI) instrument. As only minimal standardisation of neutron diffraction instruments and their data processing software exists, available packages were not directly compatible with the NDIFF instrument modalities. A number of diffraction data processing frameworks (such as Mantid and GumTree) are available, but these tend to be very expansive and have a steep learning curve, which needs to be overcome in order to add functionality. New purpose-built software named ScanManipulator was consequently created for NDIFF.In order to produce a complete diffraction pattern from datasets at different detector angles as measured on PITSI, the data first undergoes a number of procedures, which was automated with the new software. This includes flat field and geometric correction, data cropping, normalisation, scaling and stitching. Treated data can be exported to a Fullprof compatible format enabling quantitative Rietfeld analysis.ScanManipulator can be connected to the control system of MPISI thereby providing it with near real-time data originating from the 2D position sensitive neutron detector. The necessary corrections and normalisations are automatically applied as new detector data becomes available. Peak parameters resulting from automated peak fitting of the corrected data are evaluated against statistical criteria and used to adjust the measurement time within the control loop. The use of this protocol also leads to a reduced spread in standard deviation values of d-spacing between successive measurements.ScanManipulator thus provides a platform to perform automated processing of diffraction data emanating from the NDIFF instruments.

214 - Fluorescence spectra of carbon monoxide isotopomers upon vacuum ultraviolet excitation

Photonics - Wednesday 01 July 2015 15:00 *[For award: MSc]*

Primary author: DE BRUYN, Andre *(Laser Research Institute, Stellenbosch University)*
Co-authors: *RIGBY, Charles (Laser Research Institute, Stellenbosch University); STEENKAMP, Christine (University of Stellenbosch); ROHWER, Erich (University of Stellenbosch); DU PLESSIS, Anton (Stellenbosch University)*

This project is aimed at investigating the excitation and fluorescence wavelengths for carbon monoxide (CO) in the VUV region. VUV absorption lines of the CO in the interstellar space are observed in spectra of starlight, recorded by satellite based spectrographs. The weak spectral lines of forbidden transitions (FT) of $^{12}C^{16}O$ are critical to astronomy and astrophysics. CO is a prototype molecule; a numerical model of CO has been developed. However for a large number of the FT, experimental spectroscopic data is lacking. The tunable VUV laser source allows recording of FT of CO. The narrow spectral bandwidth of the light (high spectral resolution and high spectral brightness) allows detection of the fluorescence from weakly absorbing transitions. The pulsed nature of the sources makes selective detection of the FT possible. 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 it is possible to record the CO fluorescence spectrum upon VUV excitation. By analysing the fluorescence spectrum emitted when a single rovibronic energy state of CO is excited using the tunable VUV laser, experimental transition probabilities can be determined.

215 - A model describing two-exciton effects in photosynthetic light-harvesting systems

TCP - Wednesday 01 July 2015 10:00 *[For award: MSc]*

Primary author: NÖTHLING, Johan *(University of Pretoria)*
Co-authors: *KRÜGER, Tjaart (University of Pretoria); MAN■AL, Tomáš (Charles University)*

In the light-harvesting apparatus of photosynthetic organisms, energy is transferred from captured photons to exciton states. These states, which are remarkably quantum in nature, are characterized by the sharing of an electronic excitation amongst different chromophore molecules. Energy can be passed coherently between two exciton states. Because of the presence of quantum coherence, energy can be transferred rapidly and very efficiently over large molecular distances; from the locus of photon capture to the reaction centre (where a spatial charge separation is achieved). In general, energy is transferred to the reaction centre so rapidly that only a single exciton exists in the light-harvesting system at a given time. Certain processes, however, like the annihilation of singlet excitation states by long-lasting triplet states, require a two-exciton description. We have set up a time-dependent, Redfield-type model that well-describes the time-evolution of single- and two-exciton states. This model will be discussed, as well as its application to real biological systems.

216 - The Impact of Re-homogenisation for Nodal Cross-section Corrections in OSCAR-4 as Applied to SAFARI-1 Research Reactor

NPRP - Wednesday 01 July 2015 14:00 *[For award: MSc]*

Primary author: CHINAKA, Eric *(North-west University & NECSA)*
Co-authors: *PRINSLOO, Rian (Necsa); GROENEWALD, Suzanne (Necsa); NAICKER, vishnu (north-west university)*

Calculational support to the operation of the SAFARI-1 research reactor at Necsa is primarily performed with the in-house developed OSCAR-4 nodal diffusion code. Nodal diffusion methods implement a series of non-linear corrections to the nodal cross-sections. Such corrections are needed since nodal cross-sections are most-often generated in a typical infinite assembly environment, as opposed to the actual core environment. In this work, the impact of one such correction method, termed nodal re-homogenisation, is evaluated for the case of the SAFARI-1 reactor. Furthermore, this is done with respect to a newly proposed OSCAR-4 SAFARI-1 core model. The new model is based in part on nodal cross-sections generated from the Monte Carlo based Serpent code, which supplies a consistent reference transport solution against which the capability of the non-linear model may be measured. The capability of the homogenization model to correct for the environmental error is evaluated on a SAFARI-1 fresh core 2D model, considering both an All-Rods-In (ARI) and an All-Rods-Out (ARO) case. Such analysis has as yet not been applied to research reactors and in this work, we show that the environmental error for a SAFARI-1 core may be as large as 536 pcm and induce a maximum assembly power error of 9.2%. Both cases are then re-calculated, with the re-homogenisation model activated, to illustrate the capability of the re-homogenization correction method.

218 - Very-high-energy emission from pulsars

Astro - Wednesday 01 July 2015 14:40

Primary author: BREED, Monica *(Centre for Space Research, North-West University, Potchefstroom Campus, Private Bag X6001, Potchefstroom, 2520, South Africa)*
Co-authors: *VENTER, Christo (Centre for Space Research, North-West University, Potchefstroom Campus, Private Bag X6001, Potchefstroom, 2520, South Africa); HARDING, Alice (Astrophysics Science Division, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA)*

It is now nearly seven years since the launch of the hugely successful Fermi Large Area Telescope (LAT) gamma-ray mission. The LAT has released two pulsar catalogues during this time, collectively describing the light curve and spectral properties of 117 gamma-ray pulsars. The vast majority of the Fermi-detected pulsars display exponentially cutoff spectra with cutoffs falling in a narrow band around a few GeV. Early spectral modelling utilized standard pulsar magnetospheres and predicted spectral cutoffs at energies of up to 50 GeV. It was therefore not expected that pulsars would be visible in the very-high-energy (VHE) regime (>100 GeV). The VERITAS announcement (confirmed by MAGIC) of detection of pulsed emission from the Crab pulsar at energies up to 400 GeV therefore raised important questions about our understanding of the electrodynamics and local environment of pulsars. H.E.S.S. has now detected pulsed emission from the Vela pulsar up to tens of GeV, making this the second pulsar detected by a ground-based Cherenkov telescope. Deep upper limits have also been obtained by VERITAS for the Geminga pulsar. We will review the latest developments in VHE pulsar science, including an overview of the latest observations, refinements and extensions to radiation models and magnetic field structures, and the implementation of new radiation mechanisms. This will assist us in understanding the VHE emission detected from the Crab pulsar, and predicting the level of VHE emission expected from other pulsars, which would be very important for the upcoming CTA.

219 - Ability of Gold Nanoparticles in mediating cellular damage in human breast cancer cells (MCF-7) using laser irradiation

Photonics - Tuesday 30 June 2015 11:50 *[For award: PhD]*

Primary author: MFOUO TYNGA, Ivan *(Laser Research Centre)*
Co-authors: *HOURELD, Nicolette Nadine (Laser Research Centre); ABRAHAMSE, Heidi (Laser Research Centre)*

Cancer is considered one of the scariest diseases that has severe impacts on health, social and economic global aspects. Nanomedicine is considered a new approach for cancer treatment. Certain types of cancer could be prevented as they are lifestyle dependent and caused by both external and internal factors. Despites numerous efforts, the condition remains a dominant health-threatening issue worldwide. In the United States, it is estimated that over 1.6 million new cases will be diagnosed and would result in 585,720 deaths in 2014. Breast cancer is one of the most frequently diagnosed cancers worldwide and is the leading cancer among South African women. Among available treatments, Photodynamic therapy (PDT) is a targeted and light induced therapy that depends upon successful localization and specific activation of a chemotherapeutic agent to induce cell death. Nanotechnology in cancer therapy provides interesting possibilities in detecting and eradicating tumors with minimal damage to health tissues. This study aimed to synthesize and characterize a conjugate made of Zinc-Phthalocyanine (ZnPc) and gold nanoparticles (AuNPs), to identify subcellular localization as well as effects of the conjugate prior to and post laser irradiation in a breast cancer cell line (MCF-7). This presentation will discuss the outcomes of the combined treatment on cell morphology, viability, proliferation and cytotoxicity.

220 - Implementing the Deutsch Algorithm with classical light

Photonics - Thursday 02 July 2015 14:20

Primary author: PEREZ-GARCIA, Benjamin *(Tecnologico de Monterrey, University of the Witwatersrand)*
Co-authors: *FRANCIS, Jason (UKZN); MCLAREN, Melanie (University of the Witwatersrand); HERNANDEZ-ARANDA, Raul (Tecnologico de Monterrey); FORBES, Andrew (CSIR); KONRAD, Thomas (UKZN)*

We show an implementation of the Deutsch Algorithm using classical optical elements and a coherent laser source. The encoded qubits are present in form of polarisation and orbital angular momentum. Our approach, based on a Sagnac interferometer, offers excellent stability and demonstrates that optical quantum computation is achievable using classical states of light.

221 - The effect of an ion beam on ion-acoustic supersolitons

Space - Wednesday 01 July 2015 11:50

Primary author: OLIVIER, Carel *(SANSA)*
Co-authors: *MAHARAJ, Shimul Kumar (South African National Space Agency (Space Science) (formerly NRF Hermanus Magnetic Observatory)); HELLBERG, Manfred (UKZN)*

Supersolitons are electrostatic nonlinear structures which have subsidiary extrema in the bipolar electric field signatures. They are known to occur in a plasma with two electron components having different temperatures. In this study we will investigate supersolitons in a plasma consisting of positively charged (stationary) cold ions, a positively charged cold ion beam and cool and hot electrons. The weak beam ions are assumed to drift in the direction of the magnetic field as is the direction of propagation of the solitons. The main focus of the study will be to examine the effect of beam speed and beam concentration on the parametric existence regions of supersolitons.

222 - Resonant absorption of electromagnetic radiation by building materials

Applied - Friday 03 July 2015 12:10

Primary author: MTHOMBENI, Godman *(University of Johannesburg)*
Co-author: *MULABA-BAFUBIANDI, Antoine F. (University of Johannesburg)*

Subsurface scanning or imaging using radar techniques is becoming more popular in recent years, especially for the location of reinforcing rebar and voids in concrete structures. Radar has advantages in detecting steel rebar embedded in concrete structures due to the sensitivity of electromagnetic waves to metallic objects. However while radar is being used in locating reinforcing rebar embedded inside concrete, the interaction of electromagnetic waves especially at microwaves frequencies with concrete is often not well explored. At microwave frequencies the varying electric and magnetic field of an electromagnetic wave will result in the oscillation of the electric and magnetic dipoles in the dielectric material when attempting to align themselves with the frequency of the wave. In the microwave range this has resulted in the generation of heat in dielectric materials, which concrete is one of them. Due to the inhomogeneous nature of concrete, exposing it to microwave irradiation will result in an inherently non-uniform temperature distribution, resulting to stresses and strains of different magnitudes within the lattice. This will be mainly due to significantly different thermal expansion coefficients existing between different minerals and composing materials in concrete as a composite material. The stresses will lead to localised macroscopical fractions of an intergranular and transgranular nature. These are seen as benefits in mineral processing processes such as comminution and leaching. However in concrete structures the formation of intergranular and transgranular cracks will not have benefits, as they will compromise the integrity of the structures. However, the power used in scanning or imaging is very low compared to the power used in microwave heating. This paper discusses the absorption of electromagnetic radiation by concrete structures and its influence in the strength of concrete and the effect of applied microwave power levels.

223 - Dependence of the photo-ionization cross-section of α-Al2O3:C on the measurement temperature

DPCMM - Wednesday 01 July 2015 14:20 *[For award: PhD]*

Primary author: *NYIRENDA, Angel (Rhodes University)*
Co-author: *CHITHAMBO, Makaiko (Rhodes University)*

In this study we report the temperature dependence of the photo-ionization cross-section i.e. the effective area of interaction between incident photons and charge trapping states, in &alpha-Al2O3;:C, a highly sensitive dosimetric material. Samples irradiated to 1.0 Gy of beta dose were subjected to linear-modulation-optically-stimulated-luminescence (LM-OSL) technique which involves ramping the optical stimulation power from a minimum value to some maximum value at a constant wavelength. Blue LEDs (470 nm) with a total maximum power of 80 mWcm-2 at the sample position were used as a stimulation source. In our investigations, the stimulation power was ramped from 0% to 100% of the maximum power. The resultant LM-OSL curve was deconvoluted using the Bulur's analytical expression [1] for first order kinetics. For the sake of comparison, the LM-OSL first order expression which is based on experimental quantities [2] was also used. The apparently single LM-OSL peak is comprised of at least two components, herein referred to as fast and slow components. The peak positions of the component peaks shift to lower values with increasing measurement temperature. In addition, the photo-ionization cross-sections for both fast and slow components vary from $(1.19\text{-}1.69)\times10^{-18}$ cm^{-2} and $(4.05\text{-}7.20)\times10^{-19}$ cm^{-2} respectively as measurement temperature increases from 30-120°C. Furthermore, the results obtained through the analytical expression of first order are consistent with those obtained using its experimental counterpart.References1. Bulur E., 1996. An alternative technique for optically stimulated luminescence (OSL) experiment. Rad. Meas. 26, 701-7092. Kitis G. and Pagonis V., 2008. Computerized curve deconvolution analysis for LM-OSL. Rad. Meas.

225 - Optical spectroscopic observations of unclassified Active Galactic Nuclei in the Fermi-2LAC catalogue

Astro - Friday 03 July 2015 11:50 *[For award: MSc]*

Primary author: *KLINDT, Lizelke (University of the Free State)*
Co-authors: *VAN SOELEN, Brian (University of the Free State); MEINTJES, Pieter (University of the Free State); VÄISÄNEN, Petri (SAAO)*

Blazars constitute the most violent astronomical objects with relativistic jets emitting radiation at all frequencies. The 2nd Fermi-LAT catalogue of AGN contains 157 sources which are classified as unknown type. All sources lie at high galactic latitude s (|b| > 10■) with candidate optical and/or radio counterparts within the Fermi 95% error circle. We are undertaking a multi-wavelength campaign to classify a selected number of these sources which exhibit blazar-like characteristics by establishing their optical spectra, Spectral Energy Distributions and searching for variability. We present preliminary optical spectroscopic observations of 15 of these sources obtained with the SAAO 1.9-m telescope and the Southern African Large Telescope (SALT). The low-resolution spectra are mainly featureless as are expected for BL Lac objects, however Ca II K&H;, MgIb and/or NaD absorption lines appear to be present, allowing for a first estimation of the redshift range $0.1 < z < 0.8$. The strength of non-thermal jet emission is determined from the depth of the Ca II depression, which is a good indicator whether the targets are potential blazars.Keywords: BL Lacertae objects: general, galaxies: distances and redshifts

228 - Using single-molecule spectroscopy methods to investigate the environmental dependencies of photoprotection in the main plant light harvesting complex.

Photonics - Friday 03 July 2015 10:20 *[For award: MSc]*

Primary author: *BOTHA, Joshua (University of Pretoria)*
Co-authors: *KRUGER, Tjaart (University of Pretoria); GRUBER, Michael (Vrije Universiteit of Amsterdam); STOLTZ, Herman (University of Pretoria)*

The fundamental mechanisms involved in photosynthesis not only provide an opportunity to study physical principles that span over both classical and quantum physics 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). Our interest is in the fast, reversible, energy-dependent component of NPQ that takes place in the major light-harvesting pigment-protein complex (LHCII) of plants. By introducing a low solvent pH the photoprotective state of isolated LHCII proteins is triggered. A study of this emulated photoprotection is made by using Single Molecule Spectroscopy (SMS). The fluorescence lifetime of LHCII are determined by using time-tagged time-resolved (TTTR) measurements, which in turn serves as measurement of NPQ. Time resolved fluorescence intensity also allows for the investigation of fluorescence intermittency. In an attempt to remove unnatural influences on the emulated photoprotection isolated LHCII would rather be followed in free diffusion through single particle tracking (SPT) as opposed to the traditional surface adhesion method. For this purpose we have assembled a unique SMS setup, where isolated LHCII complexes will be followed in real-time with parallel fluorescence measurements being made. The first results of photoprotection on the level of a single biological entity using our novel approach will be shown.

229 - Exploring teachers' baseline knowledge of mechanics

Edu - Wednesday 01 July 2015 14:00

Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-author: *RAMNARAIN, Umesh (University of Johannesburg)*

Mechanics is a vast conceptual area in introductory Physics at university and also at the high school level. Research on conceptual understanding shows that this is an area that is characterised by a myriad of alternative conceptions. Adequate conceptual foundation in mechanics is central to meaningful understanding of various knowledge areas in Physics as an intellectually stimulating discipline. In this regard, a diagnostic questionnaire was administered to teachers enrolled for a Short Learning Programme at a university to establish their baseline knowledge of mechanics. The findings of this research revealed teachers' knowledge gaps and conceptual inadequacies associated with mechanics. The implications for teacher professional development are discussed.

230 - Radio Observations Of GRB 100418a: Test Of An Energy Injection Model Explaining Long-Lasting GRB Afterglows

Astro - Thursday 02 July 2015 11:30

Primary author: *MOIN, Aquib (University of Johannesburg)*

In this talk, I will highlight the results of our observational campaign on GRB 100418a in the radio band, for which the Australia Telescope Compact Array (ATCA), the Very Large Array (VLA) and the Very Long Baseline Array (VLBA) were used. GRB 100418a was a peculiar GRB and it had unusual X-ray and optical afterglow profiles featuring a plateau phase with a very shallow rise. This observed plateau phase was believed to be a signature of some sort of an energy injection mechanism, which kept powering the forward shock continuously, giving rise to an unusual and long-lasting afterglow. The radio afterglow of GRB 100418a was detectable several months after the prompt emission. We conducted long-term monitoring observations of the radio afterglow and attempted to test the postulate of energy injection model which advocates that the continuous energy injection is due to shells of material moving at a wide range of Lorentz factors. We obtained an upper limit of $\gamma < 7$ for the expansion rate of the GRB 100418a radio afterglow, indicating that the range-of-Lorentz factor model could only be applicable for relatively slow moving ejecta. A preferred explanation could be that its actually the continued activity of the central engine that may have continuously powered the long-lasting afterglow. We further concluded that a plateau phase in X-ray and/or optical afterglow profile can potentially be taken as an indicator of the possible longevity of the radio afterglow of a GRB, further reaffirming the role of energy injection in giving rise to long-lasting afterglows.

233 - Multi-Dimensional Analysis of Precipitates in a 12% Cr Steel

DPCMM - Tuesday 30 June 2015 15:00 *[For award: MSc]*

Primary author: *DEYZEL, Genevéve (Centre for HRTEM, Department of Physics, NMMU, Port Elizabeth, South Africa)*
Co-author: *WESTRAADT, Johan (Centre for HRTEM, NMMU, Port Elizabeth, South Africa)*

Creep-strength-enhanced ferritic (CSEF) steels are widely used in fossil fuel plants. This material is strengthened by $M_{23}C_6$ (M = Cr, Fe) and MX (M = V, X = C, N) precipitates in the tempered martensite matrix. The size, shape and distribution of these precipitates play an important role in the creep strengthening of the material, which is quantified by the Orowan back-stress. The precipitate parameters are often measured from images taken from thin-foils using the transmission electron microscope (TEM). Some problems associated with the thin-foil methods are overcome by preparing extraction replicas of the surface. 2D elemental maps are only projections of the 3D precipitates and therefore cannot sufficiently provide the spatial distribution of the precipitates. Transmission electron tomography is a technique capable of visualising the 3D structure of the precipitates. If combined with energy-filtered TEM (EFTEM), one can generate 3D chemical maps, which overcomes the limitations of the 2D maps. The aim is to use 3D elemental EFTEM maps obtained from the extraction replica, to determine the precipitate shape and spatial distribution. These results can then be compared to that previously obtained from the 2D maps. The material used for this study was X20CrMoV11-1 (12% Cr) stainless steel. TEM thin-foils and extraction replicas were prepared. 2D EFTEM elemental maps were acquired for Cr and V using the TEM. In order to construct a 3D composite image, a tomographic tilt-series of EFTEM maps was obtained with the TEM.From the results that will be presented, it can be concluded that by incorporating 3D EFTEM tomography with 2D elemental EFTEM mapping, that the projection limitation can be eliminated to obtain precipitate parameters with improved accuracy.

234 - A quasi-periodicity in the optical polarization of the blazar PKS 2155-304?

Astro - Friday 03 July 2015 11:30 *[For award: PhD]*

Primary author: PEKEUR, Nikki (UCT)
Co-authors: TAYLOR, Russ (UCT, UWC, SKA); POTTER, Stephen (SAAO); KRAAN-KORTEWEG, Renee C. Kraan-Korteweg (Astronomy Department (ACGC), University of Cape Town)

We report the possible detection of a quasi-periodic oscillation (QPO) in the polarized flux of the gamma-ray emitting blazar PKS 2155-304. The source was recorded with the HIgh-Speed Photo-POlarimeter (HIPPO), which was mounted on the 1.9 m Radcliffe telescope, operated by the South African Astronomical Observatory (SAAO). The microvariability of the polarization was observed from 25 to 27 July 2009 using a temporal resolution of 5 minutes. During this time, the mean daily polarization degree increased from roughly 3% to 10%. Simultaneous very high-energy (VHE, photons exceeding GeV energies) gamma-ray measurements with the High Energy Stereoscopic System (H.E.S.S.) showed that this increase in the polarization degree coincided with an increase in the gamma-ray flux of the source. Inspection of the intranight variability of the polarization showed that, on 24 July 2009, the polarized flux appeared to be modulated by a periodic component. This polarized QPO occurred at the onset of the increase in gamma-ray activity in PKS 2155-304, which was itself preceded by a gamma-ray flare that reached its peak flux on 23 July 2009, one day before the QPO developed. A periodogram of the polarized flux revealed the presence of a significant peak at a frequency corresponding to period of ~30 minutes. PKS 2155-304 is one of a small number of active galactic nuclei (AGN) for which convincing evidence of QPOs have been found. The most recent claim is a ~4.6 hour periodicity that was detected on 1 May 2006 with the XMM-Newton telescope at X-ray energies (0.3-10 keV). This is the first detection of QPO activity from blazars in the optical and polarized light, opening up a new method of studying the AGN phenomenon.

237 - Ultrafast energy transfer and photoprotection in the light-harvesting complexes of the diatom Cyclotella meneghiniana

Photonics - Friday 03 July 2015 11:10 *[For award: PhD]*

Primary author: ELNOUR, Huzifa (University of Pretoria)
Co-authors: RAMANAN, Charusheela (VU University, Amsterdam); VAN GRONDELLE, Rienk (VU University, Amsterdam); KRUGER, Tjaart (University of Pretoria)

Diatoms are unicellular marine photosynthetic organisms characterized by their silica shell. Their light harvesting complexes are named fucoxanthin-chlorophyll protein (FCP). Besides efficient absorption and rapid subsequent transfer of photoenergy to the photochemical reaction centre, FCP complexes are also strongly involved in photoprotection, a complex series of events known as non-photochemical quenching (NPQ) by which plants and algae dissipate excess absorbed energy that would otherwise damage the photosystems. Diatoms exhibit considerably stronger NPQ than plants. The diatom Cyclotella meneghiniana possesses two types of light-harvesting complexes, known as FCPa and FCPb, which differ primarily in their protein compositions. In this study we used femtosecond transient absorption spectroscopy to investigate the energy transfer dynamics and thermal energy dissipation pathways in FCPb at the last energy transfer stage. Two different pump energies at 680 nm excitation were used. The effect of the environment surrounding the protein was investigated by comparing the behavior of solubilized FCPb (sFCPb) with that of FCPb incorporated into proteoliposomes (pIFCPb), the latter of which serve as a model system for the study of membrane-bound enzymes and transport proteins. The results show that, while the fluorescence of the pIFCPb sample is quenched relative to sFCPb, it appears to exhibit less annihilation than sFCPb, suggesting that the proteoliposome samples may be a new model system to study NPQ mechanisms in these complexes.

238 - Investigating prompt gamma cross-section data using a Geant4-simulated AFRODITE detector system

NPRP - Thursday 02 July 2015 15:20 *[For award: PhD]*

Primary author: RAMANATHAN, Vijitha (University of Cape Town)
Co-authors: LI, Kevin (University of Stellenbosch); PETERSON, Steve (University of Cape Town); PAPKA, Paul (University of Stellenbosch , iThemba LABS)

In radiation oncology, proton therapy has become an increasingly popular treatment modality due to the superior dose distribution of the proton beam while sparing more surrounding normal healthy tissues and critical organs. To fully utilize the benefits of a proton therapy beam, it is important to monitor in-vivo dose deposition. Due to the fact that the treatment protons stop within the patient as they deliver the dose, secondary radiation is the only way to obtain a dose verification measurement. The measurement of secondary prompt gammas emitted during proton-nucleus collisions has been proposed to verify the dose distribution, particularly since the prompt gamma emission is strongly correlated with the proton depth dose profile. During the design of a prompt gamma imaging device using the Geant4 Monte-Carlo toolkit, discrepancies in the simulated prompt gamma cross-section data has been reported. The goal of this study is to investigate the prompt gamma cross-section data for protons over the energy range 66 – 110 MeV. The AFRODITE detector system at iThemba LABS was modeled using the Geant4 Monte-Carlo transport code with a Mylar target used to investigate the prompt gamma cross-section for carbon and oxygen, two of the prominent elements found in the human body. The AFRODITE detector system is composed of eight solid-state Germanium clover detectors with BGO Compton suppression. The physics governing the prompt gamma production in the Geant4 model of the AFRODITE detector system was validated against three standard gamma-emitting sources. A comparison of these experimental gamma spectra to the simulated spectra will be discussed. A series of simulated cross-section measurements from the Mylar target will also be discussed.

239 - Computational Study on Advanced Lithium – Sulphur Battery for Future Portable Energy Storage

DPCMM - Wednesday 01 July 2015 14:40 *[For award: PhD]*

Primary author: MASEDI, Cliffton (UL/ CSIR)
Co-authors: NGOEPE, Phuti (UL); SITHOLE, Happy (CSIR/CHPC)

Advanced energy storage systems are highly desired to meet the increasing demands of high energy density batteries. Rechargeable lithium batteries are expected to play a key role also in future energy storage, including both stationary and automotive applications. Li-ion batteries have transformed portable electronics and will play a key role in the electrification of transport. However, the highest energy storage possible for Li-ion batteries is insufficient for the long-term needs of society, for example, extended range electric vehicles. To go beyond the horizon of Li-ion batteries is a formidable challenge; there are few options. Here we consider a study on Li–S battery which holds the promise for the next generation of battery technology.We investigated the stabilities and atomistic properties of discharge product Li< sub >2< /sub >S formed in Li- S batteries using density functional theory within the generalized gradient approximation and molecular dynamics. Their structural, mechanical, electronics and atomistic properties were determined. The lattice parameters were well reproduced and agree with the available experimental data. The heats of formation predicts that the structure are generally stable. The elastic constants suggest that all the structure is mechanically stable which was in good agreement with calculated phonon dispersions. The Buckingham interatomic potentials describing the interactions between lithium and sulphur were successfully fitted and validated since they produced same melting temperature same as experimental studies.

240 - Extraction of statistical properties in 181Ta to investigate nucleo-synthesis of 180Ta

NPRP - Friday 03 July 2015 12:10 *[For award: MSc]*

Primary author: MALATJI, Kgashane (UWC)
Co-authors: KHESWA, Bonginkosi (IThemba LABS); INGEBERG, Vetle (University of Oslo); KLINTEFJORD, Malin (University of Oslo); LARSEN, Ann-Cecilie (University of Oslo); NYHUS, Hilde (University of Oslo); RENSTRØM, Therese (University of Oslo); ROSE, Sunniva (University of Oslo); SAHIN, Eda (University of Oslo); SIEM, Sunniva (University of Oslo); TVETEN, Gry (University of Oslo); TRIAMBAK, Smarajit (UWC); WIEDEKING, Mathis (iThemba LABS); ZEISER, Fabio (University of Oslo); BELLO GARROTE, Frank (University of Oslo); BLEUEL, Darren (Lawrence Livermore National Laboratory); GIACOPPO, Francesca (University of Oslo); GÖRGEN, Andreas (University of Oslo); GUTTORMSEN, Magne (University of Oslo); HADYNSKA-KLEK, Kasia (University of Oslo); HAGEN, Trine (University of Oslo)

Most stable and extremely low abundance proton-rich nuclei with A>110 are thought to be produced by the photodisintegration of s- and r- process produced nuclei. However, this p-process is insufficient to explain the observed low abundance (0.012%) of the180Ta isotope. Hence combinations of several processes are considered to reproduce 180Ta in the cosmos, provoking debates and making it a unique case study. Significant errors in the predicted reaction rates in some of the p-nuclei can arise due to large uncertainties in nuclear properties such as the nuclear level densities (NLD) and gamma-ray strength functions (γSF) [1]. An experiment was performed in October 2014 to extract the γSF and NLD below the neutron threshold in 180,181,182Ta which provide important input parameters for nuclear reaction models. In the present case study, these parameters were measured using the 181Ta(3He, 3Heγ)181Ta inelastic scattering reaction with 34MeV beam energy at the Oslo Cyclotron Laboratory. Using the SiRi array at backward angles (64 silicon particle telescopes) and the CACTUS array (26 NaI(Tl) detectors), the NLD and γSF were simultaneously extracted from particle-γ coincidence matrices through iterative procedures using the Oslo method [2]. These results will be used to determine the corresponding neutron capture cross sections which in turn will be utilized in astrophysical network calculations to investigate the galactic production mechanism of 180Ta. I will present preliminary results of this investigation of statistical properties for 181Ta.

242 - Effects of Cd2+ concentration on the structure, optical and luminescent properties of MgAl2O4:x% Cd2+ phosphor prepared by sol-gel method

DPCMM - Thursday 02 July 2015 14:00

Primary author: MOTLOUNG, Setumo Victor (University of the Free State)
Co-authors: DEJENE, Francis (University of the Free State); NTWAEABORWA, Odireleng (University of the Free State); SWART, Hendrik (University of the Free State)

Cadmium doped magnesium aluminate (MgAl2O4:x% Cd) powders with different cadmium concentrations have been prepared by the sol-gel method at a relatively low temperature (~ 80 0C). The prepared powders were characterized by different methods to understand their structural, optical and luminescence properties. 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 nanopowders consist of the cubic spinel structure. Cd2+ doping influences the crystallinity, crystallite size and morphology of the prepared MgAl2O4:x% Cd nanophosphors. Ultraviolet-visible spectroscopy (UV-vis) measurements reveal that the band gap of the MgAl2O4 is influenced by Cd2+ doping. Undoped (host) and Cd2+-doped MgAl2O4 nanophosphor exhibit the violet emission at 392 nm. No peak shift suggest that all emissions are originating from the defects within the host material. Increasing the Cd2+ concentration up-to 0.88% Cd2+ leads to luminescence enhancement, while further increase in Cd2+ concentration leads to concentration quenching. CIE colour coordinates confirmed non-tuneable violet emission with an increase with Cd2+ concentration.

243 - NON-SPECIALIST LECTURE: Cosmic rays from binary millisecond pulsars

Astro - Wednesday 01 July 2015 14:00

Primary author: VENTER, Christo *(North-west University, Potchefstroom Campus)*
Co-authors: *KOPP, Andreas (North-West University, Potchefstroom Campus); HARDING, Alice (NASA Goddard Space Flight Center); GONTHIER, Pete (Hope College); BÜSCHING, Ingo (North-West University, Potchefstroom Campus)*

The Fermi Large Area Telescope discovered a number of gamma-ray sources that could not immediately be identified via correlation with known sources in other wavebands. Follow-up radio observations of those sources that exhibited pulsar-like spectral characteristics yielded 65 new millisecond pulsars (MSP) detections. Many of these new MSPs (26 to date) are in exotic systems known as black widows or redbacks. These are close binaries containing a rotation-powered MSP and a compact low-mass companion. A shock will form between the colliding pulsar and stellar winds, leading to particle acceleration. We investigate the contribution of these binary MSPs to the flux of terrestrial cosmic-ray electrons and positrons. We compute the transported electron-positron spectra at Earth, following their diffusion and energy loss (via synchrotron and inverse Compton emission) through the Galaxy. The cosmic-ray contribution of binary MSPs may reach a sizable fraction of the fluxes measured by AMS-02, PAMELA, and Fermi around tens of TeV, depending on model parameters.

244 - Analysis of homogeneity in thin film photovoltaic modules using large area light beam induced current (LA-LBIC) measurements.

Applied - Thursday 02 July 2015 10:20 *[For award: PhD]*

Primary author: OKULLO, Michael *(NMMU)*
Co-authors: *VORSTER, Frederik (NMMU); VAN DYK, Ernest (NMMU); CROZIER, Jacqui (NMMU)*

Thin film Photovoltaic (PV) modules are made from a thin layer of semiconductor material deposited over a large area on a transparent material. As a consequence of the large area deposition process, the deposited layer may be prone to inhomogeneities that can cause a reduction in performance of the module. In this study the use of the large area light beam induced current (LA-LBIC) measurement technique is evaluated as a method to investigate the performance homogeneity of thin film PV modules. The accurate interpretation of the LBIC data depends on knowledge of the operating bias voltage of each cell. The inhomogeneities in the deposited semiconductor layers result in variations in the electrical performance of individual cells during scanning at a particular module voltage in the dark. The series connected cells will thus not operate at a fixed multiple of the applied constant module voltage. This unknown bias level of each cell complicates the interpretation of the results. In this work the cell that is being scanned is placed under a limiting condition using bias lighting to offset the effects of non-uniformity of the module cells. In this paper the experimental setup used is presented and LA-LBIC results discussed. Electroluminescence imaging of the scanned modules is also used to verify the results of the LA-LBIC mapping. In addition, the limitations of the LA-LBIC technique are highlighted and possible solutions to obtain meaningful results from the LA-LBIC technique are presented.Key words: LA-LBIC, Thin film, PV modules, Homogeneity

247 - Double Coset Magnons

TCP - Tuesday 30 June 2015 14:40

Primary author: DE MELLO KOCH, Robert *(University of the Witwatersrand)*

In this talk I will review the double coset ansatz which demonstrates integrability in large N but non-planar limits of N=4 super Yang-Mills theory. By writing the strings theory solutions in the coordinates introduced by Lin, Lunin and Maldacena, we are able to demonstrate how magnon excitations of open strings attached to giant gravitons are described.

250 - Magnetic properties of Ni-substituted Co-nanoferrites

DPCMM - Thursday 02 July 2015 14:20

Primary author: NDLOVU, Bongani *(UKZN)*
Co-authors: *MOYO, Thomas (UKZN); MSOMI, Justice Z (UKZN)*

We report the magnetic and electrical properties of Ni substituted NixCo1-xFe2O4 nanoferrites (where x=0.0 to 1.0 in steps of 0.1). The samples were synthesized by the glycol-thermal method and the single phase spinel structure was confirmed by X-ray diffraction measurements for all samples except for x=0.7 to 0.9. The grain sizes varied from 6.0 nm to 11.3 nm and the lattice parameters from 8.355 Å to 8.381 Å across the composition range. Magnetic properties were investigated by the 57Fe Mössbauer spectroscopy from 80 K to 300 K. Two sextets and one doublet were used to fit the Mössbauer spectra which we associate with ordered magnetic phases. For x=0.7 to 0.9, paramagnetic order is observed at room temperature. These results are complemented by room magnetization measurements on a vibrating sample magnetometer and resistivity measurements on pellets annealed at 1100 ■C. Reduction of coercivity with increased Ni content was observed due to reduced anisotropy. The resistivity measurements on pelletized and annealed in temperature range 25 ■C to 130 ■C provided evidence of semiconducting behaviour with band gaps that decrease with increase in Ni content. The pellets show significant difference in the resistance response between the two faces of a pellet.

252 - Scanning probe microscopy in material science and biology

DPCMM - Friday 03 July 2015 11:50

Primary author: URGESSA, Zelalem N. *(NMMU)*
Co-authors: *DOBSON, Stephen (NMMU); TANKIO DJIOKAP, Stive Roussel (Nelson Mandela Metropolitan University); AHIA, Chinedu Christian (NMMU); TILE, Ngcali (NMMU); FERG, E.E. (Department of Chemistry, NMMU, P.O. Box 77000, Port Elizabeth 6031, South Africa); BOL O, Lukanyo (Department of Chemistry, NMMU, P.O. Box 77000, Port Elizabeth 6031, South Africa); HELEN MORRISON, maria (Department o f Biochemistry and Microbiology); BOTHA, Johannes Reinhardt (NMMU); DEALTRY, Gill (Department of Biochemistry and Microbiology, B ox 77000, Port Elizabeth 6031, South Africa)*

Today, a wide range of analytical techniques can be used for materials research. The most commonly used high-resolution analysis techniques are Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Scanning Probe Microscopy (SPM). Although each technique can resolve surface (SEM and SPM) structure down to the nanometer scale, the different image formation mechanisms result in different types of information about the structure of the surface, making these techniques complementary. SPM is the enabling tool for nano(bio)technology, which has opened new understandings in many interdisciplinary research areas. In addition, SPM can image surface structures with atomic (height) resolution without the necessity of damaging the sample. Moreover, a SPM operates without vacuum, in contrast with electron microscopes. It can also measure different physical properties, such as electric (using Kelvin Probe Force Microscopy (KPM / KPFM)) or magnetic properties (Magnetic Force Microscopy, MFM). As a result, associated with the developments in SPM instrumentation and techniques, new and previously un-thought-of opportunities in understanding the physics and chemistry of molecular and biomolecular processes on the nanoscale level are appearing. In this presentation SPM nanoprobing of surface morphologies of different semiconducting nanostructures (like InSb, GaSb, ZnO, NiO, MgO) and phase separation in diblock copolymer films are presented and discussed. In addition, in-situ electrochemical deposition of lead (Pb) from lead sulfate solutions, for battery applications, is demonstrated. The application of SPM in understanding structural properties of biological materials (e.g. live cells or cell membranes) is also presented and discussed in detail. In addition KPFM of different semiconductor heterojunctions is presented and discussed.

253 - Qualitative assessment of Photovoltaic modules using Electroluminescence

Applied - Thursday 02 July 2015 11:10

Primary author: CROZIER, Jacqui *(NMMU)*
Co-authors: *VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU)*

Electroluminescence (EL) is a useful characterisation technique as it is fast, non-destructive and allows defects in photovoltaic (PV) cells and modules to be identified. EL imaging is very effective in detecting cell defects in modules such as cracks, broken fingers and broken cells. In this paper an automatic identification routine for defects in cells in a module is discussed. An automatic defect identification algorithm that we developed is used to identify poorly performing cells and locate specific defects in mono-crystalline modules. The difficulties in defect identification in crystalline silicon modules other than mono-crystalline, such as multi-crystalline and EFG, are addressed. The cells in a module are sorted by comparing the binary image of each cell to a binary image of a cell in the module that does not show any EL identifiable features or defects. The sorting of cells depends on the parameters selected to define an “undamaged” cell. The sensitivity or area parameters of the algorithm can be adjusted so that smaller features are either considered or ignored. In modules with no apparent defects it is important to note the small features, while in a module with severe defects like large cracks and electrically isolated areas, small cracks and micro-cracks can be ignored as their effects are negligible. Common features such as broken fingers, striation rings have a shape and orientation that allows them to be identified. Micro-cracks can be very fine and easily missed in the image processing. However, once identified, the orientation and location can be determined which is a significant factor in determining the severity of the effect of the micro-crack on a module’s performance.

256 - One and two dimentional models of dye adsorption for application in dye sensitized solar cells

TCP - Wednesday 01 July 2015 10:20

Primary author: MALUTA, Nnditshedzeni Eric *(University of Venda)*
Co-authors: *SANKARAN, Vaith (University of Venda); MPHEPHU, Ndivhuwo (University of Venda)*

The dye sensitized solar cells are currently the subject of intense research in the field of renewable energy as a low-cost photovoltaic device. The light adsorption occurs in dye molecules adsorbed on a highly porous structure of TiO2 porous film. The progress in the efficiency and stability of these solar cells is very low, due to many fundamental aspects of their operation that are still unknown. One process, for which there is limited information, is the time taken to upload the dye on the TiO2 nanoporous film which acts as a semiconductor. Dye molecule is adsorbed onto a TiO2 working electrode by dipping it into the dye solution for periods of several hours to several days. However, such long dipping times are not economic for industrial production of DSSCs. The factors controlling this process are not yet fully understood. We have developed a 1D and 2D models based on the Langmuir isotherms to study and understand the diffusion and adsorption of the dye molecules in TiO2 nanotube films. Our modelling results show that the adsorption of dye into the TiO2 nanotubes is controlled by the diffusion coefficient, the adsorption-desorption ratio and the initial dye concentration.

257 - Fundamental Laguerre-Gaussian (LGp0) mode with lower output power threshold

Photonics - Thursday 02 July 2015 15:00 *[For award: PhD]*

Primary author: BELL, July *(CSIR)*
Co-authors: *NGCOBO, Sandile (Council for Scientific and Industrial Research); FORBES, Andrew (CSIR)*

Intra-cavity generation of fundamental Laguerre-Gaussian modes using a Hamamatsu spatial light modulator (SLM) as a flat-end-mirror. The digital hologram was encoded with an amplitude ring mask, which also contains an aperture of radius r. A curved mirror with a radius of curvature of R=400 mm and reflectivity of 98 % was used as an output coupler. For the design of the optical cavity the length of the cavity was precisely choose to be 173 mm, Nd:YAG of 25 mm as a gain median pumped by a diode laser of 808 nm wavelength was used, resulting in output wavelength of 1064 nm. Laguerre-Gaussian modes of radial order (p), from 0 to 4, were generated and considered for analysis. By digitally controlling LGp0 modes by using an amplitude mask made up of p absorbing rings with ring radii selected with zeros of the desired Laguerre-Gaussian mode. It was found that the laser efficiency for p=1 is the same, regardless of divisions of rings generating these modes (LGp0). In addition, lower output power threshold is recorded, when the ring(s) is(are) divided in parts N. This work demonstrate ease of generating LGp0 modes, with an aim of having a lower laser output power threshold, by dividing absorbing rings into parts.

258 - Using single molecule spectroscopy to study the role of low-energy fluorescence bands in the photoprotection of the major plant light harvesting complex.

Photonics - Friday 03 July 2015 11:30 *[For award: MSc]*

Primary author: STOLTZ, Herman *(University of Pretoria)*
Co-authors: *KRÜGER, Tjaart (University of Pretoria); BOTHA, Joshua (University of Pretoria)*

Single molecule spectroscopy (SMS) is a technique commonly used to study conformational dynamics of individual macromolecules via changes in the fluorescence. We have applied this technique to a single light-harvesting antenna complex of a plant in order to understand the molecular dynamics involved with a process called non-photochemical quenching (NPQ). Oxygenic photosynthetic organisms function optimally in low light conditions, therefore they require some regulatory processes to dissipate excess energy during the high light conditions typically present throughout the day. This regulatory process, NPQ, is crucial for the survival of the plant. NPQ has been linked to large, rapid intensity variations in the fluorescence; known as fluorescence intermittency or blinking. An important component of the thermal dissipation process, known as qE, is characterised by the appearance of low energy absorption and fluorescence bands. By mimicking the in vivo qE states of the major plant light harvesting complex the protein dynamics under qE conditions can be monitored via changes in the absorption and fluorescent spectra. In this presentation the relationship between fluorescence blinking, fluorescence lifetime and the low energy fluorescence bands (redshifts) will be discussed.

259 - Enhancing light absorption and life-time stability of organic solar cells using pentacene encapsulation.

Applied - Thursday 02 July 2015 10:00 *[For award: MSc]*

Primary author: OTIENO, Francis *(University of Witwatersrand)*

Polymer solar cells continue to be investigated as a potentially cheap and viable photovoltaic alternative to the increased global demand for inexhaustible, clean and affordable energy. The most promising designs are based on a bulk heterojunction concept based on combination of electron-donating and electron-accepting molecular materials. However their low power conversion efficiency and stability over lifetime preclude their commercialization. In this work, the effect of surface Plasmon resonance on photo-conversion efficiency and life stability are investigated. Ag surface plasmons synthesized by RF magnetron have been characterized for optical absorption changes upon annealing. The annealed plasmons were grown on ITO before spin coating hole transport layer (PEDO:PSS) followed by P3HT:PCBM blend before thermally evaporating Al electrode. Incorporation of surface plasmons into a polymer based photovoltaic device as a proof of concept enhanced the photo-conversion efficiency by 24%. In addition, Ag plasmons encapsulated by pentacene has been investigated for multiple light absorption and charge transport using I-V characteristics and optical spectroscopy. This was done by thermally evaporating thin film of pentacene in an attempt stabilize the Ag plasmons. Besides production of multiple absorption peaks, the encapsulation has enhanced the device lifetime. We thus establish the potential degradation mechanism in detail using I-V characteristics under light illumination 70W/cm2.

260 - Thermoluminescence from semiconductor quantum dots

TCP - Thursday 02 July 2015 15:20 *[For award: MSc]*

Primary author: *DEBELO, Nebiyu Gemechu (University of the Free State (Qwaqwa Campus),)*
Co-authors: *KITTESA RORO, Kittesa Roro (R&D; (Energy Initiatives) CSIR); DEJENE, Francis (University of the Free State); MAL'NEV, V. N. (Addis Ababa University); SENBETA, Teshome (Addis Ababa University); MESFIN, Belayneh (Addis Ababa University)*

The TL from different materials has been studied by many research groups. The simplest possible model that has been used to describe the process by which materials emit the light when heated consists of two localized levels: an isolated electron trap and a recombination center. This approach is commonly called one-trap-one-recombination center (OTOR) model. The interactive-multi-trap-system (IMTS) model has also been used. It assumes that there is one active electron trap; one thermally disconnected deep trap that cannot be thermally activated, and one recombination center. Basically, in an experiment we often have more than one active electron traps taking part in TL process. In this paper, the second order kinetics describing the thermoluminescence from semiconductor quantum dots consisting two active electron trap levels and one recombination center model is proposed. The two trap levels are located at different trap depths beneath the conduction band. The rate equations corresponding to each trap level allow us to numerically simulate the variation of the concentration of electrons in both traps and the thermoluminescence intensity as a function of temperature for the semiconductor quantum dots of diameter 2-8nm. It is shown that the intensity increases with decreasing in the dot size indicating that the quantum confinement effect enhances the band to band radiative recombination rate. The two peaks of the intensity correspond to the two different active electron trap levels. With an increase in the dot size of the deeper trap, the peaks of intensity shift to the high temperature region.

261 - Magnetic and Structural Properties of Mn0.2Cr1.8-xFexO3 Nanoparticles.

DPCMM - Wednesday 01 July 2015 15:00 *[For award: PhD]*

Primary author: MBELA, Kalengay *(UKZN)*

Manganese-iron chromium oxides (Mn0.2Cr1.8-xFexO3 with x varying from 0.3 to 1.3) have been produced by hydrothermal process in a stirred pressure reactor from pure metal chlorides. Single phase corundum structure and nanophase structure of the as-synthesized samples were confirmed by X-ray diffraction (XRD) and by transmission electron microscope (TEM). The results show that the produced powders have an average size of 25 nm. The Mossbauer spectra recorded at about 300 K show transition from paramagnetic to ordered magnetic spin state at x= 0.5. The shift in hysteresis loops observed along the magnetic field axis is associated with exchange bias effect. The exchange bias field increases as the particle size decreases with increased Fe content x. The loops shifts are different with different particle sizes suggesting that the materials at room temperature may be superparamagnetic.

262 - Hot Mirrors for Parabolic Trough Solar Receivers

Applied - Thursday 02 July 2015 15:00

Primary author: FERRER, phil *(wits)*

Parabolic solar troughs are a widely studied large-scale solar power technology, primarily due to the 354 MW commercial plant operating in the California Mojave Desert. This technology involves concentrating sunlight onto a tubular receiver, the liquid in which is heated and circulated to an electric power station. In this way, the liquid inside the receiver can be heated to well over 400 Co , where heat losses to the surroundings affect solar to electric efficiency. The dominant heat loss mechanism at high temperatures is via radiation, since a transparent vacuum sleeve cuts out any other types. Traditionally, in order to minimize radiation losses , the receiver is painted with a “selective coating”, a substance which absorbs well in the visible part of the spectrum but emits poorly in the infra-red. This works well for temperatures below about 400 Co, but beyond this limit the selective coating thermally decomposes.An alternative method to curb radiation losses is to coat the transparent sleeve surrounding the pipe with a “hot mirror” coating, a substance which reflects well in infra-red but is transparent. The coating on the sleeve will be exposed to a lesser temperature, and the pipe can therefore be heated to a higher temperature, increasing (Carnot-type) efficiency.In the present work, we examine the limits to which the hot mirror can be taken, specifically how efficiency is affected by the relationship between receiver temperature and the wavelength cut-off limit of the hot mirror. The tools we use are the newly developed long range radiation interaction simulation, without which reflections on the vacuum sleeve could not be modelled.

263 - Implementation of a goodness-of-fit test for finding optimal concurrent radio and gamma-ray pulsar light curves

Astro - Thursday 02 July 2015 11:50 *[For award: PhD]*

Primary author: *SEYFFERT, Albertus (Centre for Space Research, North-West University, Potchefstroom Campus, 2520 Potchefstroom, South Africa)*
Co-authors: *VENTER, Christo (North-west University, Potchefstroom Campus); HARDING, Alice (Astrophysics Science Division, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA)*

Since the launch of the Fermi Large Area Telescope (LAT) in 2008 the number of known gamma-ray pulsars has increased immensely to over 160. Many of these sources are not only visible in the gamma-ray band, but in the radio and x-ray bands as well. Seyffert et al. (2011) demonstrated how constraints on the viewing geometries of some of these pulsars could be obtained by comparing their observed radio and gamma-ray light curves by eye to predicted light curves generated by established geometric models. While the constraints obtained through this approach compare reasonably well with those yielded by more rigorous single-wavelength approaches (e.g. Weltevrede et al., 2010), they are still a somewhat subjective representation of how well the models reproduce the observed radio and gamma-ray light curves. Constructing a more rigorous approach is however made difficult by the large uncertainties associated with the gamma-ray light curves as compared to those associated with the radio light curves. Naively applying a chi-squared-like goodness-of-fit test to both bands invariably results in constraints dictated by the radio light curves. A number of approaches have been proposed to address this issue. Johnson et al. (2014) use the gamma-ray uncertainties to generate artificial uncertainties for the radio light curves. Pierbattista et al. (2014) also introduce artificial uncertainties, but they use a more iterative approach to generate them. In this talk we investigate these approaches and compare the results they yield to those obtained using the by-eye approach. Based on what we learn, we implement our own version of a goodness-of-fit test, which we then use to investigate the behaviour of the geometric models in multi-dimensional phase space.

265 - Process tomography within the hybrid formalism

TCP - Wednesday 01 July 2015 14:20 *[For award: PhD]*

Primary author: BASSA, Humairah *(University of KwaZulu-Natal and NLC, CSIR)*
Co-authors: *KONRAD, Thomas (UKZN); UYS, Hermann (National Laser Centre, CSIR)*

We consider the problem of tracking the evolution of a single quantum system when the dynamics are not precisely known, via a sequential measurement protocol. We encode the limited knowledge of the dynamical parameters in a classical system which is coupled to an estimate of the quantum state in order to form a hybrid quantum-classical system. The estimated hybrid state is updated using information obtained from sequential measurements on the quantum system and after a sufficient waiting period, the dynamical parameter can be determined. Convergence of the estimated hybrid state to the true state is demonstrated using numerical simulations.

267 - Fano-like scattering in nanocomposites

TCP - Thursday 02 July 2015 16:30 *[For award: MSc]*

Primary author: *LETA T. JULE, Leta T. Jule (Addis Ababa University)*
Co-authors: *MAL'NEV, V. N. (Addis Ababa University); SENBETA, Teshome (Addis Ababa University); MESFIN, Belayneh (Addis Ababa University); KITTESA RORO3, Kittesa Roro3 (R&D; CORE (Energy Initiatives), CSIR); DEJENE, Francis (University of the Free State)*

In this study, the scattering properties of metal/dielectric composites in active host matrices are studied theoretically. We have calculated the effective polarization for spherical nanocomposites and silver plasma frequency (z) to realize the appearance of Fano in the nanocomposites. It is shown that Fano resonances appear as the result of effective polarizability (α^") of the inclusions. The negative value of the active host matrices reduce absorption and provide the conditions for Fano resonances. The analysis of the scattering cross-section for spherical inclusion with frequency dependent dielectric function of the core of the incident plane wave shows two resonances as the external field is enhanced. The presence of Fano-like resonances for spherical inclusions depends strongly on the effective polarizability of the inclusion. However we have carried out calculations under long wave approximation, in future we need to carry out experiment for our model to observe the spectra's for different nanocomposites.

271 - Measurement of single muon vs charged particle multiplicity at the LHC – an outlook study.

NPRP - Wednesday 01 July 2015 11:10 *[For award: MSc]*

Primary author: *MHLANGA, Sibaliso (Post Graduate)*
Co-authors: *BUTHELEZI, Zinhle (Researcher); BOSSU, Francesco (Researcher)*

In this presentation, the yield of muons from heavy flavour decays is studied as a function of charged particle multiplicity with ALICE in proton-proton collisions at 8 TeV with the aim to investigate the role of multi-parton interactions in the production of heavy quarks. This study will provide a deeper insight into the production mechanisms of these quarks in proton-proton collisions.ALICE (A Large Ion Collider Experiment) is designed and optimized to study ultra relativistic heavy-ion collisions in which a hot, dense and strongly interacting medium is created. ALICE is also studying proton-proton collisions both as reference for comparison with heavy-ion collisions and in physics areas where ALICE is competitive with other LHC experiments. In this study the production of heavy quarks is measured via the contribution of their muonic decay to the inclusive pT-differential muon yield reconstructed with the muon spectrometer at forward rapidity ($-4 < \eta < -2.5$). Charged particle multiplicity is measured in the central region $|\eta| < 1$.An outlook of the measurement as well as results obtained so far will be presented.

272 - Beyond Mixing-Length Theory: an advanced approach to treating convective energy transfer in stars.

Astro - Tuesday 30 June 2015 10:20 *[For award: PhD]*

Primary author: *MOONSAMY, Sashin (University of the Witwatersrand)*
Co-authors: *FRESCURA, Fabio (University of the Witwatersrand); ENGELBRECHT, Chris (University of Johannesburg)*

The heat transfer rates predicted by the Full Spectrum of Turbulence (FST) model of stellar convection differ significantly from those predicted by Mixing Length Theory. The difference is due to the inclusion of the entire range of scales of turbulence rather than the single scale assumption of MLT. Inclusion of these scales leads to a new governing equation for the calculation of the convective heat flux in the stellar interior. We discuss the key ingredients of the FST model and comment on its application to stars.

273 - Using classroom response systems to promote active learning

Edu - Wednesday 01 July 2015 10:20

Primary author: *HERBERT, Mark (University of the Western Cape)*

Educational research has demonstrated the benefits of interactive teaching methods. Research also reports that the electronic classroom response system (clickers) promotes interactive teaching methods, especially those that involve group and class discussions. In the classroom the clickers are used to promote interactive student engagement and to provide immediate formative feedback of the students' learning. This paper reports on the ongoing research conducted on the use of class room response systems as a tool to facilitate interactive student engagement in class discussion in the Physics Department, at the University of the Western Cape. The results of a survey on the experiences of the Physics students regarding the use of the classroom response systems, clickers and colour-coded flash cards (a low tech version of the clicker), in class discussion will be presented and discussed. The purpose of the survey was to assess if the use of clickers in class discussion (i) influences students' participating in class discussions, (ii) improve students' understanding of subject content, and (iii) whether students enjoyed class discussion using the clickers and colour-coded flash cards. During the survey, the students were also asked to reflect on the use of colour-coded flash cards in class discussions. These results will be compared with those obtained using clickers. The results obtained suggest that classroom response systems are a useful tool which engages students in class discussions as well as for both the facilitator and the students to monitor students' learning. Similar results were obtained from the colour-coded flash card survey. The results show that the students enjoyed both the clickers and colour-coded flash cards for class discussions, however, more so with clickers.

274 - Unfolding the fast neutron fluence energy distribution of a NE230 deuterated liquid scintillator detector using the MAXED code

Applied - Wednesday 01 July 2015 11:30

Primary author: *HERBERT, Mark (University of the Western Cape)*

Detailed knowledge of the neutron energy spectra is useful in basic research and applications. The overall procedure of measuring and unfolding the fast neutron fluence energy distribution with a NE230 deuterated liquid scintillator detector is described. The recoil deuteron pulse height distribution in air of a neutron beam of energy up to ~ 50 MeV produced by a 66 MeV proton beam on a graphite target at the iThemba LABS time-of-flight facility was measured. The neutron fluence energy distribution was obtained from the pulse height distribution by Bayesian unfolding with the code MAXED using a response matrix that was determined experimentally. The result obtained is in good agreement with the neutron fluence energy distribution of the graphite target measured with the NE230 scintillator using the time-of-flight method at the iThemba LABS time-of-flight facility.

277 - Estimation of energy production decrease due to shading for the Nampower rooftop system

Applied - Thursday 02 July 2015 11:30

Primary author: *DOBREVA, Petja (NMMU)*
Co-authors: *VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU)*

Photovoltaic (PV) energy has become one of the most important renewable energy technologies and the installation of PV systems on rooftops in industrial, commercial and residential sectors has become common. The operation of these systems is not without challenges and one of the challenges faced by rooftop systems is the effect of shade on the performance of the system. Potential shading of arrays or parts thereof need to be carefully considered when designing a system. In this study an operational 63.45 kW rooftop PV system, on the roof of the NamPower building in Windhoek, was investigated. The focus of this paper is the effect of the partial shading that some of the module strings of the system experience during part of the year due to surrounding buildings. We estimate the loss in energy production due to shading using simulation software and compare this to actual performance data. In the analysis of the effects of shading the current-voltage (I-V) curves for module strings that experience varying levels and configurations of shading are compared to unshaded strings. The results highlight the importance of considering the effects of shading on system performance and illustrate potential negative impact of unsuitable string configuration.

278 - Surface Brillouin Scattering Characterization of Bismuth Ferrite Thin Films

DPCMM - Tuesday 30 June 2015 15:20 *[For award: MSc]*

Primary author: *AYELE, Fekadu (University of the Witwatersrand)*

BiFeO3 (BFO) is a multiferroic material with excellent magneto-electric properties above room temperature. Despite the intensive research on magneto-electric properties, their mechanical properties in thin film format remain largely unexplored. In this work, surface Brillouin scattering has been used to study the propagation of surface acoustic waves and determine the elastic constants of BiFeO3 thin films on (001) Si prepared by RF magnetron sputtering based on the structural zone model. We apply substrate biasing to induce stress by Ar+ incorporation and determine the effect of stress evolution in BiFeO3 thin films at fixed film composition. X-ray Reflectometry and Grazing incidence X-ray diffraction have been used to determine the deposition rate, interfacial roughness, film density and phase of the crystal of the sample for the extraction of velocity dispersion curves. Atomic force microscope (AFM) yielded low surface roughness values 0.2 to 2.5nm indicating high film quality. Cross-sectional Scanning electron microscope (SEM) revealed a compact granular structure with columnar thin film growth mode. The Rutherford backscattering spectroscopy (RBS) showed a constant non-stoichiometric composition of the films independent of the growth conditions. Applying numerical approaches to fit the velocity dispersion curves, the elastic constants of BiFeO3 thin will be determined.Keywords: elastic constants, multiferroic, surface Brillouin scattering, x-ray reflectometry

282 - On the effect of optical configuration on the performance of different multijunction cells used in H-CPV systems.

Applied - Thursday 02 July 2015 11:50 *[For award: PhD]*

Primary author: *SCHULTZ, Ross (NMMU)*
Co-authors: *VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU)*

The power generation and efficiency of a High Concentrator Photovoltaic (H-CPV) modules are unsurpassed when compared to other Photovoltaic (PV) technologies. This is achieved by coupling highly efficient III-V multi-junction photovoltaic devices with high material quality and precise optics. However, depending on their configuration with respect to each other, i.e device material architecture and type of optics (reflective and/or refractive), the system optimisation may vary and efficiency affected. This is due to the partial or full photon absorption by the optical materials in different wavelength regions. This results in less photons being incident upon the different subcell regions of a multi-junction device, causing a varying degree of current mismatch between the subcells during operation. In this paper, several multi-junction device-to-optical system configurations are investigated. Utilizing Mathematica routines, the current density and corresponding Current-Voltage (I-V) characteristic curves of the sub-cells, as a function of the optical system influence, were simulated. This enabled the overall resulting device I-V curve to be used to determine the most efficient and highest power generating device-to-optical system at one-sun concentration (AM 1.5D).

285 - A Near Infrared Femtosecond Laser Source for Observation of Charge Transfer Processes in Semiconductors

Photonics - Thursday 02 July 2015 09:40 *[For award: MSc]*

Primary author: *AHMED, Essraa (M.Sc. student)*
Co-authors: *TEGEGNE, Newayemedhin (Stellenbosch University); VON STEIN, Xavier (Stellenbosch University); SLEZIONA, Vivien (Stellenbosch University); MINDA, Iulia (SU); SCHWOERER, Heinrich (Stellenbosch University)*

Our group is investigating the charge dynamics within organic-Dye Sensitized Solar Cells (DSSC). In these particular solar cells the light absorber is an Indoline dye which acts as the donor whereas the acceptor is a semiconductor (ZnO). Previous studies in our group show that after photoexcitation the dye's electrons are injected into the semiconductor's conduction band. The injected electrons can then be probed within the ZnO conduction band using femtosecond infrared light pulses. We were successfully able to generate infrared pulses tuneable between 0.9μm to 2.1μm. These pulses were produced with the use of a single-stage Noncollinear Optical Parametric Amplifier (NOPA) pumped by a 387nm pulses and seeded with a white light continuum (550nm-1300nm) generated from a (3mm)YAG crystal. In the NOPA the pump pulse was overlapped with a specific portion of the white light continuum inside a (3mm)BBO crystal to stimulate the splitting of the pump photons into two other photons; one with the same wavelength as the seeding signal λs and the other (the idler) with a wavelength λI determined by the energy conservation relation:1⁄λp=1⁄λs+1⁄λI,where λp is the wavelength of the pump pulse (387nm). Conventionally, the seeded signal is used as a source of tuneable ultrashort pulses. In this work we used the idler as our source of the infrared signal. To study the charge dynamics in the DSSC we use femtosecond transient absorption spectroscopy with the probe pulses in the range of 1.5μm to 2μm.

287 - Plasma diagnostics on the GTS-ECRIS at iThemba Labs

NPRP - Thursday 02 July 2015 14:40

Primary author: *SAKILDIEN, Muneer (iThemba LABS)*
Co-authors: *JONES, Pete (iThemba LABS); THOMAE, Wolfgang Rainer (iThemba LABS)*

A new technique is being developed to determine the prevailing charge state distribution (CSD) inside an Electron Cyclotron Resonance Ion Source (ECRIS) by measuring the characteristic X-rays emitted by the ECR heated plasma. We will report here on the results of initial measurements on the ECR ion source at iThemba LABS. The technique will in future be applied to study the two current phenomena which occur when ECR ion sources are operated in pulsed-mode.

288 - Intensity Mapping Techniques for Radio Observation

Astro - Tuesday 30 June 2015 11:30

Primary author: *ANSAH-NARH, Theophilus (Rhodes University)*

Intensity mapping is a new observational technique that will allow smaller and cheaper telescopes to be used in auto-correlations and low resolution images of the sky. This technique can map the distribution of large scale HI structure without localizing individual galaxies. The aim of this research is to determine the effect of polarization on intensity mapping experiments. To achieve this , we produce polarized beams and try to corrupt these polarized beams by using OSKAR and find ways of correcting them. We then observe what comes out of these simulations in terms of foreground that have leaked from intensity polarization. We will apply this to KAT-7 and early MeerKAT data, as well as to extensive simulations of SKA1 and dense aperture arrays.

289 - The superconductor-insulator transition in boron doped nano-crystalline diamond

DPCMM - Wednesday 01 July 2015 15:20 *[For award: PhD]*

Primary author: *MCINTOSH, Ross (University of the Witwatersrand)*
Co-authors: *NESLADEK, Milos (Institute for Materials Research (IMO), Hasselt University, Wetenschapspark 1, 3590 [illegible]
BHATTACHARYYA, Somnath (School of Physics); MOHANTA, Narayan (Department of Physics and Meteorolo[illegible]
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Theoretical Studies, Indian Institute of Technology, Kharagpur 721302, India); PETRAK, Vaclav (Ins[illegible]
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Studies of the superconductor-insulator transition are spurned by the nee[illegible]ase coherence in disordered and granular superconductors. Boron doped nano-cryst[illegible]eresting system with an unusual microstructure consisting of diamond grains sep[illegible]es. With the nature of the superconducting transition still under debate, we pre[illegible]perimental study of superconducting B-NCD. The influence of disorder, both structur[illegible]he inhomogeneous Bogoliubov-de Gennes theory in narrow-band disordered supercon[illegible]ding superconductivity in B-NCD. We employ the mean field approximation within the [illegible]teraction between holes in the narrow acceptor band. A diagonalizable Hamiltonian [illegible]ov-Valatin transformations and the eigenstates determined self-consistently. The re[illegible]through non-uniform variation of the tight-binding coupling parameter where, following [illegible]te the concurrent increase in structural disorder with increasing boron concentrati[illegible]er has a much greater effect on the density of states than on-site potential disorder at h[illegible]isorder can increase the mean pairing amplitude while the spectral gap in the density of [illegible]e focus on magnetoresistance and current-voltage measurements at temperatures close to the [illegible]sition, studying samples with different microstructures to interpret the effects of the grain boundaries. [illegible] superconducting fluctuations in competition with additional quantum phases. Below the critical temperature, [illegible]rmation of vortices. This work will provide insight into superconducting fluctuations and phase coherence in u[illegible]tional narrow-band superconductors.

WITHDRAWN

290 - Efficiency Increase in a Cold Sprayed Hot Mirror Parabolic Trough Solar Collector

Applied - Thursday 02 July 2015 15:20 *[For award: PhD]*

Primary author: *KALUBA, Victor (Wits University)*
Co-author: *FERRER, Philippe (Wits University)*

Parabolic trough solar technology is the most proven and lowest cost large-scale solar power technology available today, primarily because of the nine large commercial-scale solar power plants that are operating in the California Mojave Desert, (Hank P. et al, 2002). The technology involves collection of energy from the sun using parabolic trough shaped concentrating mirrors. The mirrors direct sunlight to a focal line where a receiver pipe or heat collection element (HCE) is positioned. In solar electricity generating systems (SEGS), electricity generated by a power block depends on the quantity and temperature of the Heat Transfer Fluid (HTF) delivered by the solar field. We have demonstrated the possibility of increasing the input temperature to the power block in the SEGS through the use of heat reflections within the solar receiver. The work presents thermal interactions involving infrared radiation reflections in a solar receiver. A 3D simulation of the thermal processes was done to get realistic results. Three different heat reflecting materials were used in comparing the Hot Mirror effect with a bare absorber surface. The work shows a much higher HTF output temperature for Indium Tin Oxide. Permutations of optical properties for hypothetical surfaces provided insight into optimum heat reflectance and solar transmittance.

291 - X-ray diffraction and Raman spectroscopy based residual stress measurements for assessment of fatigue in leached polycrystalline diamond tool bits

Applied - Tuesday 30 June 2015 15:20 *[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)*

Polycrystalline diamond (PCD) cylindrical tool-bits are complex materials systems. One aspect that has a significant influence on the in¬–service behaviour and lifetime is the residual macro-stress state created as a result of the difference in coefficients of thermal expansion (CTE) between the diamond table and the WC-Co substrate. Leached PCD, where the near-surface cobalt has been removed from the PCD layer, has a longer in-service lifetime and the reasons for this are not well understood. The measurement and study of the average in-plane stress fields on the surface of the PCD thus becomes crucial in understanding the in–service behaviour with the quest to have an extended life for the tool-bits. Two complementary non-destructive techniques namely Raman spectroscopy and X-ray diffraction have been employed for residual stress measurements on detached PCD layer samples of 16 mm in diameter and 2 mm in thickness. 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. Employing the ball on three balls fatigue set-up the samples were cyclically loaded under constant amplitude load control at a frequency of 10 Hz at room temperature and pressure conditions. Raman and XRD residual stress measurement were done as a function of the number of fatigue cycles to study the surface and near-surface stress under increasingly severe fatigue conditions. These are compared with published Raman spectroscopy results on unleached PCD.

292 - Studying Stellar Populations of Luminous Red Galaxies to probe the Hubble Parameter H(z)

Astro - Wednesday 01 July 2015 09:40

Primary author: *RATSIMBAZAFY, Ando (North-West University - Centre for Space Research)*
Co-authors: *CRESS, Catherine (Centre of High Performance Computing); CRAWFORD, Steve (South African Astronomical Observatory)*

There have been a number of attempts to measure the expansion rate of the Universe using age-dating of Luminous Red Galaxies (LRGs). Assuming that stars in LRGs form at the same time, age-dating of two populations of LRGs at different redshifts can provide an estimate of the time difference associated with the corresponding redshift interval (dz/dt). This gives a direct estimate of the Hubble parameter H(z) at the average redshift of the two populations. We explore the validity of this method by using two different sets of data. Firstly, we select a homogeneous sample of passively evolving galaxies over $0.10 < z < 0.40$ from the Sloan Digital Sky Survey Data Release Seven (SDSS-DR7) catalogue by applying a refined criteria, which is based on absolute magnitude. Secondly, we carry out series of observations on the Southern African Large Telescope (SALT) to obtain spectra of LRGs at two narrow redshift ranges $z = 0.40$ and $z = 0.55$ in order to calculate the Hubble parameter H(z) at $z = 0.47$. We utilise two distinct methods of age-dating including the use of absorption Lick index lines and full spectral fitting on high signal-to-noise galaxy spectra from our sample. The results of H(z) estimates using the two different datasets will be presented as well as the cosmological constraints.

293 - In-situ neutron powder diffraction temperature capabilities at SAFARI-1

Applied - Wednesday 01 July 2015 11:50

Primary author: HAYES, Michael (Necsa)
Co-authors: SENTSHO, Zeldah (Necsa); VAN HEERDEN, Rudolph (Necsa); MARAIS, Deon (Necsa); RAATHS, Christo (Necsa); NELWAMONDO, Maulusi (Necsa); VENTER, Andrew (Necsa)

The recently commissioned neutron powder diffractometer at the SAFARI-1 reactor of Necsa, aptly named Powder Instrument for Transition in Structure Investigations (PITSI), is equipped with both heating and cooling sample environments to allow in-situ temperature dependent studies in the temperature range 3 K to 1800 K. SAFARI-1 is a 20 MW light-water moderated tank-in-pool materials testing reactor that has an in-core flux of 4×■10■^14 neutrons cm-2s-1. The monochromatic flux of the PITSI instrument at the sample position is ≈ 106 neutrons cm-2s-1. The interchangeable heating and cooling sample environments were both procured from AS Scientific Products Ltd., UK and are specifically configured for use on neutron scattering instruments. The closed-cycle cryostat is equipped with a SHI Cryogenics RDK-408D2 cold head rendering 1W cooling power at 3.5 K, which in conjunction with a LakeShore 340 temperature controller, facilitates achieving accurate temperatures covering the range 3 K < T < 350 K. The vacuum furnace employs radiant heat generated and focussed with a 3600 W Niobium element and heat shrouds in conjunction with a West 4100+ temperature controller covers temperatures from 300 K to 1800 K. Both these sample environments are under full computer control. Temperature set points can be maintained to accuracies better than ±1 K and logged throughout the data acquisition. With envisaged modifications, the furnace system could be extended to incorporate in-situ reaction chambers.PITSI in conjunction with its temperature environments, amongst others enable in-situ studies of chemical and / or magnetic phase transitions, determination of thermal expansion coefficients, quantification of phases, etc. A number of investigations have been completed and will be reported on to demonstrate the capabilities of this instrument that is available to the research community under the R&D; User Program.

294 - Why we need a Physics Olympiad

Edu - Wednesday 01 July 2015 09:40

Primary author: RIJSDIJK, Case (ASSA/SAIP)

The report of the International Panel on “Shaping the Future of Physics in SA” (March 2004) states in recommendation 4.1.4 (page 49) that “The panel recommends that the physics community (led by the SAIP) should seriously take up the challenge of preparing SA school children for participation in the IPhO”. As a result, a successful first SA Physics Olympiad (SAPhO) was held the following year, the International Year of Physics. Whilst participation in the IPhO is a long way off, there is a need to establish a sustainable SAPHO. This talk will briefly outline the history of the SAPhO,why there should be a SAPhO and what needs to be done to make SAPhO a sustainable activity within the SAIP.

297 - Armorphization and Recrystallization of spinel $LiMn_2O_4$ nano-architectures

DPCMM - Wednesday 01 July 2015 09:40 *[For award: MSc]*

Primary author: LEDWABA, Raesibe Sylvia (University of Limpopo)
Co-authors: NGOEPE, Phuti Esrom (University of Limpopo); SAYLE, Dean Christopher (University of Kent)

Spinel $LiMn_2O_4$ has attracted attention as a potential cathode material for use in advanced lithium ion batteries. The current study focused on the effects of high temperatures on the spinel system: the 3D framework sustainability, structural transformation and impacts of melting temperature on the lithium ion diffusion. Furthermore, understanding these materials will facilitate in the implementation of armorphization and recrystallization technique for spinel nano-architectures. Molecular dynamics simulations were carried out at various temperatures. The melting points and transformations are clearly visible on the RDF plots and structural snapshots of the supercells at different temperatures. $LiMn_2O_4$ indicated a diffusion rate that increased rapidly above 1500K, just before melting (~1700 K) and reached its maximum diffusion at 2.756x10E-7 cm2.s-1 before it decreased. Simulated armorphization and recrystallization was carried out on the system. The nanoparticle started armorphizing into a nanosphere around 150 ps during the simulation and nucleated after 1500ps with the assistance of a crystalline seed in the centre of the armorphised nanoparticle. Recrystalization was complete after 6 ns, the latent heat of crystallization is therefore reflected in the energy difference between the first (0–1.5 ns) and second (6 ns –15ns) energy trace.

300 - SBS observation of higher order resonances in annealed, carbon implanted CVD

DPCMM - Thursday 02 July 2015 16:30

Primary author: MOTOCHI, Isaac (University of the Witwatersrand)
Co-authors: MATHE, Bhekumusa (University of the Witwatersrand); NAIDOO, SR (University of the Witwatersrand); DERRY, Trevor (University of the Witwatersrand)

The phase velocity of Surface Acoustic waves exhibits no dispersion in homogeneous materials. However, normal or anomalous dispersion takes place in layered systems. This dispersion effect has been used to determine the elastic constants of thin films. However, gradients in materials properties in the near surface region lead to dispersion effects also and therefore can be easily detected by surface acoustic waves (SAWs). We have used this technique to study changes in shear elastic constants of diamond irradiated with carbon ions in the energy range typically used in doping semiconductor materials. These particles only penetrate ~ 0.3 micron into the material which produced a high defect concentration for the fluences used, which, in our case, led to amorphization of the implanted diamond volume. In this study we generated and detected SAWs on the as-implanted CVD and on the annealed radiation damaged CVD plates after deposition of a very thin Pt film of thickness of 20 nm to enhance surface reflectivity. With increasing dispersion (k||h), the Rayleigh wave velocity falls gradually from that of crystalline Pt to that of annealed amorphous CVD layer. At critical values of product of parallel wavevector and film thickness (k//h), Sezawa modes split off from the bulk wave threshold of the substrate (transonic state). These are guided modes with the displacement field having an oscillating component in the layer, and falling off exponentially in the substrate. In combination with the velocity of the longitudinal bulk waves, we were able to calculate the Poisson ratio and Young's modulus of the implanted regions.

306 - Electronic tracking system for quantum cryptography and radio telecommunication

Applied - Tuesday 30 June 2015 11:50

Primary author: MARIOLA, Marco (UKZN)
Co-authors: ISMAIL, Yaseera (UKZN); MIRZA, Abdul (UKZN); PETRUCCIONE, Francesco (UKZN)

Quantum cryptography permits to share a secret key to hide a secret message between two parties exploiting the quantum state of single photons. An eavesdropper cannot measure the quantum state of the single photon without changing the quantum state according to the Heisenberg uncertainty principle. In quantum cryptography in free space, the transmitter sends a series of single polarised photons to the receiver, and the bits of the key depend on the polarisation direction of the single photon [1]. Once the transmission is finalized a set of bits is used to check if the receiver, has received the same bits sent from the transmitter. The presence of an eavesdropper is recognized by the statistical analysis of the errors in the key. Quantum cryptography in free space represents the best solution when a secure cryptography must be done between two non-stationary points.Quantum cryptography is an optical communication that requires a tracking system to align the transmitter and the receiver. Because the value of the bit of the key depends on the polarization of the single photon, the polarization base of the transmitter and receiver must be aligned.In this work a portable electronic devices is presented. The electronic device is able to align the transmitter and receiver by using the GPS technology and the polarization bases are aligned using a recent patent presented at the SAIP 2014 [2]. [1] C. H. Bennett, G. Brassard et al., “Quantum cryptography: Public key distribution and coin tossing,” in Proceedings of IEEE International Conference on Computers, Systems and Signal Processing, vol. 175, no. 0. New York, 1984. [2] M. Mariola, A. Mirza and F. Petruccione “System and method for determining angles between apparatuses, devices or systems.” Provisional patent. Reference number L 2014/03405

308 - The study on the short term planetary wave activity in the MLT region over Southern Hemisphere using SuperDARN HF radar

Space - Thursday 02 July 2015 11:30 *[For award: MSc]*

Primary author: NGWANE, Ntlakanipho (Student)
Co-authors: SIVAKUMAR, Venkataraman (University of KwaZulu Natal); MTHEMBU, Sibusiso (University of KwaZulu Natal)

The mesosphere lower thermosphere (MLT) region connects the middle atmosphere to the thermosphere. It is therefore a combination of physical dynamics due to forced waves from lower atmospheric layers and photochemical reactions enhanced by solar radiation. This work focuses on the influence that forced atmospheric waves (for e-g planetary waves and atmospheric tides) from lower layers have on the MLT dynamics. SuperDARN HF radar is used to study short term planetary wave activity in the MLT over southern hemisphere. The emphasis on the “short term” behaviour is motivated by the substantial work conducted on the relatively large period planetary waves (e-g 14, 16, 20, 23 and 27 day waves). Short period planetary waves in this work refer to waves ranging from quasi 2 to 6 day waves. This work will also study interactions between tides and planetary waves during minor sudden stratospheric warming (SSW) events. SSW is characterized by a rapid enhancement of stratospheric temperature that takes place, within few days, poleward from 60° latitude and at 10 hPa pressure level or below, and is followed by a deceleration and/or reversal of eastward winter winds.We have thus far identified the years and days of interests, where minor warming events occurred. We have produced wind dynamic spectra for those years. From the dynamic spectra, extracted the wind speed amplitudes corresponding to minor warming days. The analysis that is still pending is the wavelet spectral representation of short term planetary waves and the bi-spectra plots comprising of the planetary waves and atmospheric tides so as to study the interactions. The obtained and planned results shall be presented in the conference.

312 - Optical spectroscopy of PSR B1259-63 around the 2014 periastron passage

Astro - Wednesday 01 July 2015 15:20

Primary author: VAN SOELEN, Brian (University of the Free State)
Co-authors: VAISANEN, Petri (SAAO); SUSHCH, Iurii (North-West University); MEINTJES, Pieter (University of the Free State); ODENDAAL, Alida (University of the Free State); KLINDT, Lizelke (University of the Free State); ARMSTRONG, Richard (SKA South Africa)

PSR B1259-63 is a gamma-ray binary system which consists of a 48 ms pulsar in a 3.4 year orbit around a Be star. Of the five known gamma-ray binary systems it is the only one whether the nature of the compact object is conclusively known. This makes it an extremely important target for multi-wavelength observations. Near to periastron, the interaction between the pulsar and stellar wind creates a shock front, producing non-thermal emission from radio to TeV energies. The 2010 periastron passage was the first that was observed with the Fermi-LAT telescope and approximately 30 days after the 2010 periastron passage, an unexpected GeV flare was observed, at a time when the other non-thermal emission was already decreasing. A repeat flare event (though on a lower scale) was observed after the 2014 periastron. We report on spectroscopic observations undertaken with the Southern African Large Telescope from approximately 33 days before until 78 days after the 2014 periastron passage. These observations confirmed the variability of the Halpha and He-I line during this period, as was previously reported. Combined with multi-wavelength results, this suggests that the circumstellar disc is disrupted during periastron. The reported multi-wavelength results are also briefly discussed.

313 - NON-SPECIALIST LECTURE: Penetrating Radiation: The Power of Tomography as an Analytic Research Tool

Applied - Tuesday 30 June 2015 14:00

Primary author: DE BEER, Frikkie (Necsa)
Co-authors: RADEBE, Mabuti Jacob (Necsa); HOFFMAN, Jakobus (Necsa); BAM, Lunga (Necsa); NSHIMIRIMANA, Robert (NECSA)

Since Cormack and Houndsfield invented the first Computer Assisted Tomography (CAT) scanner to be used in a medical environment in 1972, the utilization of application of the “tomography” concept were exploited by many researchers and in many other areas of application over the past 44 years. For South African researchers, the advantage of using a CAT scanner became a reality when these machines were implemented in hospitals around the country. The first clinical CT scanners were installed after 1976. The original systems were dedicated to head imaging only, but "whole body" systems with larger regions of interests became available in 1976. However, the purpose of these machines was very specific to the medical industry and results could not be optimized for “industrial” samples e.g. rocks, wood, metals, ect. South Africa hosts a number of research based state-of-the-art tomography facilities which use X-rays, neutrons or Gamma–rays as penetrating radiation and as investigating probe to be applied in any environment or experimental set-up. These available facilities are likely to be utilized by researchers but due to a lack of knowledge and exposure to the technology, the facilities remain under utilized.This talk will focus on the evolution of the principle of computer tomography, the problems facing researchers in the early days during the development phases of tomography technology until today where the hardware and software in use provide remarkable speed, minimum time and dose and excellent spatial resolution for optimal application in many fields of application e.g. geosciences, biosciences, engineering, metallurgy, etc.

314 - Thermodynamic and mechanical stability studies of Zr-Nb(Co) alloys

DPCMM - Wednesday 01 July 2015 10:00 *[For award: MSc]*

Primary author: MALEBATI, Magoja Martinus (student)
Co-author: CHAUKE, Hasani Richard (university of limpopo)

Knowledge of phase diagram and thermodynamic properties is important in many applications. We present the $Zr_{78}Nb_{22-x}Co_x$ alloys, using the virtual crystal approximation as embedded in the Density Functional Theory (DFT), employing the Perdew Burke and Enzerhof (PBE) pseudopotentials. Their equilibrium lattice parameters, heats of formation, elastic properties and the density of states were evaluated to check the relative stability of competing phases. The smaller amount of Co is favourable for doping ZrNb alloy since it favours cladding purposes and is good for avoiding hydride attack. Furthermore, alloying with cobalt is significant since it is recommended for preparation of magnetic, wear-resistant and high strength alloys. The idea is to develop suitable materials which can withstand aggressive environments and high temperature operations.

315 - Multiple chiral bands in 193Tl

NPRP - Friday 03 July 2015 10:00 *[For award: PhD]*

Primary author: NDAYISHIMYE, Joram (Stellenbosch University)
Co-author: LAWRIE, Elena (iThemba LABS)

In order to increase the knowledge about chirality in the 190 mass region, several ■-spectroscopy studies in 193Tl were performed at iThemba LABS. The previous level scheme of 193Tl was modified and extended. Spin and parity were assigned to most of the levels. Three bands showing similar properties were identified. This near-degeneracy probably indicates the presence of chiral symmetry. The results from theoretical calculations using the Cranked Nilsson-Strutinsky (CNS) codes and the multi-particle-plus-triaxial rotor (MPR) model of Carlsson and Ragnarsson support the presence of chiral symmetry in 193Tl. Thus, the three bands in 193Tl likely form a multiplet of chiral systems.

317 - Ion Sources used to produce different beams at iThemba LABS

NPRP - Thursday 02 July 2015 15:00

Primary author: MIRA, Joele (iThemba LABS)
Co-authors: DE VILLIERS, J. G. (iThemba LABS); FOURIE, D. T. (iThemba LABS); NEMULODI, F. (iThemba LABS); SAKILDIEN, M. (iThemba LABS); CONRADIE, J. L. (iThemba LABS); CLOETE, J. (iThemba LABS); THOMAE, Rainer (iThemba LABS)

The particles for acceleration in the cyclotrons of iThemba LABS are produced in different ion sources. For high intensity beam application, an internal Penning Ion Gauge (PIG) source is used. Nuclear spin polarized protons are generated in an atomic beam source. For the production of high charge states heavy ions, a 14.5 GHz Electron Cyclotron Resonance Ion Source (ECRIS4) that was originally built for the Hahn Meitner Institute and a new ECRIS based on the design of the Grenoble Test Source (GTS) are being used. The GTS operates at room temperature and uses two microwave frequencies of 14 GHz and 18 GHz. The two ECRIS deliver highly charged ions of sufficient intensity to be pre-accelerated in the solid-pole injector cyclotron (SPC2) which are then injected into the separated-sector cyclotron to be accelerated to required energy. The principles and the performance of the different ion sources will be discussed.

320 - Is solar PV generated electricity cheap in South Africa?

Applied - Wednesday 01 July 2015 14:40

Primary author: RORO, Kittessa (R&D; core (Energy Initiatives)CSIR)
Co-authors: DEJENE, Francis (University of the Free State); MWAKIKUNGA, Bonex (CSIR National Laser Centre); BISCHOF-NIEMZ, Tobias (R&D; core (Energy Initiatives)-CSIR)

In our society, there exist myths that renewables including solar photvoltaic (PV) is expensive. In this contribution, we compiled current facts, figures and findings about solar PV globally and in South Africa to create an overall assessment of PV growth. Recent facts about PV in South Africa show that solar PV is already cost competitive.

321 - Simulation of radiography beam collimation using ray tracing method

Applied - Tuesday 30 June 2015 14:40 *[For award: PhD]*

Primary author: NSHIMIRIMANA, Robert (NECSA)
Co-authors: NOTHNAGEL, Gawie (Necsa); ENGELBRECHT, Andries (University of Pretoria)

Radiography is a non-destructive analytical technique using a penetrating radiation beam (Neutrons, X-rays or Gamma-rays) as a probe. The technique has found extensive use as a diagnostic probe in medical applications, and also find increasing application scope amongst the scientific community to retrieve qualitative and quantitative information from laboratory scale samples and artifacts in a wide range of research disciplines.Collimation of the radiation beam has a direct impact on the geometry and the flux of the beam, which in turn affect the quality of the results from the experiments. For the design of an optimal collimator for a given application modelling and simulation is imperative. In this presentation the implementation of a ray tracing method in a radiography simulation to assess and optimise the effect of collimation shall be discussed with emphasis on the benefits in terms of process speed and radiograph quality.

324 - PLENARY: Optical Techniques Applied to Materials Physics

Plenary - Tuesday 30 June 2015 09:00

Primary author: COMINS, Darrell (University of the Witwatersrand)

Brillouin and Raman light scattering techniques provide powerful methods to study the properties of materials. In general, laser light interacts with the vibrating atoms of the material and a tiny fraction of the scattered light emerging from the sample is changed in frequency. Brillouin scattering concerns the coupled movement of the unit cells constituting bulk and surface waves in the GHz region. From such studies, the elastic stiffnesses of materials are established that determine the resistance of the material to deformation and depend on variables such as temperature and pressure, microstructure, composition and strain. A (3+3) pass tandem Fabry-Pérot interferometer system and a frequency-stabilised laser are used to resolve the very small changes in frequency. Surface Brillouin scattering studies of the elastic properties of near opaque bulk solids and thin supported films at both ambient and high temperatures are discussed. Determinations of the elastic stiffnesses of bulk materials such as platinum group alloys and iron pyrite, and thin supported films of tungsten carbide are described. Raman scattering refers to the atoms within the unit cells or within molecules moving with respect to one another and is used to identify the nature of a material, its state of crystalline perfection, changes of phase, the presence of inclusions, and the effects of temperature, pressure and strain. A grating spectrograph is employed to resolve the spectral features and is fitted with a Raman microscope enabling 2-and 3-dimensional mapping. Low and high temperature stages and high-pressure cells are available. Raman scattering studies include radiation-induced defects in alkali halides, recrystallisation of ion beam induced amorphised layers, stress mapping in single crystal and polycrystalline diamond, the temperature dependence of the vibrational modes of single-walled carbon nanotubes, and the passivation and pitting of iron during corrosion processes.

326 - Effect of guided inquiry laboratory activities on first-year physics students’ views on the nature of science.

Edu - Thursday 02 July 2015 11:30 *[For award: PhD]*

Primary author: BALOYI, Vonani Michael (University of Pretoria)
Co-authors: MEYER, W.E. (University of Pretoria); GAIGHER, E (University of Pretoria); NORDHOFF, H (University of Pretoria)

This study investigated the effect of reform-based Physics practical activities on students’ views on the nature of science (NOS).The reform-based practical activities adopted a guided inquiry-based approach combined with guiding reflective questions. Seventy first-year Bachelor of Science physics students participated in this study at a well-established South African university, which compared guided inquiry and traditional recipe-based laboratory approaches. The students were divided randomly in a control group that did traditional recipe-based practicals and an experimental group, that did guided inquiry-based practical activities. Both groups had the same reflective questions on an aspect of the NOS at the end of the practical activities. At the end of the practical course, data were collected using the VNOS-form C questionnaire and follow-up focus group interviews were conducted. Additionally, there was also a practical test that consisted of both a hands-on and a written section. The results showed that students developed better understanding of the three aspects of NOS: tentative, empirical and difference between observations and inferences. However, students’ conceptions on the difference between theory and law, role of imagination and creativity, influence of social and cultural values and notion of using universal scientific method in the development of knowledge remain unchanged. This study demonstrated that there is significant effect of guided scientific inquiry-based laboratory practical activities on the students’ conceptions of NOS in first-year physics course than traditional laboratory approach.

327 - Generation of Time-Stamps by a Digital Data Acquisition System

NPRP - Friday 03 July 2015 11:50 *[For award: PhD]*

Primary author: *ERASMUS, Nicholas (University of the Western Cape)*
Co-author: *LAWRIE, Elena (iThemba LABS)*

Position sensitive γ-ray detection techniques are a cutting-edge aspect of nuclear physics research. At iThemba LABS, a 32-fold segmented clover detector is used in conjunction with Pixie-16 modules for this purpose. The benefits of accurate γ-ray tracking are far reaching, in particular, good Doppler-correction for γ-ray events are required for radioactive ion beam research.The data from each of the 32 electronic signals represent a pulse with height proportional to the energy deposited versus time. The information that can be extracted from an analysis of these pulse shapes enables the determination of the position of each interaction point of they -ray along with the corresponding energy deposited. To this end, the digital data acquisition system must be well understood. The arrival time of a pulse can be determined either by a simple threshold method, or by the use of the so-called CFD trigger. Application of the CFD trigger has given unexpected results during experimental tests. The time-stamp generated by this method has, to different extents, been delayed with respect to the actual arrival time of the pulse. The primary goal of this work was to investigate this phenomena.A simulation of the filtering techniques employed by the Pixie-16 module has been built in order to ascertain whether the spread in the time-stamps of the pulse signals can be minimized by an optimization of the parameters used in the digitization process. The problem was instead found in the method used to calculate the CFD function itself. The filtering process used in Pixie-16 unexpectedly exchanges the two terms that determine the CFD function. Correction of this results in a decrease in the spread of the arrival time of signals from about 300 ns to 50 ns.

332 - A 'road test' of ANOVA versus DFT and LS as a period-finding algorithm

Astro - Thursday 02 July 2015 09:40

Primary author: *ENGELBRECHT, Christian (University of Johannesburg)*
Co-author: *FRESCURA, Fabio (U Witwatersrand)*

The mathematical properties of harmonic functions have brought Fourier-based algorithms into popular use as period-finding tools in astronomy, specifically in asteroseismology. Recent work by Graham et al. (2013) has indicated that the ANOVA approach (see the many references by Schwarzenberg-Czerny) could outperform these traditional approaches in certain cases. Very little practical application of ANOVA has appeared in the literature, though. Given the rapidly growing body of time-domain data in astronomy and the considerable importance of some of the conclusions that have been made on the basis of these data, Graham et al.'s result prompts a closer look at ANOVA as a competitor to DFT and Lomb-Scargle (LS)-based methods in asteroseismology. In this presentation, the main findings of a comparative 'road-test' of ANOVA, DFT and Lomb-Scargle algorithms, applied to typical ground-based, time-domain data on pulsating stars will be presented and analysed.

335 - A multiplet of chiral bands in 194Tl: DSAM lifetime measurements

NPRP - Friday 03 July 2015 09:40

Primary author: *MASITENG, Paulus (University of Johannesburg)*
Co-authors: *LAWRIE, Elena (iThemba LABS); BARK, Robert (iThemba LABS); BVUMBI, Suzan Phumudzo (University of Johannesburg); LINDSAY, Robert (University); MULLINS, Simon (iThemba LABS (Gauteng)); MURRAY, Sean (iThemba LABS/UCT); NDAYISHIMYE, Joram (Stellenbosch University); NTSHANGASE, Sifiso Senzo (University of Cape Town / iThemba LABS); PAPKA, Paul (Stellenbosch University); SHARPEY-SCHAFER, John F (UWC); PASTERNAK, Alexander (A.F. Ioffe Physical-Technical Institute, 194021 St.-Petersburg, Russia); L IEDER, Evgenia (iThemba LABS); LIEDER, Rainer (iThemba LABS); SHIRINDA, OBED (iThemba LABS); LAWRIE, Kobus (iThemba LABS)*

When a left-handed and a right-handed nuclear systems form in the angular momentum space, a pair of nearly degenerate rotational bands is observed. To identify chiral symmetry most important is to establish near-degeneracy of the B(M1) and B(E2) transition probabilities of the partner bands, which needs dedicated lifetime measurements. Such measurements were performed for four bands of 194Tl, including the pair of four-quasiparticle chiral bands with close near-degeneracy. The lifetime measurements confirm the excellent near-degeneracy in this pair and suggest that a third band may be closely involved in the chiral symmetry scenario.

336 - Crosstalk correction for the iThemba LABS segmented clover detector

NPRP - Friday 03 July 2015 11:10 *[For award: PhD]*

Primary author: *NONCOLELA, Sive (UWC, iThemba LABS)*
Co-authors: *EASTON, Jayson (iThemba LABS and University of the Western Cape); BUCHER, Thifhelimbilu Daphney (iThemba LABS); LAWRIE, Elena (iThemba LABS); SHIRINDA, OBED (iThemba LABS); ORCE, Nico (University of the Western Cape); DINOKO, Tshepo (iThemba LABS); ERASMUS, Nicholas (University of the Western Cape)*

To investigate the position sensitivity of the iThemba LABS segmented clover detector, a pulse shape analysis method is being developed. This method utilizes the characteristics of pulse shapes such as rise times, amplitudes and most importantly the shape of the measured waveform in order to determine the interaction position of a gamma ray. It is therefore important to understand in detail how pulse shapes are formed. One of the major factors that influences the shape of the measured signal is the electronic crosstalk between the contacts of a highly segmented detector. Crosstalk has been found in other highly segmented detectors such as AGATA [1] and TIGRESS [2]. There are two components of crosstalk, one is the proportional crosstalk and the other is the derivative crosstalk. The former is directly proportional to the charge collecting signal, and is undesirable as it has been found to degrade the energy resolution. In the present work proportional crosstalk has been measured with the use of Co-60, Cs-137 and Eu-152 gamma ray sources. Results have shown a considerable amount of this type of crosstalk particularly on segments belonging to the crystal that has been hit by the gamma ray. Only direct neighbours to the hit segment have been affected in other crystals that are not hit. In depth analysis of the crosstalk correction will be presented. [1] B. Bryuneel, et al., Nucl. Instr. and Meth. A 608 (2009) 99–106[2] C.E. Svensson, et al., Nucl. Instr. and Meth. A 540 (2005) 348–360

337 - Fast Neutron Radiography at an RFQ Accelerator System

NPRP - Wednesday 01 July 2015 15:00

Primary author: *DANIELS, Graham (Necsa)*
Co-authors: *FRANKLYN, chris (necsa); BUFFLER, Andy (University of Cape Town)*

Improvements have been made to the 4MeV Radio Frequency Quadrupole Accelerator (RFQ) at Necsa and the HEBT focusing system. The option to change the target configuration to a solid boron carbide target has been made, for the specific purpose of producing a fast neutron source (1 - 10 MeV at 10^{11} $n.s^{-1}.cm^{-2}$) and two distinct gamma rays (4.43 MeV and 15.11 MeV). This interrogating radiation has been used for studies in the field of cultural heritage and fluid flow, by conducting fast neutron radiography (FNR) on samples from the respective disciplines. The nature of the developments will be highlighted and the investigation into anthropology and the density evolution in mineral systems, presented, with the comparisons made to theoretical simulations and experiments conducted at the fast neutron facility at Physikalisch Technische Bundesanstalt, Braunschweig.

338 - Acceleration parameters for fluid physics with accelerating bodies

Applied - Friday 03 July 2015 11:10

Primary author: *GLEDHILL, Irvy (Igle) (CSIR)*
Co-authors: *ROOHANI, Hamed (University of the Witwatersrand); SKEWS, Beric (University of the Witwatersrand)*

Theoretical work on transforming the Navier-Stokes equations into arbitrarily accelerating frames has included the continuity, momentum, and energy conservation equations [2] [3]. An analysis of the momentum equation in non-dimensional terms leads to an acceleration parameter that appears to be new in fluid physics, but is known in cosmology.A selection of cases for rectilinear acceleration has been chosen [4][5] to illustrate the point that this parameter alone does not govern regimes of flow about significantly accelerating bodies, and reference must be made, above all, to the Mach number for transonic effects. Other parameters from the literature on impulsive start-up in wind tunnels are also shown to be useful in delimiting regimes of flow, such as the Freymuth start-up time [1]. Two dominant effects in fluid dynamics with accelerating objects are shown to be flow history, a term being used to cover the difference between an instantaneous flow field with an accelerating body and the flow field about the same body at steady state, and the dependence of stagnation pressure on acceleration. The dependence of these effects on the proposed dimensionless parameters is explored.[1] P. Freymuth, W. Bank, and M. Palmer. *Z. Flugwiss. Weltraumforsch* 7:392–400, 1983.[2] I.M.A. Gledhill, K. Forsberg, P. Eliasson, J. Baloyi, and J. Nordström. *Aerospace Science and Technology* , 13(4):197–203, 2009.[3] I.M.A. Gledhill, H. Roohani, K. Forsberg, and B.W. Skews. *in preparation* , 2015.[4] H. Roohani and B.W. Skews. *Shock Waves* , 19:297–305, 2009.[5] T. Saito, K. Hatanaka, H. Yamashita, T. Ogawa, S. Obayashi, and K. Takayama. *Shock Waves* , 21:483–489, 2011.

343 - Theoretical studies of mutual neutralization in collisions of $He^+ + H^-$ and $Li^+ + F^-$.

TCP - Thursday 02 July 2015 16:50

Primary author: *NKAMBULE, Sifiso (Stockholm Univeristy, Department of Physics)*
Co-authors: *NURZIA, Pietro (Stockholm Univeristy); LARSON, Åsa (Department of Physics, Stockholm Univeristy); ELANDER, Nils (Department of Physics, Stockholm Univeristy); OREL, Ann (Univeristy of Carlifonia, Davis)*

Employing electronic structure techniques with the full configuration interaction (FCI) method, potential energy curves of the electronic states relevant in mutual neutralization of $He^+ + H^-$ collisions are calculated. We also compute the non-adiabatic couplings between the states. To complement this calculation, at short internuclear distances, electron scattering calculations, based on the complex-Kohn variational method is employed to compute energy positions and autoinisation widths of the resonant states. Employing a complete-active-space self-consistent field (CASSCF) method, potential energy curves of the states relevant for low energy (0-100 eV) mutual neutralization collisions of $Li^+ + F^-$ are computed. Here a set of eight basis sets is used to obtain the states and their corresponding non-adiabatic couplings.The non-adiabatic couplings vary rapidly with internuclear distance and may cause numerical challenges. It is common practice to transform the potential energy from an adiabatic representation to a diabatic representation. A strict diabatazition is performed, to obtain the potential energy curves of diabatic states that are crossing each other.The nuclear dynamics are studied with the diabatic representation, using Johnson's log derivative method. We report the total and differential cross sections of the neutralization reactions. The final states distributions are also calculated. We also investigate the influence of autoinisation on the reaction as well as isotope effect. The results are compared with experimental data.

345 - Reconfigurable Wavelength Selective Switching for 10 Gbps Optical Fibre Ring Networks

Applied - Tuesday 30 June 2015 10:00 *[For award: PhD]*

Primary author: BOIYO, Duncan *(Nelson Mandela Metropolitan University)*
Co-authors: *CHABATA, Tichakunda Valentine (Nelson Mandela Metropplitan University (NMMU)); GAMATHAM, Romeo (Nelson Mandela Metropolitan University); LEITCH, Andrew (NMMU); GIBBON, Timothy (NMMU Physics Department)*

Wavelength division multiplexing (WDM) is used for multi-wavelength optical fibre transmission. Multiplexing increases the spectral efficiency in high capacity systems by application of flexible spectrum. Flexible spectrum is an elastic grid whose wavelength tunability is not constrained by the static wavelength grid and fixed channel spacing. Flexible spectrum allows elastic scaling of the spectrum at different modulation formats and bitrates. As such, multi-wavelengths and dynamic bandwidth allocation can be realized to satisfy the ever increasing demand for bandwidth. The reconfigurable optical add/drop multiplexers (ROADMs) provide remote channel assignment and bandwidth allocation. This paper presents simulated wavelength selective channel add/drop at a node in a 10 Gb/s ring network topology of a metro-access network. Bit error rate (BER) analysis are used to determine the quality of signal transmission by quantifying the BER of a selected wavelength at the acceptable 10-9 level. A transmission penalty is presented for different fibre lengths and channel spacing. It is found that longer lengths and smaller channel spacing introduces crosstalk interference between the wavelengths leading to bit errors. Consequently, a wavelength with higher BER is transmitted over a shorter fibre length (dropped) and another wavelength selectively added to the empty channel in the network by using the ROADM. This work is vital for network link management, efficient spectrum usage and remote configuration of the network such as fibre-to-the-home/building (FTTH/B).Key words: WDM, flexible spectrum, ROADM, Transmission Penalty, FTTH/B

346 - Biological filament interacting with molecular motors

TCP - Wednesday 01 July 2015 09:40 *[For award: MSc]*

Primary author: MEYLAHN, Janusz *(Stellenbosch University)*

There has been a lot of work recently describing active matter in the context of biological systems. One such system is the propulsion of a biological filament by molecular motors. The motion is induced by chemical reactions with the motor proteins as well as noise. A simplified model describing these interactions is a variation of Brownian motion where the motor position along the filament is determined by a Langvin equation. We want to study the response of the filament on being brought into contact with the molecular motors as well as the fluctuations around this response. We have developed a formalism to deal with the time-dependent statistics of the motor attachment and dettachment from the filament using the innovative technique of representing the detached state via a reservoir of motors at a certain temporal point. This allows us to formulate the motions of the attachment of the motors within a single distribution function, that can be treated easily computationally and also in certain analytic approximations. The results are also tested by computer simulations.

351 - Performance Comparison between the Traditional Intensity Modulation Direct Detection and Coherent Detection in a High Speed Optical Fibre Communication System

Applied - Tuesday 30 June 2015 10:20 *[For award: PhD]*

Primary author: *CHABATA, Tichakunda Valentine (Nelson Mandela Metropplitan University (NMMU))*
Co-authors: *BOIYO, Duncan (Nelson Mandela Metropolitan University); ROTICH, Enoch (Nelson Mandela Metropolitan University); GAMATHAM, Romeo (Nelson Mandela Metropolitan University); LEITCH, Andrew (NMMU); GIBBON, Timothy (NMMU Physics Department)*

Abstract: Passive optical networks (PONs) have become a dominant approach for the fibre- to –the- home (FTTH) network deployments. Cost effective reliable technologies are a necessity for extending the unamplified transmission reach in the FTTH environment. Optical coherent detection scheme that supports even higher modulation formats and increases the receiver sensitivity is implemented. A 10 Gb/s data stream, intensity modulates a 1550 nm distributed feedback (DFB) laser with a direct detection scheme. The same modulated signal is enhanced by mixing it with a continuous wave local oscillator placed at the receiver in a homodyne coherent detection scheme. The enhanced mixed signal is then demodulated to evaluate and to compare the link performance of the direct detection and coherent cases. A back to back and a transmission through 25 km single mode fiber were simulated for the two transmission modalities. The coherently detected scheme gave better receiver sensitivity of 12 dB at an acceptable bit error rate (BER) of 10-9 as compared to the traditional intensity modulation direct detection (IMDD) scheme.Key terms:Coherent detectionDirect detectionLocal oscillatorBER

352 - First and second order Raman scattering processes in chalcopyrite $CuInS_2$

DPCMM - Friday 03 July 2015 11:50

Primary author: MACHATINE, Augusto *(University of Pretoria)*

We have investigated the first and second order ph… …high symmetry points of the Brillouin zone of $CuInS_2$ with … …optical zone-centre Raman phonons are derived and u… …pyrite compounds. These results are also useful for th… …pyrite structure photovoltaic solar cells and non-linear opt…

353 - Density functional theory study of methane dissociation over Pd nanoclusters

DPCMM - Wednesday 01 July 2015 10:20 *[For award: MSc]*

Primary author: CHUMA, Moyahabo Hellen *(University of Limpopo)*

Palladium is often used as a catalyst for many processes in emissions control technologies [1, 2]. This is due to its potential of becoming a novel catalyst for low temperature methane combustion [3]. Palladium nanoclusters have a number of surface features and various adsorption sites, their relative activity play an important role if predictions are to be made for improved materials properties. The dissociation of methane over palladium nanoclusters and high index surfaces was investigated using density functional theory (DFT) as implemented in grid based projector augmented wave (GPAW) code [4]. Methane has been adsorbed on the Pd13 nanoclusters at various active sites, and the results shows that CH4 dissociate into CH3 and H. It is found that CH3 bind strongly to the top site forming a Pd-C bond of 2.06 Å and H on 3fold hollow with a Pd-H bond of 1.91 Å. Methane dissociation was found to be more favourable on the nanocluster than on Pd surfaces.References [1] C. Mateos-Pedrero, S.R. González-Carrazán, M.A. Soria and P. Ruíz, Catal. Today 203 (2013) 158-162[2] M. Lyubovsky, S. Roychoudhury and R. LaPierre, Catal. Lett. 99 (2005) 113-117[3] S.M. Lang, I. Fleicher, T.M. Bernhardt, R.N. Barnett and U. Landman, J. Phys. Chem. A 118 (2014) 8572-8582[4] W. Kohn and L.J. Sham, Phys. Rev. A 140 (1965) 1133–1138

354 - Thomas Rotation and Quantum Entanglement

TCP - Wednesday 01 July 2015 15:00 *[For award: PhD]*

Primary author: HARTMAN, Jonathan *(University of Johannesburg)*
Co-authors: *CONNELL, Simon (University of Johannesburg); PETRUCC…*

The composition of two non-linear boosts on … …-commutativity has the result that the Lorentz transfor… …, a combination of a boost and a rotation. The rotatio… …in curved space-time, the Thomas precession combin… …space-time to produce a geodetic effect. In this work we pr… …between the spins of entangled particles and propose a way to detect for… …ing at how the Thomas precession degrades the entanglement correlation. Since the Tho… …y kinematical effect, it could potentially be used to detect any kind of force, including gravity (in the New… …ield limit). We present the results that we have so far.

358 - Fine structure of the isovector Giant Dipole Resonance in neutron-rich calcium isotopes using the (p,p') reaction at 200 MeV

NPRP - Friday 03 July 2015 11:10 *[For award: PhD]*

Primary author: LATIF, Mouftahou *(University of the Witwatersrand, Johannesburg 2050)*
Co-authors: *USMAN, Iyabo (University of the Witwatersrand, Johannesburg.); JINGO, MAXWELL (UNIVERSITY OF THE WITWATERSRAND); KUREBA, Chamunorwa Oscar (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa); DONALDSON, Lindsay (University of the Witwatersrand); NEMULODI, fhumulani (iThemba LABS); SWARTZ, Jacobus (Stellenbosch University); PAPKA, Paul (Stellenbosch University); PONOMAREV, Vladimir (Institut für kernphysik Technische Universitat, Darmstadt D-64289, Germany); VON-NEUMANN COSEL, Peter (Institut für kernphysik Technische Universitat, Darmstadt D-64289, Germany); CARTER, John (University of the Witwatersrand); NEVELING, Retief (iThemba LABS); SMIT, Frederick David (iThemba LABS); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand)*

Proton inelastic-scattering experiments have been carried out on the neutron-rich isotopes of calcium, 42,44,48Ca at zero-degrees using the high-energy resolution K600 Magnetic Spectrometer of iThemba LABS with a view to investigating the fine structure in the region of the Isovector Giant Dipole Resonance (IVGDR). Excellent energy resolutions were achieved with ΔE(FWHM)≈ 30 KeV for 44Ca and ΔE(FWHM)≈ 40 KeV for 42,48Ca leading to clear observation of fine structure thus allowing for an understanding of the damping of the resonance by comparison with state-of-the-art microscopic theoretical calculations. Double differential cross-sections have been extracted from the data obtained for each of the isotopes. Equivalent photo-absorption cross-sections were obtained from the measured data using virtual-photon production rates which agree well with those photo-absorption cross-sections already reported in the literature. In addition, preliminary results of the extracted characteristic energy scales are presented and future prospects are discussed.

360 - Generation and validation of Monte Carlo signal events for the H->ZdZd->4l Analysis

NPRP - Wednesday 01 July 2015 10:00 *[For award: PhD]*

Primary authors: UNWUCHOLA, Doomnull Attah *(University of Johannnesburg); CASTANEDA, Elizabeth (University of Johannesburg)*
Co-authors: *CONNELL, Simon (University of Johannesburg); ASSAMAGAN, Ketevi Adikle (Brookhaven National Laboratory)*

D A Unwuchola1,21 University of Johannesburg, P.O.Box 524, Auckland Park 2006, Johannesburg, South Africa.2 On behalf of the ATLAS collaborationConsidering the prediction by several models of a new sector with a light new gauge boson (Zd) coupled with Standard model, the discovered Higgs boson can be used as portal to probe this new sector [1]. The leptons from very light Zd are very boosted and therefore are potentially close to each other making the isolation criteria inefficient with background from J/Ψ and Y at lower energies below 15 GeV. The Large Hadron Collider run 2 data collection and analysis will be in the light to explore this region. We present with respect to several production modes the generation and validation of signal events for the H-> Zd Zd -> 4l and optimization of cuts.[1] Curtin D, Essig R, Gori S, Jaiswal P, Katz A, Liu T, Liu Z, McKeen D, Shelton J, Strassler M, S urujon Z, Tweedie B and Zhong Y M 2014 Phys. Rev. D 90(7) 075004 URL http://link.aps.org/doi/10.1103/PhysRevD.90.075004

364 - Fast Scheme for Approximating an Off Set PSF Response

Astro - Thursday 02 July 2015 10:00 *[For award: PhD]*

Primary author: *ATEMKENG, Marcellin (Rhodes University)*

The desire of Wide field of View (FoV), high sensitivity and high resolution has driven radio astronomers to the point of big data revolution where the data is represented in at least four dimensions with axis for spectral frequency, time, baselines and sources. The cost associated with storing and handling these data has been very large for processing (calibration, imaging, etc) and therefore it is desirable to reduce the size of the data as much as possible using data compression techniques. Unfortunately, the well known compression technique "per baseline time/frequency bins averaging" results in a baseline-length dependent loss of signal amplitude and distortion, and creates "smearing" imaging artefact's which are dependent on distance from the image phase centre. We present a new technique to accurately approximate a distort source Point Spread Function (PSF) response and compare the approximate PSF with the Direct Fourier transform (DFT). Furthermore, we show that the computational time of an approximate PSF response scale as the PSF compute with the Graphics Processing Unit (GPU). Keywords: Sensitivity, resolution, big data , spectral frequency, baselines, compression, averaging, signal, distortion, smearing, PSF, DFT, GPU.

365 - Development of Single Mode 2076.4 nm Holmium-doped Fibre Laser

Photonics - Tuesday 30 June 2015 15:00

Primary author: *WU, Lorinda (CSIR-NLC)*
Co-authors: *KIR'YANOV, Alexander (Centro de Investigaciones en Optica); KOEN, Wayne (CSIR National Laser Centre); JACOBS, Cobus (CSIR National Laser Centre); STRAUSS, Henchard (CSIR (National Laser Centre))*

High power 2µm laser sources have a wide range of applications in remote sensing, eye-safe LIDAR, non-linear frequency conversion, materials processing, medical and defence applications. In particular, fibre lasers possess high brightness and are robust and compact, offering high efficiency and are comparatively cost effective, thus attracting a vast amount of recent research interest. Unlike thulium-doped fibre lasers (1.8-2.0 µm), the development holmium-doped fibre lasers (2.0-2.1µm) are still in its infancy. This is due to the high absorption of silica glass beyond 2.1µm wavelength. In this work, a holmium-doped fibre laser was designed, developed and characterised using home-drawn single mode active fibre.A commercial Tm:fibre laser was used to core-pump the single-clad Ho-doped fibre (8.5µm core, 125µm cladding diameter). The resonator cavity consist of the 3m of active fibre spliced to a pair of fibre Bragg gratings (2076.4 nm) that were written on mode-matched passive fibres.Preliminary results yielded CW power output of ~2W and slope efficiency of 48%.

366 - Controlled injection of higher-order modes into an optical fiber from a solid state digital laser

Photonics - Thursday 02 July 2015 15:20

Primary author: *NGCOBO, Sandile (CSIR)*
Co-authors: *BELL, July (CSIR); FORBES, Andrew (CSIR); BRUNING, Robert (University of Jena); DUPARRE, Michael (University of Jena)*

Mode division multiplexing has been mooted as a future technology to address the impending data crunchof existing fibre networks. Present demonstrations delineate the light source from the mode creation steps,potentially inhibiting integrated solutions. Here we demonstrate an integrated mode generating source in theform of a digitally controlled solid state laser with an intra-cavity spatial light modulator. In our proof-of-principle experiment we create fibre modes on demand and couple them directly into a few-mode fibre, whereafter transmission they are decoupled by modal decomposition. This is the first demonstration of a singlesource for encoding information into the spatial modes of light.

367 - Energy yield monitoring of photovoltaic technologies

Applied - Wednesday 01 July 2015 15:00

Primary author: *SCHULTZ, Ross (NMMU)*
Co-authors: *WOODFORD, Grant (NMMU); VORSTER, Frederik (NMMU); VAN DYK, Ernest (NMMU)*

Photovoltaics (PV) has been recognised as one of the major renewable energy sources to be used in South Africa on a large scale. One of the fundamental questions is which technology is best to deploy in specific areas in order to generate the highest energy yield. The main focus of this study is to obtain high temporal resolution performance data from various PV technologies operation in different climatic regimes in Southern Africa. This will facilitate the determination of the suitability of a PV technology for a specific region. The study involved the establishment of an energy yield monitoring network based on commercial PV module monitoring stations capable of measuring PV module current-voltage (I-V) curves periodically, typically every minute. In addition, meteorological data such as plane of array (POA) irradiance, humidity, wind speed and direction, ambient temperature as well as back of module temperatures are also recorded. In this paper we report on the system design, installation and commissioning, data analysis and give preliminary results. These initial results are used to demonstrate the value of high temporal resolution performance data and also for detailed energy yield analysis.

368 - NON-SPECIALIST LECTURE: Neutron diffraction facilities MPISI and PITSI at SAFARI-1

DPCMM - Thursday 02 July 2015 15:00

Primary author: *VENTER, Andrew (Research and Development Division, Necsa Limited SOC, Pretoria, South Africa)*
Co-authors: *HAYES, Michael (Necsa Limited SOC); SENTSHO, Zeldah (Necsa Limited SOC); VAN HEERDEN, Rudolph (Necsa Limited SOC); MARAIS, Deon (Necsa Limited SOC); RAATHS, Christo (Necsa Limited SOC)*

Two new neutron diffraction instruments have recently been commissioned at the SAFARI-1 research reactor of Necsa. The SAFARI-1 materials testing reactor has commemorated its 50 year operation on the 18th of March 2015. In line with this significant milestone, two new diffraction instruments, MPISI (Materials Probe for Internal Strain Investigations) and PITSI (the Powder Instrument for Transition in Structure Investigations) have been modernised through extensive in-house developments that have culminated with their full commissioning and characterisation during the past year. This brings the neutron diffraction capabilities in line with international standards and capabilities.The instruments are respectively dedicated to the applications neutron strain scanning / texture, as well as neutron powder diffraction. The latter instrument is equipped with high (300 K < T < 1800 K) and low (3 K <T < 350 K) temperature sample environments to facilitate in-situ magnetism and phase transformation studies. Both instruments are equipped with Popovi type bent Si-multiwafer monochromators, sturdy high-precision diffractometers with integrated sample manipulation stages, adjustable apertures interchangeable with radial collimators, and area detectors. The data acquisition and control system was sourced from ANSTO, configured and implemented to comply with site-specific requirements. In addition, a wifi based remote hand-held instrument control module running on Android has been developed to aid with sample setups. In-house developed data reduction software, Scanmanipulator, was developed. The instruments are now available for routine operation and accessible with the R&D; User Facility Program. We shall present details of the instrument performances, illuminated with high-resolution results from the first completed projects.

370 - Ultrafast photochromism in metal-organic complexes

Photonics - Thursday 02 July 2015 10:00 *[For award: MSc]*

Primary author: *VON STEIN, Xavier (Stellenbosch University)*
Co-authors: *SCHWOERER, Heinrich (Supervisor); BOSMAN, Gurthwin (Co-supervisor); STEENKAMP, Christine (Co-supervisor)*

Meriwether et al conducted the first thorough investigation of the photochromic properties of the metal dithizonates in 1965. Until recently however, the photochromism of metal-dithizonates have not been studied in the ultrafast regime (in the order of femto- to picoseconds). This study serves as a continuation of the prior research conducted by G.W. Bosman in 2012. A variety of metal dithizonates are investigated using a pump-probe spectroscopic technique, namely, transient absorption spectroscopy (TAS), to determine whether they display photochromism. Furthermore, using TAS will allow for speculation of the underlying mechanism that is responsible for the photochromic behavior. What makes these molecules particularly interesting is that the photochromic mechanism is not yet confirmed (albeit it is thought that isomerisation plays a key role) and that these molecules can potentially be incorporated into molecular electronics.

371 - H.E.S.S. observations of radio galaxies

Astro - Thursday 02 July 2015 14:00 *[For award: PhD]*

Primary author: *DAVIDS, Isak Delberth (North-West University, Potchefstroom Campus)*
Co-author: *BÖTTCHER, Markus (North-West University, Centre for Space Research)*

Observations of radio galaxies, in the Very-High Energy (VHE) gamma-ray band, will further enhance studies of the processes in relativitic jets and in the vicinities of supermassive blackholes. Centaurus A, M 87 and 3C 120 are some of the radio galaxies that have been observed with H.E.S.S. (High-Energy Stereoscopic System). The implications of the H.E.S.S. results on the emission processes and sites of emission, as well as implications on different available models will be highlighted.

375 - Progress with the Colliding Shock Lens

Applied - Friday 03 July 2015 12:50

Primary author: *MAHLASE, Conrad (SAIP)*
Co-authors: *MICHAELIS, Max (Rutherford-Appleton Laboratories); GLEDHILL, Irvy (Igle) (CSIR)*

The Colliding Shock Lens (CSL) exploits the interference of shock waves in a gas to form a region in which high pressure, temperature and density change the refractive index of the gas, making it possible to focus laser light tested . They are real optical elements, sometimes have very good optical qualities and can be made out of air. CSL's are dynamic lenses, which last for a few microseconds and are always evolving. As gas structures, they can be applied to focus high powered laser light when solid lenses would be damages. The shocks are generated by spark gaps of exploding wires.Another application of colliding shocks is the formation of virtual capillaries, which are a series of spark gaps set out on the surface of a cylinder forming a cylindrical lens. A set of exploding wires on a circumference were investigated experimentally.The limitations with experiments is that physical probes positioned at points of interest would interfere with the experiment, hence making it impractical to determine the parameters of interest as mentioned above. Computational Fluid Dynamics (CFD) was employed to try and alleviate the above problem.

376 - Spatial resolution evaluation of digital neutron radiography and tomography facilities

Applied - Tuesday 30 June 2015 15:00 *[For award: PhD]*

Primary author: *RADEBE, Mabuti Jacob Radebe (Necsa)*
Co-authors: *KAESTNER, Anders (Paul Scherrer Institute); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); DE BEER, Frikkie (Necsa)*

Digital Neutron Radiography/Tomography as analytic technique has found applications ranging from quality assurance to research because of the unique nature of interaction of neutrons with materials. These radiation based imaging analytical techniques have gained acceptance because they are non-destructive and their output are radiographs or tomograms in real space. Neutron Radiography facilities provide results which lead to quality related decision making or diagnosis of an abnormality – therefore it is necessary to qualify the performance of the total experimental geometrical and detection setup. Spatial resolution has been identified as one of the important key factors for characterization of the performance of Radiography and Tomography setups. It can be assessed in a discrete and continuous context, and together with contrast, another important parameter in the radiography setup, determines the sharpness of the produced radiograph of a specimen. This work establishes the performance of Radiography and Tomography facilities through the design of test objects, experimental protocol, data post-processing and analysis procedures. An end product of this PhD component is the establishment of a software package to be used as an internationally accepted specification for the automated assessment of the spatial resolution performance of neutron radiography facilities.This presentation will focus on Matlab-software simulations backed by experimental measurements to assess the spatial resolution of a facility through application of the Modulation Transfer Function (MTF).

378 - Progress in Relativistic Electro-Magneto-Fluid Dynamics of Polarized Media

TCP - Friday 03 July 2015 10:20

Primary author: *MURONGA, Azwinndini (University of Johannesburg)*

2015 marks an important milestone in the history of physics: one hundred years ago, in November 1915, Albert Einstein wrote down the famous field equations of General Relativity. In its 68th sesion the UN General Assembly proclaimed 2015 as the International Year of Light and Light-based Technologies (IYL 2015). Following the epoch-making paper of 1905 by Einstein on special relativity there had been a need to adapt thermodynamics, electrodynamics and continuum mechanics to the requirements of Lorentz invariance. For more than 100 years physicists have been debating the correct form of the energy-momentum tensor required to describe the thermodynamics of a polarized medium in interaction with electromagnetic and gravitational fields. In this paper we look at the progress on this subject to date and offer the possible solution to the debate.

381 - Characterisation of traditional ceramic materials used in the Sotho culture (South-Africa) for clay pot making

DPCMM - Thursday 02 July 2015 16:10

Primary author: *HLEKANE, Phindile (University of Johannesburg)*
Co-author: *MULABA-BAFUBIANDI, Antoine Floribert (University of Johannesburg)*

Different types of clayey soils are readily available as a natural resource in South Africa. Some are used for brick making, some for eating in a geophagic habit while some others are used as cosmetic ingredients in cultural ceremonies or in traditional ceramic applications. Among the above mentioned numerous utilisations, clay pot making and trade are claimed to contribute to the improvement of the household income generation in the rural area of QwaQwa (Free State, South Africa). Traditional clay pots are made in Africa by people from different cultures. South Africa, a country with nine provinces and eleven official languages is enriched with a vast number of minerals. This paper discusses the outcomes from the characterisation of pots clay as traditionally used by the Sotho people of the Free State Province of South Africa. Clayey soil raw materials are collected from the local river banks and processed through a shaping, sun drying and firing set of subsequent processes. The knowledge of mineralogical composition, mineral phases formed during the processing of clays and the mastering of physio-chemical properties including plasticity helped to understand the thermal properties of the processed material generated, their forming and shaping, and the application of clay pots produced. Clayey soils, the main raw materials used, were randomly collected from the QwaQwa region of the Free State province and analysed using XRD, XRF,. FTIR, and Mossbauer spectroscopy. Main crystallite phases found include quartz, montmorillonite, illite and kaolinite. While 25 % of clay minerals were found in the material used only 5 % was kaolinite. The clayey soil showed a plastic limit of 31.74. Room temperature Mossbauer spectra displayed two paramagnetic doublet characteristics of Fe3+ in both octahedral and tetrahedral sites.

383 - The numerical investigation of the stochastic Schroedinger equation with memory

TCP - Wednesday 01 July 2015 14:00

Primary author: *IULIIA, Semina (University of KwaZulu-Natal)*
Co-author: *FRANCESCO, Petruccione (University of KwaZulu-Natal)*

Currently, there is growing interest in the study of non-Markovian quantum dynamics. This is a topic of importance for the field of open quantum systems. One of the useful tools for the description of such kind of systems is the stochastic wave function method, which allows to describe the dynamics by averaging over trajectories. We consider the heterodyne detection of a two-level system, that was obtained with the help of the random Hamiltonian method, when the coefficients of the liner equation are not random and the Hamiltonian produces dissipation. Two extra terms are added in order to introduce the heterodyne detection and the losses in the system. The transition between the linear and non-linear versions of the stochastic Schroedinger equation is connected by the change of probability and the Girsanov transformation. Moreover, the non-linear stochastic Schroedinger equation is the starting point for the stochastic simulations allowing to find a solution of the corresponding master equation numerically.

384 - NON-SPECIALIST LECTURE: Non-destructive Testing of wind power generators

Applied - Thursday 02 July 2015 14:00

Primary author: *JOHANNES, MANFRED (CSIR)*

The emphasis in power generation internationally is currently placed on alternative ways of producing electricity. One of the technologies employed is the utilization of the energy contained in moving air i.e. wind turbines. In general the size of these wind turbine structures is growing bigger and bigger with the associated increase in stresses and strains experienced not only by the support structure but by also the energy conversion system i.e. the blades of the turbines.The blades are rotating at tip speeds just below the speed of sound and hence the impacts by foreign objects, such as bird and lightning strikes, cause serious harm to the system. Areas affected by these external influences generally allow rain water or condensation to ingress into the structure. This ingress causes imbalance forces which then affect the main bearing and the generator which are both located in the nacelle more than 100 meters above the ground.Technology exists to assess the quality of the highest stressed components before they are placed in position at enormous heights. These finger prints allow then that one can perform inspections in situ without having to guess what the origins of the indications detected could be. All the technologies employed in the NDT operation can be classified as applied physics, as the bases of the technologies is always a material parameter which can be measured by some sensor, which then again is based on some physical principle. It is the aim of this paper to briefly describe some of the technologies available to inspect these giant structures and to indicate where there are areas which still warrant research, both in the field of solid state physics and radiation detection is the infrared and near-infrared part of the EM spectrum.

385 - PLENARY: Space Weather – why should we care?

Plenary - Tuesday 30 June 2015 12:10

Primary author: *KOSCH, Michael (SANSA)*

There is much talk about how potentially dangerous space weather storms are to modern society. However, mankind has survived for millennia and therefore many a solar storm long before we even knew they existed or were a problem. So just how vulnerable are we? In this presentation we review the chain of events from solar eruptions to geomagnetic storms as well as some impacts on the space environment, atmosphere, and technology. Example impacts relate to radiation hazards for spacecraft and human spaceflight, the radiative and chemical balance of the atmosphere, and power outages on the ground, respectively. How can developing countries contribute to this important science? The effective use of relatively low-cost ground-based instrumentation is introduced.

386 - PUBLIC TALK: Conflict in climate change

Plenary - Tuesday 30 June 2015 19:00

Primary author: *MINGAY, Don (Retired)*

Climate Change is a critically important issue with respect to both humankind and key Governmental planning. There pervades an unequivocal statement by the IPCC that CO2 is the dominant driver of global warming. With this comes the further alarmist warning that anthropogenic release of carbon dioxide must be reduced to avoid dangerous warming of the planet. This dogma has become a political religion and dogma having strong vested interests while attempting to silence the growingly powerful so-called “denialist” arguments as to why this is not so. The counter argument is based on a long stated and established role of Solar sun spot variability in addition to Mankowic sun-earth cycles which affect cosmic ray impacts on cloud formation as being the true drivers of Climate Change over aeons. This is gaining ground in credibility and provides evidence that we could well be entering a period associated with Global Cooling, rather than Global Warming! There is no clear total understanding of Climate Change but it is necessary that sanity prevails ultimately in terms of the correct and complete exploration of and conclusions drawn from the scientific data available.

390 - Characterization of torrefied sugarcane bagasse for gasification in a downdraft biomass gasifier system.

Applied - Wednesday 01 July 2015 15:20 *[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)*

Biorefining of lignocellulosic materials such as sugarcane bagasse to produce multiple bio-based products which includes synthesis gas is becoming a dynamic research area. Pre-processing techniques that improve the quality of bagasse are essential for the successful application of this feedstock in energy production. This study investigated modifications in the composition of sugarcane bagasse subjected to a torrefaction process as a preparation of bagasse for gasification. Characterization of bagasse was undertaken in terms of proximate and ultimate analyses as well as energy value, and results used to conduct computer simulation of the gasification process. The gasification process results showed that torrefied bagasse is a suitable feedstock for gasification in terms of conversion efficiency which was found to be approximately 70%.

393 - PLENARY: Exploring the World with Accelerator Mass Spectrometry

Plenary - Thursday 02 July 2015 08:40

Primary author: KUTSCHERA, Walter *(University of Vienna)*

Accelerator Mass Spectrometry (AMS) is a method to measure minute traces of long-lived cosmogenic and anthropogenic radioisotopes in all domains of our environment at large: atmosphere, hydrosphere, biosphere, cryosphere, lithosphere, cosmosphere, and technosphere [1]. In the context of AMS, a long-lived radioisotope is one whose detection by atom counting is much more efficient than counting radioactive decays. For example, from the 60 million C-14 atoms in one milligram of carbon, only one decays per hour, whereas it is possible to detect one million C-14 atoms in an hour by direct atom counting. AMS is almost exclusively performed with tandem accelerators, because the use of negative ions and the terminal stripping process provides an efficient suppression of background from stable isotopes, which allows one to measure radioisotope-to-stable isotope ratios in the range from 10^{-12} to 10^{-16}. Although AMS started originally at accelerators used for nuclear physics experiments – and are still performed at such facilities – a variety of dedicated AMS facilities were developed [2]. Currently, there are about 100 AMS facilities world-wide, with the first one in Africa now operational at the iThemba Labs in Johannesburg. Due to its presence in organic matter and its attractive half-life (5700 yr) for dating, C-14 is by far the most-used radioisotope in AMS. However, there are a number of other radioisotopes such as Be-10, Al-26, Cl-36, Ca-41, I-129, U-236 which are also frequently used with AMS. Here, a few selected examples from archaeology, astrophysics, geophysics, and biology will be discussed.[1] W. Kutschera, Int. J. Mass Spectr. 349-350 (2013) 203[2] H.-A. Synal, Int. J. Mass Spectr. 349-350 (2013) 192

395 - NON-SPECIALIST LECTURE: South Africa and the International Measurement System: Billion or Trillion?

Edu - Thursday 02 July 2015 09:40

Primary author: WYNAND, Louw *(NMISA)*

The International System of Units (SI), a globally agreed set of units, established a system of quantities and chosen definitions for a set of units that are used worldwide as the preferred language of science and technology. First adopted in 1948 and updated periodically, the SI is to undergo a major change in 2018 when four of the base units, the kilogram, ampere, kelvin and mole will be re-defined. The effect of the re-definition on the local scientific community is explored, as well as a fundamental decision to be taken to use either the Long or the Short scale to express multiples. So how much is a billion, is it one thousand times a million or one million times a million?

396 - Perceptions of Professional Academic Development: Barriers and bridges between physics lecturers and physics education researchers.

Edu - Thursday 02 July 2015 11:50

Primary author: LOMBARD, Elsa *(NMMU)*

Although physics lecturers are experts in evidence-based research, they often rely on anecdotal experience to guide their teaching practices. Adoption of research-based instructional strategies (pedagogical approaches that has shown effectiveness through empirical measurement) remains surprisingly low, despite a large body of physics education research and extensive dissemination efforts by physics education researchers. Addressing the low adoption of research-based instructional strategies is becoming increasingly important in the context of undergraduate physics teaching in South Africa. As part of a larger study focusing on introductory physics teaching, five lecturers were interviewed to uncover their perceptions of Professional Academic Development. Qualitative content analysis, using 'disciplines as epistemic cultures' as conceptual framework, was employed to analyse the lecturers' interviews. The findings of the study provided valuable insights into the barriers between physics lecturers' perceptions regarding the provision of Professional Academic Development, and physics education researchers with a professional development agenda. In particular, the findings suggested that if the agenda is to enhance undergraduate physics teaching, greater emphasis should be paid to contextualizing Professional Academic Development for 'hard' disciplines such as physics.

397 - Teaching of the Strand Planet Earth and Beyond in Primary School Natural Science

Edu - Wednesday 01 July 2015 14:40

Primary author: LEEUW, Lerothodi *(University of South Africa)*
Co-authors: *GROUWS, Eldrie (UNISA); DE WITT, Aletha (Hartebeesthoek Radio Astronomy Observatory)*

The study will assess the teaching of the strand Planet Earth and Beyond, with the goal of learning what is needed to help improve primary school learner performance and attrition in Natural Science. Planet Earth and Beyond is currently regarded as the worst taught and most avoided Natural Science knowledge strand (Astro-Education 2014). This is possibly due to teacher lack of content and pedagogical knowledge in astronomy, as well as related kits or interactive tools for demonstration purposes. Based on the findings of this research, recommendations will be made on how to assist teachers to teach the strand better and improve learner performance and attrition in Natural Science.

399 - Rotation Curves and Bars: Accounting for non-circular motions in barred spiral galaxies

Astro - Thursday 02 July 2015 16:30 *[For award: PhD]*

Primary author: RANDRIAMAMPANDRY, Toky *(University of Cape Town)*
Co-authors: *CARIGNAN, Claude (University of cape Town); DEG, Nathan (University of Cape Town)*

The rotation curves (RCs) of disk galaxies are a tool for studying their mass distribution and the dark matter content. The assumption underlying this type of work is that galaxies are axisymmetric and the rotational velocity of their gas traces the gravitational potential. Unfortunately, this is surely not the case for barred galaxies since the measured velocities depend on both the gravitational potential and the gas' streaming motion along the bar.The so-called "tilted-ring method" is commonly adopted when deriving RCs of galaxies, but it can produce erroneous values for the derived parameters of galaxies with large non-circular motions. There are methods used to correct for the non-circular motion which are based on harmonic decomposition and Fourier analysis of the velocity field. However, these methods do not work when the bar is aligned or perpendicular to the major axis because of degenerate velocity components.Using the case of NGC 3319, we show the importance of properly accounting for these non-circular motions. We use snapshots of N-body/hydrodynamic simulations with similar bar properties to adjust the observed RC of NGC 3319. The mass models of the adjusted RCs vary greatly from those obtained using the observed RC. These lead to wildly different conclusions about the dark matter concentration and domination. These results demonstrate that future studies of barred spiral galaxies must include careful corrections for the non-circular motions.

400 - The Vela Supercluster - does it provide the missing link to explain the local flow fields ?

Astro - Wednesday 01 July 2015 11:10 *[For award: MSc]*

Primary author: ELAGALI, Ahmed *(Cape Town University)*
Co-authors: *KRAAN-KORTEWEG, Renee (Cape Town University); CLUVER, Michelle (University of Western Cape)*

As part of a larger effort to uncover the structures hidden behind the Milky Way, we analyse 4, 756 optical redshifts for galaxies in the Hydra/Antlia and Vela region, ($245° < l < 295°$; $|b| < 10°$),obtained from several telescopes and from literature, mainly from the 2dF+AAOmega spectrograph at the Anglo-Australian Telescope. This analysis confirms the surmised existence of a supercluster in this region, hereafter the Vela Supercluster. The Vela SC extends about 15° × 20° on the sky, with the centre at cz ~ 18, 000 km s^{-1} , and contains 13 galaxy clusters and 19 galaxy groups. Using a sophisticated algorithm, we find the galaxy cluster/group members that lie within 1 Abell radius from the optimized centres, and determine their velocity dispersions and the corresponding masses. The masses of these galaxy clusters/groups lie in the range $3.6 \times 10^{15} M_{sun} - 0.2 \times 10^{14} M_{sun}$. The above implies that Vela SC is comparable to the Shapley Supercluster, but less extended. Consequently, this supercluster will have huge implications on the bulk flow and peculiar velocity of the local group (LG), since the Shapley SC contribution to the LG motion is 30.4% (Kocevski & Ebeling 2006). Further, the existence of this supercluster is likely key in resolving the long-enduring bulk flow controversies and the misalignment of flows with the Cosmic Microwave Background (CMB) measurement.

405 - A PAPER-32 Stokes I Sky Catalogue

Astro - Wednesday 01 July 2015 10:00 *[For award: MSc]*

Primary author: PHILIP, Liju *(Rhodes University)*

Observations of the redshifted hyperfine Hydrogen 21 centimeters line from the Epoch of Reionization (EoR) are the most promising tools to investigate the birth of the first stars and galaxies as well as the history of the intergalactic medium. Such observations are challenged by the presence of foreground emission that is a few orders of magnitude stronger than the 21-cm signal, requiring very accurate calibration. I present my work to derive an accurate all-sky model and primary beam models for the Precision Array to Probe the EoR (PAPER), in order to improve the calibration accuracy of EoR observations.References:Daniel C. Jacobs et al. 2013, 'A flux scale for Southern Hemisphere 21cm EoR experiments', ApJ 776 108Interferometry and Synthesis in Radio Astronomy A. Richard Thompson, James M. Moran, George W. Swenson, Jr

406 - A Study Of Potential Calibrators Using The KAT-7 Telescope

Astro - Tuesday 30 June 2015 11:50 *[For award: PhD]*

Primary author: KASSAYE, Ermias *(Rhodes University, Department of Physics)*
Co-authors: *OOZEER, Nadeem (Square Kilometer Array, South Africa); BASSETT, Bruce (University of Cape Town (UCT))*

We studied Active Galactic Nuclei (AGN) as potential calibrators, which were observed by the Karoo Array Telescope (KAT-7) between Oct 13, 2012 and Feb 23, 2013. The KAT-7 is an engineering prototype for the coming sensitive array, the MeerKAT, one of the pathfinders for the Square Kilometer Array (SKA). The KAT-7, whose construction started in early 2008, has been undergoing engineering and science verifications since late 2010. In this presentation, we report the flux-density and position measurement accuracy of the KAT-7. Moreover, we explain the first steps towards identifying possible flux-density standards using variability metrics for short baseline interferometers such as the KAT-7.

408 - Development of kHz applied optical remote sensing for atmospheric insect monitoring applications

Photonics - Wednesday 01 July 2015 15:20 *[For award: PhD]*

Primary author: GEBRU, Alem *(Stellenbosch University, Lund University)*
Co-authors: *ROHWER, Erich (Stellenbosch University); NEETHLING, Pieter (Stellenbosch University); BRYDEGAARD, Mikkel (Lund University)*

Alem Gebru1, 2, Erich Rohwer1, Pieter Neethling1, and Mikkel Brydegaard1, 2 1. Stellenbosch University 2. Lund UniversityEffective ways of monitoring insect activities in situ is crucial for entomologists. Such studies have in the past relied more on manual analysis using traps and sweep nets [1-3]. However, it is difficult to monitor fast interaction kinetics and huge numbers simultaneously, which leads us to look for other ways of studying the activity of atmospheric fauna. We have developed a kHz applied optical remote sensing system for monitoring atmospheric insect , which is capable of determining wing-beat frequency, flight directions, optical cross-section and range. This is a comprehensive system, which works both in active and passive modes. The passive mode is based on a remote dark field spectroscopy technique. We use sun light as an illumination source, a dual band detector (silicon (Si) and indium gallium arsenide (InGaAs)) to study the iridescence features, silicon quadrant detector to determine flight direction and a spectrometer for colour information. We have used a 25cm diameter F/4 receiving telescope and dark termination box to reduce the back ground signal. In the active mode, which is continuous wave light detection and ranging (CW-LIDAR) technique, we use a 3W, 808nm laser transmitted by F/5 refractor telescope and the same receiving telescope as in the dark field experiments. In our previous work, we were able to determine wing-beat frequency, irradiances features and flight direction of insects remotely [4, 5].This technique enables us to track fast events and huge numbers.

409 - Ultrafast mapping of crystallic structural changes in organic radical salts

Photonics - Thursday 02 July 2015 11:10 *[For award: PhD]*

Primary author: SMIT, Bart *(MSc Student)*
Co-authors: *SULEIMAN, Aminat Oyiza (Laser Research Institute); OLAOYE, OLUFEMI OPEYEMI (LASER RESEARCH INSTITUTE, PHYSICS DEPARTMENT, STELLENBOSCH UNIVERSITY, STELLENBOSCH.); ROHWER, Andrea (Stellenbosch University); ERASMUS, Nicolas (Stellenbosch University); SCHWOERER, Heinrich (Stellenbosch University)*

The one-dimensional organic radical salts of dicyanoquinonediimine, $M(R_1,R_2\text{-DCNQI})_2$, have an interestingly high conductivity along the *c*-axis. Depending on composition, these crystals exhibit spectacular phase changes. The conductive axis can become insulating at a sample specific temperature within 1K. Few compositions even show a sudden re-entry to the metallic phase upon further cooldown. During crystal growth, *M* can be chosen to be a range of metallic ions. The R_1,R_2 sidegroups of the organic ligands can be selected as pleased, making the metal-to-insulator transitions highly tuneable. Measuring the dynamics of the crystal structure with atomic resolution during this structural phase change (called a Charge Density Wave formation), helps understand the dominant interactions of the order parameters in the materials.Femtosecond Electron Diffraction (FED) can capture these structural changes with the relevant temporal resolution (sub-ps). During an experiment, an ultrashort light pulse (the pump) is shot at the sample to drive the transition. It is probed by an ultrashort electron pulse. The acquired electron diffraction pattern taken in transmission from a 30nm thin freestanding sample, reveals a sub-ps snapshot of the atomic structure. A complete dynamical transition movie is acquired by changing the arrival time between the pulses. Our home-built set-up, equipped with a helium cryostat, is a significant improvement from initial FED set-ups. Its outstanding pressure ($\sim 10^{-10}$mbar) prevents condensation onto samples at typical sub-60K phase transition temperatures. The electron probe's brightness, stability and beam quality ensures sufficient sensitivity for ligands with low scattering cross sections. Our research goals are getting closer by the availability of ultrathin freestanding samples and our operational specialised machine.

410 - The Solar-Cycle Dependence of the Heliospheric Diffusion Tensor

Space - Thursday 02 July 2015 10:00 *[For award: MSc]*

Primary author: NEL, Amoré *(North-West University, SANSA)*
Co-authors: *BURGER, Adri (North-West University); ENGELBRECHT, Eugene (North-West University)*

Long-term cosmic-ray modulation studies using ab initio numerical modulation models require an understanding of the solar-cycle dependence of the heliospheric diffusion tensor. Such an understanding requires information as to possible solar-cycle dependences of various turbulence quantities. In this study, data for the heliospheric magnetic field is analysed using second-order structure functions constructed assuming a simple three-stage power-law frequency spectrum. This spectrum is motivated observationally and theoretically, and has an inertial, an energy-containing and a cutoff-range at small frequencies to ensure a finite energy density. Of the turbulence quantities calculated from 27-day averaged second-order structure functions, only the magnetic variance and the 14-hour spectral level appear to show a clear solar-cycle dependence. Although the energy range spectral index is solar-cycle dependent, the 20% change over a solar cycle is insignificant compared to the factor of three change of the magnetic variance over a solar cycle. The spectral index in the inertial range, as well as the turnover and cutoff scales do not appear to depend on the level of solar activity. The ratio of the variance to the square of the magnetic field also appears to be solar-cycle independent. These results suggest that the dominant change in the spectrum over several solar-cycles is its level. Comparisons of the results found in this study with relevant published observations of turbulence quantities are very favourable. Furthermore, when the magnetic variances and heliospheric magnetic magnitudes calculated in this study are used as inputs for theoretically motivated expressions for the mean free paths and turbulence-reduced drift lengthscale, solar-cycle dependencies in these quantities are seen. Values for the diffusion and drift lengthscales during the recent unusual solar minimum are found to be significantly higher than previous solar minima.

414 - Developing a sorting code for Coulomb-excitation studies at iThemba LABS

NPRP - Friday 03 July 2015 12:30 *[For award: MSc]*

Primary author: MEHL, Craig *(University of the Western Cape)*
Co-authors: *ORCE, Nico (University of the Western Cape); JONES, Pete (iThemba LABS); TRIAMBAK, Smarajit (University of the Western Cape)*

This work aims at developing a sorting code for Coulomb excitation studies at iThemba LABS. In Coulomb excitation reactions, the inelastic scattering of the projectile transfers energy to the partner nucleus (and vice-versa) through a time-dependent electromagnetic field. At energies well below the Coulomb barrier, the particles interact solely through the well known electromagnetic interaction, thereby excluding nuclear excitations from the process [1,2]. The data can therefore be analysed using a semiclassical approximation [3]. The sorting code was used to process and analise data acquired from the Coulomb excitation of 20Ne beams at 73 MeV and 96 MeV, onto a 3mg/cm2 194Pt target. The detection of gamma rays was done using the AFRODITE HPGe clover detector array, which consists of 9 clover detectors, in coincidence with the 20Ne particles detected with an S3 double-sided silicon detector. The new sorting code includes Doppler-correction effects, charge-sharing, energy and time conditions, GEANT simulations, kinematics and stopping powers, among others, and can be used for any particle-gamma coincidence measurements at iThemba LABS. Other Coulomb excitation measurements at iThemba LABS will also be presented.[1] R.H. Spear, Phys. Rep. 73, 369 (1981).[2] J.N. Orce, Phys. Rev. C 86, 041303(R) (2012).[3] T. Czosnyka, D. Cline, and C. Y. Wu, Bull. Am. Phys. Soc. 28, 745 (1983).

415 - CHPC Introduction to Linux and Python Course: A capacity building tool for High Performance Computing

TCP - Friday 03 July 2015 09:40

Primary author: MOEKETSI, Daniel Mojalefa *(CSIR Meraka Institute (CHPC))*

The Centre for High Performance Computing in South Africa was established in 2007 by the Department of Science Technology. It operates as national infrastructure to support computational intensive research across different fields of science and engineering. The centre houses the supercomputer with Linux operating system. Large percentage of researchers using CHPC is from academia. Most of academic institutions in South Africa use Windows Operating System. This is a challenge to new users of the CHPC because to use Cluster effectively one requires background of Linux. As an attempt to address this challenge, the CHPC has introduced basic Linux and Python scientific programming school in 2011 for postgraduate's science and engineering students in the field of computational science. The paper discusses our past year experiences to date with successful implementation of the training program and how it can be used as HPC training model in developing countries.

416 - Radioelement results which was obtained with a self-developed measuring method of a new in situ gamma ray detection system

NPRP - Thursday 02 July 2015 14:00

Primary authors: BEZUIDENHOUT, Jacques *(Stellenboch University); GOMES, Nuno (Independent University of Angola)*

Gamma ray spectroscopy as a survey tool has been successfully applied in the fields of morphology, geology and mineral exploration. Gamma ray surveys are regularly done in hugely varying geographical environments. A newly develop mobile gamma ray survey instrument named the GISPI (Gamma In Situ Potable instrument) was utilized for these measurements. This system acquires gamma ray spectra, extract radionuclide concentrations and finally interpolate data to provide radionuclide concentrations and produce maps while on location. The GISPI was employed to map nuclide concentrations in different geographical settings that demanded various means of transport, which included motor vehicles, quad motorcycles and transporting the system on foot. A fundamental mathematical model that was used to analyze the in situ gamma ray spectra were also developed and implemented. The results from different geographical area will be displayed and variances of radionuclides will be discussed. Final conclusions will also be made on the success of methods and equipment that was utilized for the study and environmental concerns of the sites that were investigated.

418 - Stellar Streams: Modelling and Methodology

Astro - Tuesday 30 June 2015 10:00

Primary author: DEG, Nathan *(UCT)*

Stellar streams are powerful probes of the Milky Way. However, unlocking their full power is not trivial. It is necessary to explore the full parameter space of available Milky Way models. Moreover, non-stream constraints should be combined with the constraints from some stellar stream. In addition to these methodological considerations, it is important to model the streams themselves efficiently and accurately. To that end, we explore three different stream modelling algorithms that are particularly efficient and can be easily applied to current observations. The simplest algorithm, orbit-fitting, is insufficiently accurate. However, the other two algorithms, the streamline and distribution methods, are provide great improvements over the orbit-fitting method.

420 - The Design and Construction of an Active Target Detector for the Study of the 20Ne(α,α')20Ne* Reaction

NPRP - Friday 03 July 2015 12:50 *[For award: MSc]*

Primary author: *BRUMMER, Johann Wiggert (Stellenbosch University)*
Co-author: *PAPKA, Paul (Stellenbosch University)*

The excited 3α resonant state in 12C, which is crucial for thermonuclear fusion of carbon in red giant stars, was predicted by Fred Hoyle in 1954. Since the experimental observation of the Hoyle state studies have evolved to examine alpha decay processes in other light nuclides such as 8Be and 16O. Cluster studies of 20Ne done with the 22Ne(p,t) reaction revealed a candidate for a 5α state at 22.5 MeV, near the 5α decay threshold. Characterising this state is non-trivial. The cross section of the decay path to the 5α channel is expected to be very low. An active target detector (AcTar) was developed to study the break-up of the 5 α state populated by the 20Ne(α,α') reaction. It is designed to be a high-efficiency detector in order to measure reactions with low-energy reaction products and low cross sections.Over the past two years, AcTar has been designed, built and successfully tested with a 226Ra source. A proposed in-beam test has been accepted by the iThemba LABS programme advisory committee to test the limits of the detector regarding background, count rates and detection of low-energy α-particles. The detector's printed circuit board has 5 sectors, each with 16 signal wires alternating with 17 guard wires. A high-voltage plate opposite the PCB creates an electric field, establishing an active detection region to detect drift electrons that result from decay α-particles moving through the active region. Full kinematic track reconstruction is possible to determine particle energies and positions in order to establish the interaction point within the gas cell. AcTar also has the potential to study clustering in other gas targets such as 16O, 18O, 21Ne, 22Ne and 36Ar, with low-energy detection capabilities for particles decaying from astrophysically important resonances.

421 - Modeling antenna primary beams using characteristic basis function patterns

Astro - Tuesday 30 June 2015 11:10 *[For award: PhD]*

Primary author: *IHEANETU, Kelachukwu (Rhodes University)*
Co-authors: *SMIRNOV, Oleg (Rhodes University & SKA SA); PERLEY, R (NRAO); DE VILLIERS, Mattieu (SKA SA)*

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 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.

422 - Wigner distribution function and the complex curvature applied to Laguerre-Gaussian modes propagating through first order systems

Photonics - Wednesday 01 July 2015 10:20

Primary author: *MAFUSIRE, Cosmas (University of Pretoria)*
Co-author: *KRÜGER, Tjaart (University of Pretoria)*

A general rotational symmetric laser field can be represented as (i) a superposition of rotationally symmetric modes such as an infinite set of the discreet Laguerre-Gaussian functions or (ii) simply by fitting a Gaussian function. In the first approach, the propagation of the field through a first-order system is represented by the propagation of each mode. The field at any subsequent plane is evaluated by a sum of the modes calculated at that plane. With this method, we can make the fit as accurate we want by making the number of modes as large as required. The second approach is to calculate the moments of the rotational symmetric field in phase space using the Wigner distribution function. This method is simpler and presents closed form results. The beam width, far-field divergence and the space-angular moment of the beam were calculated using the moment definition of these parameters using both approaches. In the limiting case of a single mode, preliminary results show that these parameters increase with the mode order. Expressions for the evolution of each of these parameters through first order systems are extracted and provided in terms of the complex beam parameter, q. The invariance of the propagation is expressed in terms of the beam parameter product. Other parameters, such as the waist width, waist position and Rayleigh range, are presented in terms of the second moment parameters, including even less familiar but equally important parameters such as the local divergence, curvature divergence and focusing parameter. Applications of the results in the analysis of the radiometry of these modes during first order propagation are presented. The radiometric parameters concerned are the geometric vector flux and the total radiant flux.

429 - Optimizing low Reynolds number wind turbine blades

Applied - Thursday 02 July 2015 14:40 *[For award: PhD]*

Primary author: *POOLE, Sean (NMMU)*
Co-authors: *VORSTER, Frederik (NMMU); PHILLIPS, Russell (NMMU)*

A challenge for small wind turbines (<5kW) is the low Reynolds number regime in which they operate. This is due to their small size as well as the general low wind speed location (especially in the built environment). This research looks at an alternative approach from the conventional BEM (Blade Element Momentum) theory. Conventional BEM theory optimizes the blade design with the goal of maximizing the lift to drag ratio for the given aerofoil. The researched alternative approach considers the sensitivity of the lift to drag ratios relative to the Reynolds number, and therefor aims to optimize the design by considering "oversizing" the blade chord length in order to benefit from the higher Reynolds number. Other benefits would also include a flatter wind turbine power curve which would suite gusty and turbulent conditions better, as well as a higher turbine start up torque. Accurate wind measurements using a 3D sonic anemometer along with the turbine power and speed measurements will be used to develop the power curves for the proposed turbine. These power curves will then be compared to the curves of a conventional wind turbine of similar size. The expected results should show increased energy yield in low wind speed conditions as well as in turbulent and gusty conditions.

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

Edu - Wednesday 01 July 2015 11:30

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 question 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.

432 - Open-Source electronic board designed in South-Africa, for Africa

Applied - Friday 03 July 2015 10:00

Primary author: *MARIOLA, Marco (University of kwazulu-natal)*
Co-author: *PETRUCCIONE, Francesco (UKZN)*

Several experiments require acquisition devices to read the signals from the external environment. These devices can be interfaced with a computer through the serial communication. The continuous evolution of the electronics changes the communication standards for example from the standard RS-232 to USB. For this reason it is necessary to use an external adapter to connect laboratory equipment with a computer. The laboratory equipment is often expensive and is not affordable for schools or universities located in developing areas. Through the use of Open Source it is possible to design experimental equipment without license fees and build proper electronic devices using inexpensive components. In this article we show an electronic board for prototyping using the Arduino features, called AFRICHINO. This board was developed from our research experience, and represents a synthesis of what is necessary to have a complete experimental board.

440 - An ab-initio study of the metastability of the boron-vacancy (B-V) complex in silicon.

DPCMM - Thursday 02 July 2015 16:50

Primary author: *MEYER, Walter (University of Pretoria)*
Co-author: *OUMA, Cecil (Student)*

We have investigated the metastability of the boron-vacancy (B-V) complex using PBE and the Heyd-Scuseria-Ernzerhof (HSE06) hybrid functional within density functional theory (DFT) and compared it's predictions to experimental observations. Both the formation energies and thermodynamic transition levels of the defect were found to depend on the position of the silicon vacancy with respect to the substitutional boron. HSE06 predicted thermodynamic charge transition levels and charge-state controlled metastability of the B-V complex that was consistent with experimental observations. The nearest neighbor and next-nearest neighbour configurations of BVcomplex were identified as the two metastable configurations of the defect complex.

441 - Investigation of the annealing behaviour of the donor-vacancy complex in alpha-particle irradiated Ge.

DPCMM - Wednesday 01 July 2015 11:50 *[For award: MSc]*

Primary author: *BARNARD, Willem (University of Pretoria)*
Co-authors: *NGOEPE, Phuti (University of Pretoria); OMOTOSO, Ezekiel (University of Pretoria, Pretoria, South Africa); AURET, Danie (University of Pretoria); MEYER, Walter (University of Pretoria)*

The annealing behaviour of the E-centre in Ge has been investigated by deep level transient spectroscopy (DLTS). The E-centre has been identified as the donor-vacancy complex. In this study Sb-doped Ge was used and the Sb-vacancy had an activation energy of 0.37 eV for electron emission as determined by DLTS. The defect has been introduced in this study by irradiating the Ge sample with alpha particles from an Am-241 source. The E-centre in Ge has been observed to anneal out in a two stage process. In the first stage the defect concentration decreases rapidly when the sample is heated to approximately 320 K, and then remains relatively constant with annealing temperature. In the final stage, at a temperature of approximately 370 K, the defect concentration decreases quite rapidly until the defect finally anneals out completely. A possible hypothesis is that the E-centre observed is in fact two different defects corresponding to the fast and slow annealing components. However, in this study, we find that both the slow and the fast annealing components of the E-centre have the same DLTS signatures (activation energy and apparent capture cross section) as well as the same true capture cross section. In effect, both the fast and the slowly annealing components of the E-centre seem to be the same defect. In this study, an investigation of this phenomenon is performed by investigating different irradiation and annealing procedures. We show that the fast annealing component of the E-centre can be explained by Ge self-interstitials, released from other radiation induced defects at 50 K recombining with the vacancy in the E-centre.

442 - Dynamical mass estimates of Sunyaev-Zel'dovich effect selected galaxy clusters in the Millennium Gas simulations

Astro - Wednesday 01 July 2015 10:20 *[For award: MSc]*

Primary author: *MTHEMBU, Nhlakanipho Kwaz (Student)*
Co-author: *HILTON, Matt (Senior Lecturer)*

Galaxy of Clusters are the most massive gravitationally bound systems in the Universe, by studying them they provide powerful means of tracing the growth of cosmic structures and, ultimately, constraining cosmological parameters (e.g. Allen, Evrard & Mantz 2011). Despite the richness of data clusters can provide, probing strong constraints from cluster surveys is a non-trivial problem due to the complexity of estimating accurate cluster masses. Mass is not a directly observable quantity but can be determined in several ways. One way is to find it is by using the Sunyaev-Zel'dovich (SZ) effect – this is the inverse Compton scattering of photons from the cosmic microwave background by hot gas in clusters (see e.g., Carlstrom et al. 2002 for review). Experiments like the Atacama Cosmology Telescope (ACT; Marriage et al. 2011, Hasselfield et al. 2013) have carried out surveys using the SZ to find clusters . To use clusters to measure cosmological parameters, we need well-calibrated results between the SZ signal and cluster mass (the quantity predicted by models of structure formation). Mass also can be measured using the line of sight velocity dispersion of galaxies; however depending on the type of galaxies selected, such measurements may be subject to biases. We investigate this issue using simulated cluster and galaxy catalogues produced by the Millennium Gas project (Short et al. 2010; Kay 2012).We aim to design an optimal observing strategy for calibrating the dynamical mass - SZ-signal scaling relation using future Southern African Large Telescope (SALT) observations. We use the Millennium Gas simulations (MGs) to determine how many member galaxies in each cluster we need to observe, in order to quantify the bias and scatter in the relations between observables and cluster mass.Well calibrated mass-observable relations are crucial for current and future cosmological studies

443 - A new approach to modeling the heliospheric current sheet

Space - Thursday 02 July 2015 09:40 *[For award: PhD]*

Primary author: *RAATH, Jan-Louis (North-West University)*
Co-authors: *POTGIETER, Marius (North-West University); STRAUSS, du Toit (North-West University)*

Recently, the modulation of cosmic rays in the heliosphere has increasingly been studied by solving the well known transport equation via an approach based on stochastic differential equations (SDEs). This approach, which is now well established and published, allows for an in-depth study of the modulation effects of the wavy heliospheric current sheet (HCS), in particular as its waviness increases with solar activity up to extreme maximum conditions. This is possible because of the numerical stability of the approach as well as its ability to trace pseudo-particles so that insightful trajectories of how they respond to the wavy HCS can be computed and displayed. The results of this numerical modeling study are presented.

444 - Search for Extreme Metal-Poor Stars in the Edinburgh-Cape Blue Object Survey

Astro - Friday 03 July 2015 10:00 *[For award: MSc]*

Primary author: *XABANISA, Sivuyile (University of the Western Cape)*

The chemical abundances of the metal-poor stars provide the opportunity to investigate conditions in the earlyuniverse, formation of the first stars and the processes that created the chemical elements observedtoday (e.g. Frebel et al. 2013, ApJ 786, 74). We aim to determine metal abundances of extreme metal-poor candidate stars, identified in the Edinburgh-Cape Blue Object Survey, using high resolution HRS spectra. Here we discuss the project in general, and show preliminary HRS spectra of one of our targets (EC04564-2629) taken during HRS perfomance verification phase.

446 - Difficulties in Learning Physics: Analysis of FET Learners' Representational Modes in Some Basic Concepts.

Edu - Thursday 02 July 2015 11:10

Primary author: *AFOLABI, FOLASHADE (DISTANCE LEARNING INSTITUTE, UNIVERSITY OF LAGOS, NIGERIA)*

Over the years, research suggests that physics as a subject is considered as most challen… ol subjects in Africa and South Africa in particular. Learners believed that physics is diff… t researchers in physics education on their toes in searching for solution to … ; which has not yielded the desired results. This study probed … is assumed to be difficult to understand and pass. F… …ain the problem of representational mode which ob… …ically investigated learning difficulties that occurr… …ed concepts in physics. It also examined the repres… …ove their understanding in relating the concept to real …pso province participated in the study. From the findings, it was …major problem confronting learners as most learners were confused and could …forms of representational modes are used apart from the writing/ verbal mode.It was …atic and graphical provided a clearer picture and improved learners' understanding of the selected …g others. The findings have implications designing interventions as well as identifying a strategy that will incorporate …ary representational modes for more clarity.

449 - A calibration facility for in-situ gamma-ray detector efficiency

NPRP - Thursday 02 July 2015 14:20 *[For award: MSc]*

Primary author: *SEHONE, Alfred (Military Academy, Faculty of Military Science, Stellenbosch University, Saldanha, 7395, South Africa)*
Co-authors: *MALEKA, Peane (Department of Nuclear Physics, iThemba LABS NRF, Somerset West, 7129, South Africa); NEWMAN, Richard (Department of Physics, Stellenbosch University, P/Bag X1, Matieland, 7602, South Africa)*

In-situ gamma-ray detectors can be used to measure the activity concentrations in for example soil or on river- or sea-beds. In order to extract the activity concentrations the gamma-ray detection efficiency of the detector needs to be characterized. A facility was recently constructed at iThemba LABS for such characterizations. The facility comprises a concrete brick castle, with dimensions 121 cm (height), 119 cm (width) and 134 cm (depth); which has a 10 cm diameter hollow PVC tube for inserting a detector to be characterized. The castle has a wall thickness of 55 cm (width) and 63 cm (depth) to reduce the background radiation from reaching the detector. A sample of the concrete bricks were analyzed radiometrically in order to determine its average natural radioactivity content (40K, uranium and thorium series radionuclides). The spectrum measured with the detector in the castle contains contributions from the radionuclides. By comparing this spectrum with one simulated for the same source geometry and activity concentrations using a Monte Carlo code it is possible to characterize the detection efficiency of the detector. We present results associated with the characterization of a CsI scintillator detector using the new calibration facility.

452 - The Fundamentals of Single Molecule Microscopy.

Photonics - Wednesday 01 July 2015 11:10

Primary author: *BOSMAN, Gurthwin (Stellenbosch University)*

In the last decade, single molecule microscopy has become the technique of choice when sub-diffraction imaging is required [1]. Sub-diffraction imaging using optical microscopes requires that single molecule fluorescent markers be imaged stochastically (in techniques like stochastic optical reconstruction microscopy (STORM) or photoactivated localization microscopy (PALM)) or with very low concentrations such that only a small fraction of the emitters are imaged at any given time [2]. When combining the abovementioned techniques with point-spread function tailoring, three dimensional localization accuracies well below 50 nm are readily achieved [3]. In this presentation the fundamental requirements for achieving high localization accuracies with single molecule microscopy will be discussed. References:[1] B. Flier, et. al. Heterogeneous Diffusion in Thin Polymer-Films as observed by High-Temperature Single Molecule Fluorescence Microscopy; J. Am. Chem. Soc. 2012, 134, 480-488. [2] C. Galbraith, et al. Super-resolution microscopy at a glance; J Cell Sci. 2011, 124(10): 1607–1611.[3] S. Pavani, et. al. Three-dimensional, single-molecule fluorescence imaging beyond the diffraction limit by using a double-helix point spread function; PNAS 2009, 106(9), 2995-2999.

456 - Algebraic graphs vs. Kinematics graphs –CUT's First year physics students' dilemma

Edu - Wednesday 01 July 2015 11:50 *[For award: MSc]*

Primary author: PHAGE, Itumeleng *(Honorary)*
Co-authors: *LEMMER, Miriam (North-West University (Potchefstroom)); HITGE, Mariette (North West University, Potchefstroom C*

Studies have found that there area high failure and drop out rates of first year university student
investigate poor performance of first year students in physics and hence the causes of
was triggered by first year students' inability at Central University of Techno
require background knowledge and understanding in linear al
Rinzema, 2004). These students struggle to appl
would give in terms of the type of
implication or meaning of
with their re

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learning in high school the
relate kinematics graphs and equations
studies have proven that students come to the study
(McDermott, L.C. and Reddish E.F., 1999) and this could be a
e expected from them in class. The study investigated the perspectives of first
knowledge of, as well as their ability to solve, kinematics graphs and equations using the
previous or present linear algebra learning. The research also investigated the causes of students'
these concepts and what teaching strategies can be used to help remedy the students' inability, either from high
school background or tertiary learning.

458 - NON-SPECIALIST LECTURE: Accelerating light

Photonics - Wednesday 01 July 2015 11:30

Primary author: FORBES, Andrew *(U. Witwatersrand)*

In this non-specialist talk I will outline how to make light accelerate as it propagates. Using digital holograms to create and propagate structured light fields, I will illustrate linear acceleration with Airy beams and angular acceleration with vortex beams.

459 - PLENARY: 1,2,3 …. infinity: high-dimensional quantum entanglement with patterns of light

Plenary - Friday 03 July 2015 08:40

Primary author: FORBES, Andrew *(U. Witwatersrand)*

Photons can be described in terms of their spatial modes – the "patterns" of light. As there are an infinite number of spatial modes, entanglement in this degree of freedom offers the opportunity to realise high-dimensional quantum states. In this talk I will review the recent progress in quantum entanglement of photons in their spatial degree of freedom. I will explain how to create high-dimensional quantum states in the laboratory, how to measure them, and what the present state of the art is in terms of applications. In particular, I will outline the advantages and disadvantages of using such entangled states as a means to encode information for secure quantum communication channels, and will consider the preservation of entanglement through noisy channels, e.g., a turbulent atmosphere. Finally I will outline some ideas on mimicking quantum entanglement behaviour with classical light.

470 - PLENARY: Exploring the Solar System and Beyond: Some Recent Results

Plenary - Thursday 02 July 2015 12:10

Primary author: VAN ZYL, Jakob *(Jet Propulsion Laboratory, Cal. Inst. of Technology)*

Are we alone? For centuries humans have looked up at the night sky and wondered if there was another world like our planet out there. The sixteenth century Italian philosopher Giordano Bruno speculated that there could be multiple worlds like our own. But it was not until the first discovery in 1992 of two exoplanets orbiting a pulsar that we had definitive evidence of planets outside of our own solar system. In 1995 the first exoplanets orbiting a main sequence star, 51 Pegasi, were announced providing further evidence of planets orbiting stars outside of our own solar system. Finding planets outside of our own solar system, especially those orbiting within the so-called habitable zone of their parent star, raises the intriguing possibility that life may have evolved elsewhere. Recent developments in the study of our own solar system raises important questions about our model of where life may have evolved, with tantalizing evidence of liquid water and organic molecules present on some of the moons of Jupiter and Saturn.This talk will detail some of the recent results in our quest for understanding how planetary systems form and evolve, including where one might look for signs of life, both within our solar system and beyond.

471 - PUBLIC TALK: Exploring the Universe - The Search for Signs of Life

Plenary - Thursday 02 July 2015 19:00

Primary author: VAN ZYL, Jakob *(Jet Propulsion Laboratory, Cal. Inst. of Technology)*

Are we alone? For centuries humans have looked up at the night sky and wondered if there was another world like our planet out there. The sixteenth century Italian philosopher Giordano Bruno speculated that there could be multiple worlds like our own out there. But it was not until the first discovery in 1992 of two exoplanets orbiting a Pulsar that we had definitive evidence of planets outside of our own solar system. In 1995 the first exoplanets orbiting a main sequence star, 51 Pegasi, were announced providing further evidence of planets orbiting stars outside of our own solar system. Finding planets outside of our own solar system, especially those orbiting within the so-called habitable zone of their parent star, raises the intriguing possibility that life may have evolved elsewhere. Recent developments in the study of our own solar system raises important questions about our model of where life may have the chance to evolve, with tantalizing evidence of liquid water and organic molecules present on some of the moons of Jupiter and Saturn.This talk will detail the results in our quest for understanding where one might look for signs of life, both within our solar system and beyond.

472 - PLENARY: Status of Women in STEM in the US

Plenary - Wednesday 01 July 2015 12:10

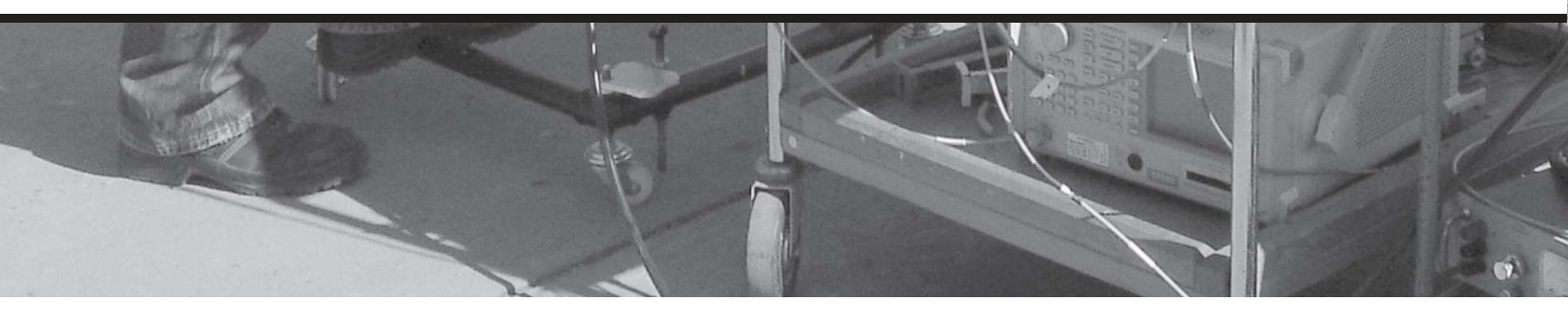
Primary author: FOLKS, Liesl *(University at Buffalo)*

Despite decades of effort to encourage and support the advancement of women and other under-represented groups in science, technology, engineering and math (STEM) disciplines in the USA, the pace of change has been frustratingly slow in many fields. The STEM workforce is largely white and male, despite widespread encouragement by business and government leaders for broader demographic participation. There have been local success stories that we can point to, but not the national shifts that would signal a sea change across STEM. In this presentation, I will present recent data on trends, along with commentary from experts who study demographic changes in the workforce. I will discuss the challenges we face in changing the cultural dialogue around gender and other diversity axes, and make recommendations for what we can aim to achieve collectively to redress the imbalances we observe.

Poster Abstracts

Book of Abstracts

POSTER PRESENTATIONS



3 - The unusually strong coronal emission lines of SDSS J1055+5637

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: D1.3)*

Primary author: *WINKLER, Hartmut (Dept. Physics, University of Johannesburg)*

Many Seyfert galaxies display weak 'coronal' emission features corresponding to [Fe VII], [Fe XI] and [Fe XIV] in their optical spectra, whereas elsewhere these seem to be entirely absent. These lines appear to highlight zones in the nucleus irradiated by high-energy photons. The presence of these zones and the conditions therein as determined by the relative line strengths and profiles impose important constraints on the physical models of active galactic nuclei, and Seyferts in particular. In 2009 the discovery was announced of the highly unusual spectrum of SDSS J0952+2143, where the coronal lines are exceptionally strong. This paper presents a second object with abnormally strong coronal features, SDSS J1055+5637. The spectrum, line ratios and related parameters are compared to those of SDSS J0952+2143, three AGN with moderate coronal lines and one where the coronal lines are missing altogether. Possible mechanisms are discussed that may account for the stronger than usual coronal features.

4 - pQCD Short Path Length correction to Energy loss formulae

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.4) [For award: MSc]*

Primary author: *KOLBE, Isobel (University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

In the heavy ion experiments at RHIC and the LHC, it is widely believed that a state of matter known as the quark-gluon plasma (QGP) has been produced. The so-called 'hard particles', or particles with very high momentum that are produced as a consequence of the asymptotic freedom of QCD, can be used as tomographic probes of the QGP. We study the way in which energy is dissipated in this QGP by calculating, in pQCD, corrections to the well-known energy loss formulae for short path lengths. This is necessary to address the discovery at the LHC that shockingly small systems appear to be exhibiting collective behaviour.

5 - Low cost empirical modelling to determine milk production in a dairy plant: A case study of Fort Hare Dairy Trust

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.5) [For award: PhD]*

Primary author: *MHUNDWA, Russel (Fort Hare Institute of Technology)*
Co-authors: *MEYER, Edson (Fort Hare Institute of Technology); SIMON, Michael (Fort Hare Institute of Technology); TANGWE, Stephen (Fort Hare Institute of Technology)*

Pasteurised milk constitutes for 51% of the liquid milk production in South Africa. This paper presents an overview of a dairy processing plant for pasteurised milk. A low cost empirical model is built and developed using the minimum measurable parameters to predict the desire output (quantity of the pasteurized milk produce) in a dairy plant. The mathetical model took into account the number of lactating cows per given milking time, the amount of raw milk produced and electrical energy consumption at Fort Hare Dairy Trust. The average ambient temperature and relative humidity were also determine for the various pasteurized milk period. Critical process temperatures for pasteurised milk production were monitored and electrical energy consumption measured using power and energy logging meter. The percentage cost of electrical power consumption for the production of pasteurised milk in relation to the cost of milk per litre is also presented. As a final point, a statistical test was conducted to determine the contribution of each of the predictors by weight of importance to the quantity of the pasturized milk produce. The findings from the empirical model will be used in future work on energy efficiency in the dairy sector. Key words: Empirical modelling, Energy efficiency, Pasteurisation, Predictors

12 - Investigation of the Energy Spectra of Even-Even Nuclei in the Lower Half of the sd - Shell

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.12)*

Primary author: *GBAORUN, Frederick (Benue State University, Makurdi, Nigeria)*
Co-authors: *FIASE, O. Joseph (Department of Physics,Benue State University, Makurdi, Nigeria.); IKYUMBUR, Jonathan (Department of Physics, Federal College of Education, Pankshing, Nigeria)*

The behavior of the energy spectra of even-even nuclei in the lower half of the sd-shell, particularly in the range 16<A<26 is examined using NUSHELL shell model code. The lowest order constrained variational technique is employed to generate two-body matrix elements in which tensor correlation function is incorporated. The matrix elements calculated are used as input data into the NUSHELL shell model code to calculate the energy spectra of these nuclei. It is observed that the spectral of these nuclei are compressed when tensor correlation function is removed from the two-body matrix elements, providing significant disagreement with experimental data. However, the energy spectra of these nuclei, when calculated with the presence of the tensor correlation function incorporated in the two-body matrix element, show reasonable expansion, and hence give astonishing agreement with experiment.

14 - Fluorescence behaviour of europium doped Gd2O3 nanosheets

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.14)*

Primary author: *PANDEY, Anurag (University of the free state)*
Co-author: *SWART, H. C. (University of The Free State)*

Gadolinium is an interesting material for luminescence investigation owing to its characteristics of serving both as host as well as a doping element for different application purposes. It gives a suitable environment for doping elements as a host and strong energy transfer characteristics when used as dopant. Numerous studies have been performed by researchers with lanthanides and/or transition metals doped/codoped gadolinium oxides for strong multicolor emissions via upconversion and downconversion processes. Various synthesis techniques have been adopted for producing gadolinium based nanomaterials in different size and shapes. Whereas the europium is among the best activators to observe fluorescence upon UV excitations that supports host sensitized emission in gadolinium based materials. The formation of sheet like structures and luminescent emission from the europium doped gadolinium oxide powder was the purpose of the study. Characterization techniques such as scanning electron microscopy, electron dispersive spectroscopy and X-ray diffraction have been used to confirm the structural information of the present material. The photoluminescence study showed strong red emission upon UV excitation from the nanosheets. The fluorescence spectroscopy involved is discussed and the purity of light emitted was checked by the calculated color coordinates corresponding to the emitted radiation.

18 - Does proficiency in units and measurements contribute towards success in first year university physics?

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.18)*

Primary author: *REDDY, Leelakrishna (University of Johannesburg)*
Co-authors: *OELOFSE, Jan (Member paid-up); NAIR, Padmanabhan (University of Johannesburg); RAMAILA, Sam (University of Johannesburg)*

Basic physics principles may be understood well if students are proficient in fundamental and derived units. A correlation between the two was investigated in Physics modules offered for Engineering and Health faculties at University of Johannesburg (UJ). The results from this investigation established a reliable correlation between the proficiency in units and measurement and their performance in theoretical and practical components of physics courses at UJ. The performance varied from modules to modules depending on the quality of students entering the university. This report has endeavored to provide us with some insight into the competence levels of students engaged in scientific enquiry.

19 - Exploring teaching-learning activity in large class groups

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.19)*

Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-authors: *REDDY, Leelakrishna (University of Johannesburg); NAIR, Padmanabhan (University of Johannesburg)*

Due to steadily increasing national matric pass rates over the last few years, teaching large groups of students has become a norm in higher education institutions as more and more students gain admissions. This article examines the complexities associated with the teaching-learning activity involving first year students in the National Diploma programs at the University of Johannesburg. Teaching-approach, the impact of audiovisual media; the availability and suitability of lecture venues, as well as the student-lecturer interactions were scrutinized. These insights provide interesting outcomes towards teaching and learning activity detailed in this article.

20 - Assessment of Physics practicals using a software-embedded and improvisation based scientifically efficient system

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.20)*

Primary author: *REDDY, Leelakrishna (University of Johannesburg)*
Co-authors: *NAIR, Padmanabhan (University of Johannesburg); RAMAILA, Sam (University of Johannesburg); OELOFSE, Jan (Member paid-up)*

Traditionally Physics practicals done at most universities are evaluated on the basis of a laboratory report which is bedeviled by a considerable amount of subjectivity. One of the drawbacks of laboratory report writing is that the learner needs to be language proficient in presenting the report in terms of interpretation and discussions of results which could ultimately affect the marks awarded for the experiment. This article elaborates on how the assessment of the practicals could be made scientifically efficient using software-excel rubric evaluation system, thereby avoiding report writing requiring language proficiency. The merit of the software based report evaluation is that it is precise with figures, graphs, drawings and calculations. The efficacy of the system is that large volumes of practicals are evaluated in the shortest possible time thereby allowing students to do more practicals per semester.

21 - Quality vs Quantity: the National Senior Certificate - a case study

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.21)*

Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-authors: *REDDY, Leelakrishna (University of Johannesburg); NAIR, Padmanabhan (University of Johannesburg)*

Experts believe that a country's global competitiveness and technological advancement is intrinsically linked to the performance of the students in the gateway subjects such as Mathematics and Physical Science at matriculation level. However, there has been a serious debate over the years about the quality of the National Senior Certificate results in relation to these subjects. There has been a steady quantity improvement in the pass rates of these subjects amidst quality concerns. The impact of such deliberations is most pronounced when analyzed in terms of input characteristics versus academic performance of students in Electrical Engineering, Homeopathy, Chiropractic and Analytical Chemistry diploma programs at the University of Johannesburg, which is the subject of this investigation.

22 - Global competitiveness as a barometer of scientific endeavor

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.22)*

Primary author: *RAMAILA, Sam (University of Johannesburg)*
Co-authors: *REDDY, Leelakrishna (University of Johannesburg); NAIR, Padmanabhan (University of Johannesburg)*

The competitiveness of a country can be quantified as a measure of the quality of its scientific outputs. Concerted efforts have been made globally by many scientists in a bid to elevate both quality and quantity of scientific outputs in the face of pervasive resource constraints. This article aims to provide a comparative analysis of scientific outputs in terms research publications and its interrelatedness to the number of Nobel laureates it produces. In keeping with these developments, a concomitant reflection of the key factors associated achievement level of scientific progress and technological development in selected counties has been the core thrust of this paper. These factors have been considered as critical parameters that underpin scientific progress and technological development.

30 - Vertically aligned silicon nanowires synthesized by metal-assisted chemical etching for photovoltaic applications

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.30) [For award: MSc]*

Primary author: *NGQOLODA, Siphelo (University of the Western Cape)*
Co-author: *CUMMINGS, Francious (University of Western Cape)*

One-dimensional silicon nanowires (SiNWs) are promising building blocks for solar cells as they provide a controlled, vectorial transport route for photo-generated charge carriers in the device as well as providing anti-reflection for incoming light. Two major approaches are employed to synthesize SiNWs, namely the bottom up approach during vapour-liquid-solid mechanism or the top down approach via metal assisted chemical etching (MaCE). MaCE provides a simple, inexpensive and repeatable process that yields radially and vertically aligned SiNWs in which the structure is easily controlled by changing the etching time or chemical concentrations. During MaCE synthesis, a crystalline silicon (c-Si) substrate covered with metal nanoparticles (catalyst) is etched in a diluted HF solution containing oxidizing agents. Since the first report on SiNWs synthesized via MaCE, various publications have described the growth during the MaCE process. However lingering questions around the role of the catalyst during formation, dispersion and the eventual diameter of the nanowires remain. In addition, very little information pertaining to the changes in crystallinity and atomic bonding properties of the nanowires post synthesis is known. As such, this study investigates the evolution of SiNWs from deposited metal nanoparticles by means of in-depth electron microscopy analyses. Changes in crystallinity during synthesis of the nanowires are probed using X-ray diffraction (XRD) and transmission electron microscopy (TEM). Deviations in the optical properties are quantified using reflectivity and absorption measurements, whereas the bonding configurations of the nanowires are probed by Raman and Fourier transforms infrared spectroscopy. Diameters of 100 – 300 nm vertical SiNWs were obtained from scanning electron microscopy with lengths changing with etching time (order of micrometres). Crystallinity remained unchanged as compared to the starting single crystalline Si wafer, findings confirmed by TEM and XRD analysis. These nanowires showed low reflection of less than 10% over visible range compared to an average of 30% for bulk Si.

34 - Determination of the band gap of AlGaN epilayers by FTIR reflectance spectroscopy

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.34)*

Primary author: *SEPHTON, Bereneice (NMMU)*
Co-authors: *MINNAAR, Ettienne (NMMU); ENGELBRECHT, Japie (NMMU); WAGENER, Magnus (NMMU)*

AlGaN alloys are used in high-power, high-temperature and high-frequency devices such as field-effect transistors, UV-light emitting LED's and laser diodes. Different electrical and optical properties can be obtained by varying the alloy composition of AlxGa1-xN by changing the amount of Al in the alloy. It is therefore essential to characterize the alloys to establish the various physical properties as a function of Al content. Optical characterization is preferred as this technique has the advantage of being non-contact and non-destructive. In this work, infrared reflection spectroscopy was employed to evaluate 5 AlxGa1-xN epilayers grown with varying Al content by metalorganic vapour phase deposition (MOCVD) on sapphire substrates. Samples were investigated using a Bruker V80 FTIR/Raman instrument, in the wavenumber range 50000 – 10 cm-1. Measurements were taken at room temperature at 8 cm-1 resolution, using a Pike 10Spec specular reflection attachment, taking 100 scans. The band gap of the respective samples is obtained from the obtained reflectance spectrum at the transition between the interference fringes and a straight line in the spectra. In addition, the thickness of the layers could be obtained from the interference fringes. Results obtained indicated that the band gap varied between 3.6 and 5.1 eV, while the epilyer thicknesses were between 0.9 and 1.3 ■m. The results corresponded very well with data obtained by techniques such as photoluminescence and growth parameters.

35 - Synthesis, Production and Tc-99m-DISIDA (N-2,6-diisopropylphenylcarbamoylmethyliminodiacetic) acid Scan

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.35) [For award: Hons]*

Primary author: *KWETANA, Musa Lonwabo (DST/NRF)*

Radiopharmaceuticals are compounds labeled with a radioactive isotopes that are used for studying different organs in the human body. Technetium-99m labeled iminodiacetic acid (IDA) derivatives are commonly used as hepatobiliary imaginary agents. The first iminodiacetic acid (IDA) derivative employed in nuclear medicine was 2,6-dimethylphenylcarbamoylmethyliminodiacetic acid (HIDA). The IDA agent of choice is DISIDA. A cold kit is a pre-prepared vial containing DISIDA and stannous chloride dihydrate as the reducing agent.DISIDA kits are commercially available. Labeling is accomplished by adding 99mTcO4- to the kit and mixing well with synthesis of DISIDA, Labeling and Quality control of DISIDA. The biodistribution DISIDA was confirmed performing a biodistribution study on a Chacma baboon. DISIDA scan is performed to visualize the gall bladder filling and emptying. Patients with pain in the right upper quadrant of the belly and or nausea may receive a DISIDA scan to evaluate the gall bladder.

37 - Spectral studies of flaring quasar PKS 1424-418 above 100 MeV with Fermi-LAT

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: D1.37) [For award: PhD]*

Primary authors: *DIRIRSA, Ferael (University of Johannesburg); BRITTO, Richard (University of Johannesburg); RAZZAQUE, Soebur (University of Johannesburg)*

Flat Spectrum Radio Quasar (FSRQ) PKS 1424-418 is an Active Galactic Nucleus (AGN) located at a redshift z = 1.522. This source has shown several flaring episodes through the whole electromagnetic spectrum in recent years. A series of four outbursts were detected and studied by the Hartebeesthoek Radio Astronomy Observatory (HartRAO) at four different frequency bands during the October 2012 till September 2013 period. Fermi-Large Area Telescope (Fermi-LAT), a space-based gamma-ray detector, is collecting all sky data since 2008. We present an analysis of Fermi-LAT data on PKS 1424-418 during a period coincident with the radio activity of this FSRQ detected by HartRAO. This study of the flaring pattern of PKS 1424-418 can provide interesting constraints related to the physics of the gamma-ray production in FSRQs.

41 - Radiation hardness tests on different plastic scintillator grades for the upgrade of the Tile Calorimeter of the ATLAS detector

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.41) [For award: MSc]*

Primary author: *LIAO, Shell-may (University of the Witwatersrand)*
Co-authors: *JIVAN, Harshna (University of the Witwatersrand); ERASMUS, Rudolph (University of the Witwatersrand); MELLADO, Bruce (University of the Witwatersrand); PELWAN, Chad (University of the Witwatersrand); PETER, Gerrard (University of the Witwatersrand); SIDERAS-HADDAD, Elias (University of the Witwatersrand); SEKONYA, Kamela (iThemba LABS); MADHUKU, Morgan (iThemba LABS)*

The ATLAS detector is a large particle detector constructed at the LHC at CERN and is responsible for detecting particles which arise from energetic p-p collisions produced by the LHC. The Tile Calorimeter is the central Hadronic calorimeter of the ATLAS detector and is responsible for detecting hadrons. The performance of the Tile calorimeter therefore has a direct impact on signatures involving hadrons, jets and missing transverse energy. Plastic scintillators are found within the Tile calorimeter of the detector and exhibit fluorescence when they interact with ionizing radiation. This, together with their high optical transmittance property makes them ideal for use within large particle detectors. However, the main problem encountered by the plastics is radiation damage and the increase in beam energies for Run II of LHC data taking implies that the scintillator tiles will be exposed to more radiation. The scintillator tiles within the Gap region of the Tile calorimeter's central and extended barrels, that is, the MBTS and Crack scintillators, will need to be replaced by more radiation hard scintillators. Thus, the effects of radiation on the light transmittance of different grades of plastic scintillators was studied experimentally. The radiation damage of polyvinyl toluene based plastic scintillators as well as polystyrene based scintillators was studied. The samples were cut into dimensions of 5 mm x 5 mm x 0.35 mm and irradiated using a 6 MeV proton beam provided by the Tandem accelerator of iThemba LABS, Gauteng. They were exposed to various doses of radiation ranging between 0.8 MGy and 80 MGy and SRIM simulations were done in order to guide the experimental procedure. Transmission spectra for the irradiated and unirradiated samples of each grade were obtained, observed and analyzed in order to perceive the effects of radiation damage on the different plastic scintillators.

46 - Reaction mechanisms studied using the iThemba LABS recoil detector

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.46)*

Primary author: *NTSHANGASE, Sifiso Senzo (University of Zululand)*
Co-authors: *BARK, Robert (iThemba LABS); SHARPEY-SCHAFER, John F (UWC); LAWRIE, Elena (iThemba LABS); LAWRIE, Kobus (iThemba LABS); PAPKA, Paul (Stellenbosch University); ROUX, David (Rhodes); MAJOLA, Siyabonga (UCT/ iThemba Labs); SHIRINDA, OBED (iThemba LABS); DINOKO, Tshepo (Student); MASITENG, Paulus (University of Johannesburg); BVUMBI, Suzan Phumudzo (University of Johannesburg); STANKIEWICZ, Maciej (University of Cape Town); LIEDER, Rainer (iThemba LABS); MULLINS, Simon (iThemba LABS (Gauteng)); ASCHMAN, David (University of Cape Town)*

The iThemba LABS recoil detector has been used to study exotic asymmetric shapes in Po and U isotopes. In these studies other reaction products which were not expected to be observed according to PACE (Projected Angular Momentum Coupled Evaporation) calculation were strongly populated. These products are as a result of other reaction mechanisms other than complete fusion reaction. The presentation will discuss the unexpectedly observed nuclei and the proposed reaction mechanisms leading to their creation.

57 - A density functional theory and magnetic resonance studies of radiation damage in plastic scintillators

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.57) [For award: MSc]*

Primary author: *PELWAN, Chad (University of Witwatersrand)*
Co-authors: *JOUBERT, Daniel (School of Physics, University of the Witwatersrand); DONGHO NGUIMDO, Guy Moise (University of the Witwatersrand)*

Plastic scintillators placed in particle detectors like the ATLAS detector in the Large Hadron Collider undergo structural damage when they interact with energetic particles they detect. This interaction causes damage to the optically active molecules responsible for the scintillation mechanism, affecting the efficacy of the plastic scintillator. In this study we attempt to understand radiation damage in plastic scintillators using a computational density functional theory (DFT) approach to interpret the results of Electron Paramagnetic Resonance (EPR) techniques. This should give insight into the structural damage within the plastic scintillator. Optical absorption and emission properties of the optically active molecules at the DTF, GW and BSE levels will be discussed and the electron hole interaction strength of excited states will be estimated. Calculated hyperfine parameters will be used in an attempt to interpret the width of the measured EPR signal.

59 - A quantification evaluation of the depth resolution of AES depth profiling data of Cu/Ni multilayer thin films using the MRI model

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.59) [For award: PhD]*

Primary author: *YAN, XinLiang (University of the Free State)*
Co-authors: *LIU, Yi (Shantou University, China); SWART, Hendrik (University of the Free State); WANG, Jiang-Yong (Shantou university,China) ; TERBLANS, JJ (Koos) (UFS)*

Auger electron spectroscopy (AES) in combination with ion beam sputtering is widely used for determination of the composition–depth profiles of thin films. The quality of this depth profiling can be characterized by the so-called depth resolution ΔZ , which defines the depth range to which a certain composition has to be assigned. [1] During AES sputter depth profiling of polycrystalline thin metal films, the surface roughening induced by the ion bombardment is the main source of the degradation of the depth resolution upon sputtering.[2] A depth profiles of as-deposited Cu/Ni multilayer thin film has been investigated using AES in combination with Ar+ ion sputtering. The Cu/Ni multilayer structures were deposited on a SiO2 substrate by means of electron beam evaporation in a high vacuum. The measured AES depth profiles of the as-deposited Cu/Ni multilayer is quantitatively fitted by the MRI model assuming that the roughness parameter linearly increased with the sputtered depth. The roughness values extracted from the depth profiling data fits, agree well with those measured by Atomic force microscopy (AFM). The depth-dependent depth resolution upon depth profiling of the as-deposited sample are quantitatively evaluated accordingly.References:[1] S. Hofmann, Surf. Interface Anal. 21 (1994) 673.[2] J.Y. Wang, S. Hofmann, A. Zalar, E.J. Mittemeije r, Thin Solid Films 444 (2003) 120.

62 - Characterization of Palladium (Pd) coated Titanium alloy (Ti6Al4V)

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.62) [For award: MSc]*

Primary author: *MOFOKENG, Jabulani (University of the Western Cape)*
Co-author: *SIBANYONI, Johannes (Ithemba labs)*

In the present work, we present on the changes obtained from as-deposited Palladium coating on Ti6Al4V alloy caused by thermal annealing. The coatings (0.2 µm Pd) were prepared by physical vapour deposition method and were thermally annealed at 1000 oC for 2 hours. The coatings were characterized by SEM, XRD, RBS techniques. The surface morphology analysis obtained from SEM micrograph showed the as-deposited sample surface having fine, dense and uniformly dispersion of Pd metal being deposited on Ti6Al4V alloy. The obtained XRD pattern depicted the specimen of titanium and palladium peaks indicating that there is no phase transition during the deposition process. The RBS results show the coated thickness of 0.23µm which is close to the intended thickness of 0.2µm. Simillar experiments will be conducted on as-deposited palladium coating on cp titanium in order to study and compare the changes in the coating thickness and diffusion rate.

63 - Thermoluminescence investigations in K3Ca2(SO4)3F:Dy phosphor

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.63) [For award: PhD]*

Primary author: *KORE, Bhushan (Department of Physics, UFS Bloemfontein, South Africa)*
Co-authors: *DHOBLE, N (RTM Nagpur University); DHOBLE, S (RTM Nagpur University); LOCHAB, S (Inter University Accelerator Center, New Delhi, India)*

There is an increasing demand for dosimetry of heavy ion beams as they are increasingly used for diagnostic and therapeutic purposes. The tumors and cancer close to sensitive tissues can be cured by this technique without any surgical operation. Therefore, there is a great demand of measuring doses/ fluences of such energetic particles with great precision and accuracy, especially, while dealing with human beings. Thermoluminescent dosimetry (TLD) phosphors can be best employed for this purpose, since TLD materials are used from the last five decades for measuring the fraction of radiations such as γ-rays,β -rays etc. present in environment or for the amount of radiation dose delivered to the patient during radiation treatment. K3Ca2(SO4)3F:Dy phosphor was prepared by co-precipitation method and a thermoluminescence (TL) study was carried out in detail. For TL study the prepared phosphor was irradiated by γ-rays from 60Co and a carbon (C5+) beam. The γ-rays irradiated sample possesses TL glow peaks at 107°C and 293°C, whereas those irradiated with carbon ion have glow peaks at 126°C and 343°C. In the case of γ-ray irradiated glow curves the intensity of lower temperature peak increased with dose whereas that of the higher temperature peak decreased relatively. Unlikely, in the case of carbon ion irradiated phosphor the intensity ratio remains same over a variation in dose. The present phosphor have nearly the same TL sensitivity as that of commercial CaSO4:Dy for γ- rays and a more TL sensitivity for the carbon ion beam. The phosphor was tested for its dose linearity over a wider range of doses.The observed glow curve variation and resultant variation in values of trapping parameters with a change in ion beam energy suggest more complex interactions of ion beam within the phosphor at higher energies.

65 - Metrology of Ultrasound and Underwater Acoustics at the National Metrology Institute of South Africa

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.65)*

Primary author: *TYALIMPI, Vumile (NMISA)*
Co-author: *KARSTEN, Aletta (NMISA)*

The National Metrology Institute of South Africa (NMISA) is responsible for realising and maintaining the SI and derived units. This is accomplished by developing and maintaining national measurement standards of physical quantities for South Africa and comparing them internationally to ensure global measurement equivalence and competitiveness. The Physical Metrology Division is one of the four divisions of NMISA, under which Ultrasound and Underwater Acoustics Laboratory (UA), part of the Acoustics, Ultrasound and Vibration section falls. The NMISA UA is responsible for the establishment, validation, maintenance and dissemination of ultrasound power and ultrasonic transducer standards. The ultrasonic power, measured in watts, is realised by means of a radiation force balance (RFB) which traces it back to the mechanical quantities (i.e. kilogram, meter and second). Transducer sensitivity, measured in volts per pascal, is realised by means of reciprocity methods in accordance with the International Electrotechnical Commission (IEC) 60688, and traces the quantities back to electrical and mechanical quantities (i.e. ampere, kilogram, meter and second). Sound propagation and measurement in water is applied to a variety of applications such as research, communication, medical and Non-destructive Testing (NDT). Such applications require transducers to be completely waterproof, corrosion resistant, electrically shielded and have a low level of self-generated noise especially for weak signal measurements. Transducers are often used continuously over long periods. This requires their characteristics such as sensitivity and frequency response to remain stable with time. Hence, these devices need regular calibration in accordance with the international standards (e.g. IEC 60565) to be traceable to national standards. The UA, guided by the NMISA vision, seeks to support the country's manufacturing, trade, people's quality of life and environmental protection by supporting hospitals and clinics, occupational and environmental health, local industries, and offshore marine activities.

71 - Determination of a neutron beam fluence energy distribution using multichannel unfolding code MAXED

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.71) [For award: MSc]*

Primary author: *SHILUVANE, Thulani (UWC)*
Co-author: *HERBERT, mark (uwc)*

Detail knowledge of fast neutron beams fluence energy distributions are crucial in nuclear applications like radiation protection and neutron radiotherapy for the treatment of cancer at nuclear research facilities, for example iThemba LABS because neutron interactions with matter are energy dependent. These neutron beams fluence energy distributions can either be measured or calculated. Experimental methods like time-of-flight, recoil spectrometry, threshold spectrometry and methods based on neutron moderation are used to measure neutron beams fluence energy distributions. The time-of- flight method is the most reliable and accurate method. However, in situation where the time-of-flight method cannot be applied, for example in water phantom (simulating human tissue) where the neutron flight path due to scattering is unknown, neutron fluence energy distributions are obtained from pulse height distributions by unfolding with unfolding codes that includes Gravel HEPRO, MAXED, FRUIT and many others.In this work neutron beams of energy ranging up to 64 MeV were produced at the iThemba LABS neutron time-of-flight facility by bombarding a 66 MeV proton beams onto either a Li-target or a Be-target or a C-target. Pulse height distributions of the neutron beams in air were measured and unfolded into neutron fluence energy distributions using the unfolding code MAXED. Preliminary results obtained for the Be-target will be presented and discuss.

72 - Simulation of quasi-mono-energetic neutron beam fluence energy distributions at the iThemba LABS time-of-flight facility

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.72) [For award: MSc]*

Primary author: *NENGUDZA, Azwidovhiwi Emmanuel (University of the Western Cape)*
Co-authors: *HERBERT, Mark (University of the Western Cape); ESAU, Andrew (Department of Health)*

Many applications in nuclear physics require detail knowledge of fast neutron beams fluence energy distributions because neutron interactions with matter are energy dependent. For example, in radiotherapy for the treatment of cancer, radiation protection and calibration of detectors used for dose monitoring in space and air-crafts at research facilities such as iThemba LABS. Determining neutron beams fluence energy distributions pose a challenge. In principle, neutron beams fluence energy distributions can either be measured experimentally or calculated using Monte Carlo methods.Monte Carlo codes are useful tools for the design and optimizing the neutron beam delivery system as well as neutron beams fluence energy distributions of the targets at nuclear research facilities such iThemba LABS time-of-flight facility. At iThemba LABS, fast neutrons are produced by bombarding different targets with proton beams of energy ranging up to 200 MeV.This paper reports on work done using the Monte Carlo code MCNPX to simulate quasi-mono-energetic neutron beam fluence energy distributions produced at the iThemba LABS time-of-flight facility. Preliminary results of neutron beam fluence energy distributions for a Li-target produced by incident proton beams of 66 MeV and 100 MeV on the Li-target will be presented and discussed.

73 - Influence of alkaline earth metal cations; Ca^{2+}, Sr^{2+} and Ba^{2+} on the structural and optical properties of MAl_2O_4: Eu^{2+}, Nd^{3+} phosphors.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.73) [For award: PhD]*

Primary author: *WAKO, ALI HALAKE (University of the Freestate)*
Co-authors: *DEJENE, Francis (University of the Free State); SWART, Hendrik (University of the Free State)*

Eu^{2+} doped and Nd^{3+} co-doped MAl_2O_4:Eu^{2+}, Nd^{3+} (M = Ca, Sr, and Ba) phosphors were prepared by a solution-combustion method. XRD analysis depicts a monoclinic phase for $CaAl_2O_4$:Eu^{2+}, Nd^{3+} and $SrAl_2O_4$:Eu^{2+}, Nd^{3+} and a hexagonal structure for $BaAl_2O_4$:Eu^{2+}, Nd^{3+} phosphor. SEM results showed generally agglomerated particles with non-uniform shapes and sizes with irregular network structures having lots of voids and pores. PL revealed broadband spectra corresponding to the $4f^7$-$4f^65d^1$ absorption and emission of Eu^{2+}.Sharp emission lines were observed at 612 and 652 nm for $CaAl_2O_4$:Eu^{2+}, Nd^{3+}, at 615 nm for $SrAl_2O_4$:Eu^{2+}, Nd^{3+} and at 610 nm for $BaAl_2O_4$:Eu^{2+}, Nd^{3+} arising from the f-f transitions of the Eu^{3+} ions. The differences in emissions arise from the crystal field splitting of the 5d electron shell due to the changes in the crystalline environment of the Eu^{2+} ions caused by the substitution of the divalent alkaline earth metal cations in the host lattice.UV-VIS spectra showed absorption edges at 330,342 and 340 nm in agreement with the observed PL excitation peaks.

79 - An overview of the mainstream mechanics first year module at the University of the Western Cape and students experiences of the module

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.79) [For award: MSc]*

Primary author: *TANCI, Sinovuyo (Student)*
Co-author: *HERBERT, Mark (University of the Western Cape)*

The paper reports on a study in the Physics Department at University of the Western Cape(UWC) to promote positive attitude towards learning physics in a mixed ability physics mainstream mechanics first year class. The mainstream physics module centers its focus on improving students' attitude towards learning physics by giving them epistemological access to the study of physics. Central to the modules 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 cognitive 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 onlearning as participation and identity development. An overview of the mainstream mechanics module curriculum, pedagogical practice arnd learning environment as well as the preliminary results of a survey of students' experiences of the module will be presented and discussed.

81 - Propagation of cylindrical vector beams through fibres

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.81) [For award: MSc]*

Primary author: *NDAGANO, Bienvenu (University of the Witwatersrand)*
Co-authors: *MCLAREN, Melanie (University of the Witwatersrand); FORBES, Andrew (CSIR)*

Light carrying orbital angular momentum (OAM) has been investigated for the past 20 years. The optical field of beams carrying OAM has been shown to be quantized; defining an infinite dimensional Hilbert space. As such there is an infinite amount of information that can be encoded onto such beams. We demonstrate techniques to generate OAM carrying beams using spatial light modulators (SLMs), where the phase and amplitude are modulated. We also make use of an SLM to detect the amount of OAM present in a beam by spatial correlation filtering, also known as mode decomposition. Lastly, we investigated the effect of propagating these OAM modes through an optical fibre. Fibres have the advantage of being efficient for long distance communication and are not susceptible to atmospheric turbulence, which impedes the propagation of OAM beams. Optical Fibres possess intrinsic modes, known as the cylindrical vector (CV) modes. These modes display azimuthal symmetry in both field distribution and polarisation. We show that the polarisation and OAM density of the CV modes is preserved through the fibre and that the OAM and polarisation are non-separable before and after the fibre.

82 - Calculation of the contribution of core states in CdF2 to the electron-positron annihilation momentum density using generalized gradient approximation.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.82)*

Primary author: *JILI, Thulani (University of Zululand)*
Co-authors: *SIDERAS-HADDAD, Elias (Witwatersrand University); WAMWANGI, Daniel (Witwatersrand University); MADHUKU, Morgan (iThemba LABS)*

Calculations of high momentum components (HMC) in various atomic structures using generalized gradient approximation (GGA) and local density approximation (LDA) have become a prominent tool in positron-electron annihilation momentum density analysis. In the present work we investigate positron-electron annihilation momentum density using GGA. LDA approximation is also employed as a comparison between the two approximations. The probability that 2p electrons in fluorine, with momentum less than 4 mrad, annihilate with positrons is higher than in cadmium. Cadmium 4d electrons dominate the electron-positron annihilation momentum density between 4.3 mrad to well over 40 mrad with 4s electrons dominating in the momentum range between 23.75 mrad and 31.16 mrad. Annihilation rates calculated in the LDA and GGA are found to differ considerably. The difference is discussed at length. The bulk correlation energies for positrons are found to be -9.052 eV (-0.665 Ry) and -8.374 eV (-0.603 Ry) in the LDA and GGA, respectively.

89 - Thermoluminescence (TL) study of β-stimulated $BaAl_2O_4$:Eu^{2+},Dy^{3+} phosphor

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.89) [For award: PhD]*

Primary author: *WAKO, ALI HALAKE (University of the Freestate)*
Co-authors: *DEJENE, Francis (University of the Free State); SWART, Hendrik (University of the Free State); KIPROTICH, Sharon (University of the Free State)*

Thermoluminescence (TL) properties of beta irradiated Eu^{2+} doped and Dy^{3+} co-doped barium aluminate $BaAl_2O_4$:Eu^{2+},Dy^{3+} have been studied. The $BaAl_2O_4$:Eu^{2+},Dy^{3+} phosphors were prepared using solution - combustion synthesis method at initiating temperature of 500^oC technique using urea (CH_4N_2O) as a reducing agent and $Ba(NO_3)_2$, $Al(NO_3)_3.9H_2O$, $Eu(NO_3)_3.5H_2O$ and $Dy(NO_3)_3$ as raw materials. The electron-trapping properties in terms of TL glow curves are reported. The TL intensity was recorded for different beta (β) doses at different heating rates and was observed to increase with increasing β dose. The influence of repeated measurements on the same sample on peak temperature and TL intensity was also investigated so as to ascertain its repeatability and stability. Different kinetic parameters like activation energy (E), frequency factor (S) and geometrical factor were calculated by different methods including initial rise, variable heating rate and peak shape methods.

91 - Radiation Shielding Calculation using FLUKA transport code for Radiactive-ion Beam Facility at iThemba LABS.

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.91) [For award: MSc]*

Primary author: *MANTENGU, Nkanyiso Robert (University of Zululand)*
Co-authors: *BARK, Robert (iThemba LABS); MALEKA, Peane (iThemba LABS); NTSHANGASE, Sifiso (University of Zululand)*

Most ion-beams used in physics are stable, that is, they are comprised of atoms that occur naturally. However, in both nuclear and material science, increasing attention is being paid to using artificially produced, radioactive atoms to form an ion beam. One method of producing Radioactive-Ion Beams (RIBS) is the Isotope Separation OnLine (ISOL)method. In this method, a beam from a primary driver accelerator impinges on a RIB production target. By heating the target, the reaction products evaporate out of the target material, migrate down a tube to a region where they are ionized and extracted using a HV potential.iThemba LABS is planning to build a Radioactive-Ion Beam ISOL facility, by buying a second cyclotron in a project estimated to cost around R1000 M. As a first step, it will use the existing accelerator to produce low-energy radioactive beams in a R25M project to build a RIB target/ion-source test facility.The target will be placed in a shielded vault, as it will produce a large flux of radiation which must be attenuated for safe operation. Since the design of the vault has changed, new radiation safety calculations must be performed for the vault. Furthermore, neutrons emitted from the targetwill "activate" the surrounding material. This induced radioactivity is also a hazard and must also be calculated. The ideal computer code to simulate shielding and activation is FLUktuierende KAscade(FLUKA), which is a fully integrated particle physics MonteCarlo simulation package. It has many applications in high energy experimental physics and engineering, shielding, detector and telescope design, cosmic ray studies, dosimetry, medical physics and radio-biology.So FLUKA will be used in this project to calculate shielding requirements and the level of activation of the surrounding material.

97 - XRD and AFM studies of graphene and single-walled carbon nano tube

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.97)*

Primary authors: *SHAI, Moshibudi (University of limpopo); RAMMUTLA, Erasmus (university of limpopo)*
Co-author: *MOSUANG, Thuto (university of limpopo)*

Graphene and single-walled carbon nanotubes were studied using X-ray diffraction (XRD) and atomic force microscopy (AFM). The lattice constants for both materials were determined and agree well with our computational calculation results. When preparing carbon nanotubes for AFM characterization, three solvents chloroform, toluene and ethanol were used. Chloroform was found to be the best solvent. The diameter of single-walled carbon nanotubes were determined and agree well with literature.

101 - Isolation and characterization of carbon nanoballs and nanofibers from an internal combustion (I.C) engine

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.101)*

Primary author: *PARASHAR, Vyom (University of Johannesburg)*
Co-authors: *REDDY, Leelakrishna (University of Johannesburg); NGILA, Jane Catherine (University of Johannesburg); KUMAR, Neeraj (University of Johannesburg)*

The emissions of particulate matters exhaust from engines have receive much concern from the general public and environmental researchers. Moreover, increased exposure to elemental carbon and gases from fuel combustion was associated with impaired growth of lung function and long-standing severe asthma in children. Further, researchers have identified that humans and environmental systems are increasingly being exposed to nanomaterials like C60; carbon nanotube (CNT). The carbon nanoballs have a broad distribution of size 5 nm to 150 nm. Whereas, the carbon nanofibers have diameter of 500 nm with lengths exceeding 10 microns. Therefore we sought to investigate the presence of carbon nanomaterials in I. C. engine exhaust. Interestingly we observed the presence of carbon nanoballs and nanofibers which were further characterized using XRD (X-ray diffraction), SEM (scanning electron microscope) and AFM (atomic force microscope). Our results suggest that presence of carbon nanomaterials in exhaust system might burden the environment and health.

102 - Reaction rates determination using Monte Carlo simulations for the Bi target at 90 MeV neutron energy.

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.102) [For award: MSc]*

Primary author: *LAMULA, Thobeka (University of Zululand)*
Co-authors: *NTSHANGASE, Sifiso (University of Zululand); MALEKA, Peane (iThemba LABS); NCHODU, Rudolph (iThemba LABS); NDLOVU, Ntombizikhona Beaulah (Stellenbosch University)*

The iThemba LABS neutron beam facility (D-line vault) can produce quasi mono-energetic neutron beams in the energy range 30 - 200 MeV using lithium (Li) or beryllium (Be) targets, i.e. (p, n) reactions. Recently, various foils were activated at the neutron beam facility using 90 and 140 MeV neutrons and are currently being analysed using gamma-ray spectroscopy method. These measurements campaign are part of the study to improve and extend the International Reactor Dosimetry Fusion File (IRDFF) evaluated cross-section library. Contribution from iThemba LABS will add to the library the high threshold reactions (n, 3-6n) with cross sections peaks located between 40 and 200 MeV to meet the requirements of the higher energy nuclear installations. In parallel with the gamma-ray spectra analysis, studies using Monte Carlo simulations are being conducted to determine the reaction rates in all target materials used. The main aim of these investigations is to examine the dominant and competing reactions possible at these high neutron energies. For this contribution, reaction rates calculated using Monte Carlo simulations for ^{209} Bi(n,x) reactions with 90 MeV neutrons will be presented.

105 - Diamond -like carbon (DLC) thin films:Synthesis and investigation

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.105) [For award: PhD]*

Primary author: *MBIOMBI, WILFRED (WITS UNIVERSITY)*
Co-authors: *BHEKUMUSA, MATHE (WITS UNIVERSITY); WAMWANGI, DANIEL (WITS UNIVERSITY); BILLING, DAVE (WITS UNIVERSITY)*

Diamond-like carbon (DLC) thin films are becoming increasingly important in many industrial applications, including wear-resistant coatings for hard-disk drives and optical components, as well as in semi-conductor devices. In this work we seek to establish the correlation between the structural and electronic properties of DLC based on the zone structure model through variation of the sp2 composition. Thin films of DLC were grown by RF Sputtering methods in argon atmosphere at different power starting from 100 W to 200 W and DC sputtering power (100 W to 600 W) based on the structure zone model. The physical, electronic and electrical properties of diamond like carbon thin films were investigated using the Raman spectroscopy at laser excitation energy 488nm and voltage (V) - current (I) relationships. Furthermore X-ray Reflectometry and grazing incidence X-ray diffraction have been used to determine the density, growth rate and structure of thin DLC films.

106 - Influence of a buffer layer on the electrical properties of ZnO/Si heterojunction

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.106) [For award: PhD]*

Primary author: *TANKIO DJIOKAP, Stive Roussel (Nelson Mandela Metropolitan University)*
Co-authors: *URGESSA, Zelalem N. (NMMU); MBULANGA, Crispin (NMMU); BOTHA, Johannes Reinhardt (NMMU)*

As a wide band gap semiconductor, zinc oxide (ZnO) has attracted a great deal of attention because of the desire to fabricate, for example, efficient ultraviolet light-emitting diodes. ZnO is also of interest because it exhibits a large exciton binding energy of 60 meV, allowing exciton-governed light emission at room temperature. Up to now, light emission from ZnO homojunctions is difficult to achieve due to the lack of stable p-type doping. This difficulty has prompted researchers to focus on p-n heterojunctions with different substrates, among them silicon (Si), which is cheaper and readily available. The two main problems of using Si as the p-side of the junction are lattice mismatch and the nature of the band offsets. The problem of band offset arises from the type II staggered band alignment between ZnO and Si. This results in a large valence band offset and a small conduction band offset, causing electron-hole (e-h) recombination on the Si-side of this type of junction. It is believed that efficient electroluminescence from ZnO light emitting diodes will be achieved by inserting a barrier layer, which can simultaneously confine electrons in the ZnO region and allow the holes in the Si valence band to be injected into the ZnO side during forward bias, so that the recombination happens in the ZnO. Aluminium nitride (AlN), magnesium oxide (MgO) and nickel oxide (NiO) have been used to study the effect of a barrier layer on the electrical properties of the device . Their influence as well the effect of barrier layer thickness is discussed in detail.

118 - Impact of dose rate on radiation damage of plastics scintillators for the Tile Calorimeter of ATLAS.

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.118) [For award: 3rd]*

Primary author: *TLOU, Sijiye (University of the Witswatersrand)*
Co-authors: *JIVAN, Harshna (University of the Witwatersrand); MELLADO, Bruce (University of Wisconsin - Madison); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); MADHUKU, Morgan (iThemba LABS); ERASMUS, Rudolph (University of the Witwatersrand); SEKONYA, Kamela (iThemba LABS (Gauteng))*

ATLAS (A Toroidal LHC Apparatus) is a particle physics experiment at the Large Hadron Collider at CERN that is involved in the search of new particles through the head-on collisions of protons of extraordinarily high energy. The Tile Calorimeter (TileCal), the central section of the hadronic calorimeter of the ATLAS experiment, detects hadrons, jets and taus and measures the missing transverse energy. TileCal is built of steel and scintillating tiles, which were chosen due to their properties of high optical transmission. Plastic scintillators suffer radiation damage due to the highly ionising nature of the particles to be detected. The effects of radiation dose rates on the light transmission properties of two different types of scintillators were investigated. The two different types of plastic scintillators were the EJ208, which was provided by ELJEN technologies and the Protvino samples, which was sourced from the Tile calorimeter of the ATLAS detector. Twelve small square samples (5mm by 5mm) from each plastic scintillator went through light transmission testing before and after being irradiated. The radiation of the samples took place at the Tandem accelerator of iThemba LABS in Gauteng. Samples were irradiated to a dose of approximately 1 Mega Gray with dose rates of approximately 50 Gray/s, 150 Gray/s, 750 Gray/s and 3kGray/s. The results obtained generally showed slight differences in the transmittance spectra of the irradiated and unirradiated samples. These preliminary results will be presented in a poster.

120 - Viability of map-reduce algorithms for the measurement of Higgs boson properties with the ATLAS detector at the LHC

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.120) [For award: MSc]*

Primary author: *O'CONNELL, Sheena (University of the Witswatersrand)*

With the discovery of a Higgs boson in 2012 the focus has shifted towards the study of its properties and the search of new physics via the measurement of its couplings. This results in the manyfold increase of data volumes compared to those used for the discovery. This introduces significant overheads to data analyzers, reducing their efficiency in producing physics results. The problem of processing batch data collected during higgs to gamma gamma decay events is particularly suited to map reduce. The general algorithm followed during examination of such events is examined; the suitability of the map-reduce paradigm with regard to this specific problem is detailed; Hadoop, an open-source tool designed specifically for executing map-reduce programs on computer clusters, is described in brief; and an argument is made that Hadoop and its ecosystem are in general well-suited to a large class of computational problems within the domain of experimental high energy particle physics.

122 - Effect of temperature annealing on 4H-SiC Schottky barrier diodes after alpha-particle irradiation at high fluences

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.122)*

Primary author: *OMOTOSO, Ezekiel (University of Pretoria)*
Co-authors: *MEYER, Walter (University of Pretoria); AURET, Danie (University of Pretoria); DIALE, Mmantsae (University of Pretoria)*

Aim of the work is to study the effect of room temperature annealing on the deep level emanated after bombarding 4H-SiC Schottky diodes with 5.4 MeV alpha-particles at fluence of 9.2 × 10^(11) particles-cm^(–2). The investigation was carried out by means of current-voltage and capacitance-voltage characteristics in 300 K temperature, and deep level transient spectroscopy in temperature range of 25 – 350 K. The dependence of ideality factor, Schottky barrier height and free carrier concentration were investigated as a function of radiation fluence was determined. Ideality factor increases with radiation fluence. But, Schottky barrier height and free carrier concentration decrease with radiation fluence. The activation energy and apparent capture cross section of the new defect introduced were determined to be 0.37 eV and 5.5 × 10^(–16) cm^(2), respectively. This new defect annealed out at room temperature after one week.

127 - Surface characterisation of ZnO nanorods grown by Chemical Bath Deposition on Si substrate

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.127) [For award: MSc]*

Primary author: *MBULANGA, Crispin (Nelson Mandela Metropolitan University)*
Co-authors: *URGESSA, Zelalem N. (NMMU); TANKIO DJIOKAP, Stive Roussel (Nelson Mandela Metropolitan University); BOTHA, Johannes Reinhardt (NMMU); SWART, Hendrik (University of the Free State)*

There is a growing interest in quasi-one-dimensional ZnO nanostructures (e.g. nanorods, nanowires, nanobelts and nanotubes) considered as potential candidates for application such as gas sensors, biosensors, nanolasers, optical waveguides and light emitting diodes. However, nanostructured materials have a large surface-to-volume ratio compared to bulk-like material that amplifies surface related effect in many ways. For optoelectronic applications such as light emitting diodes and solar cells, surface states in the band gap can lead to technical challenges. Therefore, it is important to investigate the complete chemical composition of ZnO, the surface stoichiometry and identify the chemical origin and the nature of surface recombination centres in ZnO nanostructures. In this work, we report on the surface characterization of solution grown ZnO nanorod arrays (ZNAs) by Time of Flight Secondary Ion Mass Spectroscopy (TOF-SIMS), X-ray Photoelectron Spectroscopy (XPS) and Auger Electron Spectroscopy (AES).X-ray diffraction and SEM analysis revealed that as-grown nanorods are well-aligned with the c-axis approximately perpendicular to the substrate and have good crystalline quality. TOF-SIMS revealed species such as hydrogen, hydroxyl groups, and zinc hydroxide to be the most abundant near the surface, but less abundant in the bulk. Annealing caused a complete out-diffusion of H (and OH) from the near surface but not from the bulk region. XPS and AES supported the above TOF-SIMS observations. From XPS results, the near surface region has been found to be ~30 nm in width. Finally XPS and AES showed also that the near surface region of as-grown ZNAs are Zn-rich and that annealing in an oxygen environment reduces the activation rate of oxygen vacancies at elevated temperatures (~600 oC).

128 - Effect of Background gas and substrate temperature on ZnO:Zn thin films

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.128) [For award: MSc]*

Primary author: *HASABELDAIM, Emad (UFS)*
Co-author: *SWART, Hendrik (University of the Free State)*

The dependence of the structural and optical properties of ZnO:Zn thin films deposited by Pulsed laser deposition on the preparation conditions has been investigated. All the films showed highly c-axis orientation, and their crystallinities were improved with an increase in the substrate temperature. The stress in the thin films was varied (-12.7 to -7.30GPa) according to the chamber atmosphere gas.The minimum value was obtained in the case of the Oxygenbackground gas. The optical bandgap varied from 3.12 to 3.19 to 3.20eVwith changing the deposition chamber gas from Argon – Vacuum to Oxygen, respectively, it also varied from 3.14 to 3.20eV in the case of the variation in the substrate temperatures from 200 to 400 °C. The thin films obtained in the Oxygen atmosphere showed strong photoluminescence emission around the orange region(627nm), while a weak emission around 450 and 753nm was observed for the Argon atmospherefilm and ultra violet emission (UV) was obtained for all deposition conditions. These ZnO:Zn thin films may be used in the design, simulation and fabrication of optoelectronics devices such as white light emitting diode and sensor/actuator in hard disk drives.

129 - Calibrating the 8000M Ball Miller Using Anatase and Rutile Titania Nanoparticles

Poster1 - Tuesday 30 June 2015 16:10

Primary author: *MALINDISA, Ramokone (University of Johannesburg)*
Co-authors: *RAMMUTLA, Erasmus (University of Limpopo); NUBI, Olatunbosun (University of Limpopo)*

Titanium dioxide nanopowders were synthesized using the sol-gel method and dried at 100^{o}C. Portions of the powder were annealed at 300^{o}C and 800^{o}C to obtain the anatase and rutile phases of TiO_2 respectively. The samples were then ball-milled for various time periods ranging from 1 hour up to 14 hours using the stainless steel vial set. X-ray diffraction characterization technique was performed on the samples in order to determine the crystallite sizes. The sizes of the anatase samples were found to increase slightly as milling time increased. On the other hand, the reduction in the crystallite sizes of the rutile powders with increasing milling time were observed to follow a 3rd order polynomial trend. The results were used in constructing calibration functions for the 8000M ball miller.

130 - Experimental evaluation of emission models from a thermal evaporation source

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.130)*

Primary authors: *CRONJE, Shaun (UFS); ROOS, Wiets (University of the Free State); KROON, Ted (University of the Free State)*

Thermal evaporation is a well-known phenomenon used to produce metallic thin films for many industrial and research applications. Generally the focus is not on the evaporation rate, but the deposition rate which can be measured using a quartz crystal microbalance (QCM). In this study the interest is in the evaporation process, for which well-known models such as the Hertz-Knudsen equation exist but are not always accurate. A novel approach was developed to use the deposition rate on a QCM to study the evaporation flux from a surface. This requires a model for the angular distribution of evaporating atoms in order to link the measured deposition rate to the evaporation rate. The literature generally assumes a point source with a $\cos^{n}\theta$ angular dependence and n = 0, 1, 2 corresponding to isotropic emission, cosine emission associated with Knudsen effusion cells and more directed emission, respectively. To measure low evaporation rates the model considers evaporation from a surface placed so clos e to the QCM that the assumption of a point source is questionable. Since a treatment of the evaporation rate from an extended source was not found in literature, a model was developed by treating the extended surface as many point sources and integrating numerically using MATLAB software. The fraction of evaporated atoms incident on the QCM for point and extended circular sources for$n$ = 0, 1 and 2 are compared. The results also predict how the deposition rate should change with the distance between source and QCM. This is compared to data measured for the evaporation of antimony from a custom designed resistance heater in an ultrahigh vacuum environment to determine the most suitable emission model.

131 - Thermodynamic properties of NdCu4Au

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.131) [For award: PhD]*

Primary author: *BASHIR, Aiman (university of western cape)*
Co-authors: *TCHOULA TCHOKONTE, Moise Bertin (Department of Physics, University of the Western Cape); STRYDOM, Andre (University of Johannesburg); BRITZ, Douglas (UJ)*

The studies of magnetic susceptibility, χ(T), magnetization, σ(μ0H), and specific heat, Cp(T), of the new antiferromagnetic (AFM) NdCu4Au compound are reported. The room temperature X-ray diffraction analysis indicates a cubic MgCu4Sn – type crystal structure with space group F-43m (No. 216) for the NdCu4Au. The field cooled (FC) and Zero-field cooled (ZFC) dc χ(T) data show a coincide which suggest no evidence of an inhomogeneous magnetic ground state in this compopund as a result of spin – glass – like state. The low temperature χ(T) data shows an AFM - like anomaly associated with a Néel temperature TN = 3.9 In the paramagnetic, χ(T) data follows the Curies – Weiss law with an effective magnetic moment μeff = 3.42(2) μB and a paramagnetic Weiss temperature θp = −6.96(6) K. The value obtained for μeff is close to the value of 3.62 μB expected for the free Nd3+ - ion. σ(μ0H) data shows a linear behaviour up to 7 T in the paramagnetic region at T = 10 K and deviation from linearity above 2.5 T in the ordering region at T = 2 K characteristic of metamagnetic behaviour. Cp(T) data confirm AFM phase transition at TN = 3.5 K close to 3.9 K observed in χ(T) result. The 4f – electron specific heat shows a Schottky – type anomaly around 25 K with energy splitting Δ1 = 14.5(4) K and Δ2 = 63(1) K of the Nd3+ (J = 9/2) multiplet, that are associated with the first and second excited state of the Nd3+ - ion. The 4f – electron entropy reaches the value of Rln2 close to the TN at 4.2 K and saturates at the value of Rln(2J+1) at T = 70 K.

134 - The surface structure and interfacial reaction analysis of W in 6H-SiC

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.134)*

Primary author: *THABETHE, Thabsile (university of pretoria)*
Co-authors: *HLATSHWAYO, Thulani (Physics Department University of Pretoria); NJOROGE, Eric (University of pretoria); MALHERBE, Johan (University of Pretoria)*

Tungsten thin film was deposited on bulk single crystalline 6H-SiC substrate and annealed in vacuum at temperatures ranging from 500 to 1000 ºC for 1h. The resulting solid state reactions (phase composition) and surface morphology were investigated by Rutherford backscattering spectroscopy (RBS), grazing incidence X-ray diffraction (GIXRD), scanning electron microscopy (SEM) and atomic force microscopy (AFM). The RBS spectra were simulated using the RUMP software in order to obtain the deposited layer thickness, reaction zone compositions and reaction zone thickness. The as-deposited spectra fitted well with those annealed at 500 and 600 °C. This indicated that there was no reaction taking place at these two temperatures. At temperatures of 700 °C and above, W reacted with the SiC substrate and formed a mixed layer of carbide and silicides. XRD was used to identify the phases present and to confirm the RBS results. WC and WSi2 were the initial phases formed at 700 ºC. At 800 and 900 ºC, additional carbide and silicide phases (that is W2C and W5Si3) were also present; while at 1000 ºC, tungsten carbide with different compositions together with both the silicides were present. The SEM images of the as-deposited, 500 ºC and 600 ºC annealed samples showed uniform granular surface of W. The W layer became heterogeneous during annealing at higher temperatures as the W granules agglomerated into island clusters at temperatures of 800 ºC and higher.

135 - Understanding double Higgs boson production with vector boson fusion with the ATLAS detector at the LHC

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.135) [For award: Hons]*

Primary author: *MOLUPE, Tshidiso (University of the Witwatersrand)*

The discovery of the Higgs boson on 4 July 2012 was one of the most monumental discoveries in particle physics. The discovery of a scalar Higgs boson in nature confirmed the existence of the Higgs field, which permeates throughout space. The Higgs field is responsible for giving mass to elementary particles that interact with it. The Higgs boson is created by spontaneously breaking the symmetry of the Mexican hat potential, resulting in a Higgs self-coupling term, which leads to double Higgs production. There are various production mechanisms for the Higgs boson, with vector boson fusion as one of the most important production mechanisms for the Higgs boson. In proton collisions at the Large Hadron collider at CERN, vector boson fusion happens when quarks from each one of the two colliding protons radiate W or Z bosons that subsequently interact or "fuse" to produce a Higgs boson. I am studying the kinematics of double Higgs production via vector boson fusion.

137 - Density Functional Theory on a Lattice: Particle Number Dependence of the Exchange-Correlation Potential.

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.137) [For award: PhD]*

Primary author: *KOSSI, Amouzouvi (University of the Witwatersrand)*
Co-author: *JOUBERT, Daniel (University of the Witwatersrand)*

In Kohn-Sham Density Functional Theory, the interacting system is mapped onto a fictitious independent particle system. In an ensemble continuous particle number formulation the exchange-correlation contribution to the potential of the independent particle system has a discontinuity as a function of particle number at integer particle numbers. This discontinuity is equal to the difference between the fundamental gap of the interacting system and the independent particle system. We numerically investigate the exact exchange-correlation potential as a function of particle number for a finite dimensional Hubbard model and compare the exact results to a local density approximation to the exchange-correlation functional.

139 - Evaluation of an empirical model for a flat plate solar collector

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.139) [For award: MSc]*

Primary author: *NDLOVU, Nothando (University of Fort Hare)*
Co-authors: *SIMON, Michael (FHIT); TANGWE, Stepehn (University of Fort Hare)*

A simple empirical model for a flat plate solar collector is presented. The model describes the hot water temperature at the collector outlet for the system installed in Alice, South Africa. The empirical model takes a top-down approach in which collected data is used to predict collector outlet temperature. The fluid outlet sensor of the two collector plate system was positioned to measure combined water temperature of both collectors. A data acquisition system was designed and built to measure weather data, temperatures and flow data and these variables used as predictors to the model. The regression results indicate an adjusted R squared value of 0.946 which is an acceptable value. Model validation was done by evaluating the root mean square error (RMSE), mean bias error (MBE) and the correlation coefficient (CC). The results comparing measured and calculated temperature show that the model is reliable in predicting the collector out let temperature. The average maximum error was found to be 4.83 which is in the range of the acceptable error margin.

143 - Computational modelling studies of recrystallised nano-architectured TiO2 structures at different lithium concentration and temperatures for energy storage applications.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.143) [For award: MSc]*

Primary author: *RIKHOTSO, Blessing (University of Limpopo)*
Co-author: *NGOEPE, P.E (University of Limpopo)*

TiO_2 is a safe anode material in lithium ion batteries due to its higher Li-insertion potential of 1.5V when compared with the commercialised carbon anode materials [1]. In this study we investigate how the structure of the lithiated nano-architecture structure of titanium dioxide behaves at different lithium concentration as the structure recrystallises. It is observed that lithiation tends to armophised the structure in accordance with pair distribution function experiments. X-ray Diffraction pattern was produced and compared with the experimental XRD's.Microstructure was generated and found to be highly twinned hence forming straight and zigzag tunnels.

150 - Williamson-Hall and X-ray peak profile analysis of Mn and Cr doped ZnO

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.150) [For award: MSc]*

Primary author: *AMAMI, Paul Erhire (Department of Physics, College of Science, Engineering and Technology, University of S*
Johannesburg 1710, South Africa)
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Owing to its fundamental and technological impor… …ely used in many practical applications such as … …rials. To investigate the important role played by … …crystalline Mn and Cr doped ZnO samples wi… …nxO(x = 0.02, 0.04, 0.05) and Zn1-xCrxO (x= …ological change induced in ZnO due to Mn and Cr doping were …x profile analysis (XPPA) and Williamson-Hall analysis were carried out for …ium respectively. Parameters like stress and energy density value were calculated for all …y diffraction corresponding to wurtzite hexagonal phase of ZnO lying in the range 20-70 degree using …nalysis with models like uniform deformation model (UDM), uniform stress deformation model (USDM), uniform …rmation energy density model (UDEDM) and the size–strain plot (SSP); then thereby correlating them to the values estimated from SEM analysis and Scherrer's formula.

156 - Numerical modelling of hydrodynamical astrophysical outflows

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: D1.156) [For award: MSc]*

Primary author: *VAN DER WESTHUIZEN, Izak (University of the Free State)*
Co-authors: *VAN SOELEN, Brian (UFS); MEINTJES, Pieter (UFS); BEALL, Jim (St. John's Collage, Annapolis, MD); RIEKERT, Stephanus (UFS)*

High resolution radio imaging of Active Galactic Nuclei (AGN) jets has revealed that there are complex small scale structures, such as radio knots, present in the relativistic outflows. With continuous observation of these sources we note that the structures are highly time dependent. In order to gain a better understanding of how these structures form and evolve it is necessary to build a numerical model of the system. Due to the large length scales of astrophysical processes compared to particle interaction scales we can treat most of these processes as neutral fluids and use hydrodynamical conservation laws to obtain an appropriate model. In this study the opensource magnetohydrodynamical code PLUTO will be used to create a numerical model of relativistic AGN outflows. The PLUTO code uses High Resolution Shock Capturing (HRSC) schemes to evolve the time dependent partial differential conservation equations on a structured mesh. The magnetohydrodynamical code can be used to simulate a large number of other astrophysical environments such as accretion disks around compact objects. In this paper we present our initial model for the creation of a relativistic hydrodynamical jet and compare it to models obtained in previous studies. We will also present some of possibilities for future simulations.

160 - Synthesis and magnetic properties of Sn-doped CoFe2O4 nanoferrites

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.160) [For award: MSc]*

Primary author: *NGEMA, Nokwanda (University of KwaZulu-Natal)*
Co-authors: *MSOMI, Justice (University of KwaZulu-Natal); MOYO, Thomas (University of KwaZulu-Natal)*

CoSnxFe2-xO4 (x = 0.5 and 1.0) nanoparticles have been synthesized by glycol-thermal route. The compounds have been characterized by X-ray diffraction, transmission electron microscopy, FTIR, Mössbauer spectroscopy and SQUID measurements. XRD data confirm single phase formation and particle size of about 10 nm. The Mössbauer spectra recorded at about 300 K is indicative of ordered magnetic spin phase. Magnetization data show superparamagnetic nature of the compounds. The evolution of the properties as a function of grain size and sample measuring temperature is also presented. The magnetic properties have been explained on the basis of particle size and Sn concentration.

165 - Efficient processing of physics quantities for the Processing Unit for the upgrade of the Tile Calorimeter of ATLAS

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.165) [For award: PhD]*

Primary author: *OHENE-KWOFIE, Daniel (University of The Witwatersrand, High Energy Physics Group)*
Co-authors: *OTOO, Ekow (University Of the Witwatersrand); MELLADO, Bruce (University Of the Witwatersrand)*

The ATLAS detector, operated at the Large Hadron Collider (LHC) records proton-proton collisions at CERN every 50ns resulting in a sustained data flow up to Pb/s. Tile Calorimeter is a sub-component of the ATLAS detector in charge of measuring the energy, position and time of hadrons produced in proton-proton collisions. These physics quantities are generated at a rate of 40 MHz out of 10 thousand channels. The upgraded Tile Calorimeter of the ATLAS experiment will, sustain about 5PB/s of digital throughput. These massive data rates require extremely fast data capture and processing. Although there has been a steady increase in the processing speed of CPU/GPGPU assembled for high performance computing, the rate of data input and output, even under parallel I/O, has not kept up with the general increase in computing speeds. The problem then is whether one can implement an I/O subsystem infrastructure capable of meeting the computational speeds required by the upgraded LHC ATLAS TileCal.We propose a technique that leverages the Partitioned Global Address Space (PGAS) model of computing to maintain an in-memory data-store for the Processing Unit (PU) of the upgraded electronics of the Tile Calorimeter for high throughput data processing. The approach seeks to enhance data processing throughput for the PU which will be used as a co-processor to offload some data processing tasks of the Super Rod (sROD) of the upgraded TileCal. The physical memory of the PUs are aggregated into a large global logical address space using RDMA-capable interconnects such as PCI-Express. The technique uses RDMA in user space for high throughput data processing.

166 - Structural and optical properties of TiN coatings produced by reactive magnetron sputtering at different substrate temperatures

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.166) [For award: MSc]*

Primary author: *THETHWAYO, Charles Thulani (University of Zululand)*
Co-authors: *MAVUNDLA, Sipho (University of Zululand); NDWANDWE, Muzi (University of Zululand)*

This paper reports the effect of substrate temperature on the structural and optical properties of titanium nitrate (TiN) coatings. TiN coatings were deposited on silicon (100) wafer and glass slide substrates using direct current magnetron sputtering system at substrate temperatures varied from room temperature (RT), 150, 250, and 350 &#176C. The optical properties, structural, chemical composition and thickness of the film were investigated using photoluminescence (PL), UV-Vis spectroscope, X-rays diffraction (XRD), energy dispersive X-rays spectroscope (EDS) and Rutherford backscattering (RBS). The RBS results show that the thickness of the film decreases with the increase in substrate temperature. PL and UV-Vis show that TiN coatings have a good light absorption at sample prepared at lower substrate temperatures. The crystallinity of TiN coatings increases with the increase on the substrate temperature.

167 - The effects of Li adatoms on defected graphane: A first-principles study

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.167)*

Primary author: *MAPASHA, Edwin (University of Pretoria)*
Co-author: *CHETTY, Nithaya (University Of Pretoria)*

Using density functional theory (DFT), we study the energetics, electronic and magnetic properties of lithium (Li) adatom on the hexagonal, bridge and vacancy sites of graphane. We find that Li is most thermodynamically stable on the vacancy site.The incorporation of Li enhance strong spin polarized states within the band gap of graphane, due to notable hybridization between Li-1s and C-2p states. Li on defected graphane exhibits half-metallic character with a magnetic moment of 2 Bohr magneton in the ferromagnetic states. Moreover, our calculated magnetic moment is mainly dominated by Li-1s and C-2p states. Lithium adatom on defected graphane is found to play an important role of defects in semiconductor which facilitate the tunability of the bandgap and also influence the magnetic ordering of localized states on the vacancy site.

172 - The influence of the number of pulses and post annealing on the morphology and photoluminescence properties of CaS: Eu^{2+} pulsed laser deposited thin films

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.172) [For award: PhD]*

Primary author: *NYENGE, Raphael Lavu (University of the Free State & Kenyattta University)*
Co-authors: *NTWAEABORWA, Martin (University of the Free State); SWART, Hendrik (University of the Free State)*

Thin films of CaS: Eu^{2+}have been deposited on Si (100) substrates using the pulsed laser deposition (PLD) technique employing a 266-nm pulsed Nd: YAG laser. The influence of the number of pulses, and annealing on the photoluminescence properties of the grown films has been studied. The crystalline quality, surface morphology and photoluminescence (PL) properties of deposited films were characterized by X-ray diffraction (XRD), atomic force microscopy, scanning electron microscopy and photoluminescence spectroscopy. The roughness of the films increased with increase in the number of pulses. The PL intensity of the CaS: Eu^{2+} films is dependent on the surface roughness of the films, with PL intensity increasing as the number of pulses is increased. XRD studies demonstrated an improvement in crystallinity of CaS: Eu^{2+} thin films upon annealing, thus greatly improving the PL intensity. From these initial studies, thin films of this phosphor are promising for applications in phosphor-converted light emitting diodes.

175 - White luminescence from sol-gel silica doped with silver

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.175) [For award: PhD]*

Primary authors: *ABBASS, Abd Ellateef (Sudanese); SWART, Hendrik (University of the Free State); KROON, Ted (University of the Free State)*

Many researchers have recently been attracted to research white phosphors for applications in solid state lighting with the goal to replace fluorescent lamps. White light can be generated from light emitting diodes by two basic approaches, namely by mixing light of different colours using different emitting chips or by the use of phosphors to convert the light emitted from a blue or ultraviolet chip to longer wavelengths. Silicon dioxide (SiO_2) is a potential candidate material for optoelectronic applications because it is environmental friendly, low-cost, easy to fabricate and has good thermal and chemical stability. Much attention has been paid to SiO_2 doped with impurities to control its luminescence for different applications. In this study, undoped and Ag doped SiO_2 were prepared by the sol-gel method and annealed in air for 2 h at 1000 °C. The undoped sample showed photoluminescence emission in the range 400 - 500 nm which has previously been attributed to oxygen deficiency related defects. The addition of 1 mol% Ag caused significant broadening of the SiO_2 emission compared to the undoped sample and two new peaks in the ultraviolet and red regions were observed. The formation of Ag nanoparticles in the SiO_2 was confirmed by X-ray diffraction, ultraviolet diffuse reflection and X-ray photoelectron spectroscopy data. The additional red luminescence changed the emission of the pure SiO_2 from blue with CIE coordinates (0.22, 0.19) to emission with CIE coordinates (0.32, 0.34) when Ag was added, which is very close to pure white light having CIE coordinates (0.33, 0.33). The origin of the new peaks related to doping with Ag will be discussed.

178 - Catalyst-free thermal evaporation of Zn powder at atmospheric pressure

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.178)*

Primary author: *MULLER, Theo (University of the Western Cape)*
Co-authors: *TOBIAS, Hilton (University of the Western Cape); CUMMINGS, Franscious (University of the Western Cape); MOTAUNG, David (Council for Scientific and Industrial Research); ARENDSE, Christopher (Physics Dept., UWC)*

Zinc-oxide is a direct band-gap semiconductor material and in its nanoscale form exhibits novel optical and electronic properties. A myriad of forms and shapes have been produced by a variety of deposition methods. These structures are of interest to researchers for application in various fields such as optoelectronics, sensors, biomedicine and solar cells. Thermal chemical vapour deposition is one such deposition method favoured by researchers. Thermal evaporation is based on the thermal sublimation of the source material, and in this work a simple method was utilized whereby zinc (Zn) powders have been heated to a temperature above both its boiling and melting point. The catalyst-free experiment was conducted in an open-ended quartz tube, at atmospheric pressure in air. No carrier gas was used in what is a pre-cursor experiment to controlled thermal chemical vapour deposition. Electron microscopy analysis revealed the growth of micro-sized tetrapods and pencils that contain both zinc and oxygen, with tapered nano-sized tips formed by the stacking of nanospheres of decreasing diameter.

179 - Investigation of MOVPE-InSb Quantum Dots grown using TMIn and TDMASb

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.179) [For award: PhD]*

Primary author: *AHIA, Chinedu Christian (NMMU)*
Co-authors: *TILE, Ngcali (NMMU-Physics); URGESSA, Zelalem N. (NMMU); BOTHA, Johannes Reinhardt (NMMU)*

The size distribution and growth conditions of self-assembled InSb quantum dots (QDs) on a GaSb substrate (2° off (100)) using different V/III ratios were investigated. The QDs were grown using atmospheric pressure MOVPE and a growth temperature of 425°C. Scanning electron microscopy (SEM) of the uncapped QDs revealed that their dimensions ranged from 10 nm to 60 nm in diameter. A scanning probe microscopy (SPM) analysis of the uncapped QDs showed a bimodal size distribution of QDs on the misoriented surface of the substrate and confirmed a reduction in dot density and diameter as the V/III ratio increased from 1 to 3. Also from SPM, the heights of the QDs were determined to range from 5 nm to 19 nm. The experimental results confirm that the V/III ratio affects the size distribution and density of the QDs, which can be attributed to a change in the surface migration length of the indium species during deposition.

180 - MOCVD growth of GaSb/GaAs quantum dots

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.180) [For award: PhD]*

Primary author: *TILE, Ngcali (NMMU-Physics)*
Co-authors: *AHIA, Chinedu Christian (NMMU); URGESSA, Zelalem N. (NMMU); BOTHA, Johannes Reinhardt (NMMU)*

Quantum dots (QDs) formed through the creation of Gallium Antimonide (GaSb) nanostructures in a Gallium Arsenide (GaAs) matrix have some unique and appealing properties that are being continually exploited. This system has a type-II band alignment, providing strong spatial confinement for holes, and only binding electrons via the Coulomb interaction, leading to optical properties different from type-I QDs, such as a long radiative lifetime, a dot-shape dependent oscillator strength, and a large tunability of emitted/absorbed photons. It has been found recently that GaAs based p-i-n solar cells containing layers of GaSb quantum dots/rings fabricated by Molecular Beam Epitaxy showed improved efficiency at longer wavelengths of up to 1.5 µm. In order to improve this device functionality there is a need to understand the formation of these dot structures in order to control/tune their structural properties and therefore improve their optical and electrical properties. A Metal Organic Chemical Vapor Deposition (MOCVD) system provides a set of deposition conditions that would allow one to systematically study the QD formation. In this work we show the fabrication of GaSb QDs in a GaAs matrix using MOCVD. Tributylarsenic, Triethygallium (TEGa), and Trisdimethyaminoantimony (TDMASb) were used as arsenic, gallium, and antimony sources, respectively. We studied the influence of TDMASb/TEGa ratio and growth temperature on the size, morphology and density of the QD structures. We also studied the optical properties of the capped QD structures by photoluminescence spectroscopy.

185 - Synthesis and characterisation of mechano-chemically synthesised Zinc Oxide nanoparticles using ball milling

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.185)*

Primary author: *MANAMELA, MF (University of Limpopo)*
Co-authors: *RAMMUTLA, Erasmus (University of Limpopo); MOSUANG, Thuto (University of Limpopo)*

Zinc oxide (ZnO) nanoparticles were mechano-chemically prepared from the commercial micro-sized ZnO powders using high energy ball milling. The as-purchased ZnO powder was ball milled using steel balls and vials at different time intervals between 1 and 12 hrs. The structural and optical modifications induced in the as synthesized samples were investigated using X-ray diffraction (XRD), scanning electron microscopy (SEM) and photoluminescence (PL). XRD and SEM show a gradual decrease in particle size on increasing the milling time (tm). A new band at around 367 nm is revealed by the PL results and its intensity is found to in crease linearly with decreasing particle size. Studies of the effects of indium (In) doping on the structural and optical properties of ball milled ZnO are currently underway.

186 - Investigating charge carrier effects in silicon membranes using fs laser.

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.186) [For award: PhD]*

Primary author: *NDEBEKA, Wilfrid (Laser Research Institute, Stellenbosch University)*
Co-authors: *NEETHLING, Pieter (Laser Research Institute, Stellenbosch University); STEENKAMP, Christine (Laser Research Institute, Stellenbosch University); STAFAST, Herbert (Leibniz Institute of Photonic Technology, Jena, Germany); ROHWER, Erich (Laser Rese arch Institute, Stellenbosch University)*

The second harmonic (SH) generated at the Si/SiO2 interface varies on a time scale of several seconds when illuminated with high intensity near infrared laser pulse (λ = 800 nm, with 80 MHz frequency, Epulse ≤ 10 nJ). The temporal behaviour arises from generation of trap sites and subsequent trapping of charges at the interface via multi-photon processes. These trapped charges create an interfacial electric field which influences the nonlinear properties of the Si/SiO2 interface and leads to a time dependent second harmonic (TDSH) signal on continuous irradiation. This is known as electric field induced second harmonic (EFISH) generation. In this work, measurements are focused on the simultaneous measurements of EFISH signal from a free standing oxidized Si membrane both in reflection and transmission as a function of the irradiation time. Results show that the transmission of the fundamental irradiation as well as the transmitted SH signal generated from the Si membrane increases, reaches a maximum, and then decreases again as the input intensity is increased. The nonlinear behaviour of the transmitted signal is explained using free charge carrier absorption (FCA) in silicon.

195 - High-Momentum Particle Production at RHIC, Fermilab, and LHC

Poster2 - Wednesday 01 July 2015 16:10 *[For award: Hons]*

Primary author: *ADAMIAK, Daniel (University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

We compute the distributions of charged particles at large transverse momenta in p-p, p-pbar, and pA collisions at RHIC, Fermilab, and LHC. Our calculations are performed using leading order perturbative quantum chromodynamics (pQCD), with 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 data across the three machines, multiple orders of magnitude in centre of mass energy sqrt(s), and over many orders of magnitude in transverse momentum. We then examine the transverse momentum dependence of the partonic contributions to these cross sections when using both the PDFs and nPDFs, which provides the critical input spectra for theoretical predictions for the suppression of charged particle spectra in heavy ion collisions.

196 - Radon exhilation of building materials

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.196)*

Primary author: *WENTZEL, Farrel Sidney (University of the Western Cape)*
Co-author: *LINDSAY, Robert (University)*

There is considerable public concern about radon exhalation from building materials. The purpose of this study is to address this public concern and to estimate the contribution of building materials to indoor radon levels. As in soil and rock; radon gas is formed inside the building materials by decay of the parent nuclide ^{226}Ra. It is not possible to determine the radon exhalation rate simply from the activity concentration of ^{226}Ra, instead one must measure radon exhalation rates directly from the surface of the material.^{222}Rn has been identified as an important factor that could result in a health hazard by studies all around the world. The experiments were done at the UWC physics department, in the Nuclear Physics Lab. A RAD7 radon detector was used to measure the energies of each alpha particle emitted. The RAD 7 records the number of alpha particles with energy of 6.11 MeV which results from the decay of ^{218}Po, the daughter of ^{222}Rn. The RAD 7 detector converts counts into Becquerel's per cubic metre (Bq/m3) or Becquerel's per Litre (Bq/L). The building materials tested was the raw materials used in construction such as two different types of building sand, stones and gravel. The building materials used for composed of various raw materials to create a final product was floor-and-roof tiles and various granites from across the country. Many building materials were found to have a very low rate of radon exhalation. The only materials that had any significant radon exhalation were 2 granites. It is safe to say that the overwhelming majority of building materials are safe to use but some granites may require further study.

200 - Demonstration of a new ultrafast pulse reconstruction modality – PIRANA

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.200) [For award: MSc]*

Primary author: *SPANGENBERG, Dirk-Mathys (University of Stellenbosch)*
Co-authors: *VILJOEN, Ruan (Stellenbosch University); NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); ROHWER, Erich (University of Stellenbosch); FEURER, Thomas (IAP, University of Bern)*

Ptychography, a phase retrieval scheme used in lensless imaging, is an iterative procedure to reconstruct the phase and amplitude of an object. It has recently been shown that ptychography can be applied to reconstruct temporal objects under the condition that the illumination pulse is fully characterised. We have modified this procedure to be able to reconstruct temporal objects (recovering its amplitude and phase), with an unknown illumination pulse. In this work we explain this iterative procedure and its experimental realisation. We compare results with a known reconstruction modality such as FROG (a similar procedure for recovering the phase of a temporal object). We specifically highlight the removal of the phase ambiguity inherent in second order FROG using PIRANA.

202 - Molecular dynamics studies of Schottky and Frenkel defects in cerium dioxide

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.202)*

Primary authors: *LEKOKO, Oldoria (University of Limpopo); RAMMUTLA, Erasmus (University of Limpopo); MOSUANG, Thuto (University of Limpopo)*

Schottky and Frenkel defect energies in cerium dioxide are studied using the classical molecular dynamics. Buckingham potentials are used to understand the cerium-oxygen and oxygen-oxygen interactions in the bulk and defect structures. The formulation uses the NVT Evans ensemble to obtain the various defect energies. Oxygen and cerium vacancy defect energies relative to bulk cerium dioxide total energies are used to get more insight on cerium dioxide as a catalyst in exhaust systems. Oxygen ions transport properties are studied using the time-dependent mean square displacement. The anion Frenkel-pair defect is the most favourable form of intrinsic ionic defect.

203 - Ambient gamma dose rate measurements at Manyoni uranium mines, Singida, Tanzania

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.203)*

Primary author: *KASOGA, K. F. (Department of Physics, The University of Dodoma, P O Box 338, Dodoma, Tanzania)*
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Recent uranium exploration studies in Tanzania have found several economically viable uranium deposit sites. This has brought concern to the public in nearby villages on the radiological health hazard, which may be associated with uranium mining. At Manyoni, pre-mining baseline data of the ambient gamma radiation dose rates are carried out, which serves as a reference information during and after uranium mining. Dose rate measurements on contact (at the surface) and in air (one meter from the ground) are taken using a survey meter from the expected mining zones and eleven villages surrounding Manyoni and in Manyoni town locating the sampling coordinates by the global positioning system (GPS).High levels of natural radiation are measured at the proposed Manyoni uranium mines. The absorbed gamma dose rates at the surface and in air due to the naturally occurring radionuclides varied from 131 to 1678 nGy h^{-1} (98 to 1657 nGy h^{-1}) with the mean value of 904 nGy h^{-1} (877 nGy h^{-1}). The maximum value measured is about thirty times the world average of 59 nGy h^{-1} [1]. The annual effective dose rates for the region range from 0.16 to 2.06 mSv yr^{-1} (0.12 to 2.03 mSv yr^{-1}). The main conclusions are: high gamma radiation background at Mwanzi, Kinangali and Kinyika-Mbwekoo villages; and there is a need for conducting effective dose equivalents and health risk assessment for general public near the proposed uranium mining site. We report preliminary findings of our results and discuss them. [1] UNSCEAR, Sources and effects of ionizing radiation, United Nations Scientific Committee on the Effect of Atomic Radiation, United Nations, New York, 2000.

205 - A quantum walk-based MPPT optimization algorithm for a stand-alone PV system

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.205)*

Primary author: *SENEKANE, Makhamisa (Quantum Research Group, School of Chemistry and Physics, University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa)*
Co-authors: *ZULU, Bheki (Student); PETRUCCIONE, Francesco (UKZN)*

A novel quantum walk-based maximum power point tracking (MPPT) optimization algorithm for stand-alone photovoltaic (PV) system is proposed in this paper. A quantum walk is a quantization of a classical random walk algorithm. Since a classical random walk has proven to be a very powerful algorithmic tool, it is prudent then to investigate its quantum analogue, namely a quantum walk, for design of algorithms. The paper further provides a numerical analysis of the algorithm in order to determine its suitability as an MPPT optimization algorithm. Simulation results show that this quantum walk-based algorithm can quickly reach maximum power point (MPP), thereby reducing PV system power loss.

209 - Measurement of diffusion capacitance of mono-crystalline and poly-crystalline photovoltaic cells using LBIC

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.209) [For award: Hons]*

Primary author: *DIX-PEEK, Ross (NMMU)*
Co-authors: *VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU)*

The ability to characterise silicon photovoltaic (PV) cells using non-destructive procedures is valuable for the photovoltaic manufacturing industry. This enables the identification of potential problems during cell manufacturing processes and elimination of these problems thus improves PV module performance. This study investigates the merits of an expansion of the Light Beam Induced Current (LBIC) technique to map the magnitude of an observed hysteresis effect on a cell's current-voltage (I-V) curve. This effect is found when the applied bias voltage on a cell is rapidly changed in the forward and reverse direction when the spot-illuminated I-V curve of a cell is measured. The difference in the short circuit current (Isc) of the forward and reverse swept I-V curve can be linked to the density of the charge carriers generated by the raster scanned light beam. In this study a signal generator is used to apply a forward and reverse bias sweep on spot illuminated poly and mono crystalline silicon cells to determine the relative magnitude of the diffusion capacitance at each illuminated measurement point. Preliminary results show that several PV cell defect features can be associated with changes in the cell's diffusion capacitance.

211 - Electrical Characterization of MeV Alpha-particle Irradiated Ni/4H-SiC Diodes and their Recovery by Annealing Treatment

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.211)*

Primary author: *DIALE, Mmantsae (University of Pretoria)*
Co-authors: *LEGODI, Matshisa (University of Pretoria); OMOTOSO, Ezekiel (University of Pretoria, Pretoria, South Africa); AURET, Danie (University of Pretoria)*

In this paper, the formation and evolution of defects induced by ion irradiation with 5.4 MeV alpha particles from an Am-21 radio nuclei source in Ni/4H-SiC Schottky barrier diodes were studied and correlated with the electrical properties of the contacts. The current voltage properties of the contacts monitored before and after irradiation showed an increase in Schottky barrier height, series resistance, reverse leakage current and ideality factor with increasing irradiation dose. The changes in barrier height and series resistance could be attributed to the dopant deactivation in the near-interface region, while the increase in leakage current is associated to the formation of radiation induced defects. These defects showed evolution with increasing irradiation dose. Moreover, the current voltage measurements and deep level transient spectroscopy allowed us to demonstrate that the increase in leakage current is primarily influenced by the Z1/Z2 centre of 4H-SiC.

213 - Electrical characterization of undoped and niobium-doped n-silicon diodes

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.213) [For award: MSc]*

Primary author: *THEBE, Mohapi (Student)*
Co-author: *MSIMANGA, Mandla (Co-supervisor)*

The research undertaken was to characterize the Schottky diodes fabricated on undoped and metal-doped n-silicon substrate using current-voltage (I-V) and capacitance-voltage (C-V) measurements. The metal used is niobium. The obtained results were used to investigate the effects of niobium on silicon material. The I-V data were used to extract the saturation current, the ideality factor and Schottky barrier height, while the C-V data on the other hand, was used to determine the doping profiles for all fabricated diodes. In overall, the results show that the silicon has become relaxation-like.

217 - The influence of annealing on radioluminescence and thermally stimulated luminescence in natural quartz

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.217)*

Primary author: *CHITHAMBO, Makaiko (Rhodes University)*
Co-author: *LONTSI SOB, Aaron Joel (University of Cape Town)*

The kinetics of the main thermoluminescence peak in natural quartz have been investigated for glow curves measured between 30 and 500oC. For an irradiation dose of 10 Gy and heating at 5.0oC/s, the main peak is found at 92 oC for an unannealed sample and at 86 oC for a sample pre-annealed at 500 oC. Re-using a sample leads to an enhancement of the main peak, a feature possibly due to sensitization. The peak position is independent of dose and this, together with its fading characteristics are consistent with first-order kinetics. The dose response of the main thermoluminescence peak of each sample is linear for doses less than 10 Gy, becomes sub-linear up to 60 Gy and changes to linear again with doses up to 150 Gy. The half-life of the main peak for the unannealed sample is 1.3 h and that of the annealed sample is 1.2h. The main peak of each sample, which can be approximated to a first-order peak, has an activation energy of about 0.93 eV. The intensity of the main peak in each case decreases with heating rate. This is evidence of thermal quenching. Complementary radioluminescence emission spectra were also measured for quartz annealed at various temperatures. Emission bands in quartz are affected by annealing and irradiation. A strong enhancement of the 3.4 eV (~ 366 nm) emission band is observed following annealing at 500oC. A new emission band whose intensity increases with annealing up to 1000oC is observed at 3.7 eV (~ 330 nm) for quartz annealed at 600oC. We correlate the changes in radioluminescence emission spectra due to annealing with the influence of annealing on luminescence lifetimes in quartz.

224 - Implementing the Deutsch-Jozsa Algorithm with classical light

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.224)*

Primary author: *PEREZ-GARCIA, Benjamin (Tecnologico de Monterrey, University of Witwatersrand)*
Co-authors: *MCLAREN, Melanie (University of the Witwatersrand); HERNANDEZ-ARANDA, Raul (Tecnologico de Monterrey); GOYAL, Sandeep (UKZN); FORBES, Andrew (CSIR); KONRAD, Thomas (UKZN)*

We demonstrate an optical implementation of the Deutsch-Jozsa Algorithm using classical light. Our approach makes use of a spatial light modulator in order to digitally realize the quantum oracle. Furthermore, we take advantage of the intrinsic Fourier transforming properties of a lens to perform the measurements.

226 - Investigating the structural changes in strontium implanted glassy carbon using Multiwavelength Raman Spectroscopy

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.226) [For award: PhD]*

Primary author: ODUTEMOWO, opeyemi *(university of pretoria)*
Co-authors: *MALHERBE, Johan (University of Pretoria); PRINSLOO, Linda (University of Pretoria); ERASMUS, Rudolph (University of the Witwatersrand)*

The effect of strontium ion implantation and annealing on the structure of glassy carbon was investigated using Multiwavelength Raman Spectroscopy. Three wavelengths for the excitation beam were used namely 244, 514, and 785 nm. The Raman spectra of the virgin glassy carbon for the latter two excitation beams showed the carbon D and G peak positions at 1350 cm-1 and 1588 cm-1 respectively. The Raman spectrum with the 244 nm wavelength showed the G peak position at 1588 cm-1 and an additional D peak at approximately 1423 cm-1. The bombardment of 200 keV strontium ions resulted in amorphisation of the implanted region with the D and G peak merging into a single broad band. The G peak position reduced from 1588 cm-1 to 1543 cm-1. The reduction in the G peak position was also accompanied with a reduction in the ID/IG ratio from 1.4 to 0.47. Slight recovery of the glassy carbon structure was achieved after heat treatment at several temperatures.

227 - Physical properties of $Cr_{78}Al_{22}$ thin films

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.227)*

Primary author: PRINSLOO, Aletta *(University of Johannesburg)*
Co-authors: *SHEPPARD, Charles (Department of Physics, University of Johannesburg); DERRETT, Helen (University of Johannesburg); VAN DEN BERG, Nic (University of Pretoria); FULLERTON, Eric (University of California San Diego)*

The $Cr_{100-x}Al_x$ alloy system shows astonishing behaviour at higher Al concentrations [1]. Very high Néel temperatures (TN>800 K) are observed in samples with x>20. The SDW amplitude for these alloys are also larger than in other Cr alloy systems. In addition both the Hall coefficient and the resistivity for samples in the concentration range 15≤x≤25 is large. In this concentration range the resistivity have a negative temperature dependence and is in form characteristic of that of narrow-gap semiconductors [1]. Combining these unique bulk characteristics with exceptional thin film properties seen for Cr and its alloys [2], appears to be a way forward in order to improve modern technologies. For this reason the present study focus on $Cr_{78}Al_{22}$ thin films in a thickness (t) range 12 to 400nm, prepared on MgO(100), MgO(110) and fused silica substrates, prepared by DC magnetron sputtering. AFM results on the fused silica samples indicate interesting growth patterns with cubic structures forming in the thicker samples. This is supported by XRD results indicating that for the samples prepared on fused silica substrates preferred Cr(110) growth occurs for t≥100nm. XRD results also show good epitaxial growth of the films prepared on the MgO substrates. Resistance (R) as function of temperature investigations were done using the standard four-point probe method in a temperature range T<400K and show negative temperature dependence. Interestingly, the behaviour of R(T) differ for those samples prepared on MgO(100), as the film with t=400nm shows metallic characteristics.[1] E Fawcett, HL Alberts, VY Galkin, DR Noakes and JV Yakhmi, Rev. Mod. Phys. 66 (1994) 25 [2] HJ Zabel, J. Phys.: Condens. Matter 11 (1999) 9380

231 - Computer simulation as a strategy for generating manganese dioxide nanotubes

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.231) [For award: MSc]*

Primary author: TSHWANE, David Magolego *(University of Limpopo)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); MAPHANGA, Rapela (University of Limpopo)*

Nanostructured materials are attractive candidates for efficient electrochemical energy storage devices because of their unique physicochemical properties. Introducing nanotube systems as electrode materials represents one of the most attractive strategies that could dramatically enhance the battery performance. Nanostructured manganese dioxide has been considered as an ideal electrode material for energy storage devices such as high-energy and power lithium-ion batteries. In this paper, computer simulation strategy is used to generate various structures of manganese dioxide nanotubes by varying Miller index and diameter and determine their effect on nanotube generation. It is found that diameter and Miller index have a direct control on nanotube morphology and stability of generated models depends on the surface and termination. Molecular dynamic simulation is further used to investigate the structure of manganese dioxide nanotube and the effect of temperature on the generated systems. Molecular graphical images showing the atomic positions for the nanotubes are presented and the nanotube structures are described using radial distribution functions and XRD patterns. The calculated XRD patterns are in good agreement with the experiments, thus validating the generated structural models for the nanotubes. The resulting models conforms to pyroluiste polymorph of manganese dioxide, featuring octahedrally coordinated manganese atoms.

232 - Computaional Modelling of $Ti_{50-x}Pt_{50}Zr_x$ SMAs

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.232) [For award: MSc]*

Primary author: MASHAMAITE, Mordecai *(University of Limpopo)*
Co-authors: *MAHLANGU, Rosinah (University of Limpopo); CHAUKE, Hasani (University of Limpopo); NGOEPE, Phuti (University of Limpopo)*

Shape memory alloys (SMAs) are unique metals that can remember their previous shape after being deformed and can return to their previous form when heated above certain temperatures. SMAs exhibits two unique properties arising from a solid-to-solid, diffusionless phase transformation namely the shape memory effect and superelastisity. The stability of the $Ti_{50-x}Pt_{50}Zr_x$ ternary is investigated using the supercell approach. The supercell approach, embedded in VASP was used to partially substitute Ti with Zr atoms on the cubic $Ti_{50}Pt_{50}$ to form $Ti_{50-x}Pt_{50}Zr_x$. We found that the lattice parameters were reproduced and agree with the available experimental values. The calculated heats of formation predict that the $Zr_{18.25}Ti_{31.25}Pt_{50}$ is the most stable structure whereas $Zr_{25}Ti_{25}Pt_{50}$ is the least stable. The mechanical properties in terms of elastic constant at 0K were found to be consistent with the calculated heats of formation. LAMMPS code was successfully used to determine the mechanical and temperature dependence of the $Ti_{50-x}Pt_{50}Zr_x$ ternaries at various temperature range.

236 - Neutrino mass hierarchy and CP phase measurement using atmospheric neutrino flux

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.236)*

Primary author: RAZZAQUE, Soebur *(University of Johannesburg)*

Multi-megaton scale ice or water Cherenkov detectors with relatively low (sub-GeV) threshold energy can accumulate huge statistics of atmospheric neutrino data. With reasonable energy and angular reconstruction efficiency for the neutrino events, these data can be used to establish yet unknown neutrino mass hierarchy with high confidence. Leptonic CP phase can also be measured using atmospheric neutrino flux, once hierarchy is established and uncertainty on the flux and other neutrino parameters are better understood. Following up on previous work on this topic we will present the latest calculation results in lights of recent developments.

241 - The magnetic properties of Cr + 1 at.% Al thin films

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.241) [For award: MSc]*

Primary author: MUDAU, patience *(University of Johannesbug)*
Co-authors: *SHEPPARD, Charles (Department of Physics, University of Johannesburg); PRINSLOO, Aletta (University of Johannesburg); VENTER, Andrew (Necsa Limited); FULLERTON, EE (Center for Magnetic Recording Research, University of Califonia, USA)*

Pure bulk Cr has an electron-to-atom ratio (e/a) of six and exhibits a Néel temperature (TN) at 311K [1]. Studies on dilute Cr alloys show that alloying Cr with elements with e/a>6 results in an increase in TN, whilst alloying with elements rendering an e/a<6 results in a decrease in TN [1]. In $Cr_{100-x}Al_x$, where Al has e/a=3, the phase diagram shows a sharp decrease in TN values, reaching a minimum near x=2, where after the TN values again increase [1,2]. As thin films of Cr alloys generally show properties not observed in the bulk [3], this study extends investigations to $Cr_{99}Al_1$ thin films with thicknesses (t) varying from 28 to 450nm deposited on fused silica, MgO(100) and MgO(110). XRD was used to determine the crystallographic orientations of the films. Results show epitaxial growth in films prepared on the MgO substrates, while those on fused silica are polycrystalline. TN values were obtained from standard four-point probe resistance (R) investigations as function of temperature. For samples deposited on fused silica no anomalies were observed, while R(T) curves for films deposited on MgO showed anomalies in the forms of domes associated with TN. It has been found that these TN values decreased with increase in t, levelling off at approximately 260K for the 450nm sample. This result correlates with the TN value expected from the magnetic phase diagram of bulk $Cr_{99}Al_1$ [1].[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

245 - Minimum Norm Estimates for the Bioelectromagnetic Inverse Problem

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.245)*

Primary authors: NGOMANE, Alex Otavia *(University of Venda)*; MALUTA, Eric *(University of Venda)*; DE MELLO KOCH, Robert *(University of the Witwatersrand)*

We consider the bioelectromagnetic inverse problem, in the case that one has a priori information about the generating sources. This problem is ill posed, so that additional input must be used before any inverse can be constructed. We consider two approaches to this problem: maximum-likelihood estimation as well as minimum norm estimation. We show how to make use of a priori information, if it is available. We argue that the minimum norm solution is a valuable approach to this problem.

246 - Computer modeling studies of the adsorption energies of heavy metals onto vermiculite surface

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.246)*

Primary author: PHALA, Feredi *(University of Limpopo)*

Computer modelling studies were performed to investigate the adsorption energies of selected heavy metal cations onto vermiculite (001) surface, using universal force field. The metal cations studied are Cu, Ni, Zn, Pb, Cd and Mn. The energies of the selected cations were negative showing that they are all miscible with vermiculite interlayer surface. The metals showed increasing adsorption energies in the following order: Cu < Ni < Zn < Pb in agreement with experimental findings. The other two metal cations, Cd and Mn, showed lower absorption energies contradicting experimental findings.

248 - The search for Dark Matter in association with the Higgs boson with the di-photon decay

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.248)*

Primary author: RUAN, XIFENG (WITS)
Co-authors: KUREBA, Chamunorwa Oscar *(University of the Witwatersrand); MELLADO, Bruce (University of the Witwatersrand)*

The ATLAS and CMS experiments at the Large Hadron Collider discovered a Higgs like particle in 2012. The differential and fiducial cross sections of the Higgs are measured using 20.3\,fb^{-1} 2012 data taken at $\sqrt{s}$\,=\,8\,TeV after the discovery by ATLAS. The measurement is focusing on the Higgs kinematics and jet activity, including Higgs transverse momentum, rapidity and Higgs+jet production mode. The Higgs candidates are extracted by fitting the two-photon invariant mass spectrum. The observed kinematic distribution of Higgs is translated to particle level to reduce the detector efficiency and resolution, using bin-by-bin unfolding method. A distortion of Higgs transverse momentum is found in comparison with the state-of-the-art predictions. One of the explanations is the Higgs production associated with invisible particles, such as the dark matter. The observation indicates that the missing particle has intermediate energy and same order of production cross-section as the Standard Model gluon-gluon fusion to Higgs process. The search for dark matter in association with the Higgs boson will be performed in the 2015 data taking in Higgs decaying two-photon channel. The study will focus on the Higgs production associated with intermediate missing energy. The knowledge and understanding of the missing energy reconstruction is critical.

249 - Evaluation of photovoltaic modules using standard electrical power measurements and imaging techniques

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.249) [For award: Hons]*

Primary author: *RADEMEYER, Yvette (NMMU)*
Co-authors: *CROZIER, Jacqui (NMMU); VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU)*

Photovoltaic (PV) characterisation techniques are quick and reliable tools to evaluate the performance of PV modules. Defects can be identified during visual inspection, electroluminescence (EL) imaging and thermographic inspection. These defects explain the reduced performance observed in the current-voltage (I-V) curves. It is important that these potential problem areas are detected to ensure efficient power generation and long life span of the module. In this study three different photovoltaic module technologies are used, namely monocrystalline, polycrystalline and Edge Defined Film-Fed Growth (EFG) silicon. These modules are subjected to the standard tests according to IEC 61215, as well as EL imaging and thermographic imaging. The results obtained from each of the tests are evaluated in order to assess the performance of each module. During visual inspection the modules are checked for any visible defects or failures according to the standard test. The I V curves for each module are measured using an indoor solar simulator. These two standard tests provide a baseline of the module performance. EL imaging and thermal imaging techniques are used to identify defects and failures that are not visible during the visual inspection. In all the modules, defects were detected in the EL image that were not identified in the visual inspection. The performance of the module was limited by these defects as evident in the I-V curves. Potential hot-spots detected in thermal imaging could be attributed to cell mismatch within the module.

251 - Measuring the optical thermometry properties of a phosphor

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.251) [For award: MSc]*

Primary author: *ERASMUS, Lucas (University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); TERBLANS, JJ (Koos) (UFS)*

This study is focused on the investigation and measurement of optical thermometry properties of different phosphors by utilising the Photoluminescence (PL) technique. After a literature study it was concluded that the optical thermometry properties of phosphors can be measured by two techniques. Firstly the fluorescence intensity ratio technique, where fluorescence spectra of a phosphor is obtained and the intensity ratio between two thermally coupled levels are monitored as a function of temperature. The second technique is where an excited phosphor's fluorescence peaks are monitored as relaxation takes place. The fluorescence half-life of the phosphor is determined as a function of temperature. Currently the PL system in the Physics department at the University of the Free State is capable of measuring fluorescence spectra of a phosphor at room temperature and thus the aim of this study is to enhance the current system to investigate and measure the optical thermometry properties of different phosphors at different temperatures by using both these techniques. The preliminary results obtained and the custom build system will be discussed in detail.

254 - Electronic and magnetic properties of the $(Cr_{84}Re_{16})_{100-x}Mn_x$ alloy system

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.254)*

Primary author: *JACOBS, Bincy Susan (University Of Johannesburg)*
Co-authors: *CAMARGO, Paulo (UFSCar, Brazil); OLIVIERA, Adilson (UFSCar, Brazil); FACETO, Angelo (UFSCar, Brazil); SHEPPARD, Charles (Department of Physics, University of Johannesburg); PRINSLOO, Aletta (University of Johannesburg)*

The electrical resistivity (ρ) and magnetisation (M) of $(Cr_{84}Re_{16})_{100-x}Mn_x$ alloys with x = 0.3, 0.4, 0.6, 0.8 and 3.1 at.% Mn were studied as a function of temperature (T) and applied magnetic field.Anomalies are observed in the ρ(T) curves corresponding to the Néel temperature (T_N). M(T) curves in a constant small applied field (100 Oe) was obtained on increasing T after cooling in zero magnetic field (ZFC). Measurements were also done after cooling in a field of 100 Oe (FC). At T < 10 K, a sharp increase in magnetisation is observed on increasing T after ZFC. A prominent sharp peak is observed close to 30 K beyond which the magnetisation rapidly decreases to lower values. In samples with concentrations 0.6, 0.8 and 3.1 at. % Mn, the magnetisation approaches zero above 30 K. In the FC state, there is a slower decrease in M on increasing T up to around 30 K beyond which the behaviour is identical to that observed in the ZFC state except for the alloy with 3.1 at. % Mn. In this case, the magnetisation obtained in both the FC and ZFC state first increases to a maximum value resulting in a peak before rapidly decreasing to low M values. The behaviour of M is indicative of possible spin glass state and is similar to behaviour that has been previously observed [1,2]. Results to test the characteristics of the spin glass state will also be presented. [1] Galkin VY *et al*., J.Phys.:Condens Matter 7 L649 (1995)[2] Galkin VY *et al*., J.Phys.:Condens Matter 8 7925 (1996)

264 - A precise measurement of the ½⁺ to ½⁺ ft value in ^{19}Ne beta decay

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.264) [For award: MSc]*

Primary author: *MABIKA, Phumzile (University of the Western Cape)*
Co-author: *TRIUMF, 8-Pi collaboration (TRIUMF, Canada)*

The Standard Model (SM) of particle physics successfully describes the fundamental particles as well as their interactions. Despite this success, there is reason to believe that the SM is incomplete as many of the ingredients in the model are taken directly from the experimental evidence alone. For example, $SU_L(2) \times U(1)_{EM}$ standard electroweak theory allows only left-handed weak currents. However, several theoretical extensions to the model allows the change of massive exotic particles of both helicities, beyond the established V-A structure of weak interactions.One way to look for physics beyond the SM is by low energy experiments that tests the symmetries in the model The beta decay of ^{19}Ne is highly sensitive to right-handed (V+A) type of interactions. In this project we present data from a previous ^{19}Ne beta decay experiment to obtain its ft value with high accuracy and precision. The experiment was performed at TRIUMF (Canada's National Laboratory for Particle and Nuclear Physics), using an array of HPGe detectors and plastic scintillators called the 8π array and SCEPTAR respectively. Together with the beta asymmetry parameter for ^{19}Ne beta decay [1], the measured ft value can be used to place bounds on predicted right-handed weak interactions.[1] F.P Calaprice et al., Phys. Rev. Lett, 38, 1566 (1975)

266 - Wavelength-modulated spectroscopy of the sub-band gap response of solar cell devices

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.266) [For award: MSc]*

Primary author: *HASINJATOVO MANDANIRINA, Nambinintsoa Romeoh (Nelson Mandela Metropolitan University)*
Co-authors: *BOTHA, J R (Nelson Mandela Metropolitan University); WAGENER, M C (Nelson Mandela Metropolitan University)*

In the global effort to improve the efficiency of solar cells, many structures and materials are currently being investigated. These various technologies can generally be classified into three generations, of which the third generation overcomes the Shockley-Queisser limit. One such approach is to incorporate quantum structures into a single junction solar cell. The quantum structure has a lower band gap energy than the matrix material and therefore extends the photo-response of the solar cell towards longer wavelengths, reducing transmission losses. In order to better understand the sub-band gap photo-response of this type of solar cell, we make use of wavelength-modulated spectroscopy to evaluate the contribution by the embedded quantum structures. The excitation wavelength is modulated by oscillating the exit slit of the monochromator used for the photo-response measurements. However, due to the spectral dependence of most excitation sources, the optical intensity is inherently also modulated. The challenge is therefore to maintain that intensity at a constant level. To do so, this work proposes a method to control the photon flux density of the light using a flux control module. We will also report on the wavelength-modulated spectroscopy of GaSb/GaAs quantum dot solar cells.

276 - Synthesis and characterization of diamond like carbon (DLC) thin films for gas sensing applications

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.276) [For award: MSc]*

Primary author: *CHONCO, Nelisiwe Princess (University of Zululand)*
Co-authors: *MWAKIKUNGA, Bonex (CSIR); NDWANDWE, Osman Muzi (University of Zululand); NDLANGAMANDLA, Ceboliyozakha (University of Zululand)*

DLC thin films were deposited on Si and Aluminum strips using DC magnetron sputtering system. Thin films on Si substrate were characterized using XRD, SEM, EDX, RBS, AFM and Raman. Thin films deposited on Al strips we used for gas sensing purposes. DLC films were very smooth with a roughness ranging 0.29 -3.2 nm. DLC thin films were found to be polycrystalline with a pronounce peak of DLC. The composition of the sample was C and Si. The sp3 to sp2 ratio (ID/IG) was estimated to be 0.7- 0.9. In gas sensing applications material that withstands poisonous gasses such as H2S are required. DLC thin films were observed to be more sensitive on gases like NO2 and NH3 at room temperature. This gas sensor was found to be selective became its sensitivity was less for gasses like CO,H2 and H2S at room temperature.

279 - Security of quantum key distribution

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.279)*

Primary author: *MAFU, Mhlambululi (Botswana International University of Science ad Technology)*

Quantum key distribution, one aspect of quantum cryptography refers to the art of generating a secret key between authorized parties in the presence of an eavesdropper. The security of quantum key distribution is solely based on the laws of quantum mechanics. Therefore, we explain the role played by quantum mechanics in cryptographic tasks and also investigate how secure is quantum cryptography. We show by a proof that for any state sent by the sender, the eavesdropper can only guess the output state with a probability that will allow her not to learn more than half of the classical Shannon information shared between the authorized parties. This means that quantum key distribution is secure almost always.

280 - Higher dimensional quantum key distribution in the presence of quantum noise

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.280) [For award: PhD]*

Primary author: *MAFU, Mhlambululi (Botswana International University of Science and Technology)*
Co-authors: *SENEKANE, Makhamisa (University of KwaZulu-Natal); GARAPO, Kevin (University of KwaZulu-Natal); PETRUCCIONE, Francesco (University of KwaZulu-Natal)*

Quantum key distribution (QKD) allows two parties, Alice and Bob, to generate a secret key in the presence of an eavesdropper, Eve [Gisin N, Ribordy G, Tittel W and Zbinden H 2002 Rev. Mod. Phys. 74 145-195]. QKD promises the legitimate parties to exchange private information by means of provable-secure protocols. The security is solely based on the quantum mechanical laws of physics. Since QKD is at the level of implementation and since these protocols usually operate in some noisy channels, we investigate how the addition of noise in the communication channel affects the secret key generation rates. The effect of noise for low dimensional QKD protocols has been already studied [Mertz M, Kampermann H, Shadman Z and Bruß D 2013 Phys. Rev. A 87(4) 042312]. Here, we investigate the behavior of secret key rates when one adds some noise before classical processing for a class of high dimensional QKD protocols

281 - Mössbauer and magnetic study of Co(Ti,Sn)xFe2-xO4 nanoferrites

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.281)*

Primary author: *MSOMI, Justice (University of KwaZulu-Natal)*

Sn or Ti-substituted CoFe2O4 ferrite, Co(Ti,Sn)xFe2-xO4 (0≤x≤1.0, in steps of 0.1), fine powders with particle size of about 10 nm were synthesized by high energy ball milling. The compounds were also prepared by hydrothermal process to study the relationship between the preparation processes and the magnetic processes. TEM analysis shows formation of spherical nanoparticles with spherical nanoparticles. Our work indicates that the various synthesis routes can determine the properties of the magnetic nanoparticles. The properties of the nanosized specimen produced are compared to those of bulk samples reported in reference [1]. The Mössbauer spectra indicate ordered magnetic spin state in all the compounds. The evolution of the magnetic properties as a function of particle size is also presented.

283 - High resolution X-ray diffraction and photoluminescence of $InAs_{1-x}Sb_x$/GaSb

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.283)*

Primary author: *DOBSON, Stephen (NMMU)*
Co-authors: *WAGENER, Viera (Nelson Mandela Metropolitan University); WAGENER, Magnus (NMMU); BOTHA, Johannes Reinhardt (NMMU)*

$InAs_{1-x}Sb_x$ has the lowest energy band gap among all the III-V semiconductors and has thus received a great deal of attention as an important material to be incorporated into infrared optoelectronic devices. Photodetectors containing this ternary have potential to reach wavelengths up to 9 µm. To achieve this, high quality thin films with few defects and impurities are required. One of the key issues in using $InAs_{1-x}Sb_x$ in the device architecture (particularly for wavelengths greater than 4 µm) is the lack of available lattice-matched substrates. To date, the best performing InAsSb-containing devices are lattice matched to GaSb substrates, with a 9% antimony solid content. (i.e. $InAs_{0.91}Sb_{0.09}$). This paper focuses on the deposition of high quality thin films of $InAs_{0.91}Sb_{0.09}$ (between 2 µm and 4 µm thick) on 2" GaSb substrate. The material deposition is performed in a metal organic chemical vapour deposition (MOCVD) system. The process begins by the deposition of a thin (nanometer thickness range) low temperature buffer layer of either GaSb followed by the deposition of strain free InAsSb. High resolution X-ray diffraction (HRXRD) is used to precisely determine the composition of the ternary alloy as well as to investigate the uniformity across the entire wafer. Photoluminescence (PL), using a Fourier-transform infrared (FTIR) spectrometer, is employed to further explore the material quality and purity. Preliminary measurements indicate consistent thickness and compositional uniformity of the InAsSb layers.

284 - Electrical characterization of introduced in bulk grown ZnO during electron beam exposure

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.284) [For award: MSc]*

Primary author: *MAYIMELE, Meehleketo Advice (university of Pretoria)*
Co-authors: *AURET, Danie (University of Pretoria); DIALE, Mmantsae (University of Pretoria)*

We have investigated by deep level transient spectroscopy (DLTS) the defects introduced in ZnO during electron beam exposure (EBE). In EBE, the samples were exposed to e-beam conditions, without metal deposition prior to Pd Schottky barrier diodes deposited by resistive evaporation. Melt grown ZnO contains three prominent defects, E1 at EC-120 meV, E3 at EC-300 meV and E4 at EC-690 meV. After the EBE a number of new defects were introduced that were not previously observed after electron beam deposition (EBD). The EBE-induced defects were caused by particles that were implanted during the EBE process and diffused deeper into the ZnO. There was not enough energy available to generate Frenkel pairs, thus the discrete breathers mechanism is required to transfer energy deep into the material to generate E-centers.

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

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.295) [For award: MSc]*

Primary author: *MOKGOLOBOTHO, Makabata Jeremia (University of the Western Cape)*
Co-authors: *ORCE, Nico (University of the Western Cape); WIEDEKING, Mathis (iThemba LABS); JONES, Pete (iThemba LABS); KHESWA, Ntombi (iThemba); BARK, Rob (iThemba LABS); THOMAE, Rainer (iThemba); PAPKA, paul (Stellenbosch University); RAJU, M. Kumar (University of the Western Cape); MEHL, Craig (University of the Western Cape); SINGH, Bhivek (University of the Western Cape); ERASMUS, Nicholas (University of the Western Cape); REBEIRO, Bernadette (University of the Western Cape); TRIAMBAK, Smarajit (University of the Wester Cape); DINOKO, Tshepo (iThemba LABS); ADSLEY, Phillip (iThemba LABS and Stellenbosch University)*

The present study aims at determining the spectroscopic quadrupole moment Q_s, for the first 2^+ excited state in ^{40}Ar by carrying out the first order Coulomb-excitation reorientation-effect measurements of ^{40}Ar beams at safe energies. Only one such measurement [1]was done in the 1970's with unsafe beam energies. We have used the ^{208}Pb (^{40}Ar, ^{40}Ar*)^{208}Pb* reaction at 143.2 MeV, for which the minimum distance of closest approach between the nuclear surfaces is ~ 6.6 fm. The first 2^+ state at 1460 keV in ^{40}Ar is populated via Coulomb-excitation and the de-excited γ-rays are detected using the AFFRODITE clover detector array[2] which comprises of 8 HPGe detectors (5 at 90° and 3 at 135°). The scattered particles are detected in coincidence with γ-rays using a double sided S3 silicon detector which consists of 24 rings (for angular distribution) on one side and 32 sectors (for Doppler correction) on the other. These measurements were done at low beam currents of ~0.5 nA and with the target (1mg.cm^{-2} ^{208}Pb) positioned at 10.05 mm from the S3 detector at backward angles to be sensitive to Q_s. The integrated γ-ray yields per ring carry information about the $Q_s(2^+)$ value and will be compared with the semi-classical coupled-channel Coulomb-excitation code GOSIA. References :1)R. H. Spear, Phys. Rep. 73, 369 (1981).2) M. Lipoglavsek et al., Nucl. Instr. Meth. Phys. Res., A557, 523 (2006).

296 - Multiple chiral bands associated with the same strongly asymmetric many-particle nucleon configuration

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.296)*

Primary author: *SHIRINDA, OBED (iThemba LABS)*
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]. It is revealed by the observation of degenerate $\Delta I = 1$ partner bands [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 existence has been 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 model (TQPRM), confirm that more than one pair of chiral bands may exist in a nucleus with the same two-quasiparticle configuration (this was also reported in [1]). The present work studies the existence and properties of multi chiral bands built on the same many-particle nucleon configuration. Multi-particle-plus-triaxial-rotor (MPR) model calculations were performed for chiral partner bands associated with strongly asymmetric many-particle nucleon configuration in the 100, 130 and 190 mass regions. Multiple chiral systems were found, but they may not necessarily form well defined pairs of near-degenerate bands. The results from these calculations will be presented and discussed.[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)172504This work is supported by the NRF, South Africa.

298 - Sensitivity to New Physics via the study of the Higgs boson transverse momentum at the ATLAS detector

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.298) [For award: Hons]*

Primary author: *GOSSMAN, David (University of the Witwatersrand)*

When simulations based on the Standard Model (SM) of particle physics are compared to actual data obtained by the ATLAS experiment at the CERN Large Hadron Collider (LHC). The observed spectrum in data does not seem to follow well the prediction from the SM. In order to make predictions for higher centre of mass energies at the LHC, simulations of processes resulting in the production of Higgs bosons were done for different centre of mass energies. At the energy scales seen at the LHC, the SM predicts that the main production mechanism for Higgs bosons is gluon fusion. The production of a Higgs boson in this manner must be accompanied by the production of one or more partons in order for the Higgs boson to acquire transvers momentum. If a heavy scalar boson is produced in these interactions which decays into a Higgs boson and some other particle, the emission of this other particle would give the Higgs boson extra transverse momentum above what is predicted by the SM.

301 - Multiwalled nanotube-rare earth magnet (MWNT-Gd) based spin valve design and characterization.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.301) [For award: PhD]*

Primary author: *NCUBE, Siphephile (University of the Witwatersrand)*
Co-author: *BHATTACHARYYA, Somnath (University of the Witwatersrand)*

We report the magneto-transport characteristic of spin valve devices based on Multiwalled nanotube-rare earth element composites. The desired function (switching) is encoded in the composite from which gated devices are fabricated by e-beam lithography. The magnetic field dependent electronic transport characteristics are investigated through the Cryogenic high field measurement system from 2-300 K at different fields. Structural characterization of the material through transmission and scanning electron microscopy, X ray diffraction data and Raman spectroscopy of the pristine and composite is presented. The magnetic characteristics of the pristine MWNTs and MWNT-rare earth composite show the distinct difference in hysteresis loops. The electronic transport shows a magnetic field dependence which is characteristic of spin valve and furthermore this spin valve feature is temperature dependent. This work will find application in spintronics and can be extended to photo physical studies.

302 - Deep level defects in alpha-particle irradiated epitaxially grown silicon

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.302) [For award: MSc]*

Primary author: *DANGA, Helga (University of Pretoria)*
Co-authors: *DIALE, Mmantsae (University of Pretoria); AURET, Francois (Uninersity of Pretoria); COELHO, Sergio (University of Pretoria)*

In this work, we investigated the defects introduced when epitaxially grown silicon was irradiated by making use of a 5.4MeV americium 241 foil radioactive source with a fluence rate of 7×10^{6} cm^{-2} s^{-1} at room temperature. Deep level transient spectroscopy (DLTS) and Laplace-DLTS measurements were used to investigate the electronic properties of the defects introduced. After exposure to alpha-particles with a fluence of 1.3×10^{10} cm^{-2} , the energy levels of the hole traps measured were: EV+0.16eV, EV +0.33eV and EV +0.52eV. EV +0.33eV was identified as the interstitial carbon (Ci) related defect. It was a result of induced damage and could only be explained by the presence of donor-like traps. EV +0.52eV was an electron beam deposition (EBD) process induced defect because of its presence in the as deposited sample. According to literature, this defect is boron impurity related. The identity of EV +0.16eV was not clear.

304 - Microstructural analysis of proton irradiated zircaloy-4

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.304) [For award: MSc]*

Primary author: *MAHAFA, Tshepo (University of Johannesburg and Necsa)*
Co-authors: *FRANKLYN, Chris (Necsa); DANIELS, Graham (Necsa); CARLESCHI, Emanuela (Department of Physics, University of Johannesburg)*

To help understand the microstructural evolution of reactor materials under neutron irradiation, charged particle irradiation of materials in an accelerator environment are carried out. Charged particles have been shown to produce damage effects equivalent to those of neutrons in materials. In this experiment, zircaloy-4 in tubular form was exposed to a pulsed proton beam in a radio frequency quadrupole (RFQ) accelerator at the South African Nuclear Energy Corporation (Necsa). The sample was irradiated to a total dose of 1.19x10E19 ions /cm2. Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and X-ray diffraction (XRD) were used to characterize the induced changes in the materials microstructure. With XRD, a reversal of the residual stress and grain growth were observed after proton irradiation. SEM and TEM revealed crack formation in the microstructure plus grain growth as revealed by XRD.

305 - Thermoluminescence of annealed synthetic quartz

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.305) [For award: MSc]*

Primary author: *MTHWESI, zuko (Rhodes University)*
Co-author: *CHITHAMBO, Makaiko (Rhodes University)*

Thermoluminescence from synthetic quartz annealed at 1000° for 10 minutes has been studied. The sample was exposed to beta irradiation of 10Gy then heated at linear heating rate of 1°/s. The glow curve obtained has three peaks. One known as the main peak, has the highest intensity component while the other two have weaker intensities. This study focuses on the properties of this main peak whose peak position was found at 76&deg.; Kinetic analyses were carried out to determine kinetic parameters such as activation energy (E), frequency factor (s) and order of kinetics (b); using a variety of methods namely initial rise, peak shape and variable heating rate. Observations indicate that the behaviour of this peak is consistent with first-order kinetics. The activation energy was found to be about 1.17eV using the initial rise method and 0.89eV using the variable heating rate method. The frequency factor, a measure of the number of times a trapped electron attempts to escape from its trap was found to be about 4x10^11 Hz. Further work which includes dose dependence study of the main peak is in progress.Key words: Thermoluminescence, synthetic quartz, annealed, glow curve.

307 - Structural and photoluminescence properties of $LaV_{1-x}P_xO_4$:1 mol % Dy^{3+} phosphor powder prepared by solution combustion method

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.307)*

Primary author: *MOTLOUNG, Selepe (University of the Free State)*
Co-authors: *TSHABALALA, Kamohelo (University of the Free State); NTWAEABORWA, Odireleng (University of the Free State)*

$LaV_{1-x}P_xO_4$: 1.0 mol % Dy^{3+} (x=0.0, 0.25, 0.5, 0.75, and 1.0) phosphor powders were prepared by combustion method with different vanadate to phosphate molar concentration. The phosphor powder samples were characterized using x-ray diffraction (XRD) for phase identification. The XRD results for samples with x = 0.0 and x = 1.0 revealed a standard monoclinic structure of LaVO4 and LaPO4 respectively. The diffuse reflectance spectra indicates a broad absorption band around the UV region ranging from 200 nm to 550 nm. The photoluminescence properties were investigated using a Cary Eclipse fluorescence spectrophotometer at the excitation wavelength of 227 nm. Two characteristic emission peaks of Dy^{3+} were observed at λ = 478 nm (blue) and λ = 572 nm (yellow) corresponding to $^4F_{9/2}$ - $^6H_{15/2}$ and $^4F_{9/2}$ - $^6H_{13/2}$ transition of Dy^{3+}, respectively. Furthermore, the PL intensity is the highest when x = 0.5.

309 - Beam experiments with the Grenoble Test Electron Cyclotron Resonance Ion Source at iThemba LABS

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.309)*

Primary author: *NEMULODI, Fhumulani (iThemba LABS)*
Co-authors: *MIRA, J (iThemba LABS); CLOETE, J (iThemba LABS); THOMAE, R. W. (iThemba LABS); CONRADIE, J. L. (iThemba LABS); FOURIE, D (iThemba LABS)*

At iThemba Laboratory for Accelerator Based Sciences (iThemba LABS) a copy of the so-called Grenoble Test Source (GTS) for the production of highly charged ions is installed. The source in combination with the K-200 cyclotron delivers high energy, high intensity beams for nuclear physics experiments.In this talk we present experiments with the GTS2 for Argon beams at iThemba LABS, in which the results of CW, pulsed and afterglow operation for different bias disc position and different supporting gases are compared.

310 - Development of an in-house high precision experimental entanglement source

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.310) [For award: Hons]*

Primary author: *MAXWELL, Christopher (University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa)*
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Quantum entanglement is a fundamental physical concept with applications in communication, computing, biology and chemistry. Binding these principles with new-age technological techniques we can experiment with a higher precision.In this study we confirm the violation of the Bell Inequality result by experimentally constructing a single photon source. This is achieved by a method of Spontaneous Parametric Down Conversion by pumping a non-linear crystal and producing down-converted entangled pairs detected using single photon detectors [1]. The envisaged experiment will generate entangled pairs of photons and test the quality of this source by verifying the Clauser, Horne, Shimony and Holt experimental inequality [2] thereby resolving the Einstein, Podolsky and Rosen paradox[3].In order to realize the above, we are developing a highly efficient, disruptive 'plug and play' entanglement source. The core output will be an easy-to-use commercial product that universities and research institutes can use as an essential tool for further applications of entanglement, in particular quantum key distribution.

311 - Phototransferred thermoluminescence in argon implanted synthetic quartz

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.311)*

Primary author: *NSENGIYUMVA, Schadrack (Rhodes University)*
Co-authors: *MAKAIKO, Chithambo (Rhodes University); LUC, Pichon (University of Poitiers)*

Phototransferred thermoluminescence (PTTL) in synthetic quartz samples implanted with 70 keV Ar ions at fluences ranging from 1x10E14 and 5x10E15 ions/cm2 is reported. Subsequent to 40 Gy beta irradiation and pre-heating, PTTL was monitored as a function of illumination time from the main glow peak at 120°C using a Risø TL/OSL reader. It was observed that the PTTL signal only appears in the sample implanted at higher fluences while absent in other implanted samples. This suggests that at lower fluences the deep traps responsible for the PTTL cannot be accessed. For the sample implanted at higher fluence, the results show that the PTTL intensity increases with illumination time from 3 s to 20 s and then starts decreasing for higher illumination times. The decrease in the PTTL intensity is an indication of a loss of electrons from the trap responsible for PTTL to other traps not giving rise to the PTTL. This is evidenced by an increase in intensity of the glow curve peak at 200°C under the illumination process.

318 - CZTS solar cell: A green energy source produced in a green way.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.318) [For award: MSc]*

Primary author: *FOURIE, Antonie (University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); TERBLANS, JJ (Koos) (UFS)*

A solar cell can be produced by using low-cost, abundant and non-toxic constituent elements. This can be done using inexpensive production methods including electroplating and electron beam evaporation. It is possible to select the constituent elements as well as the chemicals used during the production to have as little as possible environmental impact. A micrometer thick layer of molybdenum evaporated onto soda-lime glass is used as a substrate, the glass can be replaced with a flexible substrate to produce a flexible solar cell. Cu2ZnSnS4 (CZTS) is used as the absorber layer of a solar cell because it is a p-type semiconductor with a bandgap of about 1.45 eV. A Cu-Zn-Sn precursor layer is also electrodeposited in one step using a deep eutectic solution consisting of choline chloride and urea. This type of ionic solution is classified as “green chemistry”, due to the low environmental impact of the chemicals involved. The Cu-Zn-Sn layer is deposited by electron beam evaporation. The CZTS layer is then formed by annealing it in a sulfur containing atmosphere. The rest of the solar cell is an n-type layer consisting of zinc oxide combined with either magnesium or sulfur to modify its conduction band offset, followed by a zinc sulfide window layer. Characterisation of the layers is done using X-ray diffraction, Auger electron spectroscopy, Scanning electron microscopy, X-ray photoelectron spectrometry. Preliminary results will be presented.

322 - Time-evolution studies of thermal sprayed hydroxyapatite coatings

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.322)*

Primary author: NTSOANE, Tshepo *(Necsa)*
Co-author: *TOPIC, Mira (iThemba LABS)*

Coatings of Hydroxyapatite (HAp, Ca5(PO4)3OH), widely used in reconstructive surgery and dental implants, were characterized utilising both conventional and hard X-rays. The samples investigated were prepared by thermal spraying technique deposited under atmospheric conditions. Subsequent to spraying, the samples were incubated in simulated body fluid for periods of time ranging from 1 day to 56 days. The samples were investigated for phase composition and residual stress at time t1, after the incubation. The near-surface results of the as-sprayed and incubated samples show that within the probing depth, the coating experienced tensile residual stresses; relaxing with incubation time. The two major chemical phases, HAp and metastable tetracalcium phosphate (TTCP,Ca4(PO4)2), show an opposite trend, with majority of changes taking place within the first 28 days before levelling off at longer incubation period. Through-thickness results of the as-sprayed sample showed HAp decreasing with depth while TTCP showed an opposite trend. Residual stress varied with depth from compressive to tensile with the neutral axis approximately midpoint below the surface, reaching maxima around the interface region. Further characterisation was carried out on samples from the same batch, left sealed in plastics for approximately 8 years. In this talk, depth-resolved investigation results of residual stress, phase composition and crystallinity of the sample left sealed will be presented. A comparison of the results obtained from measurements carried out at arbitrary time t after incubation and 8 years later will be made. In addition, results of morphological examinations of the coating surface will also be presented.

323 - Optimization of losses introduced by p absorbing mask in a Digital Laser

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.323) [For award: PhD]*

Primary author: BELL, July *(CSIR)*
Co-authors: *NGCOBO, Sandile (Council for Scientific and Industrial Research); FORBES, Andrew (CSIR)*

Using the digital laser one can generate modes of any kind, namely, Laguerre-Gaussian modes. The laser was used generate Laguerre-Gaussian modes, and forced to only select fundamental mode LGp0, by using a mask made up of absorbing circle of with h. It is evident that forcing the fundamental mode of the cavity to be LGp0, reduce losses. Furthermore, circle of mask divided into N parts, show a dramatic reduce of losses, which results in lower threshold power. It is also evident that this does not necessary decrease or increase the slope efficiency of the laser.

325 - Prediction of Structures and Energy stabilities of VO_2 nanoparticles.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.325)*

Primary author: NETSIANDA, Makondelele *(University of Limpopo)*

We have employed a Genetic Algorithm (GA) Hybrid technique as implemented in GULP code to predict the ground-state energies of various small V_nO_{2n} nanoparticles (n = 1-15). The search procedures were based on the GA techniques and the Interatomic Potential (IP) model, and did not refer to any known VO_2 polymorphs. All stable structures were optimized using Density Functional Theory (DFT) employing Dmol code. More importantly, ground state VO_2 nanoparticles (clusters n = 1-3), were identified. The results showed that for n = 1 (VO_2), the energies of both the core and shell candidate structures were found to be similar. As n increases, the symmetry changed from D2h to C2v and the structures became more stable. Interestingly, their atomic arrangements were also observed to be similar to those of TiO_2. Furthermore, the O-V-O bond angles for both the core and shell models (111.2o) compare well with those for titania (111.4o).

329 - Effect of Pb doping and annealing temperature on the structural and optical properties ZnO nanoparticles synthesized by sol-gel method

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.329)*

Primary author: DEJENE, Francis *(University of the Free State)*
Co-author: *ALI, Abdub (University of the Free State)*

Un-doped and Pb-doped ZnO nanoparticles were successfully synthesized in an ethanolic solution by using a sol-gel method. Structural and optical properties of the samples dependence on annealing temperatures and Pb concentrations were investigated while other parameters were kept constant to ensure reproducibility. It was observed that the structural properties, particle size, band gap, photoluminescence intensity and wavelength of maximum intensity were influenced by the amount of Pb ions present in the precursor and the annealing temperature. The XRD spectra for ZnO nanoparticles show the entire peaks corresponding to the various planes of wurtzite structure, indicating a monophasic material. The diffraction peaks of doped samples are slightly shifted to lower angles with an increase in the Pb ion concentration, signifying the expansion of the lattice constants and increase in the band gap of ZnO. All the samples show the absorption in the visible region. The absorbance spectra show that the excitonic absorption peak shifts slightly towards the lower wavelength side with the Pb-doped ZnO nanoparticles. The PL spectra of Pb-doped ZnO consist of UV emission at 340 nm and two broad visible emissions at 370 and 460 nm with varying relative peak intensities. The amount of Pb concentrations red shifts the 460 nm emission but other emissions are hardly affected. The doping of ZnO with Pb amount up 2 mol% enhances significantly the defects emission but quenches thereafter while UV luminescence is hardly affected. The SEM images also clearly show the change in shape and size of ZnO nano particles with increase in annealing temperature.

330 - Orientation of the Ge crystals of the iThemba LABS segmented clover detector

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.330)*

Primary author: DINOKO, Tshepo *(iThemba LABS)*
Co-authors: *LAWRIE, Elena (iThemba LABS); BUCHER, Daphney (iThemba LABS); SHIRINDA, Obed (iThemba LABS); NONCOLELA, Sive (iThemba LABS); EASTON, Jayson (iThemba LABS); ERASMUS, Nicolas (iThemba LABS)*

The iThemba LABS segmented detector include four Ge crystals in a clover configuration in a single cryostat [1]. The orientation of the Ge crystals inside the cryostat is measured with a collimated source, where the axis of the collimator is perpendicular to the front face of the detector cryostat. In addition, the orientation of the crystal lattice is being investigated by measuring the T30 and T90 rise times. This orientation plays a crucial role in the correct simulation of the charge collection and generating realistic pulse shapes.[1] F. A. Beck, et al., Proceedings of Workshop on Large g Ray Detector Arrays, Chalk River, AECL-10613. 1994, p. 359.

331 - Preparation and electrochemical investigation of the cobalt hydroxide carbonate/activated carbon nanocomposite for supercapacitor applications

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.331) [For award: PhD]*

Primary author: MASIKHWA, Tshifhiwa Moureen *(University of Pretoria)*
Co-authors: *BARZEGAR, Farshad (university of pretoria); MADITO, Moshawe J (university of pretoria); DANGBEGNON, Julien. K. (university of pretoria); MANYALA, Ncholu. (university of pretoria); BELLO, Abdulhakeem (university of pretoria); MOMODU, Damilola. Y. (university of pretoria)*

Cobalt hydroxide carbonate/Activated carbon (AC) composites were successfully synthesized by the hydrothermal method. Morphological characterization of the composites was performed by scanning electron microscopy (SEM), and the results show that AC (activated carbon) was well dispersed in the loosely packed cobalt hydroxide nanorods. The structure and the optical characteristics of the composites were further characterized by XRD and FTIR respectively. Because of the synergistic effects coming from cobalt hydroxide carbonate nanorods and AC, the electrochemical performances of pure cobalt hydroxide carbonate material were significantly improved by adding AC. The cobalt hydroxide carbonate/activated carbon composites showed a specific capacitance of 273.43 F g-1 at a current density of 1 A g−1 in 6 M KOH electrolyte. Furthermore, these composites exhibited good cycling stability and lifetime. Therefore, based on the above investigation, such cobalt hydroxide carbonate/activated carbon composites could be a potential candidate for supercapacitors.

333 - Quantum Key Distribution Using Entangled Source

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.333) [For award: Hons]*

Primary author: SHABALALA, Lizwi *(UKZN)*
Co-authors: *ISMAIL, Yaseera (UKZN); MIRZA, Abdul (UKZN); PETRUCCIONE, Francesco (UKZN)*

Shabalala L, Ismail Y, Mirza A and Petruccione FQuantum Key Distribution (QKD) is the physical process that uses quantum mechanics to secure the communication. QKD is a means of generating a secured key shared between two parties using quantum channel and an authenticated classical channel [1]. A QKD scheme requires the use of entangled photons.Quantum entanglement is a fundamental physical concept with applications in quantum key distribution, computing, biology and chemistry. It can be implemented by a process known as spontaneous parametric down conversion [2]. This process uses a nonlinear crystal to split photons in accordance with the conservation laws of energy and momentum. In this paper an entangled single photon source will be constructed and optimized to perform a quantum key distribution protocol. This will be implemented by performing the Ekert protocol [3] by making use of the polarization state of a single photon. The goal for this research is to develop the high efficiency source of entanglement that will be easy to use.

334 - Synthesis of ZnO nanoparticles by Green process and investigation of their growth mechanism

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.334) [For award: MSc]*

Primary author: NETHAVHANANI, Takalani *(University of the Western Cape; iThemba LABS)*
Co-authors: *DIALLO, Abdoulaye (iThemba LABS-National Research Foundation); MADJOE, Reginaldt (University of the Western Cape); MAAZA, Malik (Nanosciences African Network (NANOAFNET), iThemba LABS-National Research Foundation; UNESCO-UNISA Africa Chair in Nanosciences-Nanotechnology, College of Graduate Studies, University of South Africa)*

ZnO is a wide band-gap semiconductor (~3.7 eV) at room temperature with a wurtzite crystal structure. It has attracted a significant interest worldwide above its initial potentiality as the ideal candidate for blue-UV light emitting diodes applications. Its multifunctionality as a transparent conducting oxide, effective piezoelectric and an efficient catalyst support among others, has made it as one of the most studied simple oxide in its nano form in the modern era.Nano-scaled ZnO has been synthesized in a plethora of shapes. A variety of physical and chemical methodologies were used to synthesize undoped or doped ZnO. The physical methods necessitate high vacuum and relatively high temperatures. The chemical routes have been proved to be suitable in preparing various ZnO nanostructures due to their low growth temperature, cost effectiveness, and potential for mass production. The chemical route has the disadvantage of using chemical compounds/organic solvents as reducing agents which can be toxic as well as not easy in treatment of the waste end product. Green “physical-chemistry” approach which is based on using biogenic processes, reduces the pollution risk at source level and avoids waste rather than treat or clean it up after it is formed. More accurately, biogenic processes whereby the precursor of the nano-material to be synthesized is reduced/oxidized effectively via a biochemical interaction with the active compounds of the natural system, is gaining a global momentum. Plants’ natural extracts mediated biosynthesis are used to synthesize at a certain extent oxide nanoparticles.This contribution reports on the synthesis and the main physical properties of nano-scaled pure ZnO particles synthesized for the first time by a completely green chemistry process using Aspalathus Linearis’s natural extract as an effective chemical reduction agent without addition of any acid or base standard component.

340 - Fringe Fitting Calibration of VLBI Data

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: D1.340)*

Primary author: *AKOTO-DANSO, Alexander (Rhodes University, Grahamstown)*

Models in VLBI correlators usually presents its own errors. The causes, effects and methods of correcting these correlator models will be presented. Fringe Fitting calibration which is basically applied to VLBI data and not connected interferometer is basically any process of estimating the delay and or rate residuals. This is done by either applying a least squares method or Fast Fourier Methods.The aim of this research is to determine the delay and the rate of the data obtained at selected stations of a VLBI experiment, calibrate it and then develop a pipeline for the results.To achieve this, the three(3) fringe fitting techniques , namely; baseline, baseline with closure constrains and global fringe fitting techniques will be employed. The corrections for the residual delay and the rate errors can then be made as phase corrections as a function of time and frequency. These will take into consideration polarisation data.

341 - Electrical characterization of 5.4 MeV alpha particle irradiated, low doped n-type Gallium Arsenide.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.341) [For award: MSc]*

Primary author: *TUNHUMA, Shandirai (University of Pretoria)*
Co-authors: *AURET, Danie (University of Pretoria); DIALE, Mmantsae (University of Pretoria)*

Gold Schottky diodes were fabricated on n-type GaAs with a free carrier density of 1E15. The diodes had excellent rectification properties with an ideality factor of 1.03 signifying the dominance of the thermionic emission process in charge transport across the barrier. The diodes were irradiated with alpha particles up to a fluence of 2.56×■10■^10 ■cm■ ^2. Deep level transient spectroscopy (DLTS) performed on these contacts in the 15-300K range revealed the prominent well known radiation induced defects E1-E3. Laplace deep level spectroscopy split the E3 defect into two components, revealing the metastable E3 component with an activation enthalpy of 0.38eV. Current-voltage (I-V) and Capacitance-voltage (C-V) measurements revealed degraded diode characteristics after irradiation, with the reverse saturation leakage current and the free carrier density being the most susceptible.

342 - Fibre-to-the-Hut Technology: A Solution to Cheap Access for High-Speed Optical Network in South Africa

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.342) [For award: PhD]*

Primary author: *ISOE, George (Optical Fibre Research Unit,Nelson Mandela Metropolitan University)*
Co-authors: *ROTICH KIPNOO, Enoch (Optical Fibre Research Unit,Nelson Mandela Metropolitan University); GAMATHAM, Romeo (Square Kilometre Array Project (SKA), South Africa); LEITCH, Andrew (Optical Fibre Research Unit,Nelson Mandela Metropolitan University); GIBBON, Tim (Optical Fibre Research Unit,Nelson Mandela Metropolitan University)*

Fibre-to-the-Home (FTTH) is a technology where optical fibre networks are deployed from a central access point to individual homes to provide high-speed broadband access. FTTH has been most successfully deployed in countries with high population density within large cities and urban centres and high per capital income. However, African countries are still facing some challenges like uneven population distribution with isolated remote villages and socio-economic challenges. This hinders the implementation of traditional FTTH solutions in Africa. It is for these reasons that we specially customize the FTTH based on challenges facing Africa and design a Fibre-to-the-Hut (FTTHut) optical network to suit the African scenario. We propose the use of VCSEL within a Raman amplified optical fibre framework to support FTTHut technology in South Africa. VCSELs offer high bandwidth at low drive currents, while Fibre Raman amplifiers offer longer amplification spans. We therefore investigate experimentally the Noise Figure (NF) and Optical Signal to Noise Ratio (OSNR) of a Fibre Raman Amplifier (FRA) using a VCSEL as a signal source. A 1550nm VCSEL is directly modulated with an effective bit rate of 4.25 Gbps. An (OSNR) of 6.8 dB and 6.4 dB was achieved for co- and counter pumping schemes, respectively, for 25 km SMF-Reach. An (OSNR) of 4.5 dB and 4.3 dB was attained for 50 km fibre for co- and counter pumping respectively. A NF of -1.3dB and -0.7 dB was achieved for Co- and Counter pumping schemes, respectively, for 25 km fibre at 23 dB pump power. The NF also increased with increase in fibre. This work is extremely valuable in providing South Africa with increased Hut-to-Hut broadband access especially in long-reach networks serving rural populations at reasonable low cost.

344 - New Minimization Techniques, Solvers and Calibration Algorithms

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: D1.344) [For award: MSc]*

Primary author: *SEBOKOLODI, Makhuduga (RU)*

The improved sensitivity of SKA pathfinder and precursor instruments poses interesting calibration and imaging challenges. The higher sensitivity means that spurious emission induced by the calibration process - which has been hidden below the noise with less sensitive instruments – may limit the dynamic range capabilities of these instruments. Experience with the JVLA and WSRT instruments suggest that this spurious emission is generally characteristic of the observing instrument. In this work, we aim to exploit our knowledge of the instrument (e.g, the point spread function and the primary beam) in an attempt to find a reliable technique that distinguishes between astrophysical and spurious emission. Assuming that the noise in a radio map is symmetric about zero and that astrophysical emission is positive, other work has shown that noise artefacts can be distinguished from astrophysical emission by studying the properties of high negative peaks. In our case, we know that calibration artefacts tend to the follow the point spread function, which while not symmetric about zero, may have a quasi-symmetry if one considers the first few successive peaks and troughs of the sidelobes. With our implementation of the technique described in the work of Serra et al., we have been able to correctly classify spurious emission using JVLA data. Using simulated JVLA data, we have studied the impact of SNR, source position (w.r.t the pointing centre), and length of observation on our ability to classify calibration artefacts using this technique.

348 - Creating and Measuring 2 µm Light Using a Spatial Light Modulator

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.348) [For award: PhD]*

Primary author: *MAWEZA, Loyiso (CSIR)*
Co-authors: *DUDLEY, Angela (Council for Sientific and Industrial Research); LITVIN, Igor (CSIR NLC); FORBES, Andrew (CSIR); STRAUSS, Hencharl (CSIR (National Laser Centre))*

It has been extensively shown that a Spatial Light Modulator (SLM) can create different shapes of light in the visible and near Infra red (IR). This requires proper calibration of the SLM to verify that for this wavelength, a phase shift from 0 to 2π occurs successfully over all the 256 grey-levels. The process is achieved by introducing a phase shift on one of the two interfering plane waves while the other is kept constant. The resulting shift of the interference pattern is directly proportional to the phase shift the beam experiences. We plan to demonstrate the SLM operation in the Mid IR region for the first time as this will prove useful for optical communications and defence applications. Here the SLM also needs to be calibrated so that it achieves a 0 to 2■ phase shift. Furthermore, as in the visible region, we can develop for these applications, non diffractive 2 µm Bessel or Bessel like beams (BLB) and vortex beams which have several advantages. With an SLM we can generate and exploit the Bessel beams' strong diffraction resistance and self-healing properties.

349 - Analysis of temperature models for the computation of global solar radiation in the climatic conditions of Western Cape province of South Africa

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.349) [For award: PhD]*

Primary author: *NEMANGWELE, Fhulufhelo (University of Venda)*
Co-authors: *MALUTA, Nditsheni Eric (University of Venda); SANKARAN, Vaith (University of Venda); MULAUDZI, Tshimangadzo Sophie (University of Venda)*

Solar radiation is a crucial parameter in designing solar power devices, installation of solar technologies systems etc. These data are usually not available for most areas due to the lack of weather stations especially in developing countries. An attempt has been made to study the two different temperature models to determine the global solar radiation for the climatic conditions of Western Cape Province of South Africa. These empirical relations available in the literatures use the temperature weather station data which can be easily measured using the minimum and maximum thermometers. The weather station temperature data from the Agricultural Research council (ARC) and South African Weather Services (SAWS) are used in the present study to evaluate these temperature based models for few stations in Western Cape Province. The computed global solar radiation data for these stations have been compared with the experimentally observed solar radiation data received from ARC and SAWS. We observe a reasonable comparison between the computed and observed global solar radiation, which suggests that these temperature based models can be used to estimate the global solar radiation for the climatic conditions of the Western Cape province of South Africa.

350 - Phase noise analysis for 1.7-14.5 GHz clock signal transmission over 12km telescope network optical fibre

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.350) [For award: MSc]*

Primary author: *DLAMINI, Phumla (optical fibre research unit (nelson mandela metropolitan university))*
Co-authors: *GAMATHAM, Romeo (Nelson Mandela Metropolitan University); LEITCH, Andrew (NMMU); GIBBON, Timothy (NMMU Physics Department)*

Distribution of highly stable clock tones over optical fibre from the central station to each antenna is of extreme importance to MeerKat and the overall SKA Square Kilometer Array) project. This ensures that the timing signal correctly drives the digitizer and time stamping for data identification. Short-term stability of the clock distribution can be specified in the frequency domain as phase noise and as jitter in the time domain. The phase of a signal can have random and/or deterministic parts of phase noise. Component noise is introduced by devices such as laser transmitters, amplifiers, and receivers, while thermal effects in the fibre can cause phase instability. A detailed phase noise analysis is performed at different points in the optical fibre clock distribution link. RF signals from 1.7 to 14.5GHz are transmitted over 12km of fibre. The contribution of phase noise is simulated and analyzed for different components towards achieving phase noise of -130dBc/Hz at an offset frequency of 100Hz. This corresponds to clock signal stability of a few femtoseconds RMS jitter.

357 - Single muon pT distributions from heavy quark decay in pp collisions at 7 TeV with ALICE

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.357) [For award: MSc]*

Primary author: *DINDIKAZI, Nomvelo (University of Zululand)*
Co-authors: *BUTHELEZI, Zinhle (iThemba LABS); FÖRTSCH, Siege (iThemba LABS); DIETEL, Tom (UCT)*

The study of matter under extreme conditions known as the quark gluon plasma (QGP) is key to the understanding of the early universe. The QGP is a high-density Quantum Chromodynamic (QCD) medium of "free" quarks and gluons (deconfinement), expected to form at high temperature and density where quark and gluon degrees of freedom dominate.The Large Hadron Collider (LHC) has 4 major experiments, one of which is ALICE (A Large Ion Collider Experiment) - 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 lead-lead collisions and in physics areas where ALICE is competitive with other LHC experiments.Heavy quarks which consist of charm and beauty quarks are formed in the initial stages of the collision through gluon fusion which is a dominant process at the LHC. The study of heavy quark production in proton-proton collisions at the LHC provides an important test of perturbative Quantum Chromodynamics (pQCD) calculations, particularly in the forward rapidity of ALICE ($2.5 < y < 4$) where their production is expected to be sensitive to Bjorken-x values down to ~ $6 \cdot 10^{-6}$ - $2 \cdot 10^{-5}$. In addition, the investigation of heavy quark production in proton-proton collisions also constitutes an essential baseline for the corresponding measurements in heavy ion collisions. In this study the production of heavy quarks is measured via the contribution of their muonic decay to the inclusive pT-differential muon yield reconstructed with the muon spectrometer at forward rapidity ($-4 < \eta < -2.5$).

359 - A circular current's bi-Cartesian magnetic dipolar model and the bias in

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.359)*

Primary author: CHIRWA, Max *(Walter Sisulu University)*

Traditional reliance on deriving fields from potentials where there is symmetry does not explain generally why this may or may not be successful. In our bi-Cartesian dipolar model of a circular current, it shows that for each Cartesian component distribution of current its magnetic field at any field point is the curl of its own Cartesian component of the magnetic vector potential. We present various pre-evaluated magnetic vector potentials and determine whether their curls are equal to their own (but equally functionally limited) magnetic fields or not. Traditional set ups in which a circular current's magnetic fields are derived from potentials are in this class of pre-evaluated magnetic vector potentials. Thus the traditional an hoc definition of a circular current's magnetic dipolar moment is based on functionally limited component magnetic vector potentials, and is incorrect by a factor of 2. Finally we show an example from literature where pre-evaluation of a function is reckless.

361 - Fabrication and Characterisation of CdO-CNS hybrid for LPG Sensing

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.361)*

Primary author: SEFAGE, Amanda *(Student)*
Co-authors: *NDWANDWE, Muzi (Supervisor); DHONGE, Baban (Co-Supervisor); MBUYISA, Puleng (University of Zululand)*

In this research work Cadmium oxide (CdO) nanorods were synthesised by chemical bath deposition on a CdO film deposited via DC sputtering deposition on a silicon substrate. The produced nanorods were characterized by scanning electron microscope (SEM), Atomic force microscope (AFM), X-ray diffraction (XRD),and Rutherford backscattering spectrometry (RBS). CdO-Carbon nanostructures hybrids were grown by acetylene chemical vapour deposition on the nanorods at different temperatures with the CdO rods as the catalyst for the carbon nanostructures growth. The different structures grown using the two different techniques were exposed to LPG and Nitrogen gases while monitoring the change in the sensors electrical resistances. The gas sensing responses shows different sensing abilities of the sensors at different operating temperatures and different gas concentrations.

362 - FPGA- based implementation of cascade error correction protocol for QKD applications

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.362) [For award: MSc]*

Primary author: QWABE, Henry Simphiwe *(University of KwaZulu-Natal)*
Co-authors: *SENEKANE, Makhamisa (Quantum Research Group, School of Chemistry and Physics, University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa); MIRZA, Abdul (UKZN); PETRUCCIONE, Francesco (UKZN)*

Quantum Key Distribution (QKD) uses quantum mechanical concepts such as Heisenberg Uncertainty Principle, quantum no-cloning theorem and entanglement to ensure a secure communication between two communicating parties, commonly referred to as Alice (the sender) and Bob (the receiver) in such a way that the presence of an eavesdropper (conventionally called Eve) could be revealed. It provides information-theoretic security in the sense that it does not place assumptions on the computational capabilities of Eve. QKD implementation involves several steps namely; quantum communication, sifting, error correction and privacy amplification. Error correction step is responsible for correcting all the bits in the key string that are incorrect, in order to ensure that both Alice and Bob reconcile errors in their respective keys. Cascade is the most commonly used protocol for error correction in QKD. This is due to the fact that it is the most efficient error correction protocol. We report the implementation of Cascade error correction protocol using Field Programmable Gate Array technology. The results obtained underline the utility of the implementation for error correction in QKD.

363 - Active phase correction using a VCSEL for clock tones transmitted along a 24 km optical fibre link

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.363) [For award: PhD]*

Primary author: WASSIN, Shukree *(NMMU)*
Co-authors: *GIBBON, Timothy (NMMU Physics Department); GAMATHAM, Romeo (Nelson Mandela Metropolitan University); LEITCH, Andrew (NMMU)*

Abstract- Africa, together with Australia will host the world's larger radio telescope, the Square Kilometre Array (SKA). The combined surface area of the dishes or telescopes within the SKA equates one million square metres. Stable clock tones are essential for time stamping the received data and for driving the digitizers located at the individual antennae. Furthermore the dissemination of high precision, stable clock tones via optical fibre from the principle processing station to each dish is a primary requirement for the SKA. Temperature variations and vibrations give rise to temporal changes along an optical fibre link. These factors result in the random variations of optical path and refractive index properties of the optical fibre. In this paper, an active phase compensation scheme based on real time phase correction is proposed. This technique exploits the wavelength tuneability of a 4.25 Gbps vertical cavity surface emitting laser (VCSEL), along with the inherent chromatic dispersion properties of the fibre. The fundamental principle for phase delay correction up to 1702.77 ps is proposed, along a 24 km G.652 single mode optical fibre, by tuning the VCSEL across a 3.95 nm wavelength range. The active phase correction occurred within the lower frequency region of the X-band (8 – 14.5 GHz) around the 1550 nm transmission region.

372 - Characterisation of municipal organic waste for microwave plasma gasification

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.372) [For award: MSc]*

Primary author: NGUBELANGA, Nolitha *(University of Fort Hare)*
Co-authors: *MAMPHWELI, Sampson (University of Fort Hare); AGHDASI, Farhard (University of Fort Hare); AJIBADE, Peter (University of Fort Hare)*

The inadequate supply of energy in the country has become critical. The use of fossil fuels, which contribute more than 90% of the South African electricity production cause a lot of environmental challenges. There is a global shift towards alternative sources of energy that are sustainable, environmentally friendly and locally available. Municipal organic waste is considered a source of renewable energy and plasma gasification is considered one of the leading-edge technologies to harness the energy.South Africa produces approximately 20 million tons of organic waste every year, which is decomposed of in dumping sites and landfills. Its decomposition releases greenhouse gasses such as Carbon Dioxide and Methane into the atmosphere.This research involves the characterization and kinetic analysis of municipal organic waste including garden waste and food waste. These will be analysed in comparison with the requirements for the plasma gasification process. Proximate analysis of the organic waste will be conducted to determine the moisture content, volatile matter, ash and fixed carbon using thermogravimetric analysis. Ultimate analysis will be conducted to determine the quantity of chemical elements such as carbon, hydrogen, oxygen, sulphur and ash using a CNHS Analyser and energy dispersive spectroscopy. The calorific value of the organic component of municipal organic waste will be determined by using an oxygen calorimeter. The results from the Thermogravimetric Analyzer (TGA) will also be used to study the chemical kinetics of the municipal organic waste. The final paper will present the results obtained

373 - The full spacetime description of jet evolution in the weakly coupled regime

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.373) [For award: MSc]*

Primary author: MEIRING, Ben *(University of Cape Town)*

Strong coupling methods have shown success in describing the energy loss of jets moving through the quark-gluon plasma, but the initial conditions of these particles should be governed by weakly coupled physics. We use finite-time perturbative methods to derive expressions detailing the weakly coupled system which exists during the initial stages of a high energy collision. Further, we define the Quantum Field Theoretic conditional expectation value in an effort to describe jet production in heavy ion physics.

374 - Density functional theory calculation of surface properties of pyrite (100) and depression of pyrite using TGA.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.374) [For award: PhD]*

Primary author: MULAUDZI, Masilu Godfrey *(University of Limpopo)*
Co-author: *NGOEPE, Phuthi (University of Limpopo)*

The structural relaxation, atomic Mulliken populations and electronic structures of ideal pyrite (100) surface were calculated using density functional theory (DFT). The calculated results show that the relaxation of pyrite (100) surface is relatively small, and the Fe-S interaction increases at the surface compared to that in the bulk. The calculated electronic structure results suggest that the surface 5-coordinated Fe atom has high activity. Adsorption of TGA on FeS_2 (100) surfaces is investigated, and results for $CaOH^+$ and OH^- adsorption on FeS_2 (100) which are important in the depression process are also reported. The adsorption of thiolglycolic acid, hydroxyl and calcium hydroxyl ions (TGA, OH^- and $CaOH^-$) on pyrite (100) surfaces was studied using first-principles calculations to investigate the depression of pyrite by TGA, NaOH and CaO. The calculation results showed that the adsorption of $CaOH^+$ on pyrite surfaces was stronger than the adsorption of OH^- and TGA. The surface Fe atoms were the active sites for the three adsorbates. The OH obtained electrons from the surface, whereas TGA and $CaOH^+$ lost electrons to the surface. The loss of electrons resulted in the accumulation of electrons on the surface, which hindered the oxidation of pyrite and the formation of dixanthogen.

377 - Electrical characteristics of Pd Schottky contacts on ZnO and AZO nanoparticles

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.377)*

Primary author: NAMBALA, Fred Joe *(University of Pretoria)*
Co-author: *DIALE, Mmantsae (University of Pretoria)*

Aluminium (Al) doped Zinc oxide (ZnO), AZO, of different Al atomic percentages was prepared by a sol-gel method and deposited on microscope glass plates (SiO2) and a-Si/SiO2 substrates. Resistivity and Hall measurements were conducted on the samples. Palladium (Pd) contacts were deposited on the AZO nanoparticles by resistive evaporation. Current–voltage (I–V) and capacitance–voltage (C–V) measurements were performed on Pd /ZnO nanoparticles Schottky contacts at room temperature (RT) and in the range 60–300 K. The ideality factor (n), barrier height (ΦB) and carrier concentrations (ND) were calculated from the forward bias characteristics. Using temperature dependent I—V characteristics, the barrier height was observed to increase with increasing temperature. The C–V barrier height decreases with temperature increase.

380 - A comparative study of the three empirical solar models in North West, South Africa.

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: G.380) [For award: PhD]*

Primary author: *MULAUDZI, Sophie (University of Venda)*
Co-authors: *MALUTA, Eric (University of Venda); NEMANGWELE, Fulufhelo (University of Venda)*

Energy crisis in South Africa (SA) is causing a lot of problems for every one and it has a negative impact on the growth of our economy. There is a dire need to implement the 2020 strategies to harness renewable energy and evidently it needs the knowledge of the amount of solar energy falling in different areas of SA. With this knowledge the renewable energy systems can be meaningfully developed so as to sustain the outdoor conditions. The use of pyrheliometers, pyranometers, etc., to measure direct, global, etc., also plays an important role. However they cannot be installed in many areas due to lack of funds, the alternative method is to estimate these irradiances. It is of a vital importance that a model to be selected should give a reasonable estimate. This paper gives a comparative study of three modified empirical solar radiation models (Angstrom; Hargreaves & Samani and Glower & McCulloch) on a horizontal surface from sunshine hours and temperatures of different stations in North West (-■25.8080■^°;■25.5430■^°). A five year meteorological data from the four ARC stations were used to estimate the global solar radiation for this region. The estimated monthly solar irradiance data was compared with observed data using the statistical parameters such as, the mean bias error (MBE); Mean percentage error (MPE) and root mean square (RMSE). The Angstrom and temperature based models give better estimations for North West province.

382 - Iron bearing minerals characterised with Mossbauer spectroscopy at the Mineral Processing and Technology Research Centre , University of Johannesburg, South Africa

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.382)*

Primary author: *MULABA-BAFUBIANDI, Antoine-Floribert (University of Johannesburg)*

57Fe Mossbauer spectroscopy has been extensively used at the Mineral processing and technology research centre of the University of Johannesburg. Geophagic claya raw materials as well as processed products were characterised. Calcines emanating from the Nkomati nickel bearing concentrate roasted at different temperature (5500C; 650 0C; 750 0C 850 0C and 950 0C) were studied at room temperature while the beneficiation of chromite minerals, through magnetic separation and gravity concentration steps, from the PGM's flotation tailings was monitored using Mossbauer spectroscopy. This paper discusses results obtained from all the above extraction metallurgy processes as elucidated by Mossbauer spectroscopy at the Faculty of Engineering of the University of Johannesburg.

391 - Simonkolleite-graphene foam composites and their superior electrochemical performance

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.391) [For award: PhD]*

Primary author: *MOMODU, Damilola (UNIVERSITY OF PRETORIA)*
Co-authors: *BARZEGAR, farshad (University of Pretoria); BELLO, Abdulhakeem (Department of Physics University of Pretoria); DANGBEGNON, Kouadio Julien (University of Pretoria); MASIKHWA, Tshifhiwa Moureen (University of Pretoria); MADITO, Moshawe Jack (University of Pretoria); MANYALA, Ncholu (University of Pretoria)*

Simonkolleite-graphene foam (SimonK/GF) composite has been synthesized by a facile solvothermal and environmentally friendly technique with excellent electrochemical properties. The obtained product was initially analyzed by scanning electron microscopy (SEM), Brunauer–Emmett–Teller (BET), X-ray diffraction (XRD), Fourier Transform Infrared Resonance (FTIR) Spectroscopy and Cyclic Voltammetry (CV) techniques. The microscopy results reveal hexagonal sheets interlaced with each other and adjacent graphene sheets. The existence of graphene foam in the simonK/GF composite is further confirmed from the structural and the optical characteristics obtained from XRD and FTIR respectively. The BET results obtained indicate an improvement in the surface area due to the addition of graphene foam to a value of 39.58 m2 g-1. The N2 adsorption/desorption also shows the presence of active mesopores required for charge transport. As a promising electrode material for supercapacitors, the composite shows a high specific capacitance value of 1094 F/g at 1 A/g with a coulombic efficiency of 99.7% even after 1000 charge-discharge cycles. These results show a potential for adoption of this composite in energy storage applications.

394 - Morphological and elemental properties of sugarcane bagasse for gasification purposes

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.394) [For award: MSc]*

Primary author: *KULA, Mpumezo (University of Fort Hare)*
Co-authors: *MAMPHWELI, Sampson (University of Fort Hare); OKOH, Omobola (University of Fort Hare); REDDY, Prashant (DUT)*

Gasification of biomass for production of heat and power has become an attractive research area in recent years. This is as a result of the challenges associated with the use of non-renewable resources such as fossil fuels. Gasification, when compared to other thermochemical conversion mechanisms such as combustion and pyrolysis, has proven to be an efficient means of converting biomass to a gaseous product with more flexible applications. Sugarcane bagasse is the fibrous residue remaining after the extraction of the sucrose-rich juice from sugarcane stalks. Previously excess sugarcane bagasse was burned as a means of solid waste disposal but has presently been identified as a valuable feedstock for gasification and combustion in boilers. Sugarcane basically contains high levels of silicon (Si) and oxygen (O2) as a plant. These react to form silica during the gasification of sugarcane bagasse. Silica has impacts on the operation of a downdraft gasifier and affects the gas production. Channeling, slagging and sintering of ash and other by products in the gasifiers are some of the problems caused by silica. Sugarcane bagasse varies in chemical composition and physical properties which is traceable to the climate and soil in which it is grown, variety of cane, level of washing and the harvesting method employed. Hence characterization of sugarcane is essential for its efficient use as a feedstock during gasification. This research addresses the impacts of silica during the gasification of sugarcane bagasse in a downdraft gasifier. Silica levels will be traced from the sugarcane bagasse before and after gasification. Washed and unwashed bagasse will be used for the experiments. Detailed elemental and morphological characterization of washed, unwashed and depithed sugarcane bagasse will be presented in this report.

398 - Soweto Science Centre as a community engagement initiative at the University of Johannesburg

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.398)*

Primary author: *NAIR, Padmanabhan (University of Johannesburg)*
Co-authors: *REDDY, Leelakrishna (University of Johannesburg); RAMAILA, Sam (University of Johannesburg); MATHE, Themba (University of Johannesburg); MURONGA, Azwinndini (University of Johannesburg)*

University of Johannesburg is championing a community engagement programme which makes provision for tutoring of learners in the Further Education and Training (FET) band by providing contact sessions on Fridays and Saturdays at its Soweto Science Centre. There has been overwhelming participation by Grade 10, 11 and 12 learners coming from schools in and around Soweto Township in this flagship programme over the years. Prior to the commencement of coaching, learners' pre-entry characteristics in terms of topics taught at schools are established through carefully structured knowledge, synthesis and application-type questions. Learners' content knowledge in topics such as vectors, equations of motion and energy presumably taught at school in Grade 10 was assessed by means of a diagnostic test. The findings of this research revealed inadequacy in relation to the Physics content taught at schools and the competency of the FET teachers in the Physics content thereof. Key findings that emerged from this investigation appear to be consistent with well-documented subject knowledge deficiencies prevailing amongst Physical Science teachers.

401 - Cross-section Electron Microscopy studies of Boron Implanted Hexagonal Boron Nitride

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.401)*

Primary author: *ARADI, Emily (University of the Witwatersrand)*
Co-author: *DERRY, Trevor (university of the Witwatersrand)*

We have reported on the use of ion implantation as a technique to modify hexagonal boron nitride (h-BN) material to nanocrystalline cubic boron nitride (nc-BN). Single crystal h-BN was implanted with boron ion at 150 keV at fluence of 5×10^2 ions/cm^2. Transmission Electron Microscopy (TEM) measurements were carried out using the High Angle Annular Dark-Field Scanning Electron Microscopy (HAADF-STEM) mode, which showed a density contrast in the sample after implantation, with regions of low contrast representing the high density c-BN symmetry. Raman spectroscopy showed that there is a new vibrational mode observed in the spectrum after implantation which corresponded to nc-BN. Phonon confinement model was used to investigate the size of the c-BN nanoparticles created by ion implantation.

402 - Quantum State Tomography

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.402) [For award: Hons]*

Primary author:*HLONGWANE, Senzo (Y. Ismail, M. Abdul, F. Petruccione)*
Co-authors: *PETRUCCIONE, Francesco (UKZN); ISMAIL, Yaseera (UKZN); MIRZA, Abdul (UKZN)*

Quantum entanglement is a physical phenomenon that occurs when groups of particles are generated such that the quantum state of each particle cannot be described independently [1]. Entanglement sources generate photon pairs in a certain quantum state. By a process of spontaneous parametric down conservation photons can be converted into a photon pair within a nonlinear crystal. These generated photons pairs can be characterised by a process of state tomography. A state tomography is a method of reconstructing the quantum state of a system by carrying out measurements on the system. This is achieved by carrying out measurements on the state with multiple modifications of the measurement apparatus [2].In this study, a scheme for a quantum state tomography is presented that can be performed for polarized light with an arbitrary state. In this experiment the photon pairs that are created have entangling physical properties. Separate single photon detectors are used to measure the polarization state of each photon [3]. The use of the quantum state tomography is to determine the quality of the entanglement source.By doing this experiment we are developing a high efficiency entanglement source that could be easier to use as a basic tool by other research institutions or university on the application of entanglements.References[1] Kwiat P G, Waks E, White A G, Appelbaum I, Eberhar d PH, Ultra-Bright Source of Polarization-Entangled Photons, Physical Review A 60(2), 773–776, 1999.[2] Dehlinger D, Mitchell M W, Entangled Photons, Nonlocality, and Bell Inequalities in theUndergraduate Laboratory, American Journal of Physics 70(9), 903–910, 2002.[3] Zeilinger A, Dance of the Photons: From Einstein to Quantum Teleportation , Farrar, Straus andGiroux, New York, 2010.

404 - Investigating the Variability of Sources in the Data from the Karoo Array Telescope. U. Mbou Sob, S.K.Sirothia, T. Glober, O. Smirnov

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: D1.404) [For award: MSc]*

Primary author: *MBOU SOB, Ulrich Armel (Rhodes University)*

Variability of radio sources is one of the bottlenecks for source counting in radio astronomy. Earlier studies of source variab ilities suggest that these are related to the intrinsic nature of the source or to poor calibration. Since then, researcher have not make further contributions to clarify the suggestion and classify sources into two categories namely; those for which the variation is directly related to calibration impact and those for which there are an intrinsic property. In this presentation we investigate this problem using real observations of the same field of view taken consecutively over a period of two years with the Karoo Array Telescope (KAT-7). This will be done by extracting corresponding sources from these observation and statistically analysing the flux densities for the brightest of these sources.Keywords: source counting, calibration, field of view, flux density, KAT-7.

411 - Energy transfer mechanisms and material properties of Y2O3: Eu3+:Ho3+ nanophosphors synthesized by sol- combustion method.

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.411)*

Primary author: *ALI, Abdub (University of the Free state)*
Co-authors: *DEJENE, Francis (University of the Free State); SWART, Hendrik (University of the Free State)*

AbstractIn recent years, luminescent nanocrystals (NCs) doped with rare earth ions were paid more attention because of their interesting luminescent properties. Cubic Y2O3:Eu3+ is one of the most important commercial red phosphors, which can be used in fluorescent lights, cathode ray tubes, plasma display panel, and field emission display. Yttrium oxide (Y2O3) has been investigated widely as a host material for rare-earth ion doping in optical applications on account of its excellent chemical stability, broad transparency range (0.2 to 8μm) with a band gap of 5.6 eV, high refractive index, and low phonon energy. Furthermore, the similarities in the chemical properties and ionic radius of RE ions and Y2O3 make it an attractive choice as a host material. In the present study, a series of red emitting phosphors Y2O3:Eu3+: Ho3+ was prepared by sol- combustion method. The luminescence, excitation, optical absorption, structural and morphological properties of the phosphor have been studied. The X-ray diffraction patterns show cubic phase crystal structures. Scanning Electron Microscopy show agglomerates of crystalline particles having spherical shapes with average size in the range of 40 to 80 nm. The photoluminescence measurements indicate red emission of Eu3+ doped Y2O2S powders with the most intense peak appearing at 621 nm, which is assigned to the 5D0-7F2 transition of Eu3+. Y2O3:Eu3+, Ho3+ phosphor shows a red-emitting long afterglow phenomenon, and the Eu3+ ion are the luminescent center during the decay process. It was observed that ET took place between Ho3+ and Eu3+ ions. The dependence of photoluminescence (PL) spectra and decay times on doping concentration has been investigated. This phosphor can have applications in the field of photonic technology.

413 - The design of a waste heat system capable of harnessing energy from the surface of a cyclone dust collector attached to a downdraft biomass gasifier

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.413) [For award: PhD]*

Primary author: *NWOKOLO, Nwabunwanne (Institute of Technology University of Fort Hare)*
Co-author: *MAMPHWELI, Sampson (Institute of Technology University of Fort Hare)*

The gas leaving the reactor of a downdraft biomass gasifier contains large quantities of heat energy; this is due to the fact that the gas passes through a hot bed of charcoal before leaving the reactor. This heat is normally wasted in the gas scrubber/cooler that cools it from between 500°C -600 °C to room temperature (around 25 °C. The waste heat stream under consideration is the raw syngas that emanates from a gasification process in a downdraft gasifier situated at Melani village, Eastern Cape. This loss of heat is undesirable as it impacts on the thermal efficiency of the system. This study seeks to design a cyclone water containment that will harness the heat from the surface of the cyclone. The design will rely on the surface temperature measurements using thermocouples and an infrared camera as well as thermodynamics equation to predict the heat flow dynamics, and prediction of the maximum temperature that the water would attain. The water container will be manufactured and its performance will be monitored using a custom built data acquisition system consisting of type k thermocouples and a data logger. The final paper will present the initial results.

417 - Laser excitation studies and crystal-field analysis of ZnO:Tb^{3+} and ZnO:Eu^{3+} powders

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.417) [For award: MSc]*

Primary authors: *BHEBHE, NKOSIPHILE ANDILE (UNIVERSITY OF THE WITWATERSRAND); MUJAJI, Marjorie (Wits University); WAMWANGI, Daniel (wits university)*
Co-authors: *KOAO, Lehlohonolo (University of the Free State); DEJENE, Birhanu (University of the Free State)*

Results from laser excitation studies of Tb^{3+} ions and Eu^{3+} ions in zinc oxide (ZnO) powders are presented; rare-earth doped ZnO (ZnO:RE^{3+}) is currently of great interest as a prospective solid-state laser matrix and for optoelectronic device applications. The chemical bath deposition technique was utilized for synthesizing the ZnO:Tb^{3+} and ZnO:Eu^{3+} powders. Photoluminescence spectra of the pelleted samples were obtained in the 460 – 900 nm range. The spectra exhibit sharp emission lines superimposed on a broad emission background with 457.9 nm, 476.5 nm and 488.0 nm argon laser-line excitation. The sharp peaks are attributed to the $^5D_4 \rightarrow {}^7F_J$ (J = 0, 1, 2, 3, 4, 5, 6) and the $^5D_0 \rightarrow {}^7F_J$ (J = 0, 1, 2, 3, 4) electronic transitions of Tb^{3+} and Eu^{3+}, respectively. Crystal-field energy levels for the Tb^{3+} ion and the Eu^{3+} ion occupying a C_{3v} symmetry site were deduced.

419 - Expository vs Problem-based approach to Physics practicals at the University of Johannesburg-A case study

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.419)*

Primary author: *REDDY, Leelakrishna (University of Johannesburg)*

In this article we compare the dichotomy of two styles of conducting a Physics practical; one a problem-based (non-traditional) approach and the other an expository (traditional) style is. The cohorts of learners chosen for this comparative study are 64 students in the Health Sciences program at the University of Johannesburg. Students were first required to determine the wavelength of the spectral lines of mercury using a standard spectrometer employing the expository method and thereafter following a problem-based approach. At the end of the two experimental methods, the students were provided with a questionnaire to elucidate perceptions about both approaches in terms of assessments, time spent in laboratories and preparation time. The analysis of the responses in the questionnaire showed a slightly more positive preference to the problem-based approach in terms of conceptual development within the laboratory while in the expository approach the learning outcomes were achieved outside the laboratory. Albeit both methods have a role to play in different learning environments, however, instructions need to be re-act ivated to keep up with educational reforms and advances in technology.

423 - The modified interatomic potentials of FeS_2 in atomistic simulations

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.423)*

Primary author: *MEHLAPE, Mofuti (University Of Limpopo)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); PARKER, Steve (University of bath, UK)*

The modified interatomic potentials were used for both energy minimization and molecular dynamics to study the surfaces and the bulk structure of pyrite. With energy minimization we calculated the surface energies of the surfaces {100}, {110}, {111} a nd {210}. They revealed that {100} surface is the most stable surface. When we compared the surface energies calculated from the original potentials and the adjusted potentials, it is clear that the adjusted potentials improve the stability of the surfaces. It was also revealed that water stabilizes the surfaces, since the surface energies decreases when hydrated. Molecular dynamics (MD) was used to see the effect of temperature on the surfaces.

425 - Intra-cavity metamorphosis of a Gaussian beam to flat-top distribution

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.425)*

Primary author: *NAIDOO, Darryl (CSIR)*
Co-authors: *LITVIN, Igor (CSIR NLC); FORBES, Andrew (CSIR)*

We explore an intra-cavity beam shaping approach to generate a Gaussian distribution by the metamorphosis of a Gaussian beam into a flat-top distribution on opposing mirrors. The concept is tested external to the cavity through the use of two spatial light modulators (SLM), where the first SLM is used to transform a collimated Gaussian into a flat-top distribution and the second SLM is encoded with the conjugate phase of the flat-top for conversion back to a Gaussian. We implement this intra-cavity selection through the use of two optical elements of the refractive variant that are designed from the phase profiles addressed to the SLMs. We consider a solid-state diode side-pumped laser resonator that consists of two planar mirrors where the refractive optics are positioned at the mirrors. We out couple the Gaussian and flat-top beams and we show that we increase the energy extraction while maintaining a beam quality that is comparable to our predictions.

426 - Synthesis and Characterization of LaVO4:Ln (Ln=Eu, Li) by Combustion method

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.426) [For award: PhD]*

Primary author: *FOKA, Emily (Student)*
Co-author: *SWART, Hendrik (University of the Free State)*

Luminescence materials doped with rare earths have been studied in the past few decades because of their wide applications in lighting and laser displays [1]. The rare earth ion activated luminescence material such as Y2O2, YVO4, and YBO3 are used as host because of their single crystal structure and high chemical stability. LaVO4 was prepared by the combustion method. The structure and luminescence properties of LaVO4 have been studied. Photoluminescence showed a strong red emission peak at 5Do-7F2 transition at 616 nm. This is due to energy transfer to Eu3+ ions followed by absorption of UV light in the VO43- group. X-ray diffraction (XRD) spectra indicated that YVO4:Eu3+ thin films phosphor material is successfully prepared by combustion. References[1] Li-Ping, W.; Li-Miao, C.; Materials Characterization, 2012, 69, 108-114.

427 - Electrical characterization of bulk 4H-SiC

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.427) [For award: Hons]*

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Co-authors: *VENTER, Andre (NMMU); BOTHA, Johannes Reinhardt (NMMU)*

The crystal lattice of SiC is identical to that of silicon and diamond, with half the lattice sites filled by Si and the other half by C atoms. SiC is the only chemical compound formed between Si and C. The compound crystalises into three stable polytypes namely 3H-, 4H- and 6H-SiC, each with unique physical properties. The high thermal conductivity and large break-down field make SiC a very attractive material for high temperature, high voltage devices. Additionally, SiC is resistant to particle and cosmic radi ation, suggesting that these devices could operate in harsh environments.In this study, the electrical properties of 4H-SiC is revisited as part of an honours research project. Pd Schottky barrier diodes were employed to determine the current transport characteristics by current-voltage measurements, while the free carrier concentration depth distribution, barrier height and built-in voltage were determined by capacitance voltage measurements. A prominent compound defect was detected around 200 K (20ms rate window) and consequently characterised by Laplace DLTS.

431 - Structure Prediction of Manganese Dioxide Nanoclusters Using Computer Simulation Techniques

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.431)*

Primary author: MAPHANGA, R. Regina *(University of Limpopo)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); CATLOW, Richard (University College London); WOODLEY, Scott (University College London)*

The characteristics of nanoclusters are linked to the high value of their surface/volume ratio, and therefore the structure of nanoclusters plays an important role in determining their physical properties. Manganese dioxide as a well-known transition-metal oxide is one of the most attractive inorganic materials because of its structural flexibility and wide range applications in many chemical processes such as ion exchange, separation, catalysis, molecular adsorption, biosensors and energy storage in batteries and supercapacitors. In order to enhance the properties of MnO_2 for various applications, some new or modified MnO_2 compounds are developed recently. One of the major demands for developing these materials is to modify and strengthen the structural stability in order to prevent the rapid capacity fading during the process of charge/discharge cycling. The interest in synthesis and characterisation of nanoclusters is driven by a wide range of applications of nanoparticle materials in catalysis, electronics and energy conversion. The lowest energy configurations for $(MnO_2)_n$ clusters, n =1 to 10 are predicted, employing the interatomic potential technique and electronic structure density functional theory method at the PBEso10 level. The application of an evolutionary algorithm to different energy landscapes, as defined by interatomic potentials, for each cluster size was used to generate the plausible structures for refinement using DFT. The order of stability and degeneracy of different sizes of nanoclusters are investigated. In addition, geometric properties of the nanoclusters are predicted. The DFT based, MnO_2 global minima nanoclusters were found to be similar to those predicted for isostructural TiO_2.

435 - Synthesis of vanadium oxide (VxOy) using CO2 Laser Pyrolysis

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.435)*

Primary author: MASINA, Bathusile *(CSIR-NLC)*
Co-author: *FORBES, Andrew (CSIR-NLC)*

We make use of CO2 Laser Pyrolysis to deposit vanadium oxide on Corning glass using several concentration of precursors. The effect of precursors concentration on the vanadium oxide phases and crystallization has been investigated using XRD, Raman spectroscopy, AFM and SEM. We observed that as the precursor concentration varies the crystallization and the vanadium oxide phases vary as well. Vanadium pentoxide (V2O5) nano-rods and nano-stars like structure were produced after the vanadium oxide films were annealed in atmospheric pressure of Argon at 500oC.

437 - Optical Spectra of Herschel Gravitational Lenses and their Astrophysical Implications

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: D1.437)*

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.

439 - The Generation of Surface Acoustic Waves using a Normal Transducer and Perspex Wedges

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: F.439)*

Primary author: SIKAKANA, Ike *(Department of NDT & Physics, Vaal University of Technology)*
Co-author: *MASHA, Tokisho (Department of NDT & Physics, Vaal University of Technology)*

Compressional waves (P-waves)are mode converted to shear waves (S-waves)when incident at non-normal angle at an interface of two different acoustic impedance materials. Increasing the incident angle results in two critical angles, corresponding to the P-waves (first) and later the S-waves (second). For a range of larger incident angles, Surface Acoustic Waves (SAW) are produced. Using a normal longitudinal transducer mounted on machined Perspex wedges, the transmitted signal is studied for a Perspex-carbon steel interface. Our results show that for Perspex wedges with geometrical angles in the range of 70 degrees, SAW are produced on carbon steel. A plot of the acoustic wave transmission intensities against the angles of incidence confirms established behaviour. The propagation of SAW is further studied on a 3-notch eddy current calibration 4340 steel block. This simple instrumentation is shown to be effective in the characterisation of surface flaws.

445 - Determination of the Origin of a High Frequency Signal Superimposed on the Light Emission detected from a Detonating Explosive in a Free Environment

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: C.445) [For award: MSc]*

Primary author: MQADI, Wonder Mhlakubuswa *(Walter Sisulu University)*
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The intense light flash emitting from a detonating explosive charge has been the subject of a number of experimental investigations. Optical detectors were employed to capture such emitted light. However, during these studies, a high frequency oscillation was observed superimposed on most of the measured signals. The origin of this high frequency oscillation observed is of interest since it could be possible that it can be an intrinsic property of detonations and the post detonation behavior of the explosive products. Alternatively, it could be an artefact of the measuring methodology.To study the origin of this oscillation Comp B ex plosive charges were used with varying mass. EMI screening aids and procedures were undertaken to characterize this oscillation during dynamic and static tests measurements. Mathematical and digital signal processing tools were used to analyze the measured signals in order to investigate the origin of the high frequency oscillation. During the study, it emerged that the light emitted from the detonation event is linked to the problem under investigation. It is thought that the optical devices detect light rays which are affected/disturbed by turbulence through index of refraction variations during explosion of a detonating charge and record them as a high frequency oscillation. Key words: High frequency oscillation, explosive charge, detonation, EMI screening, light emission

447 - Synthesis, photoluminescence and thermoluminescence of the BaAl2O4:Dy3+ phosphor

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.447) [For award: MSc]*

Primary author: COLEN, Manaka *(UNISA)*
Co-authors: *MOSES, Mothudi (UNISA); SIMON, Dhlamini (UNISA)*

Dy3+ doped BaAl2O4 phosphors were prepared by the combustion technique using urea as a fuel. The crystallinity of the sample was confirmed by X-ray diffraction and the sample morphology was investigated using scanning electron microscopy. The photoluminescence (PL) and photoluminescence excitation (PLE) spectra were measured at room temperature using a Spex Fluorolog-3 spectrofluorometer (Instruments S.A., N.J., U.S.A) equipped with a 450 W Xe light source and double excitation monochromators. TL spectra were recorded using a Riso TL/OSL reader (Model DA-20). The effects of Dy3+ doping concentration variation on both PL emission and TL emission, heating rate variation, and beta dose variation were studied. PL emission spectrum showed three characteristic emission peaks of Dy3+ in the BaAl2O4 matrix at 482 nm, 575 nm and 663 nm. TL spectrum showed an intense peak at 66 oC and a shoulder at 130 oC. Dose variation confirmed a linear response of the BaAl2O4: Dy3+ phosphor. From the linear response and the occurrence of an intense TL peak at low temperatures, it can be speculated that the BaAl2O4: Dy3+ phosphor may be used in dosimeter. The optimum PL intensity was observed at 10% Dy3+ doping concentration and the one for TL emission was observed at 1%.

448 - Interface state density distribution in sulphur treated bulk Au/*n*-GaSb Schottky barrier diodes

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.448)*

Primary author: *VENTER, Andre (NMMU)*
Co-authors: MURAPE, Davison Munyaradzi *(NUST); BOTHA, Johannes Reinhardt (NMMU); SWART, Hendrik (University of the Free State)*

The current transport properties and interface state density of sulphur treated bulk (100) *n*-GaSb are investigated using current-voltage measurements. X-ray photo spectroscopy reveals the presence of an abundance of native oxides on the as-received GaSb surface. Sulphurization is achieved by treating the material with three different sulphur containing solutions ($Na_2S.9H_2O$, $(NH_4)_2S$ and $[(NH_4)_2S/(NH_4)_2SO_4+S]$ respectively) prior to Au Schottky barrier diode (SBD) fabrication. The ideality factor decreases while apparent unpinning of the Fermi level causes an increase in the barrier height subsequent to sulphur treatment. Additionally, sulphurization decreases the reverse leakage current while the series resistance of the SBDs, compared to those fabricated on untreated material, also moderates. A 10-fold improvement in the rectification ratio of the treated SBDs, measured at ±0.2 V, is consequently observed.

450 - Thermal and compositional defects in dip-coated iron oxide (α-Fe_2O_3) thin film photoanodes: Effects on film properties

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.450)*

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Hematite (α-Fe_2O_3) is an attractive semiconductor material for solar assisted electrolysis of water due to its narrow band (~ 2.1 eV), low cost and non-toxicity. α-Fe_2O_3 thin films photoanodes were synthesized by dip coating and their properties investigated with FESEM, XRD and photocurrent density spectroscopy. Strong dependence of structural and photoelectrochemical properties on film compositions and temperature was observed. The crystallites size was observed to increase with increasing Ti doping concentration. By fixing the doping concentration at 1 mol %, the photocurrent density at water splitting potential (1.23 V vs RHE) increased from 0.006 mA/cm^{-2} at 450 °C to 0.386 and 0.766 mA/cm^{-2}at 500 and 550 °C respectively then decreased to 0.249 mA/cm^{-2} at 600 °C. Subsequent annealing temperatures introduced textural and structural defects with modifications in the film properties. The films cracked with cracks averaged 50 nm. Cracks may act as collection centres for impurities diffusing out of the lattice hence act as scattering sources for photons and carriers with consequent decrease in photoresponse of the films.

451 - Ultra smooth surface of diamonds, towards Å scale roughness for the (111) orientation

Poster1 - Tuesday 30 June 2015 16:10 *(Poster Board: A.451)*

Primary author: *CONNELL, Simon (University of Johannesburg)*
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Synthetic diamond of exceptional quality is required for many high technology applications. We mention two examples: δ-doped diamond as an electrical switch in FETs, expected to operate at high power and high frequencies; and 111-oriented diamond plate s that are needed at synchrotrons such as the ESRF to serve as beam splitter monochromators working in reflection geometry (Bragg case). The surface is of special interest. It should be smooth, flat and defect free. For the diffraction application, the requirements is in addition a low miscut for the 111 surface,. In this paper, we present a summary of the different polishing techniques as wel l as their advantages and limits:- Mechanical polishing with nano diamond powder.- Oxygen electron cyclotron resonance etching, oxygen radio frequency etching or microwave etching in a O_2+SF_6+Ar gas mixture.- Oxygen implantation, followed by annealing in vacuum at 950 °C. "Lift-off" resulted from either a hydrogen plasma or an acid etch, and the final anneal in air at 500 °C provided an additional soft isotropic etch. - Hot metalling: the diamond is moved with low speeds over a surface of pure Fe at 1000oC in vacuum for at least 3 hours- Mechanical diamond-grit-less sciafe polishing at high speeds, high temperatures and high loads,The best results include a surface with a roughness less than 2Å (rms) level over 10x10μm2 areas as measured by AFM and optical profiling, for the (111) surface orientation. The polished diamonds were then carefully quality checked by X-ray diffraction synchrotron topography at beamline BM05, at the ESRF, France, in order to visualize defects in the crystals caused by the surfa ce damage from the polishing process.

453 - Channelling radiation of electrons in high-quality HPHT diamond single crystals

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: B.453)*

Primary author: *CONNELL, Simon (University of Johannesburg)*
Co-authors: *TRAN THI, Thu Nhi (UJ); BACKE, Hartmut (Johannes Gutenberg-Universität Mainz); HÄRTWIG, Jürgen (European synchrotron Radiation Facility (ESRF)); LAUTH, Werner (Johannes Gutenberg-University Mainz, Institute for Nuclear Physics, Mainz); D, Calista (CEA-Grenoble, France)*

The channeling phenomenon applies to the motion of charged particles within a crystal lattice whereby the velocity is closely aligned with atomic rows (strings) or crystal planes. The motion is governed by many correlated collisions with the crystal atoms. As a result, the particles are steered gently along strings or planes and cross-sections associated with the interaction of charged particles with matter are substantially changed in comparison to amorphous matter. Although the channeling potential depths in the laboratory frame are only of the order of some tens of eV, transitions between quantum states for the transverse oscillatory mo tion may result in photons with energies in the range between keV to multi MeV if the relativistic particle energies are in the range between a few MeV to some GeV, respectively. This so called channeling radiation is well studied. There is however renewed interest based on the prospect of channeling within a periodically bent crystal. In this case, there also be crystal undulator radiation which may be in the gamma regime. High quality synthetic HPHT diamond single crystals with thicknesses varying from 40μm to 500μm were used for detailed studies of channeling radiation. The radiation spectra and dechannelling length, were measured using electron beams with energies of 450 MeV and 855 MeV for (110) and (100) planar channelling conditions. The dechanneling phenomenon in bent crystals can be inferred from that of regular crystals using calculations based on the Fokker-Planck equation where the centrifugal force accounts for the undulator motion. Companion studies of synchrotron based X-ray diffraction white beam topography of all the diamond crystals were used in order to visualize the defects in the crystals and deduce their influence on the channelling effect.

455 - A Comparative Study of the Preparedness for Undergraduate Studies of Students entering the University with South African Matriculation Examination results and Zimbabwe ZIMSEC Examination results.

Poster2 - Wednesday 01 July 2015 16:10 *(Poster Board: E.455)*

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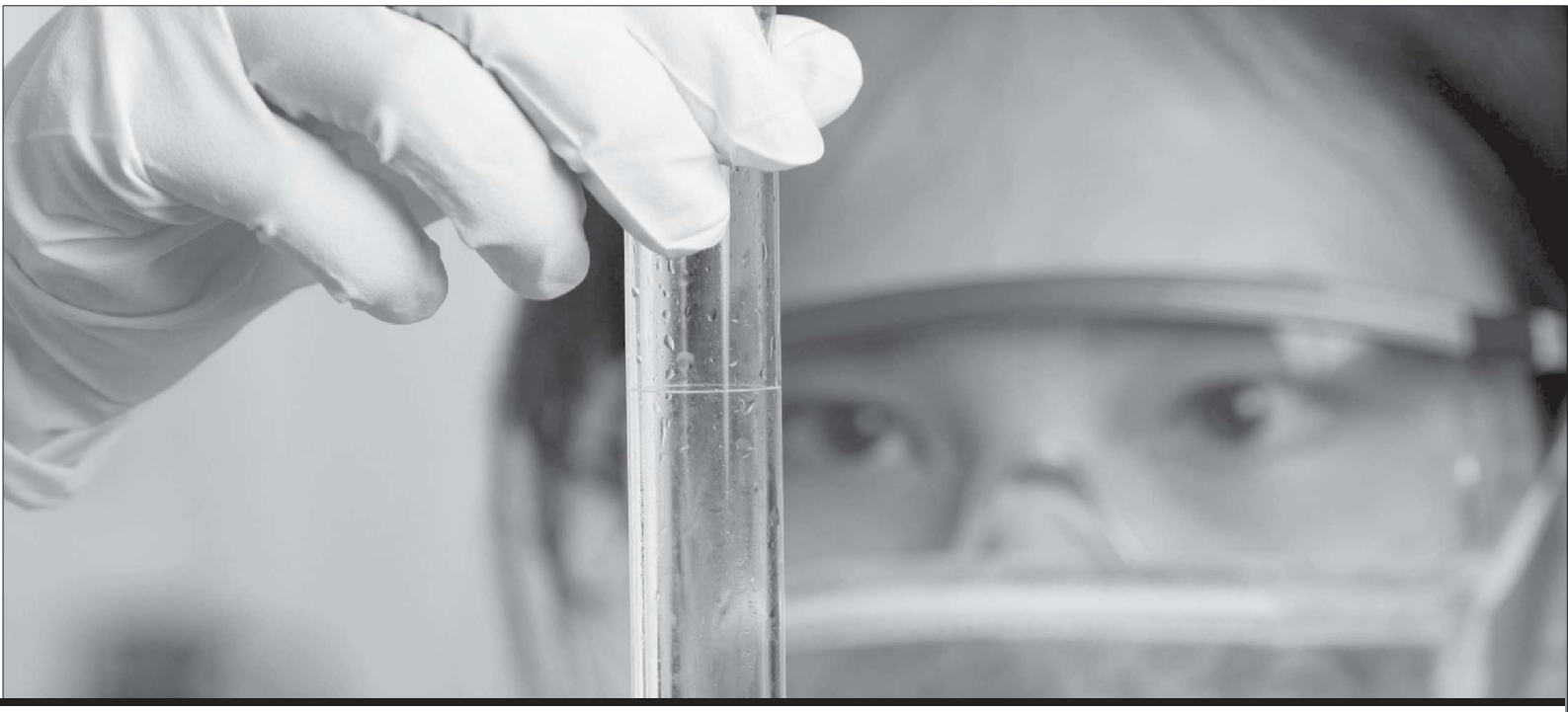
Co-authors: *NAIR, Padmanabhan (University of Johannesburg); RAMAILA, Sam (University of Johannesburg); REDDY, Leelakrishna (University of Johannesburg)*

The preparedness of South African matriculants for university studies in comparison to students entering university through Zimbabwe's ZIMSEC system has been highly debated at different levels within society. Physical Science, Mathematics and English matriculation and ZIMSEC results are commonly used as a measure of science students' preparedness for university study. This research compares the performance of first-year undergraduate students in physics modules in relation to their matriculation and ZIMSEC results for a number of science subjects and English. Results generally show a marked difference in the performance of students holding ZIMSEC results compared to students holding matriculation results. Factors that may contribute significantly to this disparity were also considered.



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SACNASP

South African Council for Natural Scientific Professions

What is SACNASP?

SACNASP is the legislated regulatory body for natural science practitioners in South Africa.

The natural sciences encompass a wide range of scientific fields covering all of the basic sciences and many of their applied derivatives.

Our mission is to establish, direct, sustain and ensure a high level of professionalism and ethical conscience among our scientists.

Their conduct should be internationally acceptable and in the broad interest of the community as outlined in the SACNASP Code of Conduct.

SACNASP's main objectives are to:

- Promote the practice of the natural science professions in South Africa.
- Ensure and administer the mandatory registration of natural scientists as required in terms of The Natural Scientific Professions Act of 2003.
- Exercise control over the standard of conduct of professional natural scientists.
- Monitor the standard of education and training of natural scientists.
- Set standards for the recognition of education and training natural scientists.
- Ensure that prospective registrants meet the educational standards required for registration.

Register to be recognised

The Natural Scientific Professions Act of 2003 requires all Natural Scientific Practitioners in SA to be registered with SACNASP.

For a complete list of the current fields of practice recognised by SACNASP, visit our website at www.sacnasp.org.za

www.facebook.com/SACNASP

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