
SOUTH AFRICAN INSTITUTE OF PHYSICS
SOUTH AFRICAN INSTITUTE OF PHYSICS
59th Annual Conference
7-11 July 2014
UNIVERSITY OF JOHANNESBURG
RETHINK. REINVENT.
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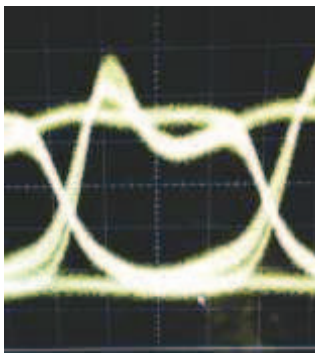

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The Optical Fiber Research Unit forms part of the Department of Physics at the Nelson Mandela Metropolitan University (NMMU). We are involved in exciting collaborative Research projects with Square Kilometre Array, Telkom and other leading Industry players. We have further links with a number of Research groups at International universities across the world. If you are interested in joining our ream, please contact:

Prof Tim Gibbon
Nelson Mandela Metropolitan University
PO Box 77000, Port Elizabeth, 6031
Email: Tim.Gibbon@nmmu.ac.za

www.nmmu.ac.za

http://physics.nmmu.ac.za/Research/Optical-fibre-research

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

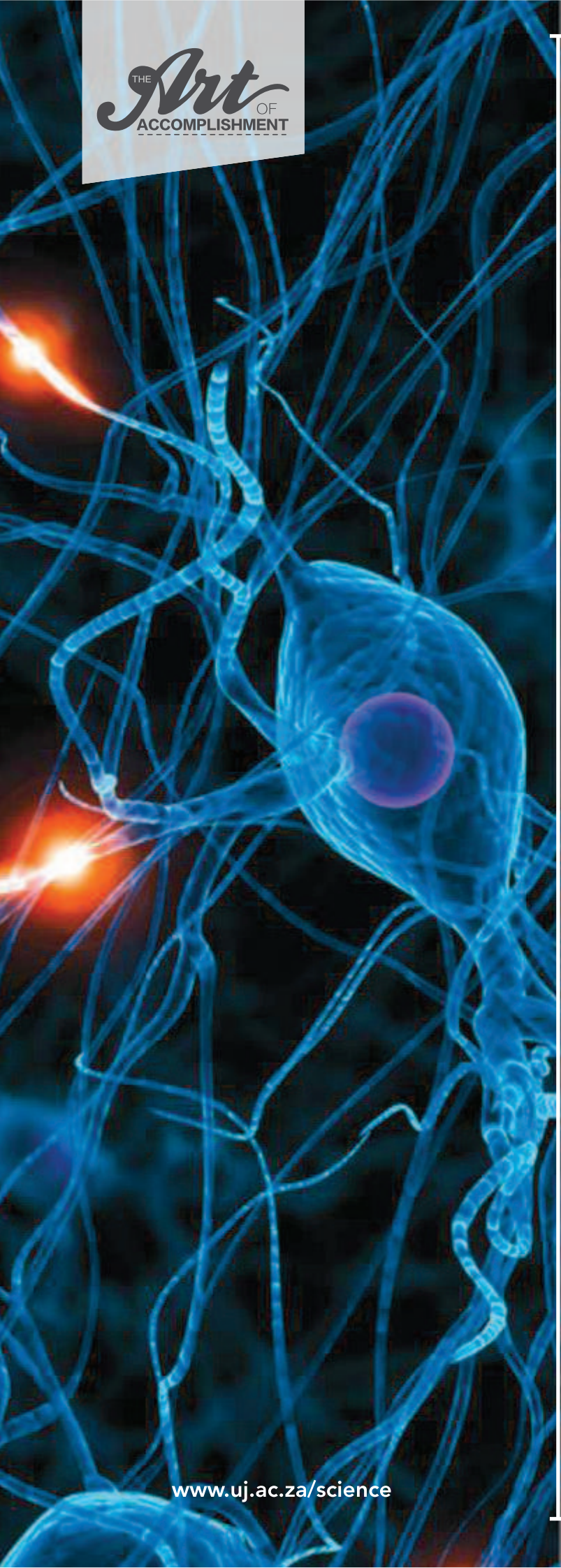
Emergency Numbers

EXTERNAL EMERGENCY NUMBERS

Fire brigade	011 375 5911 / 10777	Garden City Clinic	011 495 5000
		Milpark Hospital	011 480 5600
Netcare Ambulance	082911		011 480 5912
NETCARE	010 209 8651	Poison centre	021 931 6129

INTERNAL EMERGENCY NUMBERS

Safety Coordinator	**011 559 6129**	**Occupational Health Nursing Practitioner**	**011 559 4969**
Mr Kobus de Bruyn	082 328 7162	Sr Margareth Langeveldt	
Occupational Safety Practitioner	**011 559 4221**	**Occupational Health Nursing Practitioner**	**011 559 1272**
Mr Willem Kilian	082 808 6397	Sr Anne Henning	
Occupational Safety Practitioner	**011 559 1445**	**Head Primary Health care APK**	**011 559 4962**
Anzani Rautenbach	072 462 4235	Sr Mimi Geya	082 455 8451
Safety Administrator / Secretary	**011 559 6146**		011 559 1238
Ms Susan Prinsloo	082 303 4919		011 559 1619
Fire Marshal	**011 559 6750**	**Director Protection Services**	**011 559 3115**
Solly Nkosi	072 246 7223	Charles Monyai	083 668 2595
Head: Occupational Health Practice	**011 559 2200**	**APK Control Room**	**011 559 2555**
Sr Elana Venter	082 341 0299	Security	



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INNOVATIVELY CREATING NEW KNOWLEDGE AND LEADING SCIENTISTS AS SHOWN BY HIGH NUMBER OF PEER REVIEWED ARTICLES

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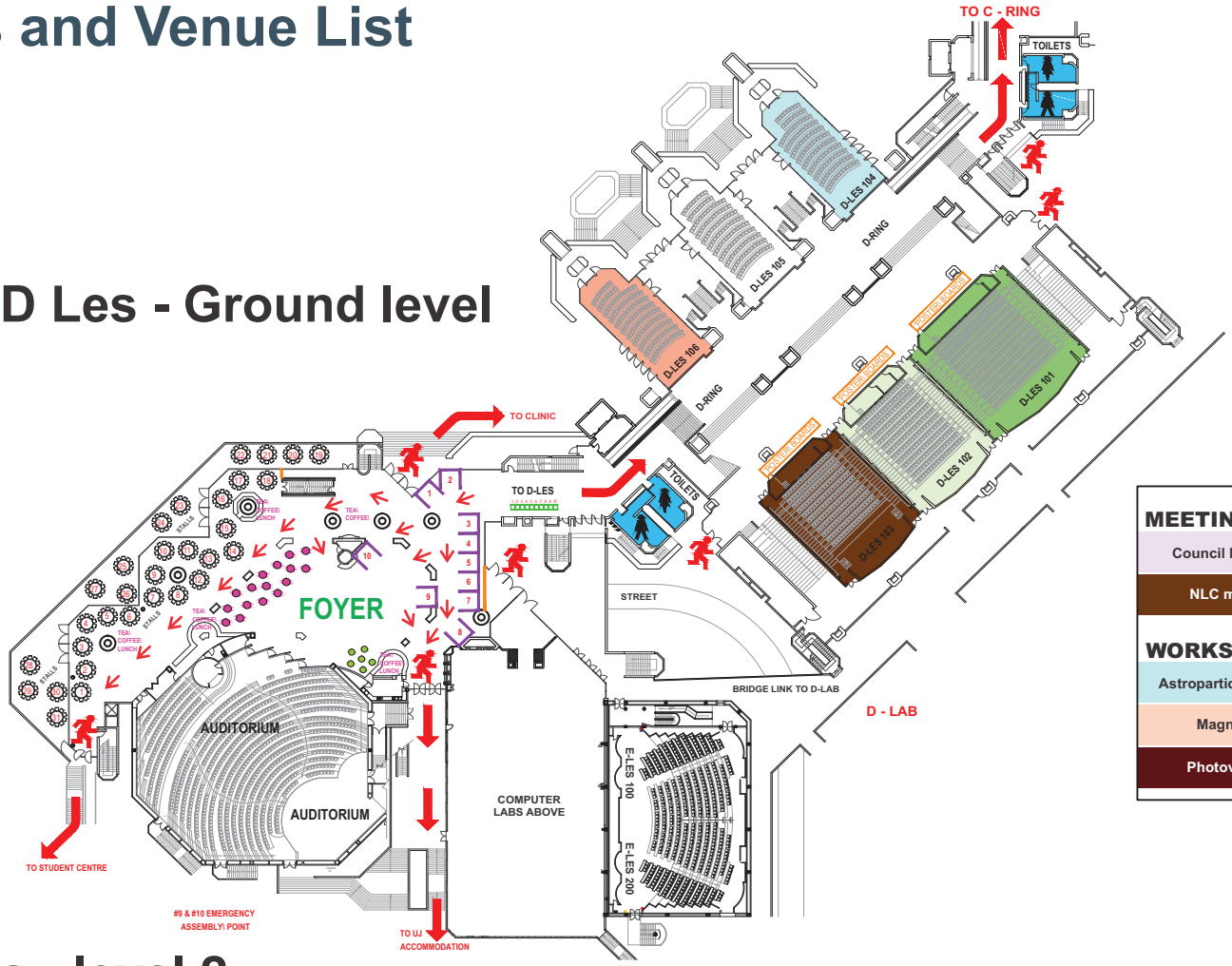
Maps and Venue List

D Les - Ground level



MEETINGS

- Council Meetings (D Les 310)
- NLC meeting (D Les 103)

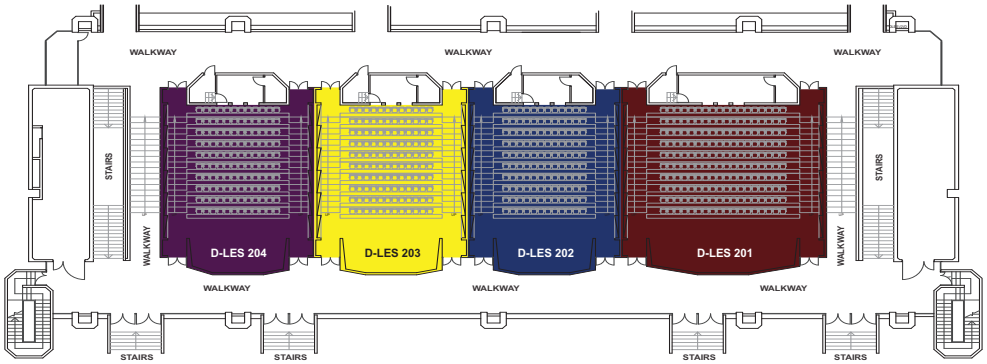
WORKSHOPS

- Astroparticle physics (D Les 104)
- Magnetism (D Les 106)
- Photovoltaics (D Les 201)

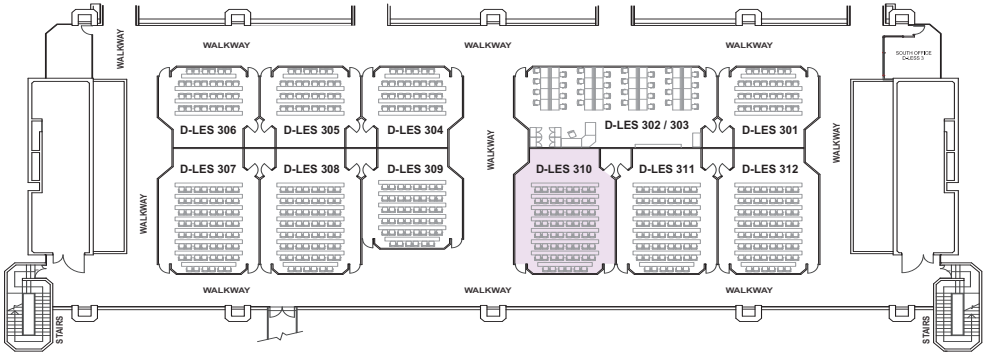
LEGEND

- Exhibition Stalls
- Toilets
- Emergency Exit
- A1: Div. for Physics of Condensed Matter and Materials (D Les 201)
- A2: Div. for Condensed Matter Physics and Materials (D Les 202)
- B: Nuclear, Particle and Radiation Physics (D Les 101)
- C: Photonics (D Les 102)
- D1: Astrophysics (D Les 203)
- D2: Space Science (D Les 204)
- E: Physics Education (D Les 310)
- F: Applied Physics (D Les 103)
- G: Theoretical and Computational Physics (D Les 104)

D Les - level 2



D Les - level 3



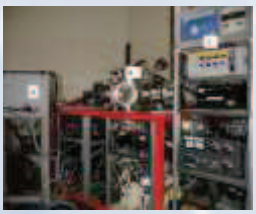
Stronger than Diamond?

The DST-NRF Centre of Excellence in Strong Materials (CoE-SM) is hosted by the University of the Witwatersrand, in partnership with the Nelson Mandela Metropolitan University, the Universities of Johannesburg, KwaZulu-Natal and Limpopo, with NECSA and Mintek.

Research areas include:

- **Carbides and Cermets:** Manufacturing, testing and characterisation of mainly WC, VC, Cr-C and TiC sintered alloys and coatings**.**
- **Carbon Nanotubes and Strong Composites:** Carbon nanotubes for potential chemical and mechanical applications.

- **Ceramic Materials:** Multi-component, ultrahard-phase (diamond, cubic boron nitride and others) containing composites for cutting tools and wear parts.
- **Diamond, Thin Hard Films and Related Materials:** Defect analysis and studies using diamonds include radiation detectors and radiation damage effects.
- **New Ultrahard Materials:** Computational and experimental investigations of potentially new ultrahard materials including advanced borides, carbides, nitrides and oxides.



- **Strong Metallic Alloys:** Development of new alloys, structure-property relationships and phase diagrams.

The CoE-SM offers bursaries and other support to students studying towards their Masters and Doctoral level degrees in strong materials, in the disciplines of Physical Metallurgy, Materials Engineering, Mechanical & Chemical Engineering, Physics and Chemistry.

science & technology
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Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF
National Research Foundation

Contact us:
Casey Sparkes
Tel: +27 11 717 6873 | Fax: +27 11 717 6830
Email: info.coe-sm@wits.ac.za

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 loaded on the relevant venue presentation computer 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 full day of the poster session
- 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

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General Information

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

PARKING
You are requested to use the designated SAIP parking. Any reserved parking should not be used.

MESSAGES
Message board will be situated near the registration desk

POSTER SESSIONS
Posters should be put up on the poster boards on the D-Les ground level, for the full day of the poster session. It is important that presenters avail themselves during their allocated session for discussions.

TEA AND REFRESHMENTS
Tea, coffee and refreshments will be served during tea breaks in the morning and afternoon sessions.

LUNCHES
Lunches are served in the foyer.

PRESENTATION PREVIEW FACILITIES
Your presentation must be handed in a day before, but at least 30 min before each session. Assistance will be available in the mornings before the start of the first session, during tea breaks and 30 min before the start of the session after lunch. A computer will be available to preview your presentation and to obtain technical assistance.

TRANSPORT
Transport during the conference is for your own arrangement. Limited bus seats will be available for the conference banquet on Friday 11 July 2014. Please book your seats at the registration desk.

SAIP2014 T-Shirts and Caps
Ordered shirts and caps will be issued during registration. Additional items will be on sale throughout the duration of the conference at the registration desk.

SAFETY
Take precaution of your personal possessions at all times. Ensure that your car doors are locked whilst driving and after parking.

EMERGENCY NUMBERS
For any type of emergency please enquire at the registration desk. Emergency contacts or listed on page one.

WIFI / INTERNET
Connectivity will be provided at certain areas in the conference venue. NB: All social services sites (eg. Facebook) will be blocked.

Organising Committee

UNIVERSITY OF JOHANNESBURG
Hartmut Winkler (Chair)
Steven Karataglidis (Scientific Chair)
Aletta Prinsloo (Fundraising and Marketing)
Pap Nair (Winter School Coordinator)
Emanuela Carleschi (Social Functions and Catering)
Jesman Changundega (Social Functions and Catering)
Chris Engelbrecht (Proceeding Editor)
Charles Sheppard (Venue Coordinator)
Lianie Döman (Budgeting and Finance)
Paulus Masiteng (Delegate Liaison)
Sam Ramaila (Delegate Liaison)
Simon Connell

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National Research Foundation | iThemba LABS | Laboratory for Accelerator Based Sciences

CREATING OPPORTUNITIES

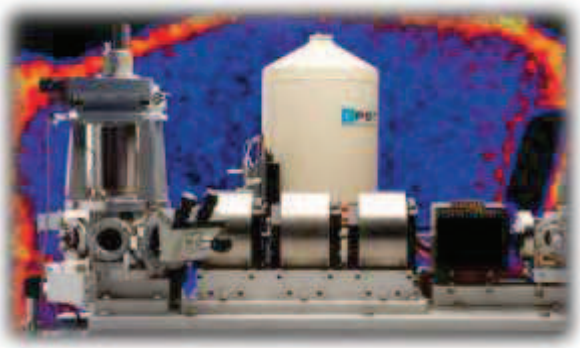
iThemba LABS is one of seven National Facilities administered by the National Reasearch Foundation. The National Research Foundation (NRF) is an independent statutory body setup in accordance with the National Rerseach Foundation Act. Its mandate is to support and promote research through funding , human resource development and the provision of necessary research facilities in oder 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 two **structured Master's programmes** (MANUS,MATSCI). These programmes are offered in partnership with the universities of **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 the community of practice that is the South African Institute of Physics, and especially to the event where we interact the most: the Annual Conference.

This is the forum where physicists get together and listen to novel ideas and advances, and field the questions of their peers. This is where the new discoveries on the global scene become accessible across the spectrum of specialists.

This is also where many South Africans give their first paper, and are welcomed into the scientific community. I would especially ask you, if you are attending for the first time, to walk around and find the experienced people in your field and talk with them – about physics, about the community, and about the world in general. Similarly, if you have been in physics for years (even a few!), I'd ask you to find some students and make sure they're introduced to their peers in physics. It's important that young people enter the roles that Divisions and Forums offer – this year is an election year, and there are significant opportunities to work at the national level. We are continuing to build the amazing capacity of young South Africans in "thinking physics", and in the national and international science infrastructure.

Dear Distinguished Plenary Speakers, you may not know this yet, but your presence draws South African physicists to this conference. Thank you for travelling to share your wisdom and excitement – and, I hope, your talents for dancing - with us.

In previous years, SAIP and the Council on Higher Education jointly reviewed undergraduate teaching and learning. A finding, coming from all the institutions participating, was the relatively low level of preparation of the majority of matriculants for entrance to university-level physics. SAIP has identified Teacher Development as a specific, useful, and effective intervention, and has received very positive feedback on workshops with teachers to date run with the partnership of the Institute of Physics, London. Therefore, I would especially like to extend a very warm and cordial welcome to Teachers attending this conference. Let's get excellent optics back into the curriculum, since we are a host of the biggest telescope in the world!

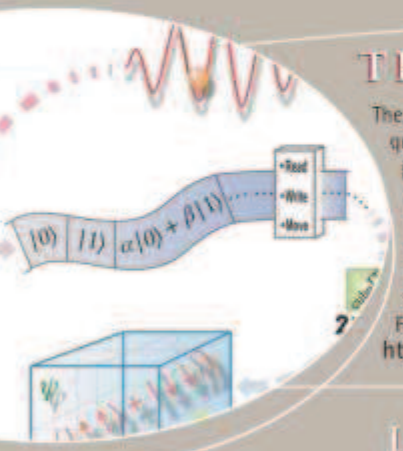
The conference is growing; the number of sessions is growing; and the venue and organisational requirements are significant. The University of Johannesburg is an excellent venue, providing the right size and space for interaction, and I'm very grateful indeed to the UJ team, led by Prof. Hartmut Winkler, for the massive effort that they've put in to make the conference successful. The SAIP Executive Officer, Brian Masara, and his able and energetic staff, take responsibility for continuity from year to year, as well as undertaking a great deal of the organisational work – thank you. This year's Winter Schools are on Magnetism, and on Astroparticle Physics. The conference is a good place to hold parallel meetings, and the Astronomy Town Meeting, the National Laser Centre Rental Pool meeting, and two workshops are taking place during this time. The Scientific Committee, headed by Prof Steven Karataglidis, has taken on the demanding task of managing the abstract and paper reviews, and I thank you for helping South Africa move forward in its physics publications in this way. I request members of the community to assist by reviewing carefully and replying promptly!

So much has happened in physics in the last year that it would take me a week to tell you about it. Hold on, we're there already – it's this week. Welcome to the Annual Conference – have a blast.

IGLE GLEDHILL
PRESIDENT
South African Institute of Physics

THE PLACE TO STUDY PHYSICS:
STELLENBOSCH

The Stellenbosch University Physics Department recently celebrated its centenary. We are a department with a proud history in physics, producing outstanding research, and graduating many excellent students over the years. Today the department still boasts a vibrant environment for young physicists to grow as researchers. Our research is focused in three main areas: theoretical, laser and nuclear physics



THEORETICAL PHYSICS

The research of the postgraduate students and staff of the Institute of Theoretical Physics focuses on quantum field theory, quantum mechanics, statistical and computational physics with applications to condensed matter theory, high energy physics and other complex or many-body systems. There is strong interaction with the activities of the National Institute of Theoretical Physics and the African Institute for Mathematical Sciences. We have published widely on disordered systems, polymer and biological physics, cascades and turbulence, correlations and fluctuations in ultrarelativistic collisions, solitons in field theory, chirality and exceptional points, the development of the mathematical formalism related to bosonization in many body-physics and non-Hermitian quantum mechanics. Please feel free to contact any of the academic staff of the Institute with any queries about our wide range of research projects for MSc and PhD. For more details visit:

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

LASER PHYSICS

A dynamic group of staff and post graduate students is advancing laser science under the banner of the Laser Research Institute. Our research, in which honours, MSc, PhD students and post docs are actively involved, comprises laser development as well as scientific applications of lasers. We are involved in short pulse fibre laser and gas laser development. Our research projects include high resolution vacuum ultraviolet laser spectroscopy, investigation of nonlinear optical effects on surfaces and interfaces, femtosecond spectroscopy of organic molecules and ultrafast electron diffraction experiments. Various applications to material processing, fluorescence and plasma techniques complete the portfolio of the LRI. The well funded research infrastructure includes a modern femtosecond laser system and associated ultrafast diagnostic equipment. We benefit from collaborations with the National Laser Centre, the African Laser Centre and research partners in South Africa, Africa and Europe. We offer an honours course in Laser Physics and have positions for MSc and PhD students available. For more information on the activities of the group visit:

http://www.laser-research.co.za

NUCLEAR PHYSICS

Research and the training of postgraduate students form integral part the group activities. We have developed expertise of international standard in applied, experimental and theoretical nuclear physics and radiation physics. Our group enjoys an active collaboration with local universities and national research institutions as well as numerous international laboratories and tertiary institutions in the USA, China, France, Germany, Italy, Bulgaria, Russia, Slovakia, Japan and Chile. Models that are developed through these studies allow the extension of theoretical predictions to the behaviour of exotic nuclei beyond the valley of stability. These models and the concomitant technologies in fundamental nuclear physics are applied to fields such as environmental radiation and safety studies, geophysics, radiation therapy, nuclear energy and nuclear astrophysics. We are currently also assisting in the development of Environmental Radiation Laboratory at iThemba LABS (near Cape Town). Our outreach and community efforts involve learners in research projects that are linked to local environmental issues to enrich their school curriculum.

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

For more information on our Physics programs and courses visit our website

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Message from UJ Vice Chancellor

It is a special privilege and a great honour for me to welcome the participants of the South African Institute of Physics 2014 Annual Conference at the University of Johannesburg.

Our university is now in the tenth year of its existence, having consolidated after the 2005 merger of three very disparate institutions, and having progressed to becoming a respected player in the African and global higher education landscape. We are now embarking on an excellence drive to further elevate our global excellence and stature - we are a member of the prestigious Universitas 21 network, are ranked within the top 4% position on the QS World University Rankings, and 61st in BRICS (QS BRICS University Rankings). We are particularly pleased that we were able to achieve this while retaining our mandate as a comprehensive university (without a medical school) to pursue our intensive undergraduate teaching programmes that are now diversifying many domestic vocations and professions.

We have recognised the importance of physics as a discipline crucial not only as a driver of knowledge generation and innovation in its own right, but also as a key component in training scholars and professionals in other disciplines, including health scientists and engineers. As such, we have invested significantly in human capital and laboratory resources to turn Physics into one of our areas of significant strength, as evidenced by our scholars' seminal contributions to the ATLAS, Higgs-boson, hadron-Hadron scattering and LHC research projects. We are therefore thrilled that the South African physics community has chosen UJ as its hosting institution for this year's annual conference. We look forward to the academic buzz that this conference will generate on campus, and trust that you will spend a very fruitful week exchanging ideas, strengthening inter-institutional networks and exposing the many postgraduate students present to this form of open academic engagement.

IHRON RENSBURG
VICE-CHANCELLOR
University of Johannesburg

Message from the Dean

On behalf of the Science Faculty of the University of Johannesburg, I am delighted to see you participating in the 2014 annual conference of the South African Institute of Physics, which we are proud to be hosting.

Physics is a discipline that underpins most of the teaching and research in Science, and therefore we strongly support your endeavours to meet annually to share your research findings and experience in student training, both at postgraduate level and, perhaps even more so, for undergraduates that we know find your subject difficult to master due to circumstances largely out of your control.

We trust that your interaction over the week will lead to a re-energising of your efforts to strengthen the discipline nationally. We hope that the many students, for whom this conference is often their first opportunity to present their work to a wider audience, will also emerge from the conference with added confidence and enthusiasm to bring their studies to successful completion.

As this is an exciting time to be doing Physics, with the SKA construction in progress and other initiatives such as SA-CERN growing steadily, we are particularly pleased that SAIP chose the University of Johannesburg this year to host this important event.

We thank you for the confidence in us, and trust you will have a most fruitful week at the University of Johannesburg.

ANNAH MOTEETEE
ACTING DEAN
UJ Faculty of Science


STUDY PHYSICS
AT THE FACULTY OF SCIENCE
UNIVERSITY OF JOHANNESBURG
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Message from the HOD - Dept of Physics

On behalf of the Local Organising Committee, I extend a special welcome to the delegates to the SAIP 2014 annual conference at the University of Johannesburg.

Since UJ's foundation 2005, we have grown into an active and vibrant physics community here at UJ, centred on the Physics Department at our Auckland Park campus (the previous Rand Afrikaanse Universiteit) and the Applied Physics & Engineering Mathematics Department at our Doornfontein campus (originally the former Technikon Witwatersrand). The centre of expertise in the study of magnetism and related properties developed at the former RAU continues to flourish and expand, and was therefore chosen as one of the topics for our Winter School. We have furthermore developed strong capacity in astrophysics, high-energy physics and theoretical nuclear physics, which prompted us to choose astroparticle physics as our second Winter School topic. We have in addition a keen interest in physics education and the popularisation of the discipline, reflected in our leadership role in the Soweto campus Science Centre.

Our local organising team has been hard at work for over a year now, and we are pleased that we are able to offer you what we believe will be a memorable annual SAIP conference, with scientific content highlighting some of the most notable recent developments in our discipline here in South Africa, such as the SKA, SA-CERN and others. We are particularly grateful to the UJ executive management and various support units for their generous assistance in securing us a superb venue and organisational backing.

We thank you for having chosen to spend part of your winter break with us here in Johannesburg, and trust that you will experience surprising charms on offer not traditionally associated with our dynamic metropolis. We look forward to your anticipated contribution to the success of the conference.

Enjoy the conference and return to your home institutions energised and scientifically enriched.

HARTMUT WINKLER
HEAD: UJ DEPARTMENT OF PHYSICS
CHAIR: SAIP2014 LOC

Invited Plenary Speakers

Prof Megan Donahue
Michigan State University, United States of America

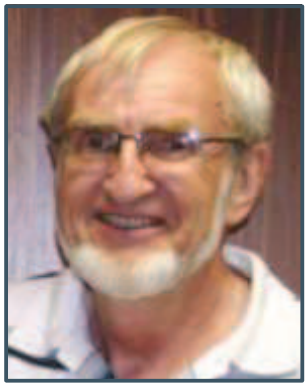
Megan Donahue has a physics S.B. degree from MIT (1985) and a Ph.D. in astrophysics from the University of Colorado, Boulder (1990). Donahue completed five years of post-doctoral research in observational astronomy at the Observatories of the Carnegie Institution of Washington, in Pasadena, California and at the Space Telescope Science Institute (STScI) in Baltimore, Maryland. In 1995, Donahue joined the science staff at STScI, continuing her research on clusters of galaxies and cosmology, while providing scientific guidance for the Hubble Space Telescope data archive and scientific development for the James Webb Space Telescope.

Donahue has been a professor at Michigan State University in East Lansing, Michigan in the physics and astronomy department since 2003, where she carries on research on clusters of galaxies, the physics of gas and galaxy formation, and dark matter. She teaches large astronomy classes, mentors graduate students, and participates in a significant number of national and international science advisory committees, including the International Astronomical Union's Office of Astronomy for Development in Cape Town, South Africa (2010-2014), the US National Academy of Science Committee on Astronomy and Astrophysics (2013-2015), the WFIRST Science Definition Team (2011-2015), the Giant Magellan Telescope Science Advisory Committee (2008-2014), and the Astro-2010 Decadal Survey Electromagnetic Observations from Space Prioritization Panel. She is also an author of a best-selling college-level introductory astronomy textbook series called The Cosmic Perspective, published by Pearson, together with co-authors Jeffrey Bennett, Nicholas Schneider, and Mark Voit.

ABSTRACT

DARK MATTER IN CLUSTERS OF GALAXIES : VIEWS FROM HUBBLE, CHANDRA, AND NEWTON
Tuesday 08 July 2014 09:00

I will present recent results about clusters of galaxies from the Hubble Space Telescope Multi-Cycle Treasury program named the Cluster Lensing and Supernovae with HST Survey (CLASH). Clusters of galaxies have been long known to be held together by enormous amounts of dark matter, well in excess of any normal, light-emitting matter present. Observational cosmology, based on such diverse datasets such as the distribution of galaxies in the universe and the power spectrum of the cosmic microwave background, has shown that dark matter is likely to be made up of relatively heavy, weakly interacting particles: cold dark matter (CDM). Supernova studies revealed the expansion of the universe is accelerating, and now we have a current best hypothesis for the universe called Lambda-CDM. Lambda-CDM makes predictions about how dark matter should be distributed in the gravitational potential of a cluster of galaxies. I will discuss how our Hubble Space Telescope lensing data for 25 clusters, representing 750 hours of satellite time, together with ground-based visible light images from the Subaru telescope, X-ray data from the Chandra X-ray Observatory and the XMM-Newton Observatory test the current paradigm. Gravitational lensing reveals where any gravitating matter is; the X-ray observations reveal where the majority of the baryonic matter is. Together we arrive at a complete picture of normal matter and dark matter in clusters of galaxies. I will relate the results of this work to cosmological results from Planck and discuss the next steps in our project. This talk presents the results of the CLASH collaboration, including the efforts of over 50 individual researchers in over 20 countries; the speaker acknowledges funding support from NASA.



Prof Harm Moraal
North-West University

Harm Moraal was born in the Netherlands. He was educated at the erstwhile Potchefstroom University for CHE, and was awarded his PhD there in 1974. He remained in the Department of Physics at Potchefstroom/North-West University, where he was promoted to professor in 1985, and served as Head of Department/Director of School from 1991 to 2002.

His research focuses on cosmic rays in the heliosphere, as modulated by solar activity. This is one of many branches of Particle Astrophysics. He started with experimental topics back in the early 1970s, then moved on to theoretical and numerical explanation of observations, and then back again to experimental work, with a strong focus on experiments in Antarctica. He currently teaches courses in Thermodynamics; Statistical Mechanics; and Science, Technology and Society.

ABSTRACT

PARTICLE ASTROPHYSICS
Tuesday 08 July 2014 12:10

South Africa is being marketed as a destination for multi-wavelength astronomy, with optical astronomy being the best established, while radio astronomy is the current big focus. The Centre for Space Research at North-West University traces its roots back to 1953, and over these years a multitude of Astrophysics and Space Science experiments have been conducted. From this, the current two main themes of Gamma-Ray Astrophysics and Particle Astrophysics have crystalized.

The talk will focus on these two lesser-known components of the multi-wavelength concept, demonstrate that they are complementary to optical and radio astronomy, and that they offer an opportunity to broaden the topical scope of subjects in the National Astrophysics and Space Science Programme (NASSP).

Invited Plenary Speakers

Dr Amanda Weltman
University of Cape Town

Developing a new theory to help solve challenges in cosmology is not a task to be taken lightly. However, this has not stopped Dr. Amanda Weltman who has, through her work on the chameleon mechanism, which she co-proposed with Dr. Justin Khoury, generated considerable interest and created an entirely new sub-field of cosmological research.

Dr. Weltman obtained her B.Sc. and Honours degrees from the University of Cape Town, and her MSc, MPhil and PhD from Columbia University in New York under the supervision of Brian Greene. She has specialised in the fields of cosmology, string theory and theoretical physics.

The biggest impact of Dr. Weltman's work is the proposal of a new kind of particle and interaction – the so-called chameleon fields which provides a unique method of explaining dark energy. It is also one of only three proposed mechanisms for hiding dark energy-mediated fifth forces.

Dr Weltman has worked as a postdoctoral researcher at the Centre for Theoretical Cosmology, run at the time by Stephen Hawking, at Cambridge University. She is now a Senior Lecturer in the Department of Mathematics and Applied Mathematics at UCT.

ABSTRACT

CHAMELEON COSMOLOGY NEAR AND FAR
Tuesday 08 July 2014 16:10

In this talk we will consider a novel explanation of the dark energy problem, so called chameleon gravity which gives rise to particles with unexpected consequences. These particles discovered in 2003 by Khoury and Weltman are called Chameleon scalar fields and are dark energy candidates which, unlike regular quintessence fields, suppress their expected fifth force signals in high density regions of the universe by acquiring large effective masses. In regions of relatively low energy density these fields are very light and can essentially be free allowing for a plethora of interesting observations and effects. Perhaps most enticing is the possibility to observe these fields in experiments entirely non-cosmological in nature.

These tests span from tests of gravity in space to tests of the casimir effect and quantum laser experiments on earth. In this talk we will discuss the various tests of these fields including those already completed and those currently under proposal and construction. We will also consider the possibility of testing these fields within the South African context using the SKA experiment. Chameleon gravity is one of only 3 ways known to hide the effects of scalar dark energy fields from local experiments and provide a possible window of testability connecting UV physics to IR experiments. We will discuss our results to date and explore the possibilities for the future.

Prof Miles Padgett
University of Glasgow, Scotland

Miles Padgett holds the Kelvin Chair of Natural Philosophy at the University of Glasgow in Scotland. His group has pioneered the understanding of light's momentum, including conversion of optical tweezers to optical spanners, the opportunity for angular momentum in optical communication, and demonstrating an angular form of the quantum EPR paradox.

In recognition of this work, in 2008 Miles was awarded the Institute of Physics Optics and Photonics Prize, in 2009 the Young Medal and Prize for "pioneering work on optical angular momentum" and in 2014 the Kelvin Medal of the Royal Society of Edinburgh.

ABSTRACT

LIGHT IN A TWIST: OPTICAL ANGULAR MOMENTUM
Wednesday 09 July 2014 09:00

In 1992 Allen et al. recognized that light beams carrying an orbital angular momentum, in addition to the photon spin, could be created in the laboratory. This twist can be generated using lenses, or holograms encoded onto liquid crystal displays. Both whole beams and single photons can carry this twist, or transfer it to particles causing them to spin.In this talk I will introduce the underlying properties and discuss a number of manifestations of orbital angular momentum.

These various demonstrations by our own group and others highlight how optics still contains surprises and opportunities for micro-manipulation, novel imaging modalities and high bandwidth communication in both the classical and quantum worlds. Our most recent work considers how a rotational form of the classical Doppler effect might by used to sense the rotation of distant bodies, even when the linear effect is zero.

Invited Plenary Speakers

Prof Marcia Barbosa
Universidade Federal do Rio Grande do Sul, Brazil

Marcia Barbosa is a physicist working in water. She is also the director of the Physics Institute from the Universidade Federal do Rio Grande do Sul, vice-president of the International Union of Pure and Applied Physics and member of the council of the American Physical Society and Brazilian Physical Society.

Marcia was awarded with the 2009 Nicholson Medal of the American Physical Society and the 2013 Loreal-Unesco prize of Women in Science. Marcia graduated more than 20 students and has more than 100 publications in her research in physics and in gender issues.

ABSTRACT

WOMEN AND PHYSICS : WHY SO FEW?
Wednesday 09 July 2014 12:10

Women are greatly under- represented in physics. Among all sciences, physics is the field where the increase in the number of women has been particularly slow. Because of this imbalance , many bright young people do not receive the opportunity to learn about physics and to prepare themselves for a physics career, and others are discouraged from doing so. However, the problem is not only that girls are discouraged to go to physics, they run away from it. Women will leave physics disproportionately with each step of career advance, which has been described in the US reports as the "leaky pipeline" or in the European Studies as the "seizors effect". But, why should we care about this problem? Why should women be in physics after all? Women that have a passion for physics should be able to make a living and have a successful career in this field. But, the need of gender balance in science, it is not only a equal opportunity issue. Physics need a greater participation of female researchers in order to survive. Science is changing and it is becoming more interdisciplinary. This evolution is only possible through diversity of thought and of strategies to approach problems. Therefore, excluding women more than limiting the available pool of talented people to half of humanity, we are limiting diversity. Finally, in a society where technology is governing our everyday life and where women are highly involved in the educational process, exposing women to science generates a more scientific literate public. In this talk we present statistics not only illustrating the lack of women in physics but also how the numbers are even worst at the top level of the career. Some good practices are illustrate.

Prof Andrew Forbes
CSIR

Andrew Forbes received his PhD (1998) from the University of Natal, 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. He is presently Chief Researcher at the CSIR National Laser Centre and is the Research Group Leader of the Mathematical Optics Group.

Andrew sits on several international conference committees, chairs SPIE's International Conference on Laser Bean Shaping and is Char of the OSA's Diffractive Optics and Holography technical group. He hols honourary Professorships from three universities, serves on many national and international panels, has published over 200 technical papers, and is an active populariser of science.

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

ABSTRACT

TAILORING LIGHT WITH DIGITAL HOLOGRAMS
Wednesday 09 July 2014 16:10

Digital holography as an optical technique has been in existence for more than a decade now. With the commercialisation of liquid crystal devices, digital holography as an enabling tool has become accessible to all, and with it all-digital tools for the tailoring of light has finally come of age. In this talk the role of digital holograms in shaping and controlling the spatial patterns of light will be introduced, so-called structured or tailored light. The basic principles of digital holography, implemented with rewritable spatial light modulators, will be discussed for the creation and detection of customised light fields in the laboratory.

We will show that this can be done at the many photon and single photon regimes, as well as directly at the source to form a digital laser. Such tools are highly relevant to the in situ analysis of laser systems, to mode division multiplexing as an emerging tool in optical communication, and for quantum information processing with entangled photons. In the process of the talk I give a popular overview of the research currently underway in the Mathematical Optics group at the CSIR National Laser Centre.

Invited Plenary Speakers

Prof Toshimi Suda
Tohoku University, Japan

Toshimi Suda received his PhD from Tohoku University in 1988 in the field of intermediate energy photonuclear physics. After a brief postdoctoral fellowship at the RCNP, Osaka University, he returned to Tohoku University as a research associate from 1989 to 1999, during which time he also held a von Humboldt scholarship to work at the Technical University, Darmstardt, Germany.

From 1999 he was vice Chief Scientist at the Nishina Centre for Accelerator-based Science at RIKEN, near Tokyo, and was in charge of their radioactive beams. In 2010, he returned to Tohoku University as Professor at the Research Centre for Electron-Photon Science. His research interests are in radioactive nuclei, and is in charge of the SCRIT project, to measure electron scattering form factors from exotic nuclei.

ABSTRACT

THE SCRIT ELECTRON SCATTERING FACILITY
Thursday 10 July 2014 09:00

The world's first electron scattering facility dedicated to the structure studies of short-lived nuclei, the SCRIT Electron Scattering Facility, will soon start its operation. I will discuss the facility details and physics pursued at this facility including future perspectives.The goal of this facility is to study the internal structures of exotic nuclei by electron scattering, and the immediate goal is to determine the charge density distribution by elastic electron scattering whose cross section is the largest up to a certain momentum transfer. It has been already demonstrated that the luminosity required for elastic scattering experiments, 10^{27}/cm^2/s, is achievable at this facility.The SCRIT electron scattering facility consists of the 150-MeV microtron injector, 700-MeV electron storage ring equipped with the SCRIT system, an ISOL for neutron rich isotope production and an electron spectrometer.

The electron accelerators and the SCRIT system have been already commissioned, and the commissioning of the ISOL and spectrometer is underway. The target isotopes for the Day-One experiment will be Sn including the doubly magic nucleus ^{132}Sn. A systematic change of the charge distributions for ^{112}Sn - ^[132}Sn will be revealed.Recently, additional research opportunity at the SCRIT facility has been pointed out; the measurement of the photoabsorption cross section over a wide photon energy range, 5 < E¥gamma < 40 MeV. In the talk, we will describe the facility details, physics program and future perspectives.

Prof Justin Jonas
SKA and Rhodes University

Justin Jonas is currently Associate Director, Science and Engineering, of the SKA project (South Africa), as well as Professor of Physics, in the Department of Physics and Electronics, Rhodes University. He obtained his PhD from Rhodes University in 1999, while serving as Research Officer in radio astronomy.

His expertise is in radio astronomy and also in the instrumentation of radio telescopes, and he has been central to the development of the MeerKat and SKA projects.

ABSTRACT

THE SQUARE KILOMETRE ARRAY, MEERKAT AND MORE
Thursday 10 July 2014 12:10

South Africa has been involved in the Square Kilometre Array project for about a decade, starting as a minor partner in this international endeavour and now building the MeerKAT, the largest radio telescope array in the world and an SKA precursor. This talk will present the recent history and current status of the international SKA project, and provide an overview of the activities of the SKA South Africa project office. Topics related to the SKA include the implications of the decision to locate the SKA in both Africa and Australia, the top priority science drivers for SKA Phase 1 and Phase 2, the technologies to be employed by the SKA, and the design process for Phase 1 that is currently underway.

The major activity of the SKA SA project office is the construction of the MeerKAT radio telescope and the establishment of a radio astronomy observatory facility in the Karoo. The science case and technical implementation of MeerKAT will be introduced, emphasizing the role that MeerKAT plays as an SKA precursor. A brief overview of the various ancillary projects being pursued and supported by SKA SA will be presented. These include the Human Capital Development Programme, the African VLBI Network (AVN), Big Data Africa, PAPER/HERA, C-BASS and a technology transfer and commercialization programme.

Invited Plenary Speakers

Prof Cedric Linder
Uppsala University, Sweden

Cedric Linder is Professor of Physics Education Research, Division of Physics Education Research, Department of Physics and Astronomy, Uppsala University, Sweden, Professor of Physics Education, Department of Physics, University of the Western Cape, South Africa, and Guest Professor of Science Education, Faculty of Health and Life Sciences, Linnaeus University, Sweden. He also holds a senior professorship in physics at the University of the Western Cape, and a guest professorship in education science at Linnaeus University, Kalmar, in Sweden. He studied physics and physics education at Rhodes, Rutgers, and the University of British Columbia where he obtained his doctorate looking at challenges that graduate physics students experience with understanding sound. His experience with teaching physics spans 33 years, during which he has become well known for pioneering many things. Two of these are: firstly, a new approach to teaching physics that calls for the explicit incorporation of conceptual physics into both service and mainstream physics; and secondly, the inclusion of theory building in the field of Physics Education Research as a way to better inform teaching practice aimed at improving physics learning experiences and their outcomes. His current work is embedded in viewing learning as an emergent phenomenon in a complex adaptive system, and exploring disciplinary representational issues in the teaching and learning of physics and astronomy.

Later this year, at the 2014 International Conference on Physics Education, Córdoba, Argentina in August, Cedric Linder will be receiving the International Commission on Physics Education (Commission 14 of the International Union of Pure and Applied Physics) ICPE Medal for 2014 in recognition of his outstanding contributions to physics education.

ABSTRACT

NEW WAYS OF THINKING ABOUT UNIVERSITY PHYSICS TEACHING : A DISCUSSION OF DISCURSIVE REPRESENTATIONS USING SOUTH AFRICAN EXAMPLES
Thursday 10 July 2014 16:10

Over the past two to three decades it has been convincingly shown that many of the learning challenges faced by physics students are rooted in coming to understand and work with the specialised forms of communication that physics uses. This communication is made up of discursive representational forms such as written and spoken language, mathematics, graphs, gestures, sketches, diagrams, pictures, schemata, and so on. From such a viewpoint, the teaching and learning of physics becomes inseparable from these representations and their intended disciplinary affordances. Thus, they aught to take on special significance in our educational practices.

In the face of the recent South African Council on Higher Education and the South African Institute of Physics Review of Undergraduate Physics Education it seems relevant to ask if they do? Three recent studies that include selected South African university-physics education contexts will be used to discuss this issue.

Prof Emmanuel Tsesmelis
CERN and University of Oxford, England

Emmanuel Tsesmelis is an experimental particle physicist with a career spanning scientific research, academic teaching, science communication, international relations and management at CERN and at several universities. He is a Senior Physicist and Deputy Head of International Relations in CERN's Directorate-General Unit and a Visiting Professor in Particle and Accelerator Physics at the University of Oxford. He is an elected Fellow of the Australian Institute of Physics and a supernumerary member of Jesus College, Oxford. He works closely with the SA-CERN programme.

He obtained his BSc. (Hons) and MSc. from the University of Melbourne. He then moved to the University of Dortmund, Germany, where he obtained his PhD on searches for the Higgs boson in the data obtained by the UA2 experiment at CERN. From 1993 to 1998, he worked on the neutrino programme at CERN - NOMAD and CNGS - after which he joined the CMS experiment at the LHC. During 2005 to 2008, he was Head of the LHC Experimental Areas. From 2009, he has been a member of the CERN Directorate.

ABSTRACT

CERN – A GATEWAY TO SCIENCE AND TECHNOLOGY
Friday 11 July 2014 09:00

Founded in 1954, CERN was one of Europe's first joint ventures and has become a premier example of international collaboration. Today, 60 years later, CERN is the world's largest laboratory for fundamental physics, hosting more than 10,000 scientists and engineers from around the world working on its research and engineering projects.CERN's primary subject of study is the fundamental science of particle physics, unlocking the innermost secrets of the universe. The Large Hadron Collider (LHC) is CERN's flagship project, and has launched a new era of scientific research and discovery.

Experiments at the LHC announced the observation of a Higgs boson in 2012, one of the most significant breakthroughs in the history of science, the theoretical foundations of which have been rewarded with last year's Nobel Prize in Physics.CERN also plays a vital role in advanced capacity building through academic and technical education and training. From materials science to superconductivity and computing, particle physics demands ultimate technical performance, making CERN an important test-bed for advanced technological developments in close collaboration with industry.This talk will provide an overview of these points, including the fundamental science, technological innovation, advanced scientific and technical training and international scientific collaboration.

Invited Plenary Speakers

Prof Eric Fullerton
University of California, San Diego, USA

Eric Fullerton is a Professor of Electrical and Computer Engineering and NanoEngineering at University of California, San Diego. He is also the holder of an Endowed Chair and is Director of the Center of Magnetic Recording Research. He received his B.Sc. in physics from Harvey Mudd College in 1984 and his Ph.D. in physics from University of California, San Diego in 1991.

Prior to joining UCSD, Prof. Fullerton held research positions at Argonne National Laboratory, IBM Almaden Research Center and Hitachi GST. He has co-authored more than 270 papers in refereed journals and holds 51 US patents. His awards include the Argonne Exceptional Performance Award, Fellowship in the American Physical Society and the IEEE, the IBM Outstanding Technical Achievement Award, the Hitachi GST Gold Patent, Docteur Honoris Causa from Universite Henri Poincare, and the AIP Prize for Industrial Applications of Physics.

ABSTRACT

BITS OF THE FUTURE: EMERGENT PHYSICS FOR ADVANCED MAGNETIC INFORMATION TECHNOLOGIES
Friday 11 July 2014 12:10

Hard-disk drives continue to dominate information storage and magnetic devices are emerging in memory and processing applications. Because these applications rely upon the magnetic order parameter they are inherently non-volatile. Furthermore, the dissipation energy of magnetic processes can be orders of magnitude smaller than comparable semiconductor services. However continued progress in magnetic information technologies will require new approaches and materials for controlling magnetism at the nanoscale. In this presentation I will review the challenges for achamieving high-density and low power magnetic information technologies.

To address these challenges I will discuss new ways to control magnetism beyond using applied magnetic fields. I will focus on recent experiments using sub-ns spin-polarized current pulses and sub-ps circularly-polarized light pulses to switch nano-magnets. In particular the recent demonstration of all-optical control of ferromagnetic materials using 100-fs optical pulses opens a range of new potential applications and probes fundamental ultra-fast processes in magnetic materials.

Prof Vladimir Dyakonov
Julius Maximilian University of Würzburg, Germany

Vladimir Dyakonov received his Diploma in physics from the University of St. Petersburg, the Ph.D. degree in physics from the A. F. Ioffe Physico-Technical Institute, St. Petersburg, Russia in the Department of Solid State Physics, and the Habilitation degree in experimental physics from the University of Oldenburg, Oldenburg, Germany.

Since 1990, he has been a Visiting Researcher at the Universities of Bayreuth (Germany), Antwerp (Belgium), and Linz (Austria). Since 2004, he has been full professor and the chair of Experimental Physics VI, Institute of Physics, Faculty of Physics and Astronomy, Julius-Maximilian University of Würzburg, Germany, and also the chairman of the board of the Bavarian Centre of Applied Energy Research (ZAE Bayern).

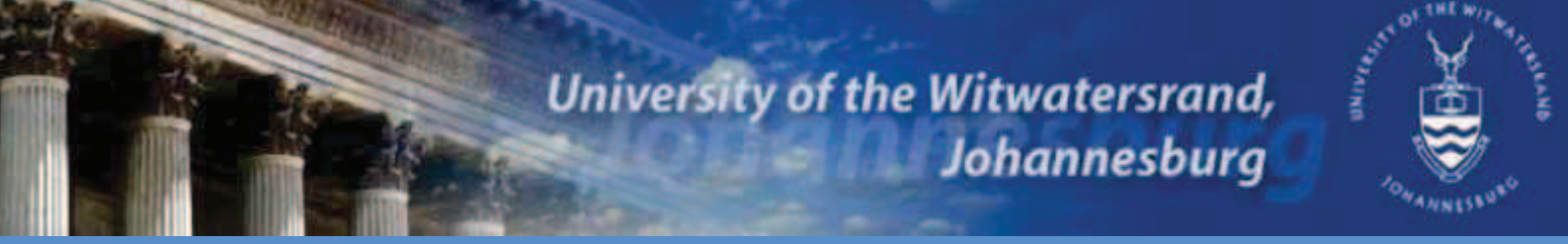
In 2010 he has been the spokesman of German Renewable Energy Research Association (FVEE). His main research interests comprise investigations of functional materials for renewable energy and energy efficiency technologies.

ABSTRACT

ORGANIC AND HYBRID ORGANIC-INORGANIC CONCEPTS FOR PHOTOVOLTAIC ENERGY CONVERSION
Friday 11 July 2014 14:00

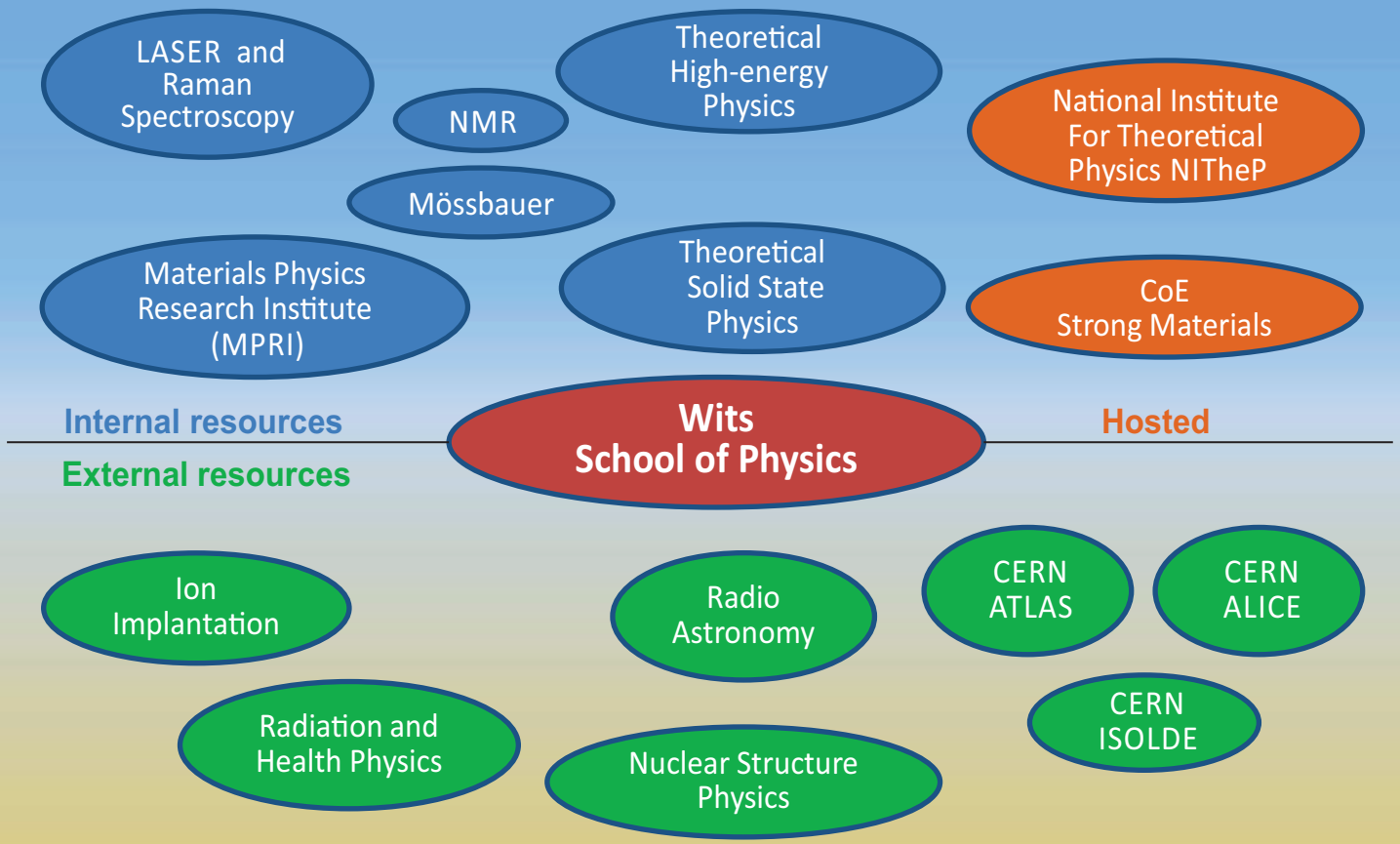
Thin film photovoltaics (PV) attracts much attention as a promising source of renewable energy to reduce the dependencies on fossil and nuclear sources of energy. The advantage of using polymers and molecules in electronic devices, such as light-emitting diodes, field-effect transistors and solar cells (OPV) is justified by the unique combination of the potentially high device performance and processability of the semiconductors used in the active layer. Power conversion efficiencies of nanostructured organic solar cells are in the range of 10-12% on a lab scale, making them ready for commercialization, e.g. in building integrated PV.

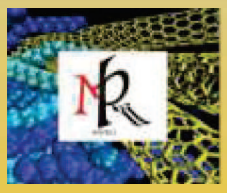
The operation principles of this type of solar cells are quite different from those we know for inorganic solar sells, based e.g. on Si of CIGS. Recently, photovoltaics based on methylammonium lead halide perovskites (PSC) having excellent semiconductor properties and leading to efficient solar cells in access of 16% have attracted much attention. However, not everything is clear about the general working principles in this new class of solar material. I will present the state of the art in both fields, OPV and PSC and discuss the mechanisms governing the charge carrier generation, recombination and transport.



The School of Physics at Wits is the largest single-campus Physics department in South Africa. The School is research intensive with over twenty NRF rated scientists. The School has state-of-the-art research laboratories and researchers in the School also participate in international high-profile experiments. Research activities encompass the sub-atomic to galactic proportions. There are strong links with research laboratories within South Africa, including iThemba LABS, HartRAO and the SKA precursors KAT7 and MeerKAT, and globally including H.E.S.S., CTA and CERN (ATLAS, ALICE and ISOLDE collaborations).

RESEARCH ACTIVITIES





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SAIP Divisions and Meetings

DIVISION	CHAIR	E-MAIL	MEETING
Division for Physics of Condensed Matter and Materials	Prof. Japie Engelbrecht	dcmpm@saip.org.za	Thursday 10 July - 11:10
Nuclear, Particle and Radiation Physics	Dr. Simon Mullins	nuclear@saip.org.za	Thursday 10 July - 17:10
Photonics	Prof. Erich Rohwer	photonics@saip.org.za	Wednesday 9 July - 10:00
Astrophysics and Space Science	Dr Ilani Loubscher	astrophysics@saip.org.za	Thursday 10 July - 10:00
Physics Education	Dr Sam Ramaila	education@saip.org.za	Wednesday 9 July - 10:20
Applied Physics Forum	Dr Freddie Vorster	applied@saip.org.za	Thursday 10 July - 11:10
Theoretical and Computational Physics	Prof. F G Scholtz	theoretical@saip.org.za	Wednesday 9 July - 10:40

Meeting list

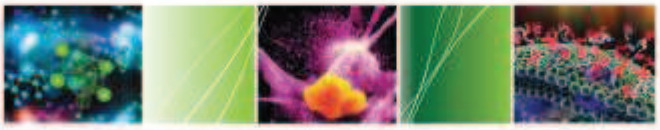
MEETING	TIMESLOT	VENUE
CSIR Rental Pool Meeting	Sunday 6 and Monday 7 July	D Les 103
SAIP Council Meeting	Monday 7 July 10:00 - 17:00	D Les 310
WiPiSA Lunch	Wednesday 9 July 13:10 - 14:00	Library 6th Floor Auditorium
Plenary speakers and students lunch	Thursday 10 July 13:10 - 14:00	Library 6th Floor Auditorium
SAIP Council Meeting with HODs	Wednesday 9 July 19:00 – 20:00	D Les 310
SAIP Council Meeting with Division Heads	Thursday 10 July 18:00 – 19:00	D Les 310
SAIP Annual General Meeting	Friday 11 July 15:00 – 16:00	Auditorium

Non Specialists Lectures

TRACK	PRESENTER	CONTRB.	TITLE	TIME
DCMPM	Prof. PRINSLOO, Aletta	#292	Unique magnetic properties in simple metals	Wednesday 09 July 11:10
Photonics	Prof. PADGETT, Miles	#463	Does God play dice with angles?	Tuesday 08 July 15:00
Astro & Space	Prof Throop, Henry	#273	Characterization of Potentially Hazardous Near-Earth Asteroids	Thursday 10 July 11:10
Applied	Dr. LAFLEUR, Trevor	#30	Optimization of the PEGASES plasma thruster	Thursday 10 July 14:00

SACNASP

South African Council for Natural Scientific Professions



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Register to be Recognised!

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. For a complete list of the current fields of practise recognised by SACNASP, visit our website at www.sacnasp.org.za

Our mission is to establish, direct, sustain and ensure a high level of professionalism and ethical conscience amongst 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 of natural scientists.
- Ensure that prospective registrants meet the educational standards required for registration.

*** Please also take note that it is illegal to practise as a Natural Scientist in South Africa, if you are not registered with SACNASP.**

www.sacnasp.org.za

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Winter School

		ASTROPARTICLE PHYSICS (D LES 104)	MAGNETISM (D LES 106)
MONDAY 7 JULY 2014	08:00 - 09:00	**REGISTRATION AND TEA**	
	CHAIR	**Dr. Chris Engelbrecht**	**Dr. Bryan Doyle**
	09:00 - 09:30	Welcome and Opening; Announcements	Welcome and Opening; Announcements
	09:30 - 10:30	Astroparticle physics of pulsar magnetospheres **Dr. Christo Venter**	Synchrotron probes of magnetism **Prof. GIOvanni Hearne**
	10:30 - 11:00	**TEA BREAK**	
	CHAIR	**Prof. Soebur Razzaque**	**Prof. GIOvanni Hearne**
	11:00 - 12:00	ATLAS Collaboration: astronomical and cosmological significance **Prof. Simon Connell**	The basics of 4f-electron magnetism **Ms. Buyi Sondezi-Mhlungu**
	12:00 - 13:00	The astrophysics approach to unveil the nature of dark matter **Prof. Sergio Colafrancesco**	Characterization of magnetic nanoparticles **Dr. Lonzeche Lodya**
	13:00 - 14:00	**LUNCH**	
	CHAIR	**Prof. Simon Connell**	**Prof. GIOvanni Hearne**
	14:00 - 15:00	Neutrino Astronomy **Prof. Soebur Razzaque**	Designed novel magnetocaloric materials: magnetic refrigeration for the future **Dr. Jyotish Chandra Debnath**
	15:00 - 16:00	Compact starts as laboratories for fundamental physics **Prof. Azwinndini Muronga**	Intelligent magnetic materials **Dr. Gildas Diguet**
	16:00 - 16:30	**CLOSURE AND TEA**	

Opening Ceremony (Monday 7 July 2014)

The Sanlam Auditorium - Auckland Park Kingsway Campus - University Of Johannesburg

18h00 Opening remarks

18h10 Welcoming address
Prof. Angina Parekh
Deputy Vice-Chancellor: Academic
University of Johannesburg

18h20 Welcoming remarks from the SAIP
Dr Igle Gledhill
President of the SAIP

18h30 Research at the University of Johannesburg
Prof. Tshilidzi Marwala
Deputy Vice-Chancellor: Research, Postgraduate Studies and the Library
University of Johannesburg

18h40 Musical interlude

18h55 Introduction of the guest of honour

19h00 Keynote address and official opening
The Hon. Naledi Pandor
Minister of Science and Technology

19h20 Final Information to delegates

19h30 Cocktails and buffet
Served in the foyer of the auditorium

TUESDAY 8 JULY 2014

08:30 - 09:00	Welcome Address (Auditorium)			
09:00 - 10:00	**PLENARY: DONAHUE, Megan** **Dark matter in clusters of galaxies: views from Hubble, Chandra, and Newton**			
TRACK	**A1:** Div. for Physics of Condensed Matter and Materials (D Les 201)	**A2:** Div. for Condensed Matter Physics and Materials (D Les 202)	**B:** Nuclear, Particle and Radiation Physics (D Les 101)	**C:** Photonics (D Les 102)
Theme *Chair*	- *Dr. Nolting, Volkmar*	- *Dr. Tshepe, Tshakane*	**Anti-neutrinos and RIBs** *Dr. Bark, Rob*	**Materials** *Dr. Neethling, Pieter*
10:00 - 10:20	Pressure induced charge order collapse in Fe_2OBO_3 162 Mr. SIBANDA, Wisdom Nkosilathi (UJ) PhD	Study of the radiation damage induced by fast neutron and deuterium ions in graphite and zircaloy-4 59 Mr. MAHAFA, Tshepo (UJ) MSc	The development of a neutron converter for the production of radioactive ion beams at iThemba LABS 360 Mr. NGCOBO, Zipho (UCT) PhD	Effect of annealing on the photoluminescence characteristics of solution grown ZnO nanorods array 115 Mr. MBULANGA, Crispin (NMMU) MSc
10:20 - 10:40	Influence of Spark Plasma Sintering parameter on Cu-CNT composites for thermal management 194 Mr. SULE, Rasidi (TUT) PhD	Structural,Electrical and Electronic Properties of Diamond Like Carbon (DLC) and Cabon-Based Materials 91 Mr. MBIOMBI, Wilfred (Wits) MSc	Looking for an influence of antineutrinos on a beta plus source-long term measurements at Koeberg power station 348 Dr. SMIT, Frederick David (iThemba LABS) -	Optical and Electrical properties of solution-grown ZnO nanorods on Si 135 Mr. TANKIO DJIOKAP, Stive Roussel (NMMU) PhD
10:40 - 11:10	Tea & Coffee Break (Foyer)			
Theme *Chair*	- *Prof. Hearne, GIOvanni*	- *Dr. Suleiman, Balarabe*	**Octupoles & VHE Spectroscopy** *Dr. Mullins, Simon*	**Ultrafast Spectroscopy** *Prof. Rohwer, Erich*
11:10 - 11:30	Atomic scale simulation in the service of nuclear materials 2 Prof. GRIMES, Robin (Imperial College London) -	Synthesis and characterization of mixed-valence $LuFe_2O_{4-\delta}$: Effect of stoichiometry δ 82 Mr. PECK, Adli (UJ) MSc	Octupole Excitations in U isotopes 215 Dr. NTSHANGASE, Sifiso Senzo (UNIZULU) -	Ultrafast charge transfer processes in organic-dye sensitised solar cells 232 Ms. MINDA, Iulia (SU) MSc
11:30 - 11:50	Field theory formulation for active network 231 Ms. MEBWE PACHONG, Stanard (SU) PhD	Computational Study on Advanced Lithium – Sulphur Battery 110 Mr. MASEDI, Cliffton (UL and CSIR) MSc	Octupole correlations and Collective Couplings in the rare earth nucleus ^{154}Dy 179 Mr. ZIMBA, George (UJ) MSc	Femtosecond electron diffraction on organic crystals 323 Mr. SMIT, Bart (SU) MSc
11:50 - 12:10	Laser spectroscopy studies of the recrystallization of an amorphous layer in GaAs produced by argon ion implantation at ~77 K 263 Mr. JAKATA, Kudakwashe (Wits) PhD	Molecular dynamics simulation of TiO_2 nanoparticles using DFTB+ code 151 Mr. GANDAMIPFA, Mulatedzi (UL) MSc	SHELS - Separator for Heavy Element Spectroscopy. First results 252 Mr. POPOV, Yury (JINR) -	Control of CO2 vibrational dynamics via shaped-pulse Coherent Anti-Stokes Raman Spectroscopy 338 Mr. HENDRIKS, Attie (CSIR) PhD
12:10 - 13:10	**PLENARY: MORAAL, Harm** **Particle Astrophysics**			
13:10 - 14:00	Lunch Break (Foyer)			
Theme *Chair*	- *Prof. Fullerton, Eric*	- *Dr. Mathe, Bhekumusa*	**ATLAS 1** *Prof. Connell, Simon*	**Pulse shaping** *Prof. Forbes, Andrew*
14:00 - 14:20	Effects of Cr3+ mol% on the structure and optical properties of the ZnAl2O4:Cr3+ nanocrystals synthesized using sol-gel process 325 Mr. MOTLOUNG, Setumo (UFS) PhD	A study of crack formation and its effective internal surface area using Micro-Focus X-ray Tomography (μX-CT) and Fractal Geometry 65 Ms. SEAKAMELA, Teffo (UJ) MSc	The development of a general purpose Processing Unit for the upgraded electronics of the ATLAS detector Tile Calorimeter 108 Mr. COX, Mitchell (Wits) MSc	Shaping coherent light 346 Mr. SPANGENBERG, Dirk-Mathys (SU) PhD
14:20 - 14:40	Nitrogen dioxide and Ammonia Gas Sensing by Tungsten Trioxide Film 329 Mr. GOVENDER, Malcolm (CSIR) PhD	Phase evolution of vanadium oxides obtained through temperature programmed annealing of ammonium vanadate in hydrogen atmosphere 192 Mr. AKANDE, Amos (UL) MSc	First look at Data Acquisition system for a fixed target experiment at the NICA complex at JINR and its connection to the ATLAS TileCal readout electronics 213 Mr. TOMIWA, Kehinde (Wits) MSc	Measuring phase with Stokes measurements 9 Dr. DUDLEY, Angela (CSIR) -
14:40 - 15:00	A Steady State Model For Interfacial Reaction And Binary Diffusion In Si-Pd System 55 Mr. AKINTUNDE, Samuel (UP) PhD	Effect of xenon (Xe) 167 MeV Irradiation on Un-implanted 6H-SiC and Poly-SiC implanted with iodine (I), krypton (Kr) and xenon (Xe) at room temperature 255 Mr. MABENA, Chemist (UP) MSc	The ATLAS Trigger/DAQ system and its system administration aspects 413 BALLESTRERO, Sergio (UJ) -	Ptychographic reconstruction of temporal objects 341 Mr. SPANGENBERG, Dirk-Mathys (SU) PhD
15:00 - 15:20	- - - -	Ion beam effects in thin metallic films due to Elastic Recoil Detection Analysis using 26 MeV Cu7+ions. 75 Mr. MAVHUNGU, Humbulani (NECSA) -	Single top channel analysis in association with higgs production at ATLAS: a feasibility study 153 Ms. ANTEL, Claire (UCT) MSc	Non Specialist lecture: Does God play dice with angles? 463 Prof. PADGETT, Miles (University of Glasgow) -
15:20 - 15:40	- - - -	- - - -	Constraining Beyond the Standard Model physics with the newly discovered Higgs boson with the ATLAS detector 13 CARRILLO-MONTOYA, German David (Wits) -	- - - -
15:40 - 16:10	Tea & Coffee Break (Foyer)			
16:10 - 17:10	**PLENARY: WELTMAN, Amanda** **Chameleon Cosmology Near and Far**			
17:10 - 19:00	**POSTER SESSION 1** **(D Les Ground Level) See page 33 for details**			

Welcome Address (Auditorium)

PLENARY: DONAHUE, Megan
Dark matter in clusters of galaxies: views from Hubble, Chandra, and Newton

D1: Astrophysics (D Les 203)	**D2:** Space Science (D Les 204)	**E:** Physics Education (D Les 310)	**F:** Applied Physics (D Les 103)	**G:** Theoretical and Computational Physics (D Les 104)
- *Prof. Smits, Derck*	- *Dr. Moeketsi, Daniel*	- *Dr. Mark, Herbert*	Biophysics *Dr. Krüger, Tjaart*	- *Prof. Scholtz, Frederik*
A Boost to Astronomy in Southern Africa 211 Mr. SIMPEMBA, Prospery C (Copperbelt University/Wits) -	Application of discrete-ordinate radiative transfer (distort) model to inhomogeneous aerosols atmosphere 16 Mr. YUSUF, Hussaini (Kano University of Science) -	Influence of a science enrichment programme on the views of the nature of science of a group of grade 10 learners 434 Mr. BALOYI, Vonani Michael (UP) PhD	Investigation of carotenoid excited electronic states in the main plant light-harvesting complex (LHCII) via femtosecond pump-probe spectroscopy 35 Ms. SINGH, Asmita (UP) MSc	Higgs quartic coupling, neutrino masses and mixing angles in 2UED models 22 Prof. CORNELL, Alan (NITheP) -
Radio Astronomy in Africa: The Case Of Ghana 174 Mr. ASABERE, Bernard Duah (UJ) PhD	Polarity changes of small-amplitude ion-acoustic and electron-acoustic solitons in multi-fluid space plasmas 178 Dr. OLIVIER (SANSA) -	Students' perceptions of the study process: A critical analysis 18 Dr. RAMAILA, Sam (UJ) -	Using single-molecule spectroscopic methods to investigate the environmental dependencies of photoprotection in main plant light harvesting complex 174 Mr. BOTHA, Joshua (UP) MSc	Evolution of Yukawa Couplings and Quark Flavour Mixings in the 2UED 23 Mr. ABDALGABAR, Ammar (School of Physics, Wits) PhD

Tea & Coffee Break (Foyer)

- *Prof. Throop, Henry*	- *Dr. Olivier, Carel*	- *Prof. Keartland, Jonathan*	Biophysics, Materials *Dr. Vorster, Frederik*	- *Prof. Cornell, Alan*
How does the Cosmic Web Shape Galaxy Formation? 398 Dr. GILBANK, David (SAAO) -	Seasonal variation of Ionospheric TEC over South Africa during the recent unusual solar minimum between cycle 23 and 24 310 Dr. MOEKETSI, Daniel (CSIR) -	Excel IF functions as marking rubrics for assessing physics practicals 107 Mr. OELOFSE, Jan (UJ) -	The role of low-energy fluorescence bands in the photoprotection of the major plant light harvesting complex 381 Mr. STOLTZ, Herman (UP) MSc	Integrability in Large N super Yang-Mills Theory 53 Prof. DE MELLO KOCH, Robert (Wits) -
The properties of radio relics and the connection with radio halos in galaxy clusters & their correlation with non-thermal phenomena 183 Mr. PAULO, Claudio Moises (Wits) PhD	Ionospheric Tomography over South Africa: comparison of MIDAS, ionosondes and GPS measurements 109 Mr. GIDAY, Nigussie Mezgebe (SANSA) MSc	DC Circuits: Context dependency of students' responses 154 Mr. JOHN, Ignatius (UCT, CPUT) -	Investigation of the involvement of specific carotenoids in the major plant light harvesting antenna during photoprotection 370 Mr. PARADZAH, Alexander (UP) PhD	SO(N) restricted Schur polynomials 67 Mr. KEMP, Garreth (Wits) PhD
The XENON100 Dark Matter Experiment 440 Mr. PIENAAR, Jacques (Purdue University) PhD	Influence of lightning on electron density in the ionosphere using WWLLN lightning data, Ionosonde data and GPS data 280 Mr. AMIN, Mahmud Mohammed (SANSA/UCT) MSc	A critical assessment of first year entering university science students' conceptual understanding 17 Dr. REDDY, Leelakrishna (UJ) -	Preparation & characterization of poly(vinyl alcohol)/graphene composite nanofibers via electrospinning 57 Mr. BARZEGAR, Farshad (UP) MSc	Non Planar Integrability in ABJM 80 Ms. SMITH, Stephanie (Wits) -

PLENARY: MORAAL, Harm
Particle Astrophysics

Lunch Break (Foyer)

- *Dr. Venter, Christo*	- *Prof. Wagener, Pieter*	- *Dr. Matthews, Alan*	Materials, Optics, Radiation *Dr. Ferrer, Phil*	- *Prof. de Mello Koch, Robert*
Comparison of photometric and spectroscopic parameters of eclipsing contact binary stars 210 Ms. SKELTON, Patricia (UNISA) PhD	Re-evaluation of the cosmic-ray parameters 304 Mr. MOSOTHO, Moshe Godfrey (NWU) MSc	The influence of backwash on problem-solving 290 Mr. CLERK, Douglas (Wits) -	Thermal measurements on epoxy-expandable graphite composite material 217 Ms. MODIBA, Fortunate (TUT) MSc	Finite N Quiver Gauge Theory 95 Mr. KREYFELT, Rocky (Wits) -
The Excitation of Pulsation Modes in Rapidly Rotating Main Sequence B-Stars 130 Mr. VAN HEERDEN, Pierre (UJ / SAAO) PhD	The effects of particle drifts on cosmic-ray modulation in the heliosphere – progress and challenges 362 Prof. BURGER, Renier (NWU) -	First year university physics students' perceptions of the teaching-learning environment: In search of a coherent pedagogic learning orientation 132 Dr. RAMAILA, Sam (UJ) -	An all printed LRC resonant circuit 335 Mr. ASHEBIR, Getinet (UCT) MSc	The Large-N Limit Of Matrix Models And AdS/CFT 321 Mr. MULOKWE, Mbavhalelo (Wits) -
MeerLICHT: Exploration of real-time commensal observing 136 Prof. WOUDT, Patrick (UCT) -	Properties of Charney-Hasegawa-Mima zonal turbulence 376 Dr. BOTHA, Gert (University of Northumbria at Newcastle Upon Tyne, UK) -	A four-year foundation degree programme. Do we really need it? 327 Mr. MOLEFE, Paul (UJ) -	Using a VCSEL to Accurately Measure the Chromatic Dispersion in Single Mode Fibre by the Phase Shift Technique 211 Mr. WASSIN, Shukree (NMMU) MSc	Saddle point analysis within a vector-like SU(2) 'QCD' model 340 Mrs. JOHNSON, Celeste (Wits) MSc
Characterization of variable stars using the ASAS and SuperWASP databases 50 Prof. SMITS, Derck (UNISA) -	Electrostatic supersolitons in plasmas 126 Prof. HELLBERG, Manfred (UKZN) -	Modeling physical phenomena with permanent magnets 454 Prof. MICHAELIS, Max (Rutherford-Appleton Laboratories) -	Simulation of the Egyptian 2nd Testing Research Reactor (ETRR-2) experimental benchmark in aid of verification and validation of the OSCAR-4 system 224 Mr. MASHAU, Maurice (UJ) MSc	The Provost metric as a systematic means to construct geometric and gravitational duals 43 Mr. VAN ZYL, Hendrik (SU) PhD
- -	Arbitrary amplitude ion-acoustic and electron-acoustic solitons in two-ion space plasmas revisited 188 Dr. MAHARAJ, Shimul Kumar (SANSA) -	- 211 - -	Microstructure evolution of rutheniumwith 6H-SiC interface under vacuum annealing and the implications for the performance of its Schottky contact for high temp. operating diodes 8 Mr. MUNTHALI, Kinnock Vundawaka (University of Namibia) PhD	Quark-Gluon Plasma Physics from String Theo 243 Dr. MORAD, Razieh (UCT) -

Tea & Coffee Break (Foyer)

PLENARY: WELTMAN, Amanda
Chameleon Cosmology Near and Far

POSTER SESSION 1
(D Les Ground Level) See page 33 for details

WEDNESDAY 9 JULY 2014

09:00 - 10:00	**PLENARY: PADGETT, Miles** **Light in a twist: optical angular momentum**			
TRACK	**A1:** Div. for Physics of Condensed Matter and Materials (D Les 201)	**B:** Nuclear, Particle and Radiation Physics (D Les 101)	**C:** Photonics (D Les 102)	**D1:** Astrophysics (D Les 203)
Theme *Chair*	- *Dr. Doyle, Bryan*	- *Dr. Smit, Ricky*	- *Prof. Rohwer, Erich*	- *Dr. de Witt, Aletha*
10:00 - 10:20	Characterization of BiFeO3 thin films for Surface Brillouin Scattering Investigation 281 Mr. AYELE, Fekadu (Wits) MSc	Radiometric Survey at A Heavy Mineral Separation plant near Koekenaap 324 Mr. SEHONE, Alfred Mogotsi (SU) MSc	**DIVISION MEETING**	Investigation of ionization temperature as an explicit parameter in C^3 models of nebulae 60 Ms. PROZESKY, Andri (UNISA) -
10:20 - 10:40	Effect of growth temperature on structural and luminescence properties of ZnO nanoparticles by Sol-Gel method 316 Mr. UNGULA, Jatani (UFS) MSc	Analytical technique to measure radon generation from Gauteng river water samples using solid state detector 453 Mr. MASEVHE, Livhuwani (UJ) MSc		Twisting photons: The role of POAM in Astrophysics 261 Mr. NICOL, Peter (UJ) -
10:40 - 11:10	**Tea & Coffee Break (Foyer)**			
Theme *Chair*	- *Prof. Engelbrecht, Japie*	**TIGRESS-type Detector Dev.** *Prof. Karataglidis, Steven*	**Resonators** *Prof. Forbes, Andrew*	**Astro** *Dr. Frescura, Fabio*
11:10 - 11:30	NON-SPECIALIST: Unique magnetic properties in simple metals 292	Efficiency and dead time measurements of the iThemba LABS segmented clover detector 330 Mr. EASTON, Jayson Lee (iThemba LABS) PhD	Selecting high-order modes in solid state laser resonators 122 Mr. IHEANETU, Kelachukwu (University of Fort Hare) MSc	Spectral modelling of H.E.S.S. -detected PWNe 234 VAN RENSBURG, Carlo (NWU) MSc
11:30 - 11:50	Prof. PRINSLOO, Aletta (UJ) -	Experimentally measured pulse shape signals of the iThemba LABS segmented clover detector 301 Dr. BUCHER, Thifhelimbilu Daphney (iThemba LABS) -	Generation of Coherent and Incoherent Superpositions of Laguerre –Gaussian Beams using a Diode-Pumped Solid-State Digital Laser 416 Mr. NGCOBO, Sandile (CSIR) PhD	Examining Radio & Gamma-ray correlation of the blazar PKS1424-418 during its flaring state 281 Mrs. VAN ZYL, Pfesesani (HartRAO) MSc
11:50 - 12:10	- -	Pulse Shape Analysis: Simulations with ADL and MGS codes 387 Mr. NONCOLELA, Sive (UWC) PhD	Breaking the intra-cavity degeneracy of vortex modes 142 Mr. NAIDOO, Darryl (CSIR) PhD	Spectral studies of Flat Spectrum Radio Quasars: constraining models at GeV energies 247 Dr. BRITTO, Richard (UJ) -
12:10 - 13:10	**PLENARY: BARBOSA, Marcia** **Women and Physics: Why so few?**			
13:10 - 14:00	**Lunch Break (Foyer)**			
Theme *Chair*	- *Dr. Carleschi, Emanuela*	**Giant Resonances & Strength Functions** *Dr. Bvumbi, Suzan*	**Spectroscopy** *Dr. Steenkamp, Christine*	**Astro** *Dr. Gilbank, David*
14:00 - 14:20	Computational study of supported Pd catalyst for methane oxidation 383 Ms. CHUMA, Moyahabo Hellen (UL) MSc	Study of the Isovector Giant Dipole Resonance across the neodymium and samarium isotope chains from spherical to deformed nuclei using (p,p') scattering at 200 MeV 277 Ms. DONALDSON, Lindsay (Wits) PhD	Interference fringe intensity measurement by optical path length variation using Michelson's interferometer 5 Mr. SULIALI, Nyasha (National University of Science and Technology) MSc	Neutrino Events at IceCube and the Fermi Bubbles 175 Dr. YANG, Lili (University of Nova Gorica) PhD
14:20 - 14:40	Study of superconducting gap in boron doped nanodiamond through differential resistance 424 Ms. SANDERS, Kirsty (Wits) MSc	Nuclear deformation effects on fine structure of the Isoscalar Giant Quadrupole Resonance and 2+ level densities from (p,p') scattering at 200 MeV 281 Mr. KUREBA, Chamunorwa Oscar (Wits) -	Coupled Optical Resonance Laser Frequency Stabilization 361 Mr. BURD, Shaun (CSIR) MSc	Photon-Axion mixing as a cosmic magnetometer 25 Mr. BECK, Geoffrey (Wits) PhD
14:40 - 15:00	Residual stress in polycrystalline thin Cr films deposited on fused silica substrates 452 Ms. MUDAU, Z P (UJ) MSc	Fine structure of the Isovector Giant Dipole Resonance from light to heavy-mass nuclei and 1-level densities using (p,p') scattering at zero degrees 287 Mr. JINGO, Maxwell (Wits) -	Vacuum ultraviolet spectroscopy of calcium fluoride crystals 152 Mr. MATINDI, Tresor (SU) MSc	A Different Approach to the Perturbation of Astrophysical Fluids 288 Dr. FRESCURA, Fabio (Wits) -
15:00 - 15:20	Ion dose effect on sound velocity in ion-implanted CVD diamond studied using surface Brillouin scattering 147 Dr. MATHE, Bhekumusa (Wits) -	Investigation of the Isovector Giant Dipole Resonance (IVGDR) strength in the selected neutron-rich calcium isotopes 42, 44, 48Ca 443 Mr. LATIF, Mouftahou (Wits) PhD	Raman spectroscopy of biofilms 395 Dr. NEETHLING, Pieter (SU) -	DFT, LS or GLS? - A 'road test' of various Fourier-based period-finding algorithms for astronomical observations 405 Dr. ENGELBRECHT, Chris (UJ) -
15:20 - 15:40	- -	Impact of the g-Ray Strength Functions on the 138La and 139La Galactic Production 101 Mr. KHESWA, Bonginkosi (iThemba LABS) PhD	- - - -	- 281 - MSc
15:40 - 16:10	**Tea & Coffee Break (Foyer)**			
16:10 - 17:10	**PLENARY: FORBES, Andrew** **Tailoring light with digital holograms**			
17:10 - 19:00	**POSTER SESSION 2** **(D Les Ground Level) See page 33 for details**			

PLENARY: PADGETT, Miles
Light in a twist: optical angular momentum

D2: Space Science (D Les 204)	E: Physics Education (D Les 310)	F: Applied Physics (D Les 103)	G: Theoretical and Computational Physics (D Les 104)
-	-	**Materials**	-
-	*Dr. Ramaila, Sam*	*Prof. van Dyk, Ernest*	*Prof. Scholtz, Frederik*
	DIVISION MEETING	Investigation of Fatigue-Type Processes in Polycrystalline Diamond Tools Using Raman Spectroscopy 26 Mr. VHARETA, Maxwell (Wits) PhD X-ray reflectivity and surface Brillouin studies of rf magnetron sputtered NbN thin films 432 Mr. KURIA, Jonah Wits) PhD	**DIVISION MEETING**

Tea & Coffee Break (Foyer)

-	-	**Modelling**	-
Dr. Maharaj, Shimul Kumar	*Dr. Naidoo, Deena*	*Dr. Govender, Indresan*	*Prof. Muronga, Azwinndini*
The polar thermospheric neutral density long-term trend using incoherent scatter radar data 137 Prof. KOSCH, Michael (SANSA) -	Attitudes and expectations of first year students towards physics labs 170 Ms. TLOWANA, Munene (UCT) MSc	Granular Flow Modelling of an Annular Shear Cell 56 Ms. BREMNER, Sherry (UCT) PhD	Thermodynamics of open quantum systems 314 Dr. SEMIN, Vitalii (UKZN) -
Analysis of ionospheric response to geomagnetic storms during solar cycle 23 225 Mrs. MATAMBA, Tshimangadzo Merline (SANSA / RU) MSc	A CHAT perspective on the tensions and dynamics in the professional development of Physical Sciences teachers in a mentoring relationship 21 Dr. RAMAILA, Sam (UJ) -	An investigation of granular rheology using Positron Emission Particle Tracking 63 Mr. PATHMATHAS, Thirunavukkarasu (UCT) PhD	Aliasing in Atomic Clocks 426 Dr. AKHALWAYA, Ismail (UJ) PhD
- - - -	Recent Development in the Physics III Laboratory Module at WITS 373 Dr. KEARTLAND, Jonathan (Wits) -	Axial Segregation in Rotating Drum - Extension of the Basic Axial Diffusion Model 64 Mr. ELBASHER AHMED, Elbasher Mohamed (UCT) PhD	Quantum feedback control of a harmonic oscillator 206 Ms. BASSA, Humairah (UKZN and CSIR) PhD

PLENARY: BARBOSA, Marcia
Women and Physics: Why so few?

Lunch Break (Foyer)

Astro - Extra	-	**Optics, General**	-
Mr. van Soelen, Brian	*Dr. Taylor, Dale*	*Dr. De Beer, Frikkie*	*Prof. Cleymans, Jean*
The ICRF-3: The next Generation Celestial Reference Frame 44 Dr. DE WITT, Aletha (HartRAO) -	Using cooperative learning to improve students' problem solving in physics 419 Dr. HERBERT, Mark (UWC) -	Improving the laser brightness of a commercial laser system 141 Mr. NAIDOO, Darryl (CSIR) PhD	Quantum Networking with Graph States 104 Prof. TAME, Mark (UNIZULU) -
Source Structure Effect on Southern Hemisphere VLBI Reference Frame 58 Mr. BASU, Sayan (UNISA-HartRAO) PhD	Lesson planning practices of South African Physical Sciences teachers in a new curriculum 133 Dr. RAMAILA, Sam (UJ) -	A single DFB laser for multilevel directly modulated signal for high speed optical fibre communication system 196 Mr. CHABATA, Tichakunda Valentine (NMMU) PhD	Homogeneous Open Quantum Walks on a Line 268 Dr. CABALLAR, Roland Cristopher (NITheP, University of KwaZulu-Natal, and University of the Philippines, Diliman) -
A strategic independent geodetic VLBI network for Europe 229 Ms. DALE, Denise (HartRAO) MSc	Conceptual resources for learning kinematics graphs 451 Mrs. DJJAN, Grace (NWU) MSc	Polarization alignment system for quantum key distribution 354 Mr. MARIOLA, Marco (UKZN) PhD	Entanglement of two distant nitrogen-vacancy-center ensembles under the action of squeezed microwave field 356 Dr. TEPER, Natalia (UNIZULU / National Institute for Theoretical Physics) PhD
Fourier Plane Modeling and Jet Physics in the Galaxy M81 160 Mr. RAMESSUR, Arvind (UNISA/HartRAO) MSc	Teaching Physics in isiZulu 62 Dr. MATTHEWS, Alan (UKZN) -	Characterization of Corona Ionization Based Micro-thrusters 46 Mr. WRIGHT, William (Wits) PhD	Efficient Quantum Simulation of Markovian Quantum Dynamics of a Qubit 93 Mr. SWEKE, Ryan (UKZN) PhD
Numerical studies of non-thermal processes in galaxy clusters 202 Mr. MEKURIA, Remudin Reshid (Wits) PhD	- - - -	The Alan Cousins Telescope - A Multi-Purpose Automatic and Remote Access Telescope 131 Mr. VAN HEERDEN, Pierre (UJ / SAAO) PhD	Quantum Neural Networks - Our brain as a quantum computer? 37 Ms. SCHULD, Maria (UNIZULU) PhD

Tea & Coffee Break (Foyer)

PLENARY: FORBES, Andrew
Tailoring light with digital holograms

POSTER SESSION 2
(D Les Ground Level) See page 33 for details

THURSDAY 10 JULY 2014

09:00 - 10:00	**PLENARY: SUDA, Toshimi** **The SCRIT Electron Scattering Facility**			
TRACK	**A1:** Div. for Physics of Condensed Matter and Materials (D Les 201)	**B:** Nuclear, Particle and Radiation Physics (D Les 101)	**C:** Photonics (D Les 102)	**D1:** Astrophysics (D Les 203)
Theme *Chair*	- *Mr. Erasmus, Rudolph*	**Monte Carlo for Medical Applications** *Dr. Bucher, Thifwe*	**Technology** *Dr. Neethling, Pieter*	- *Dr. Loubser, Ilani*
10:00 - 10:20	393 Investigation of plasma dynamics effect on the properties of the vanadium oxide thin films Ms. MASINA, Bathusile (CSIR / UNIZULU) PhD	81 Auger electron studies using Monte Carlo simulations of I-123 incorporated into human lymphocytes Mr. FOURIE, Hein (SU) MSc	339 Construction of a Terahertz time domain spectrometer Mr. SMITH, Shane (SU) MSc	**DIVISION MEETING**
10:20 - 10:40	402 Electrical properties of Hg/n-Si (MS) and Hg/PO3/n-Si (MIS) Schottky Diodes Mr. NAMBALA, Fred Joe (University of Zambia) PhD	347 Monte Carlo simulation of secondary gamma production during proton therapy for dose verification purposes – Part I Dr. PETERSON, Stephen (UCT) -	181 A New Technique to Electro-Optically Q-switch Uniaxial Gain Materials Mr. MAWEZA, Loyiso (CSIR) PhD	
10:40 - 11:10	**Tea & Coffee Break (Foyer)**			
Theme *Chair*	- *Prof. Engelbrecht, Japie*	**Nuclear Structure** *Dr. Ntshangase, Sifiso*	**Fibres** *Dr. Strauss, Hencharl*	- *Dr. Loubser, Ilani*
11:10 - 11:30	**DIVISION MEETING**	317 Search for chirality in 193Tl Mr. NDAYISHIMYE, Joram (SU) PhD	218 Propagation characteristics control by variation of PCF structural parameters Mr. JENA, James (National University of Science and Technology) MSc	273 NON-SPECIALIST: Characterization of Potentially Hazardous Near-Earth Asteroids
11:30 - 11:50		264 Exploring the spectroscopy of vibrational levels in the trasitional rare earth region Mr. MAJOLA, Siyabonga (UCT/ iThemba Labs) PhD	12 Pulse Propagation in Soliton based Optical fiber communication Mr. SABITU, Rabiu Imam (Kano University of Science and Technology, Nigeria) -	Prof. THROOP, Henry (UP) -
11:50 - 12:10		281 Two Proton Stripping via the 115In(3He,n)117Sb reaction and a GEANT4 simulation of the AFRODITE array at iThemba LABS Mr. LI, Kevin (SU, iThemba Labs) MSc	319 Towards the Fabrication of All-Fibre Laser Systems Dr. WU, Lorinda (CSIR) -	- -
12:10 - 13:10	**PLENARY: JONAS, Justin** **The Square Kilometre Array, MeerKAT and more**			
13:10 - 14:00	**Lunch Break (Foyer)**			
Theme *Chair*	- *Prof. Dejene, Francis*	**ATLAS 2** *Dr. Masiteng, Paulus*	**Quantum Optics** *Prof. Forbes, Andrew*	**Astro** *Dr. Yang, Lili*
14:00 - 14:20	214 Novel Rattling Dynamics Explain Low Thermal Conductivity in Aluminium-Doped Potassium Tungstate Defect Pyrochlore Dr. SHOKO, Elvis (Wits) -	334 Evidence for Higgs Boson Decays to Tau Lepton Pairs from the ATLAS Experiment at the CERN Large Hadron Collider Mr. BRISTOW, Kieran (Wits) -	300 Digital detection of Bessel-Gauss beams Ms. MHLANGA, Thandeka (UNIZULU) MSc	392 Importance of mergers in the growth of brightest cluster galaxies Mrs. GROENEWALD, Daniel (NWU) PhD
14:20 - 14:40	315 X-ray reflectivity and surface Brillouin studies of rf magnetron sputtered NbN thin films Mr. KURIA, Jonah (Wits) PhD	404 Search for the Higgs boson in fermionic channels using the ATLAS detector Mrs. LEE, Claire (UJ) PhD	149 Simulating spontaneous parametric down-conversion using classical light Dr. ZHANG, Yingwen (CSIR) -	36 AGN vs star formation in Brightest Cluster Galaxies Dr. LOUBSER, Ilani (NWU) -
14:40 - 15:00	166 Can Shapiro step subharmonics be "charged"? Dr. AZEMTSA DONFACK, Hermann (UNISA) -	364 The Higgs as a portal to the "hidden sector" via an analysis of H->Z'Z'->4l Mr. UNWUCHOLA, D A (UJ) PhD	145 Azimuthal spectrum after parametric down-convertion with radial degrees of freedom Dr. ZHANG, Yingwen (CSIR) -	187 Analysis of SALT Medium Resolution Fabry-Perot data Mr. TAPSOBA, Wendyam Blaise (UCT) MSc
15:00 - 15:20	41 A microscopic theory of phase transitions Dr. NOLTING, Volkmar (Vaal University of Technology) -	32 Search for the 2HDM neutral CP-odd pseudoscalar Higgs, A, in the A to Zh channel in sqrt(s) = 8 TeV pp collisions with multilepton final states using the ATLAS detector Mr. HAMITY, Guillermo (Wits) MSc	143 Propagation of vortex modes through fibres Ms. MCLAREN, Melanie (CSIR) PhD	69 Kinematics and stellar populations of dwarf ellipticals in the Fornax cluster Mr. MENTZ, Jaco (NWU) PhD
15:20 - 15:40	400 Structural and Optical Characterisation of Double-Doped TiO2 Nanoparticles Mr. NUBI, Olatunbosun (UL) -	358 The iThemba LABS Radioactive Beam Project Dr. BARK, Robert (iThemba LABS) -	444 A numerical investigation of the evolution OAM entanglement in turbulence Dr. HAMADOU IBRAHIM, Alpha (CSIR) -	185 The methodology of extracting kinemtaical properties and mass profiles from BCGs. Mr. BRANKEN, Henri (NWU) MSc
15:40 - 16:10	**Tea & Coffee Break (Foyer)**			
16:10 - 17:10	**PLENARY: LINDER, Cedric** **New ways of thinking about university physics teaching: A discussion of discursive representations using South African examples**			

PLENARY: SUDA, Toshimi
The SCRIT Electron Scattering Facility

D2: Space Science (D Les 204)	E: Physics Education (D Les 310)	F: Applied Physics (D Les 103)	G: Theoretical and Computational Physics (D Les 104)
- *Dr. Loubser, Ilani*	- *Dr. Reddy, Leelakrishna*	**Renewable Energy** *Dr. Vorster, Frederik*	- *Prof. Konrad, Thomas*
DIVISION MEETING	Quantum Optics: Do we need single photons? 150 Ms. MCLAREN, Melanie (CSIR) PhD	The evaluation and simulated performance of the potential current produce from Multi-junction cells 278 Mr. SCHULTZ, Ross (NMMU) PhD	Hamiltonian approach to open quantum Brownian motion 299 Dr. SINAYSKIY, Ilya (UNIZULU and National Institute for Theoretical Physics) -
	An evaluation of students' understanding of Newtonian Mechanics 302 Prof. NAIDOO, Deena (Wits) -	Simulation of Thermal Processes in a Hot Mirror Parabolic Trough Solar Receiver 350 Mr. KALUBA, Victor Siuluta (Wits) PhD	Finite-size key security of Phoenix-Barnett-Chefles 2000 quantum-key-distribution protocol 378 Dr. MAFU, Mhlambululi (UKZN) -

Tea & Coffee Break (Foyer)

- *Dr. Loubser, Ilani*	- *Dr. Nair, Padmanabhan*	**APF Meeting, Modelling** *Dr. Vorster, Frederik*	- *Dr. Sinayskiy, Ilya*
NON-SPECIALIST: Characterization of Potentially Hazardous Near-Earth Asteroids 273 Prof. THROOP, Henry (UP) -	First year students' beliefs about physics 421 Dr. TAYLOR, Dale (UCT) -	**APF Meeting**	A GPU Based Polyhedral Particle DEM Transport Code 84 Mr. GOVENDER, Nicolin (CSIR / UJ) PhD
	The experiences of four-year program degree students 367 Ms. SONDEZI-MHLUNGU, Buyi (UJ) -	Modelling Flow Phenomena in Time Dependant Store Release from Transonic Aircraft 425 Dr. GLEDHILL, Irvy (Igle) (CSIR) -	Massive Affordable Computing Using ARM Processors in High Energy Physics 6 SMITH, Joshua Wyatt (UCT) MSc
- -	Sound Misconceptions in a Science Centre 94 Mr. FISH, Derek (Unizul Science Centre) PhD	- -	Computer Assisted Proof of the Global Existence of Periodic Orbits in the Rössler System 161 Dr. BOTHA, André (UNISA) -

PLENARY: JONAS, Justin
The Square Kilometre Array, MeerKAT and more

Lunch Break (Foyer)

Astro - extra *Dr. Engelbrecht, Christian*	- *Mr. Clerk, Douglas*	General *Dr. Govender, Indresan*	- *Prof. Müller-Nedebock, Kristian*
Tidal Effects on Pulsation Modes in Close Binaries 344 Mr. PREDIERI, Massimo (Wits) MSc	- -	NON-SPECIALIST: Optimization of the PEGASES plasma thruster 30	Numerical modelling of the generation of Gaussian graph state 418 Mr. NZUZI MBENZA, Lucien (UKZN) -
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Rapid Photometric variability of magnetic Cataclysmic Variables 449 Mr. BREYTENBACH, Johannes (UP) PhD	- -	Characterisation of plume and thrust for the corona ionisation space propulsion system 186 Dr. FERRER, Phil (Wits) -	Structural and Electronic Properties of Fe dopped Technetium Sulphide 171 Mr. ABDULSALAM, Mahmud (Wits) PhD
Accretion processes in cataclysmic variables: Insights from optical transient surveys 266 Ms. MOTSOALEDI, Mokhine (SAAO) PhD	The impact of community engagement initiative at Soweto Science Centre of the University of Johannesburg in addressing the subject knowledge deficiency of learners in the Further Education and Training band 19 Dr. NAIR, Padmanabhan (UJ) -	Discrete Element Models applied to Aggregate Properties in Pavement Design 430 Dr. GLEDHILL, Irvy (Igle) (CSIR) -	Resonance features of stack of long Josephson junctions 236 Mr. RAHMONOV, Ilhom (Joint Institute for Nuclear Research) PhD
Real Space Lensing Reconstruction using CMB Temperature and Polarisation 431 Ms. PRINCE, Heather (UKZN) MSc	A triggering strategy for improved pass rate in a software-managed evaluations in Physics practicals for Engineering & Health Science Diploma Programmes at the University of Johannesburg 20 Dr. REDDY, Leelakrishna (UJ) -	The design and development of a force comparator standard machine to provide national traceability in force measurement to industry 40 Mr. DLAMINI, Sipho (NMISA) -	Collider Black-Holes: Preliminary Results and Outlook 129 Mr. CARLSON, Warren (Wits) -

Tea & Coffee Break (Foyer)

PLENARY: LINDER, Cedric
New ways of thinking about university physics teaching: A discussion of discursive representations using South African examples

FRIDAY 11 JULY 2014

09:00 - 10:00	**PLENARY: TSESMELIS, Emmanuel** **CERN – A Gateway to Science and Technology**				
TRACK	**A1:** Div. for Physics of Condensed Matter and Materials (D Les 201)	**B:** Nuclear, Particle and Radiation Physics (D Les 101)	**C:** Photonics (D Les 102)	**D1:** Astrophysics (D Les 203)	
Theme ***Chair***	- ***Dr. Chirwa, Max***	**Nuclear Theory** ***Prof. Cleymans, Jean***	- -	**Astro** ***Dr. Komin, Nukri***	
10:00 - 10:20	Magnetic nanoparticles as polarity -sensors: a Molecular Dynamics study on the effect of solvent interactions with surface atoms on iron oxide nanoparticles' magnetization Dr. HARRIS, Richard (Mintek) -	331	Cluster Model Analysis of Exotic Decay in Actinide Nuclei Mr. DU TOIT, Erasmus (SU) MSc	238	- -	Accretion and outflow in black hole X-ray binaries Mr. DUSOYE, Avishek (UCT) MSc	184
10:20 - 10:40	Elastic constants of Cr3C2 thin films by surface Brillouin scattering investigations Dr. WAMWANGI, Daniel (Wits) -	257	Coupled-channel studies of nucleon-scattering from oxygen isotopes Prof. KARATAGLIDIS, Steven (UJ) -	27	- -	Search for Very High Energy candidate sources using South African observatories Dr. VAN SOELEN, Brian (UFS) -	396
10:40 - 11:10	**Tea & Coffee Break (Foyer)**				
Theme ***Chair***	- ***Prof. Prinsloo, Aletta***	**Reactors and Neutrons** ***Dr. Maleka, Peane***	**Photonics** -	**Astro** ***Prof. Woudt, Patrick***	
11:10 - 11:30	Magnetic interactions in 3*d* transition metal-doped diamond Dr. BENECHA, Evans (UNISA) -	420	Representation of the Few-Group Homogenized Cross Sections of a MOX Fuel Assembly Mr. CHIFAMBA, Saymore (UJ) MSc	311	- -	The effect of an offset-dipole magnetic field on the Vela pulsar's gamma-ray light curves Ms. BREED, Monica (NWU) -	285
11:30 - 11:50	Laser-selective excitation and polarisation studies of BaF_2: Tm^{3+} single crystals Dr. MUJAJI, Marjorie (Wits) -	70	Validation of the performance of Geant4 in the simulation of neutron induced reactions relevant to reactor studies Ms. MUDAU, Rotondwa (UJ) MSc	256	- -	TeV Gamma-Ray Observations of the Large Magellanic Cloud Dr. KOMIN, Nukri (Wits) -	349
11:50 - 12:10	- - -		Fast neutron measurements with dueterated liquid organic scintillator NE230 Mr. MASONDO, Vusumuzi (University of the Western Cape) MSc	403	- -	Modelling the Cumulative Spectrum Expected from a Population of Globular Clusters Dr. VENTER, Christo (NWU) -	172
12:10 - 13:10	**PLENARY: FULLERTON, Eric** **Bits of the future: emergent physics for advanced magnetic information technologies**				
13:10 - 14:00	**Lunch Break (Foyer)**				
14:00 - 15:00	**PLENARY: DYAKONOV, Vladimir** **Organic and hybrid organic-inorganic concepts for photovoltaic energy conversion**				
15:00 - 16:00	**Annual General Meeting** **(Auditorium)**				

18:30 - 21:30	

PLENARY: TSESMELIS, Emmanuel
CERN – A Gateway to Science and Technology

D2: Space Science (D Les 204)	**E:** Physics Education (D Les 310)	**F:** Applied Physics (D Les 103)	**G:** Theoretical and Computational Physics (D Les 104)
Astro - extra ***Dr. Venter, Christo***	**Teachers** ***Dr. Naidoo, Deena***	**Radiation** ***Dr. Asante, Joseph***	**-** ***Prof. Joubert, Daniel***
Discretization of cosmological periodic orbits 3 Prof. WAGENER, Pieter (University of Fort Hare) -	Shoestring Experiments 1: Measuring the track separation on a compact diskette using a metre stick 495 Mr. CLERK, Douglas (Wits) -	A new probe to detect multiple turn extraction of a beam bunch from Injector Cyclotron 1 at iThemba LABS 73 Dr. DE VILLIERS, John Garrett (iThemba Labs) -	Dynamics of processive and non-processive molecular motors on filaments 265 Prof. MÜLLER-NEDEBOCK, Kristian (SU) -
Quasi-Newtonian and anti-Newtonian universes in f(R)-gravity 169 Dr. ABEBE, Amare (NWU) -	Shoestring Experiments 2: Resurrecting and using the 2D collision apparatus 496 Mr. CLERK, Douglas (Wits) -	Research projects Utilising Penetrating Radiation: What to Expect when using Radiation Beams for Imaging 281 Dr. DE BEER, Frikkie (NECSA) -	Vacuum Energies and Frequency Dependent Interactions 177 Prof. WEIGEL, Herbert (SU) -
Tea & Coffee Break (Foyer)			
- **-**	**Teachers** ***Dr. Ramaila, Sam***	**Renewable Energy** ***Dr. Diale, Mmantsae***	**-** ***Prof. Weigel, Herbert***
- -	Material Sciences for Teachers 497 Dr. NAIDOO, Deena (Wits) -	Analysis of the temperature models for the evaluation of global solar radiation in the coastal and interior regions of South Africa 281 Dr. MALUTA, Eric (University of Venda) -	Compact stars for NITheP internship programme 223 Prof. MURONGA, Azwinndini (UJ) -
- -	Sound and music: Part 1 498 Mr. FISH, Derek (Unizul Science Centre) -	Performance analysis of a 3.2 kWp grid-connected PV system in the Eastern Cape, South Africa 320 Dr. OKELLO, Denis (NMMU and Makerere University) -	Particle number dependent discontinuities in density functional derivatives 417 Prof. JOUBERT, Daniel (Wits) -
- -	Sound and music: Part 2 499 Mr. FISH, Derek (Unizul Science Centre) -	Enhanced light harvesting and conversion efficiency by plasmonic Ag nanoparticles incorporated in organic photovoltaics 283 Dr. RANGANATHAN, Kamalakannan (Wits) -	Josephson Junctions under external adiation: Devil's Staircases and Continued Fractions 148 Dr. SHUKRINOV, Yury (JINR, Dubna) -

PLENARY: FULLERTON, Eric
Bits of the future: emergent physics for advanced magnetic information technologies

Lunch Break (Foyer)

PLENARY: DYAKONOV, Vladimir
Organic and hybrid organic-inorganic concepts for photovoltaic energy conversion

Annual General Meeting
(Auditorium)

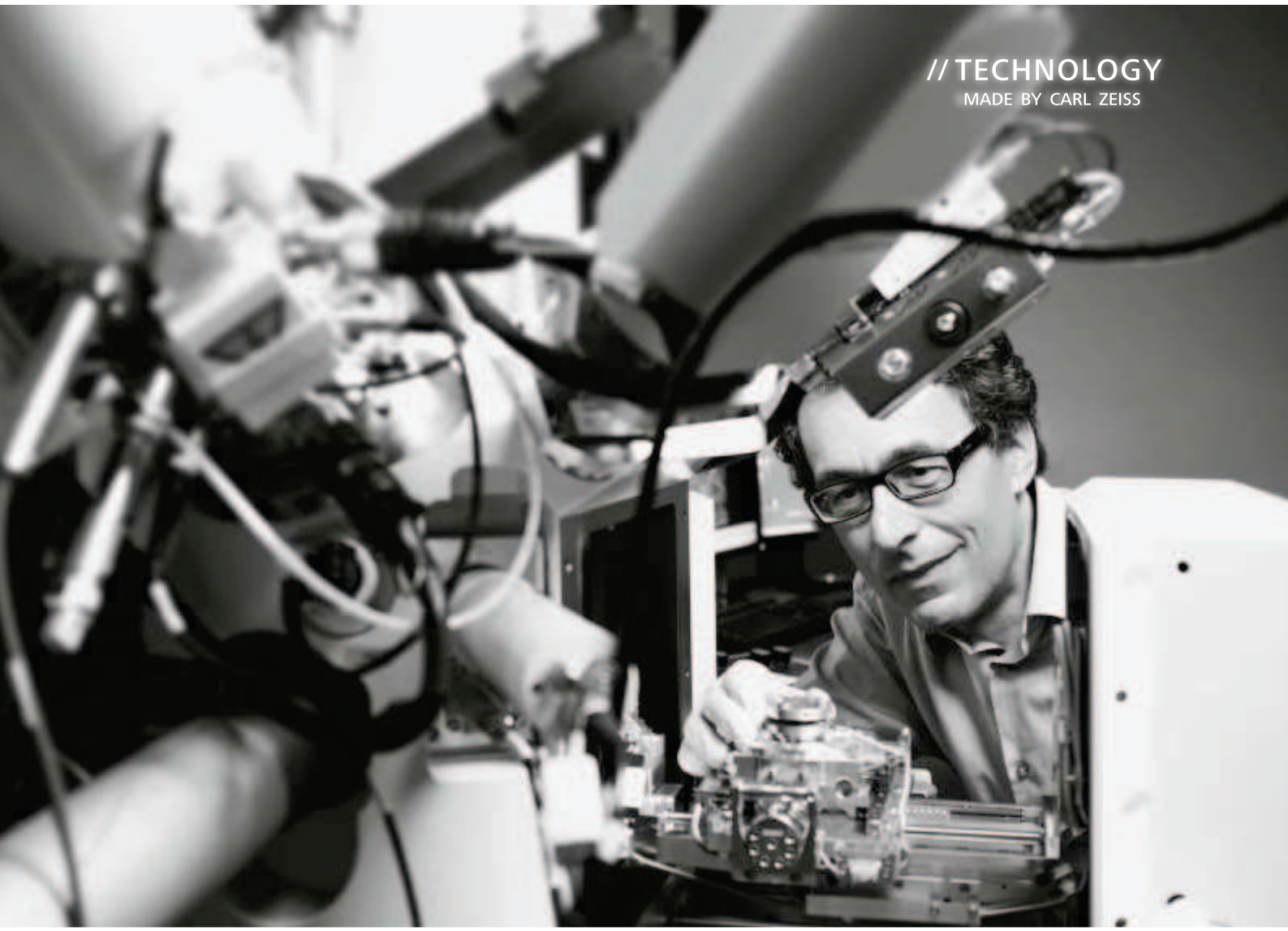
2014 De Beers Gold Medal Banquet

Helderfontein Estate

(directions on website, bus transport by arrangement. Cash only bar - No cards accepted)

18:30 - 19:00	**Light Drinks & Arrival sherry**
19:00 - 19:10	Welcome remarks
19:10 - 19:20	Remarks by a member of the UJ Executive Management
19:20 - 19:50	**Starter is served**
19:50 - 20:05	Remarks by SAIP President
20:05 - 20:50	Awarding of Student Prizes (SAIP President & Specialist Group Chairs)
20:50 - 21:20	**Dinner is served**
21:20 - 21:30	Reading of Citation for the 2014 De Beers Medal Winner
21:30 - 21:35	Award of the De Beers Gold Medal and Remarks by De Beers
21:35 - 21:40	Remarks by the Gold Medallist
21:40 - 21:50	Vote of Thanks and handover to SAIP2015 Organisers
21:50 onwards	**Dessert** & Music/Dancing

The moment I think becomes I know.
This is the moment we work for.



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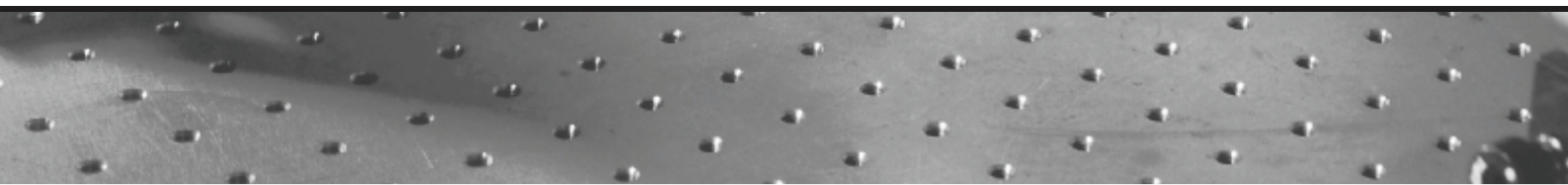
Poster Sessions 1 & 2



Poster Session 1 (8 July)

BOARD	PRESENTER	TITLE
DIVISION FOR PHYSICS OF CONDENSED MATTER AND MATERIALS		
A31	JILI, Thulani	Calculation of atomic-based electron-positron annihilation momentum density in superionic barium flouride
A51	Mr. MALEVU, Thembinkosi Donald	Synthesis of ZnO Nanostructures via zinc air cell system *[For award:* MSc*]*
A61	Mr. SEFAGE, Amanda	Iron coated ZnO nanorods catalysed growth of carbon nanostructures
A89	Mr. MASHAMAITE, Mordecai	Computational modelling of temperature dependence of $Ti_{50}Pt_{50}$ shape memory alloys *[For award:* MSc*]*
A113	Mr. LETHOLE, Ndanduleni Lesley	Computational studies of olivine $NaMPO_4$ (M: Mn, Fe, Co) *[For award:* PhD*]*
A121	Mr. MUCHONO, Blessed	Magnetic susceptibility studies of the $(Cr_{98.4}Al_{1.6})_{100-x}Mo_x$ alloy system *[For award:* PhD*]*
A139	Mr. MASWANGANYE, Mpho	The effect of silver (Ag) dopant on the structural properties of cadmium oxide (CdO) nanoparticles *[For award:* Hons*]*
A167	Mr. THETHWAYO, Charles	Hydrogen storage in ZnO-CNF hybrid nanostructures *[For award:* MSc*]*
A203	Mr. MALEBATI, Magoja Martinus	Computational modelling studies of Ti_{50}-Pt_{50-x}-Nb_x alloys *[For award:* Hons*]*
A221	Prof. RAMMUTLA, Koena Erasmus	Studies of structural properties of Al and Y co-doped tin oxide
A233	Mr. MOLEFE, Fokotsa Victor	Improvement of luminescence properties by post annealing ZnO nanopowders prepared by chemical bath method *[For award:* MSc*]*
A241	Mr. MOTOCHI, Isaac	Surface Brillouin scattering studies on annealed ion-modified CVD diamond *[For award:* PhD*]*
A267	Dr. CARLESCHI, Emanuela	Thermal-transport and electronic structure properties of $CePdIn_2$
A293	Dr. KADAM, M	Electrical properties of $Cr_{100-x}Co_x$alloy thin films on oriented MgO (100)
A303	Mrs. ABRASS, Hameda	The use of diffusion barriers to control first phase formation in solid state reactions *[For award:* PhD*]*
A307	Mr. BRITZ, Douglas	Superconductivity in LaRh2Sn2 *[For award:* PhD*]*
A337	Ms. FOKA, Emily	Combustion synthesis of Dy3+–doped YVO4 phosphor
A399	Mr. SEFAGE, Amanda	Synthesis and characterization of CdO-Carbon nanostructures hybrid for LPG sensing *[For award:* MSc*]*
A401	Mr. KABONGO, Guy Leba	Optical, ESR and surface state XPS investigation in 0D ZnO nanostructures doped with rare earth ions *[For award:* MSc*]*
A411	Mr. NGWEKHULU, Themba	Effect of diamond grain size on magnetic properties of cobalt phase in PCD *[For award:* MSc*]*
A435	Mr. DANGAISO, Tichawona	Characterisation of Aluminium/Yttrium Double-doped Tin Oxide Nanoparticles using XRD Patterns. *[For award:* Hons*]*
A439	Mr. NGOEPE, Phuti	A DLTS investigation of the annealing behaviour of the E-centre in alpha-particle irradiated Ge. *[For award:* PhD*]*
A445	Mr. MAKGOBELA, Rasitilo	X-Ray characterization of Fe and Cu doped CdO nanoparticles by ball mill method
A447	Dr. TIBANE, Malebo	Computational Phase Stability Study of Pt Alloys and Nanoparticles
NUCLEAR, PARTICLE AND RADIATION PHYSICS		
B14	CARRILLO-MONTOYA, David	Search of anomalous Higgs to invisible decays with the ATLAS detector at CERN's Large Hadron Collider
B15	CARRILLO-MONTOYA, David	Latest measurements of Higgs boson properties with the ATLAS detector
B49	Ms. BVUMBI, Suzan Phumudzo	Octupole correlations in the rare earth N = 88 isotones
B83	Mr. KUREBA, Chamunorwa Oscar	Firmware development for the upgrade of the Tile Calorimeter of the ATLAS detector
B87	Ms. JIVAN, Harshna	Radiation hardness of plastic scintillators for the Tile Calorimeter of the ATLAS detector *[For award:* Hons*]*
B111	Mr. REED, Robert	An ATCA framework for the ATLAS TileCAL Front to Back End Electronics for the Phase II Upgrade at the LHC *[For award:* PhD*]*
B123	Mr. VON BUDDENBROCK, Stefan	Exploring the tensor structure of the Higgs Boson couplings *[For award:* Hons*]*
B127	Mr. MSEBI, Lumkile	Search for intermediate states in the rare earth nucleus ^{150} Sm *[For award:* MSc*]*
B159	Mr. OHENE-KWOFIE, Daniel	PGAS Model for the Processing Unit of the Upgraded Electronics of the Tile Calorimeter of the ATLAS Detector *[For award:* PhD*]*
B165	Dr. RUAN, Xifeng	Measure the properties of Higgs boson in vector boson fusion production mode in the ATLAS detector
B207	Ms. MAPHANGA, Linah	Understanding radiation damage of the MBTS detector at ATLAS using Raman scattering
B227	Mr. MAKHATHINI, Lucky	Beta-decay spectroscopy of neutron-rich nuclei *[For award:* PhD*]*
B279	Dr. PETERSON, Stephen	Monte Carlo simulation of secondary gamma production during proton therapy for dose verification purposes - Part II *[For award:* PhD*]*
B295	Prof. MELLADO, Bruce	Measurement of Higgs production in association with high PT jets with the ATLAS detector
B297	Prof. MELLADO, Bruce	The status of the LHeC project and its impact on Higgs physics
B313	Dr. MASITENG, P L	Lifetimes and transition probabilities in the positive parity states band in ^{194}Tl
B423	Mr. SPOOR, Matthew	Fully programmable SoC based Ethernet to PCI Express Bridge for an ARM Based High Data Throughput Cluster for the sROD of the Tile Calorimeter of the ATLAS detector
B429	Prof. CONNELL, Simon	Towards a crystal undulator
PHOTONICS		
C305	Ms. MHLANGA, Thandeka	Digital spiral-phase bi-photon imaging *[For award:* MSc*]*
C351	Ms. SULEIMAN, Aminat Oyiza	Charge Density Waves Formation in 1T-$TiSe_2$ Based on Pump-Probe Femtosecond Electron Diffraction *[For award:* MSc*]*
C355	Mr. BURD, Shaun	Non-linear power amplifiers for atomic physics applications *[For award:* MSc*]*
C365	Mr. OLAOYE, Olufemi Opeyemi	Commensurate charge density wave formation in a novel organic molecular conductor (DCNQI) and tantalum diselenide (4Hb-TaSe2) crystals *[For award:* PhD*]*

Poster Session 1 (8 July)

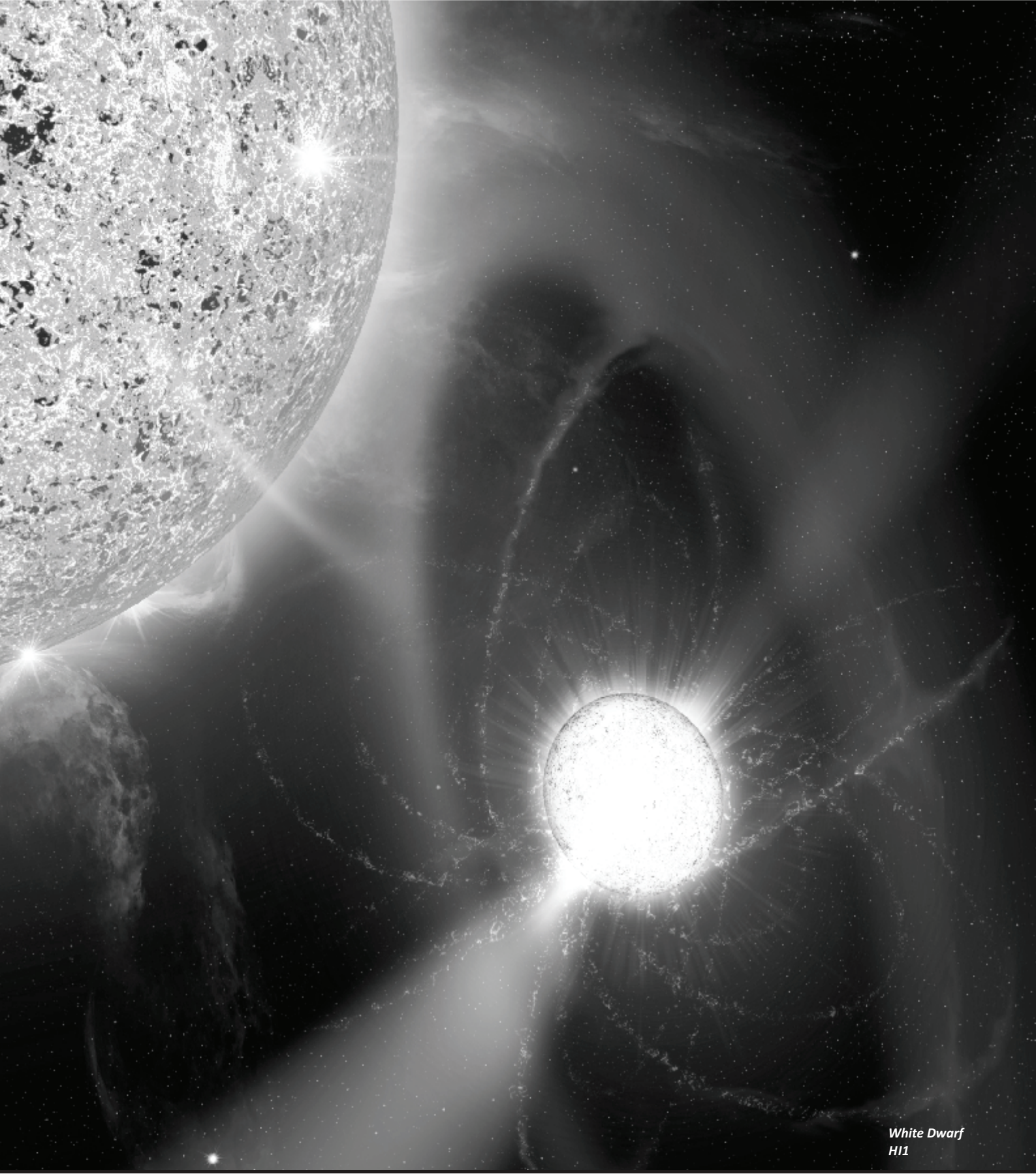
BOARD	PRESENTER	TITLE
ASTROPHYSICS		
D1.1	Prof. WINKLER, Hartmut	Spectral comparison between AGN at z = 0.1, 0.2 and 0.3
D1.220	Mr. KUDODA, Ayman	Modelling Inhomogeneities in the EBL *[For award:* MSc*]*
D1.343	Ms. KLINDT, Lizelke	Multi-wavelength classification of unidentified AGN in the Fermi 2LAC catalogue *[For award:* MSc*]*
D1.353	Ms. KOLBE, Isobel	Composition analysis of Uranus and Neptune using visible-light New Horizons data *[For award:* Hons*]*
SPACE SCIENCE		
D2.78	Prof. HELLBERG, Manfred	On the presence of stopbands in acoustic soliton existence domains
D2.228	Mr. ADESINA, Joseph	Winter and Spring aerosol characteristics over Johannesburg (South Africa) Using AERONET Data *[For award:* PhD*]*
D2.375	Dr. BOTHA, Gert	Investigating the chromosphere above sunspot umbrae with an acoustic resonator
PHYSICS EDUCATION		
E.342	Mr. SCHWARTZ, Marty	Conceptualizing Scale *[For award:* Hons*]*
E.415	Prof. ALLIE, Saalih Dr. BLYTH, Sarah	Probing student perspectives in a first year astronomy course at the University of Cape Town
APPLIED PHYSICS		
F.11	Mr. ADE, Nicholas	Dosimetric characterization of synthetic diamond detectors of various types and sizes under small high-energy photon field conditions *[For award:* PhD*]*
F.29	Mr. MOMODU, Damilola	Ex-situ Ni-Al Double Hydroxide Microspheres on a Nickel foam-Graphene Template as Electrode Material for High Performance Supercapacitors *[For award:* PhD*]*
F.33	Mr. URIRI, Solomon A.	The design of a light-emitting-diode pulsing system for measurement of time-resolved luminescence *[For award:* MSc*]*
F.157	Mr. RADEBE, Mabuti Jacob Radebe	Characteristics of statistical noise of the sCMOS based Neutron Computed Radiography Images- A simplified measurement approach
F.191	Mr. MASUKUME, Peace-Maker	Numerical modeling of the power output of a plain conical diffuser
F.193	Mr. POVALL, Timothy	Assessing continuum postulates for tumbling mills *[For award:* PhD*]*
F.199	Mr. ROTICH KIPNOO, Enoch K.	Phase Noise Analysis of a 1.712 GHz Clock Signal Transmitted over Optical Fibre for MeerKAT Time and Frequency Reference (TFR) *[For award:* PhD*]*
F.201	Mr. ROTICH KIPNOO, Enoch Prof. GIBBON, Tim	Performance Comparison of SMF-Reach and SMF-RS Optical Fibres for Raman Amplification *[For award:* MSc*]*
F.209	Mr. NSHIMIRIMANA, Robert	Optimization of a Computed Tomography Scan Using Swarm Intelligence *[For award:* PhD*]*
F.245	Ms. MAABONG, Kelebogile	Metal oxides for photovoltaic devices *[For award:* PhD*]*
F.249	Mr. NEKHUBVI, Vhutshilo	Cost effective way of heating household size biogas digesters manufactured in South Africa *[For award:* PhD*]*
F.309	Mr. TCHONANG POKAHA, Marius	Overview of the Mineral-PET run of mine Diamond bearing rock sorter *[For award:* PhD*]*
F.345	Mr. BOIYO, Duncan	Flexible Spectrum and the effects of Crosstalk on a 20 Gb/s Signal over a 12 km Optical Fibre *[For award:* PhD*]*
F.359	Mr. RAMNATH, Vishal	Analysis of a Thermal Conductivity Measurement Technique Formulated as a Nonlinear Inverse Heat Conduction Problem
F.407	Ms. TAGHIZADEH, Fatemeh	Microwave synthesis of graphene nickel aluminum layered double hydroxide (LDH) *[For award:* MSc*]*
F.409	Prof. DERRY, Trevor	A review on Effect of Ion Implantation on Hexagonal Boron Nitride *[For award:* PhD*]*
F.437	Mr. MANYEREDZI, Terrence	Adaptation of roof ventilators as micro-power generation units in homes *[For award:* PhD*]*
THEORETICAL AND COMPUTATIONAL PHYSICS		
G.65	Dr. GREBEN, Jan	A new foundation for the quantization of field theory:why it is necessary and why it matters
G.77	Ms. ADAMS, Betony	An open quantum systems approach to magnetoreception *[For award:* MSc*]*
G.79	Dr. HOROWITZ, William	Properties of the Quark-Gluon Plasma Observed at RHIC and LHC
G.237	Mr. KULIKOV, Kirill	Resonance effects in coupled Josephson junctions with LCR-shunting *[For award:* MSc*]*
G.239	Dr. DE KOCK, Michiel	Stable priors for Bayes Factors
G.251	Mr. MEIRING, Ben	First Calculation of the full Space-Time Evolution of Jets *[For award:* MSc*]*
G.363	Mr. RAMNATH, Vishal	Numerical Investigation of Temperature Profiles in Gray Gas Mediums with Combined Radiation-Conduction Heat Transfer
G.379	Dr. MOSUANG, Thuto	Molecular dynamics studies of some carbon nanotubes chiral structures
G.389	Prof. JONES, Glyn	Quantum Theory: Reality, Contextuality and Locality
G.427	Dr. AKHALWAYA, Ismail	A Monte Carlo Simulation of a Noisy Quantum Channel with Memory *[For award:* PhD*]*
G.441	Prof. KONRAD, Thomas	Multi-dimensional Quantum Walks using classical light
D1.369	Mr. VAN SOELEN, Brian	AutoCal: A Software Application for the Auto Calibration of Stellar Magnitudes
D1.391	Dr. ENGELBRECHT, Chris	Comparing the results of two different CCD image reduction packages *[For award:* MSc*]*

Poster Session 2 (9 July)

BOARD	PRESENTER	TITLE
DIVISION FOR PHYSICS OF CONDENSED MATTER AND MATERIALS		
A.32	Ms. SINGH, Asmita	Determining the Richardson constant of Ni/4H-SiC and W/4H-SiC Schottky diodes via Current-Voltage-Temperature (IVT) characteristics *[For award:* Hons*]*
A.54	Mr. FERNANDO, Pius Rodney	Magnetic and transport studies on $Cr_{100-x}Ir_x$ alloy single crystals *[For award:* PhD*]*
A.74	Mrs. JACOBS, Bincy Susan	Probing the antiferromagnetism in $(Cr_{84}Re_{16})_{100-y}V_y$ alloys using neutron diffraction *[For award:* PhD*]*
A.76	Dr. CHAVAN, A	Effect of Mo content on the Structural and Physical Properties of $Cr_{100-x}Mo_x$ Alloys
A.88	Mr. MADIBA, Itani Given	Effect of annealing temperature on vanadium dioxide thin films prepared by sol gel method
A.90	Mr. TSHWANE, David Magolego	Computer simulation study of spinel $LiMn_2O_4$ nanotubes as a cathode material for lithium-ion batteries *[For award:* MSc*]*
A.102	Ms. LINGANISO, Ella	Synthesis and characterization of binary phase NiS nanostructures
A.106	Mr. SELOWA, Phatholo Fredy	Computational modelling studies of Pd tellurides *[For award:* Hons*]*
A.134	Dr. NSENGIYUMVA, Schadrack	Influence of argon-implantation on thermoluminescence of synthetic quartz
A.146	Mr. MUSYIMI, Philip	High-pressure electrical-transport behaviour in charge-ordered Fe_2OBO_3 and $LuFe_2O_4$ *[For award:* PhD*]*
A.180	Ms. LEDWABA, Raesibe Sylvia	Atomistic Simulation Studies of $LiMn_2O_4$ *[For award:* MSc*]*
A.182	Mr. LOTHA, Thandikhaya Lungisa	Synthesis and characterization of doped perovskite oxides (CaTiO3: Pr, Al) nanophosphors by using sol-gel method. *[For award:* MSc*]*
A.190	Dr. THABETHE, Sibongiseni	Growth of FeSi nanowires by Chemical Vapour Deposition for Gas Sensing Applications
A.204	Mr. MKHONTO, Peace Prince	Electronic structures of oxygen adsorption on {110} nickel-rich pentlandite ($Fe_4Ni_5S_8$) mineral surface *[For award:* MSc*]*
A.212	Ms. DANGA, Helga	Palladium silicide formation on n-Si (111) By Thermal Annealing *[For award:* MSc*]*
A.216	Mr. SIBANDA, Wisdom Nkosilathi	Charge and magnetic ordering dynamics under pressure in $LuFe_2O_4$ *[For award:* PhD*]*
A.248	Prof. HEARNE, GIOvanni	Pressure effects on the magnetic behavior of the local moment ferromagnet CeCuSi
A.250	Ms. CHONCO, Nelisiwe Princess	Sputter deposition and characterization of diamond like carbon thin films *[For award:* MSc*]*
A.262	Mr. JAKATA, Kudakwashe	X-ray reflectometry and Surface Brillouin scattering studies of thin films of VC deposited on Si by RF magnetron sputtering *[For award:* PhD*]*
A.272	Ms. THABETHE, Thabsile	Investigation of the migration behaviour of Strontium ion implanted in Silicon Carbide
A.274	Mr. OMOTOSO, Ezekiel	Characterization of Temperature Dependence of the Electron Capture Cross Section of E-Center in Sb-Doped Germanium *[For award:* PhD*]*
A.282	Mr. NYAWO, Thembinkosi Goodman	Reactive DC sputter deposition and charactersation of AlN thin films
A.286	Ms. ODUTEMOWO, Opeyemi	Investigation of the effect of iodine bombardment in glassy carbon. *[For award:* PhD*]*
A.294	Ms. TEBELE, Angelina Seithati	Effects of Catalyst/Ba mole fraction on the structure and luminescence properties of BaCO3:1% Eu3+,2% Dy3+ phosphors synthesized using sol-gel process. *[For award:* MSc*]*
A.308	Mr. AHMED, Mustafa	Synthesis, characterization and magnetic ordering of the semiconducting intermetallic compound $FeGa_3$ *[For award:* MSc*]*
A.322	Mr. ALI, Abdub	Effect of annealing temperature on structural and luminescence properties of Eu3+-doped Y2O3 red-emitting phosphor thin films by Pulse Laser Deposition method. *[For award:* PhD*]*
A.336	Dr. MADHUKU, Morgan	Irradiation-induced improvement in crystalline quality of epitaxially grown InGaN thin films: A preliminary study
A.368	Mr. KOAO, Lehlohonolo	Effect of pH on ZnO nanostructures prepared by chemical bath method *[For award:* PhD*]*
A.380	Ms. MASENYA, Mamogo	Computational Modelling Studies of PtS surfaces
A.382	Mr. NJOROGE, Eric	Silicide formation in Pd-Si and Pd-SiC diffusion couples
A.384	Dr. MACHATINE, Augusto	Coupling coefficients and excitonic transitions in $CuGaSe_2$
A.386	Mr. WAKO, Ali	Characterization of cerium doped yttrium gadolinium aluminate garnet (Y-Gd)3 Al5O12:Ce3+ phosphor thin films fabricated by pulsed laser deposition *[For award:* PhD*]*
A.394	Mr. OSMAN, Nadir	Temperature dependence of coercivity and magnetization of Sr1/3Mn1/3Co1/3Fe2O4 nanoparticle ferrites *[For award:* PhD*]*
A.406	Mr. MAYIMELE, Meehleketo Advice	Temperature-dependent barrier characteristics of Pd/ZnO Schottky barrier diodes *[For award:* MSc*]*
A.410	Dr. DEBNATH, Jyotish Chandra	Magnetic and thermodynamic properties of Ce23Ru7Mg4 compound
A.428	Dr. MULLER, Theo	Influence of solvent casting and weight ratios on the morphology and optical properties of inorganic-organic hybrid structures
A.446	Ms. MAENETJA, Khomotso	Computational study of (110) b-TiO_2O surface *[For award:* PhD*]*
A.448	KOZAKIEWICZ, Anna	The behaviour of damage in sapphire and MgO implanted with silver ions
NUCLEAR, PARTICLE AND RADIATION PHYSICS		
B.112	Mr. COX, Mitchell	Affordable and power efficient computing for High Energy Physics: synthetic CPU performance and Fast Fourier Transform benchmarks of ARM processors. *[For award:* MSc*]*
B.116	Mr. WRIGLEY, Thomas Mr. HARMSEN, Gerhard	Memory performance of ARM processors and its relevance to High Energy Physics *[For award:* Hons*]*
B.124	Mr. PELWAN, Chad	Electron paramagnetic resonance analysis of plastic scintillators for the Tile Calorimeter of the ATLAS detector *[For award:* Hons*]*
B.128	Mr. NDLANGAMANDLA, Cebo	The modification and the development of the polarized ion source at iThemba LABS
B.164	Dr. RUAN, Xifeng	Prometeo: The new test bench for the electronics in ATLAS tile calorimeter in the upgrade.
B.222	Prof. CLEYMANS, Jean	Transverse Momentum and Tsallis Distribution]{Transverse Momentum Distributions in proton - proton Collisions at LHC Energies and Tsallis Thermodynamics
B.240	Dr. NEVELING, Retief	New research opportunities with the K600 magnetic spectrometer

Poster Session 2 (9 July)

BOARD	PRESENTER	TITLE
B.242	Dr. MALEKA, Peane Peter	Cross-section measurements for neutron-induced reactions in Co and Au at neutron energy of 60 MeV
B.258	Ms. HSU, Catherine	Searches for Z' boson decaying to two hadronic taus at a centre-of-mass energy of 8 TeV with the ATLAS detector. *[For award:* MSc*]*
B.260	Mr. MALAZA, Vusi	Data Processing System for the Time-of-Flight Spectrometer of Heavy Ions in the wide range of Energies. *[For award:* PhD*]*
B.298	Dr. SHIRINDA, OBED	Nature of the four-quasiparticle negative-parity rotational bands in ^{194}Tl
PHOTONICS		
C.10	Dr. DUDLEY, Angela	Reconstructing vector Bessel beams
C.120	Mr. DE BRUYN, Andre	Automation, characterisation and application of a spectrometer for UV and Vacuum UV *[For award:* Hons*]*
C.144	Ms. MCLAREN, Melanie	Self-healing of quantum entanglement *[For award:* PhD*]*
C.270	Mr. BELL, July	Thermally induced lensing determination from the coefficient of defocus aberration *[For award:* PhD*]*
C.306	Ms. PFUKWA, Cathrine	Investigation and evaluation of a custom Raman spectroscopy setup *[For award:* MSc*]*
C.352	Mr. VILJOEN, Ruan	Pulse shaping using a 2D spatial light modulator *[For award:* Hons*]*
C.414	Mr. NGCOBO, Sandile	Digital Laser for On-Demand Mode Pulses *[For award:* PhD*]*
APPLIED PHYSICS		
F.4	Mr. WEBBER, Graham	Calculating solar irradiance to determine yield from solar cells for De Aar *[For award:* MSc*]*
F.28	Ms. CYULINYANA, Marie Chantal	Reproducing observed solar radiation characteristics in Rwanda using theoretical models *[For award:* PhD*]*
F.38	Dr. TABI, Conrad Bertrand	Wave Instability of Intercellular Ca(2+) Oscillations
F.52	Mr. TANGWE, Stephen	An efficient and reliable model develop and employ in a simulation application to compute the coefficient of performance of an air source heat pump water heater
F.86	Mr. BALOYI, Bongani	A PEPT study of the quadratic en masse granular flows in rotating drums *[For award:* MSc*]*
F.100	Ms. NWOKOLO, Nwabunwanne	Production of electricity from eucalyptus wood *[For award:* MSc*]*
F.156	Mr. HOFFMAN, Jakobus	Structural changes associated with the differential expansion of coal during rapid heating - a preliminary study
F.158	Mr. SENEKANE, Makhamsia	A quantum circuit modeling toolkit for high performance computing *[For award:* PhD*]*
F.176	Ms. NDLOVU, Nothando	Geyser heating cycle of 2kW tank domestic solar water heater under varying loads *[For award:* MSc*]*
F.200	Mr. BAM, Lunga	Imaging of Dense Minerals in Rocks Using Micro-CT
F.208	Ms. CROZIER, Jacqui	Interpretation of Spectral Electroluminescence Images of Photovoltaic Modules *[For award:* PhD*]*
F.226	Mr. AKANDE, Amos	Chemiresistive Gas Sensing Properties of Vanadium Pentoxide nanoparticles *[For award:* MSc*]*
F.284	Mr. MELAPI, Aviwe	Comparison of the gasifier char-resin blends with gasifier soot-resin blends using different characterization techniques *[For award:* MSc*]*
F.312	Mr. KWARIKUNDA, Nicholas	Analysis of photo-response of a back contact silicon solar cell under spot illumination *[For award:* PhD*]*
F.436	Mr. OSAYEMWENRE, Gilbert	Absorption degradation of Poly crystalline silicon solar cell due to hot spot formation *[For award:* MSc*]*
THEORETICAL AND COMPUTATIONAL PHYSICS		
G.68	Mr. IGUMBOR, Emmanuel	First principle study: adsorption of molecular hydrogen sulphide on transitional gold cluster (Aun=1-5) *[For award:* PhD*]*
G.92	Mr. THENDO EMMANUEL, Nemakhavhani	Equilibration properties of hadronic matter *[For award:* MSc*]*
G.118	Mr. PIMENTA, Wade	Advanced CPU benchmarking of ARM processors for applications in High Energy Physics
G.244	Ms. MEDVEDEVA, Svetlana	Chaotic Phenomena in Stack of Josephson Junctions *[For award:* Hons*]*
G.246	Mr. HARTMAN, Jonathan	Correlation between entangled states as measured from accelerated world lines. *[For award:* PhD*]*
G.291	Mrs. SEMINA, Iuliia	The Stochastic Schroedinger Equations Approach to Open Quantum Systems *[For award:* PhD*]*
G.318	Dr. SALAGARAM, Trisha	Norm conserving pseudopotentials for 1-D systems
G.412	Dr. MOLEPO, Mahlaga	First-principles study of Fe-doped MgO
G.438	Dr. CHIRWA, Max	A circular current's bi-Cartesian magnetic dipolar model and the bias in deriving fields from own potentials



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Book of Abstracts

ORAL PRESENTATIONS

2 - Atomic scale simulation in the service of nuclear materials

DPCMM1 - Tuesday 08 July 2014 11:10

Primary author: GRIMES, Robin (Imperial College London)
Co-authors: MURPHY, Samuel (Imperial College London); RUSHTON, Michael (Imperial College London); FOSSATI, Paul (Imperial College London)

Our understanding of materials performance is based on experimental data. We use it to generate predictive models that allow us to develop improved materials and sometimes even select new materials or compositions. With nuclear energy related technologies, however, experimental data is often difficult to obtain either because the controlling factor takes place on time scales or length scales that are challenging or the hazard is such that facilities are not available. In these circumstances atomic scale computer simulations can be exceptionally useful.We can use the results of simulation in four different ways. First, most simply, to provide property values for existing models and add context to experimental data – as we have for the potential burnable poison ZrB2. Second, to 'check' or 'test' existing assumptions such as the extent of defect volumes changes associated with fission product lattice defects. Third, to improve existing models by 'developing' the physical models – as with our understanding of the role that additives have on improving the durability of nuclear waste glass. Sometimes, however, it is possible to develop totally new models so the fourth approach uses simulations to 'discover' or 'identify' the physics/chemistry behind the process – here we will consider dislocation processes in UO2. Thus, in this presentation we will consider these four issues in turn to illustrate how modelling and simulation adds value to the development of nuclear materials.

3 - Discretization of cosmological periodic orbits

Space - Friday 11 July 2014 10:00

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

A rigorous analytical derivation of discrete energies and distances of orbiting objects from a central star or massive body is presented.Given the positions of two orbiting objects as boundary values, the derived formula gives the positions of all the other objects orbiting a particular central massive body. The formula is applied successfully to the solar system, the satellites and moons of the solar planets, to the rings of planets, periodic comets and to all applicable exoplanet systems, pulsars, circumbinary and circumternary systems, and to star clusters orbiting the centre of the Milky Way galaxy. The calculated distances agree with observation within a total average relative deviation of 0.021, or 2.1\%. At present the total number of successful applications is 174.

5 - Interference fringe intensity measurement by optical path length variation using Michelson's interferometer

Photonics - Wednesday 09 July 2014 14:00 *[For award: MSc]*

Primary author: SULIALI, Nyasha (National University of Science and Technology)
Co-authors: ROHWER, Erich (University of Stellenbosch); NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); BARICHOLO, Peter (National University of Science and Technology)

We report on experimental work carried out using Michelson's Interferometer. In materials morphology, the difference between reference and sample beam optical path lengths in an Optical Coherence Tomography (OCT) setup can be used to extract internal structure information of optically dispersive media. Hence the interferometry experiments presented, form a foundation upon which modelling and setting up of a Michelson mode OCT setup is structured. A Mathematica® model of the electric field superposition is presented in the form of intensity plots at the interferometer output. A Helium-Neon laser and traditional Sodium lamp were used in this work. The interferometer was aligned and used to measure the refractive index of a gas cell which was gradually evacuated and the fringe shift corresponding to the optical path difference in the movable mirror arm of the interferometer measured. Results of change in gas refractive index against pressure were plotted. Additionally, a computation of the Sodium doublet separation was performed in order to approach the Zero Path Difference (ZPD) condition required for white light interferometry. Electronic presentation and measurement of the fringe patterns is also presented in two and three-dimensional plots.

6 - Massive Affordable Computing Using ARM Processors in High Energy Physics

Theoretical - Thursday 10 July 2014 11:30 *[For award: MSc]*

Primary author: SMITH, Joshua Wyatt (University of Cape Town)

High Performance Computing is relevant in many applications around the world, particularly high energy physics. Experiments such as ATLAS and CMS generate huge amounts of data which needs to be analyzed at server farms located on site at CERN and around the world. Apart from the initial cost of setting up an effective server farm the price to maintain them is enormous. Power consumption and cooling are some of the biggest costs. The proposed solution to reduce costs without losing performance is to utilize ARM processors found in nearly all smartphones and tablet computers. Their low power consumption and cost along with respectable processing speed makes them an ideal choice for future large scale parallel data processing centers. Benchmarks on the Cortex-A series of ARM processors including the well-known HPL and STREAM suites will be presented. Results from the PROOF benchmarks will be presented and analyzed. Issues with currently available operating systems for ARM architectures will also be discussed.

8 - Microstructure evolution of rutheniumwith 6H-SiC interface under vacuum annealing and the implications for the performance of its Schottky contact for high temperature operating diodes.

Applied - Tuesday 08 July 2014 15:20 *[For award: PhD]*

Primary author: MUNTHALI, Kinnock Vundawaka (University of Namibia)
Co-authors: THERON, Chris (University of Pretoria); AURET, F. Danie (University of Pretoria); COELLHO, Sergio (University of Pretoria); PRINSLOO, Linda (University of Pretoria); NJOROGE, Eric (University of Pretoria)

Thin films and Schottky diodes dots of ruthenium (Ru) on bulk-grown n-type-6-hexagonal-silicon carbide (6H-SiC) were annealed isochronally in a vacuum furnace at temperatures ranging from 500 -1000C. Rutherford backscattering spectroscopy analysis of the thin films showed formation of ruthenium silicide (Ru2Si3) at 800C,while diffusion of Ru into 6H-SiC commenced at 800C. Raman analysis of the thin films annealed at 1000C showed clear D and G carbon peaks which was evidence of formation of graphite . At this annealing temperature the Schottky contact was observed to convert to an ohmic contact, as evidenced by the linearity of current-voltage characteristic , thereby rendering the diode unusable. The transformation from Schottky contact to ohmic contact is attributed to graphite formation at the interface.

9 - Measuring phase with Stokes measurements

Photonics - Tuesday 08 July 2014 14:20

Primary author: DUDLEY, Angela (CSIR)
Co-authors: FORBES, Andrew (CSIR); MILIONE, Giovanni (City University of New York, USA); ALFANO, Robert (City University of New York, USA)

We present an approach to measure the phase (or wavefront) of an optical field by performing a series of polarization measurements, known as Stokes measurements. Our technique consists of a spatial light modulator and a polarization grating, which acts as a polarizing beam-splitter for right- and left-circular polarization states. This approach exploits the amplitude and phase relationship between orthogonal states of polarization to determine the phase of an optical field. We demonstrate the effectiveness of this method by reconstructing the phase of both static and propagating optical fields such as optical vortices, Airy beams and Bessel beams.

12 - Pulse Propagation in Soliton based Optical fiber communication.

Photonics - Thursday 10 July 2014 11:30

Primary author: SABITU, Rabiu Imam (Kano University of Science and Technology, Nigeria)
Co-author: YUSUF, Husaini (Kano University of Science and Techonology, Nigeria)

The main goal of the paper is to present a method of propagating pulses in a fibre without dispersion. Chromatic dispersion in standard fibre at wavelengths longer than 1310 nm causes shorter wavelengths to travel faster than longer ones. Thus a pulse composed of many wavelengths tends to disperse such that the shorter wavelengths tend to move towards the beginning of the pulse. This is called the "anomalous dispersion regime". Thus if a pulse is intense enough to modify the RI the phase and frequency of light within the pulse are changed. This is called self-phase modulation (SPM) and is caused by the "non-linear Kerr effect". So, if you have a pulse of sufficiently high intensity and short-enough duration the faster (high-frequency components) at the beginning of the pulse are slowed down a bit and the slower (low-frequency components) in the back are speeded up. Thus, if the pulse length and the intensity are right, the two effects (chromatic dispersion and SPM) strike a balance and the pulse will stay together without dispersion over quite a long distance.

13 - Constraining Beyond the Standard Model physics with the newly discovered Higgs boson with the ATLAS detector.

NPRP - Tuesday 08 July 2014 15:20

Primary author: CARRILLO-MONTOYA, German David (University of the Witwatersrand)

The discovery of the Higgs boson opens many perspectives to explore physics beyond the Standard Model. This talk describes the measurements and searches performed by the ATLAS experiment using the Higgs boson as a portal to search or constrain new physics. A selected list of the presented searches include: Constraints on the existence of weakly interacting dark-matter particles through Higgs boson to invisible decays; upper limits of Flavour-Chaning-Neutral-Currents in top quark decays and exclusion limits on the existence of Two Higgs Doublet Models. No significant signs of new physics were found in the data.Limits, in some cases the world's most sensitive, are placed on the different searches.

16 - Application of discrete-ordinate radiative transfer (distort) model to inhomogeneous aerosols atmosphere

Space - Tuesday 08 July 2014 10:00

Primary author: YUSUF, Hussaini (Kano University of Science and Techonology, Nigeria)
Co-author: SABITU, Rabiu Imam (Kano University of Science and Technology, Nigeria)

In this research work the discrete-ordinate radiative transfer (DISORT) model was applied to the single layer, scattering and inhomogeneous atmosphere of the Haze-L cloud model containing aerosols. The process involved the analytic solution as well as the numerical implementation of the radiative transfer equation (RTE) of the electromagnetic radiation from the Sun. The unknown coefficients in the analytic solutions to the RTE are determined from the boundary conditions of the diffuse intensity at the top and bottom of the atmosphere and from continuity conditions of radiation at the layer. However the result in this work is obtained numerically using the Mie theory for the calculation of the scattering efficiency, and DISORT package for fluxes and intensities. The relationship between transmission and reflection with the zenith angle of the sun was determined and parameterized for glacier, snow, sea-ice, desert and savannah surfaces respectively.

17 - A critical assessment of first year entering university science students' conceptual understanding

Education - Tuesday 08 July 2014 11:50

Primary author: REDDY, Leelakrishna *(University of Johannesburg)*
Co-authors: *RAMAILA, Sam (University of Johannesburg); NAIR, Padmanabhan (University of Johannesburg)*

Meaningful conceptual understanding is a key requirement for the acquisition of applied knowledge for the navigation of sophisticated studies in science and engineering. It is a known fact that the academic migration of students from the school sector to institutions of higher learning is essentially accompanied by the existence of conceptual knowledge gaps in various content domains. In response to this predicament and as a critical component of the First-Time Entering Students' Orientation Programme, a diagnostic questionnaire was administered among first year science and engineering students at the University of Johannesburg prior to the commencement of the academic programme in order to establish the nature and extent, if any, of their conceptual knowledge gaps. In terms of its design, the diagnostic questionnaire encapsulated items based on various conceptual knowledge areas pertaining to Grade 10, 11 and 12 Physical Science learning domain. Analysis of students' responses exhibited the existen ce of conceptual knowledge gaps which may impede meaningful learning.

18 - Students' perceptions of the study process: A critical analysis

Education - Tuesday 08 July 2014 10:20

Primary author: RAMAILA, Sam *(University of Johannesburg)*
Co-authors: *REDDY, Leelakrishna (University of Johannesburg); NAIR, Padmanabhan (University of Johannesburg); BVUMBI, Suzan (University of Johannesburg)*

The inherent structure of the study process is central to the provision of meaningful opportunities geared towards the achievement of success in any academic programme. The paradoxical complexities associated with various academic programmes may in some instances be too ghastly to contemplate for a considerable number of students resulting in undesirable consequences. Given this scenario, a Study Process Questionnaire (SPQ) was administered to first year students at the University of Johannesburg in order to establish their perceptions about the nature of the study process which underscores the academic achievement. Analysis of SPQ responses provided valuable insights into students' perceptions about the nature of the study process.

19 - The impact of community engagement initiative at Soweto Science Centre of the University of Johannesburg in addressing the subject knowledge deficiency of learners in the Further Education and Training band

Education - Thursday 10 July 2014 15:00

Primary author: NAIR, Padmanabhan *(University of Johannesburg)*
Co-authors: *REDDY, Leelakrishna (University of Johannesburg); RAMAILA, Sam (University of Johannesburg); MURONGA, Azwinndini (University of Johannesburg)*

One of the community engagement initiatives of the University of Johannesburg is championed through tutoring programme for learners in the Further Education and Training (FET) band providing contact sessions on Fridays and Saturdays at its Soweto Science Centre. This flagship program is attended weekly by over 1000 Grade 10, 11 and 12 learners coming from schools in and around Soweto Township. Prior to the commencement of coaching of these FET learners, their pre-entry characteristics in terms o f topics taught at school is investigated through carefully structured knowledge, synthesis and application-type questions. The learners' 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 results indicate an alarming revelation of the minimal physics content taught at school and the competency of the FET teachers in the Physics content thereof. This revelation is consistent with well-documented subject knowledge deficiencies prevailing amongst Physical Sciences teachers.

20 - A triggering strategy for improved pass rate in a software-managed evaluations in Physics practicals for Engineering and Health Science Diploma Programmes at the University of Johannesburg

Education - Thursday 10 July 2014 15:20

Primary author: REDDY, Leelakrishna *(University of Johannesburg)*
Co-authors: *NAIR, Padmanabhan (University of Johannesburg); RAMAILA, Sam (University of Johannesburg)*

The non-traditional approach to the evaluation of Physics practicals through an innovative software embedded system, first of its kind in South Africa, allows students to execute and report the results of an experiment independently. This system evaluates t he individual performance in an experiment in terms of accuracy, analysis of data and a report of the necessary results obtained. As part of the evaluation of the experimental report, the students' data is loaded into a software system and checked against the pre-loaded data for the particular experimental set-up and equipment. Thus, students are unaware of the exact requirements for securing marks at each step and process of the report. To overcome this difficulty, the experimental group of students are give n support through rigorous tutorials and consultations in contrast with a control group of students. Results reveal that in relation to the control group, a good correlation exists between good marks attained through such support system in comparison to the control group. This has become a valuable outcome in view of the fact that Physics practicals carry a full modular credit in the Diploma Programmes in Health Sciences and Engineering.

21 - A CHAT perspective on the tensions and dynamics in the professional development of Physical Sciences teachers in a mentoring relationship

Education - Wednesday 09 July 2014 11:30

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

This research explored mentoring in terms of the dynamics and tensions associated with the interaction between a 'keystone species' and a novice teacher within communities of practice using a case study method underpinned by the Cultural Historical Activity Theory (CHAT). A primary constraint in the implementation of curriculum reform has been the lack of professional development for teachers. Insights into the nature of the mentoring relationship between Physical Sciences teachers revealed distinctive tensions and contradictions in terms of the activity system. The benefits of mentoring relationship suggest that teacher professional development could receive a major boost if the Department of Basic Education more overtly encouraged mentorship relationships between teachers.

22 - Higgs quartic coupling, neutrino masses and mixing angles in 2UED models

Theoretical - Tuesday 08 July 2014 10:00

Primary author: CORNELL, Alan *(NITheP)*
Co-author: ABDALGABAR, Ammar *(University of the Witwatersrand)*

We shall explore the two limiting cases of the three standard model generations all propagating in the bulk or all localised to a brane, from the point of view of renormalisation group equations for the Higgs sector and the neutrino sector in a six dimensional universal extra-dimensional model. The recent experimental results of the Higgs boson from the LHC allow, in some scenarios, stronger constraints on the cut-off scale to be placed, from the requirement of the stability of the Higgs potential.

23 - Evolution of Yukawa Couplings and Quark Flavour Mixings in the 2UED

Theoretical - Tuesday 08 July 2014 10:20 *[For award: PhD]*

Primary author: ABDALGABAR, Ammar *(School of Physics, University of the Witwatersrand)*
Co-author: CORNELL, Alan *(NITheP)*

The evolution equation of the Yukawa couplings and quark mixings are performed for the one-loop renormalization group equations in a six-dimensional Standard Model on a S1/Z2 orbifold. Different possibilities for the matter fields are discussed, that is, where they are in the bulk or localized to the brane. These two possibilities give rise to quite similar behaviors. By studying the implications of the evolution of the Yukawa couplings and mass ratios we find that, for both scenarios the theory is valid up to the unification scale, leading to significant corrections.

25 - Photon-Axion mixing as a cosmic magnetometer

Astro - Wednesday 09 July 2014 14:20 *[For award: PhD]*

Primary authors: BECK, Geoffrey *(University of the Witwatersrand); COLAFRANCESCO, Sergio (University of the Witswatersrand)*

Axion-like particles (ALPs) are a candidate component of dark matter and are ubiquitous in both high-energy theories and in extensions of the standard model. Additionally, ALPs exhibit the ability to mix with photons in the presence of an electromagne tic field which makes them also interesting for astrophysical studies.In this work we calculate the probability of the ALP-photon transition for a variety of astrophysical cases and we derive the main physical characteristics of the magnetic field in cosmic structures showing ALP-photon mixing. Importantly these interactions give rise to characteristic energies, where photons entering the magnetic field with these particular energies leave as photons only. We discuss the possibility of using such characteristic energies as probes of cosmic structure and of using ALP-photon spectra to constrain both the ALP particle properties as well as those of the host magnetic field. We make specific reference to propagation in an intra-cluster magnetic field and in the inter-galactic magnetic field by using the emission of powerful active galactic nuclei (AGNs): the radio-galaxy NGC1275 at the centre of the Perseus cluster and the distant blazar PKS1830-210 at z=2.507. Using the available Fermi-LAT observations for these two sources we show that the available data on the spectral energy distribution of NGC1275 can set stronger constraints on the intra-cluster magnetic field parameters in Perseus cluster in the region $B < 1$ μG and $d < 10$ kpc than those attained from previous Faraday rotation studies (for ALP-photon couplings close to the CAST limit). The limits obtained on the inter-galactic magnetic field from the spectrum of PKS1830-210 are similarly more constraining in the region $B < 10^{-3}$ μG and $d < 1$ Mpc for similar couplings.We finally stress that the ALP-photon mixing process also has the to potential imprint information about the structure of cosmic magnetic fields upon the ALP induced polarisation spectrum of photons passing through the field. This property is also shown to survive in realistic turbulence models and to gain the power to align polarisations towards a characteristic configuration in such cases.

26 - Investigation of Fatigue-Type Processes in Polycrystalline Diamond Tools Using Raman Spectroscopy

Applied - Wednesday 09 July 2014 10:00 *[For award: PhD]*

Primary author: *VHARETA, Maxwell (University of the Witwatersrand)*
Co-authors: *ERASMUS, Rudolph (University of the Witwatersrand); COMINS, Darrell (University of the Witwatersrand)*

Polycrystalline diamond (PCD) cylindrical tool-bits used in oil well drilling are susceptible to fracture due to the hostile environment of randomly occurring impact loads to which they are subjected. The fact that the tool-bits fail after repeated use suggests the possibility of fatigue type processes in PCD. The study of stress fields on the surface of the PCD thus becomes crucial in the quest to have extended lives for these tool-bits. Since the diamond Raman peak reveals both the nature and magnitude of the stress present in the material, this technique can be employed as a non-destructive measurement tool to investigate these stress fields. Raman stress measurements at room temperature were carried out using a 36 point mapping array in area close to the size of the PCD samples. The mapping points provided histograms of the magnitude and nature of these small individually stressed regions showing a general compressive stress for the lower numbers of fatigue cycles which deteriorates to a high proportion of tensile regions. The data are also illustrated by 2-D surface maps as an alternative mode of presentation again confirming the change from surface stresses being dominantly compressive to dominantly tensile with exposure to the higher numbers of fatigue cycles. Whereas a general compressive stress is desirable in the PCD layer as it inhibits the propagation of cracks, on the contrary tensile stresses facilitate the formation of cracks ultimately leading to catastrophic failure of the tool-bits.

27 - Coupled-channel studies of nucleon-scattering from oxygen isotopes

NPRP - Friday 11 July 2014 10:20

Primary author: *KARATAGLIDIS, Steven (University of Johannesburg)*
Co-authors: *SVENNE, Juris (University of Manitoba); AMOS, Ken (university of Melbourne); CANTON, Luciano (INFN/University of Padova); FRASER, Paul (INFN/University of Padova); PISENT, Gualtiero (University of Padova); VAN DER KNIJFF, Dirk (University of Melbour ne)*

The Multi-Channel Algebraic Scattering (MCAS) method for the description of nucleon-nucleus scattering has been used with a (collective) rotational model of structure describing the target. The success of that model, when incorporating the Pauli Principle in the interactions describing the scattering and the formation of the compound systems, has been quite good. We extend that method to include the vibrational model in describing the target states, and apply the method to the scattering of low-energy nucleons from oxygen isotopes. Results for nucleon scattering from 16O, leading to states in the compound nuclei 17O and 17F, will be reported, as will preliminary results for nucleon scattering from 18O.

30 - Non-Specialist Lecture: Optimization of the PEGASES plasma thruster

Applied - Thursday 10 July 2014 14:00

Primary author: *LAFLEUR, Trevor (LPP Ecole Polytechnique, France)*
Co-author: *AANESLAND, Ane (LPP-CNRS Ecole Polytechnique, France)*

The PEGASES plasma thruster (Plasma propulsion with Electronegative GASES) is a new gridded ion engine which generates thrust by alternatively accelerating both positive and negative ions; no electrons are present in the ion beam plume, and no separate neutralizer is needed. A radio-frequency antenna in the source region of the thruster is used to ionize the injected gas and form a high density plasma, the main negatively charged species of which are electrons. A magnetic filter placed just downstream of the source then strongly cools the electrons, allowing them to attach to the gas to form negative ions. In this way an almost electron-free plasma (known as an ion-ion plasma) is produced just in-front of the thruster extraction/acceleration grids.Vital to the functioning of the thruster is the ability to be able to alternatively extract both positive and negative ions by a set of biased grids; a process that has been found to unexpectedly depend on the upstream plasma properties near the antenna, and in particular, on the choice of wall materials for the plasma source region. By performing a detailed experimental investigation of the thruster, we show that the use of conducting or insulating wall materials completely changes the nature of the plasma diffusion phenomena (i.e. ambipolar or nonamibpolar) in the source, and we demonstrate how this can be used to optimize the plasma production and extraction of charged particles through the grids into the acceleration region.

32 - Search for the 2HDM neutral CP-odd pseudoscalar Higgs, *A*, in the *A*to *Zh* channel in *sqrt(s)* = 8 TeV *pp* collisions with multilepton final states using the ATLAS detector

NPRP - Thursday 10 July 2014 15:00 *[For award: MSc]*

Primary author: *HAMITY, Guillermo (University of the Witwatersrand)*

The pseudoscalar Higgs, A, is a predicted particle of many extensions of the minimal Standard Model, known as Two Higgs Doublet Models (2HDMs), where the Higgs sector is extended to two doublets of scalar fields. The decay for A → Zh includes the Standard Model-like Higgs boson h in the final state and leads to events with isolated leptons. By assuming that the Standard Model-like Higgs boson h is the newly discovered Higgs boson with a mass of 125 GeV, we are able to search for the pseudoscalar Higgs at and below the TeV scale. Results of the search for a pseudscalar Higgs boson in the A → Zh → ■ ■ τ τ channel, where ■ ≠ τand the tau leptons decay hadronically, are presented. Studies on data-driven background estimation methods, signal optimization techniques, and the statistical interpretation of results are shown.

35 - Investigation of carotenoid excited electronic states in the main plant light-harvesting complex (LHCII) via femtosecond pump-probe spectroscopy

Applied - Tuesday 08 July 2014 10:00 *[For award: MSc]*

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

Photosynthesis is the major solar energy storing process on earth. Understanding the molecular mechanisms underlying the efficient storage of the system may be critical for future solar energy storage devices. The natural photosynthetic apparatus consists of a complex system of membrane-bound pigment-proteins. The reaction centres of both photosystem I (PSI) and photosystem II (PSII) are surrounded by more than a hundred protein-bound chlorophylls and carotenoids which absorb the solar photons and transfer the electronic excitation to the reaction centre, where a charge separation is initiated. These ultrafast processes are at the basis of the high efficiency of light harvesting and temporal storage of the harvested energy. Plants are self-protected against damage due to over-illumination, by a natural process known as non-photochemical quenching (NPQ). The role of the embedded carotenoids in NPQ has minimal understanding. The main light harvesting complex (LHCII) will be the focal point of the presentation, due to its important involvement in the process of NPQ. An investigation to the excited-state dynamics of LHCII carotenoids upon intensity-dependent, selective carotenoid excitation was conducted through femtosecond pump-probe spectroscopy studies on LHCII trimers. It will be demonstrated that by making use of this technique, new electronic states may be resolved. It will furthermore be explained how these states may be active in energy-quenching mechanisms.

36 - AGN vs star formation in Brightest Cluster Galaxies

Astro - Thursday 10 July 2014 14:20

Primary author: *LOUBSER, Ilani (North-West University)*

I will describe our observational programme on the Southern African Large Telescope (SALT), that measures the (sometimes weak) emission lines in BCGs in unprecedented detail. Our sample consists of star forming BCGs, and have existing host cluster data from the X-ray regime available, but lacks wide-wavelength, deep emission-line data that will allow us to test models for the dominant ionization processes, excitation sources, morphology and kinematics of the gas. This, combined with the multi-wavelength data, will form a complete view of the different phases and how they interact in the processes of star formation and feedback detected in central galaxies in cooling flow clusters.

37 - Quantum Neural Networks - Our brain as a quantum computer?

Theoretical - Wednesday 09 July 2014 15:20 *[For award: PhD]*

Primary author: *SCHULD, Maria (University of KwaZulu-Natal)*
Co-authors: *PETRUCCIONE, Francesco (University of KwaZulu-Natal); SINAYSKIY, Ilya (University of KwaZulu-Natal and National Institute for Theoretical Physics)*

Neuroscience and quantum physics have a central feature in common. Both disciplines study objects that largely remain a mystery to scientists. While a century after the discovery of quantum theory, physicists still struggle to interpret their quantum objects' counterintuitive behaviour, biologists are not even close to understanding the mechanisms underlying the remarkable performance of our brain. The research field of Quantum Neural Networks (QNNs) combines both `mysteries' by investigating how established models of neural networks can be formulated in the language of quantum theory. Far away from the rather esoteric discourses of a `quantum brain', QNN models first and foremost aim at developing efficient algorithms to run on future realisations of quantum computers. QNNs thereby promise to provide a substantial speed-up or increased memory capacity relative to classical neural networks. However, beyond questions of powerful computing technology, a success in the yet relatively small field of QNN research could give a first hint that our brain makes use of quantum mechanics to master its incredible tasks. In that sense, QNN research can be seen as a subdiscipline of the `dawn' of quantum biology which evaluates the question of how nature employs quantum effects in macroscopic (i.e. hot and dense) environments to optimise its processes. This presentation intends to give an introduction into Quantum Neural Networks research and to access the question of the potential of our brain to use quantum computing algorithms.

40 - The design and development of a force comparator standard machine to provide national traceability in force measurement to industry.

Applied - Thursday 10 July 2014 15:20

Primary author: DLAMINI, Sipho (NMISA)
Co-author: GOUWS, Corne (NMISA)

Precise force measurements are important in testing of materials, weighing and balancing of heavy structures such as aircrafts, ships and engineering structures. For these applications, force transducers (artifact) are used to measure the static force generated in the system. Calibration of the transducer is done against force standard devices of higher accuracy traceable, through an unbroken chain of calibrations to the reference standards of force. For South Africa, the national measurement standards for force are a range of force transducers with different capacities ranging from 20kN to 5000kN. These are maintained at the National Metrology Institute of South Africa (NMISA). Dead weight machines are commonly used to realize or generate static force with significantly lower uncertainty. However, they are expensive to procure and maintain. Alternatively force comparator machines can be used to disseminate traceability in force measurements at slightly higher yet acceptable uncertainty. A force comparator standard machine at NMISA was designed and developed to provide national traceability in force. It has been developed to disseminating the unit of force from national level to the user industries in the range of 2kN to 4500kN. This type of force machine is easy to operate and maintain and makes the calibration of commercial force transducers to be economical without significant compromise in the uncertainty. The calibration and measurement capability (CMC) expressed as an uncertainty for the standard force transducers by comparison using this comparator machine was found to be ± 0.03% in the range of 2kN to 200kN for tension and compression, ± 0.04% in the range of 500kN to 1000kN for compression only and ± 0.11 % in the range 1000kN to 4500kN for compression only. The CMC is stated as the standard uncertainty of measurement multiplied by coverage factor of k = 2 at a confidence level of 95.45%.

41 - A microscopic theory of phase transitions

DPCMM1 - Thursday 10 July 2014 15:00

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

A microscopic theory of phase transitions is presented that describes macroscopic phenomena on the basis of microscopic interactions between particles. It is shown that the equation of state p(T,V) of a gas and the spontaneous magnetization $M_S(T)$ of a ferromagnetic insulator only exhibit phase transitions in the thermodynamic limit thus describing an infinitely large system. There are no phase transitions observed in the case of a finite system. A Curie temperature is calculated in agreement with experimental realizations of the theoretical model. Furthermore, the results depend on the dimension d of the spin lattice thereby confirming the Mermin Wagner theorem.

43 - The Provost metric as a systematic means to construct geometric and gravitational duals

Theoretical - Tuesday 08 July 2014 15:00 *[For award: PhD]*

Primary author: VAN ZYL, Hendrik (Stellenbosch University)
Co-authors: SCHOLTZ, Frederik (National Institute for Theoretical Physics); KRIEL, JN (Stellenbosch University)

The AdS/CFT correspondence is a mathematical tool that has been used to study (especially strongly coupled) field theoretic problems. The correspondence conjectures a duality (a one to one mapping) between a theory of gravity in the bulk and a conformal field theory on the boundary of anti-de Sitter space-time. Examples of this correspondence are known, but a full AdS/CFT dictionary is still lacking i.e. which systems constitute duals and how the quantities in either theory are related to each other. A key element of the above correspondence is that the symmetries of the field theory appear as isometries of the metric of the theory of gravity. Within quantum mechanics there is a way to achieve the same goal using a construction first proposed by Provost. This construction provides a procedure to construct metric tensors from a given family of quantum states that encode the dynamical symmetries of the quantum states as isometries of the resulting metric and thus offers an appealing method for the construction of dualities.This talk focuses on constructing duals for tractable, simple 0-D quantum mechanical systems (only time translation) using the Provost metric. We show that this construction forces one to include an additional dimension (with the interpretation of an energy scale) on the Riemannian manifold and that quantum correlation functions can be recovered on the boundary of this manifold. This geometric “dual” is however not one-to-one and information beyond just the geometry is required. It is from this perspective that a precise duality between the large N Lipkin model (with the free particle and harmonic oscillator as specific limits) and the so-called vacuum Jackiw-Teitelboim dilaton gravity is constructed. The non-vacuum case is also discussed briefly.

44 - The ICRF-3: The next Generation Celestial Reference Frame.

Space - Wednesday 09 July 2014 14:00

Primary author: DE WITT, Aletha (Hartebeesthoek Radio Astronomy Observatory)

One part per billion (ppb) spatial resolution is required in many fields of physics in order to make progress in research. In the last several decades radio astronomers have developed a technique to achieve this ppb resolution by creating non-realtime phased-arrays of antennas. Highly stable atomic clocks allow phasing of antennas at intercontinental distances thus leading to the technique's name: Very Long Baseline Interferometry (VLBI). This technique has applications in geodesy, astrometry, astronomical imaging, astrophysics, and spacecraft navigation. We will briefly review some of these applications.In our own research, VLBI is used to pinpoint the angular positions of extragalactic radio sources with ppb (nanoradian/200 μas) precision. From positions of hundreds of these objects spread over the full sky, global celestial references frames have been constructed. This talk will discuss efforts underway to create the next standard International Celestial Reference Frame (ICRF). Because there have historically been fewer radio telescopes in the southern hemisphere, there is a great need to increase observations from southern observatories. South Africa's HartRAO is very active in supplying these observations through collaborative efforts with Australia and other observatories throughout the world. Currently there are projects underway to improve the celestial frame at 8.4 GHz and 22 GHz. The results will be compared to complementary work at 32 GHz in order to understand frequency dependent systematic errors which may limit the registration of radio and optical reference frames such as ESA's Gaia satellite.

46 - Characterization of Corona Ionization Based Micro-thrusters

Applied - Wednesday 09 July 2014 15:00 *[For award: PhD]*

Primary author: WRIGHT, William (University of the Witwatersrand)
Co-author: FERRER, Phil (University of the Witwatersrand)

A novel electrical micro-thruster (Corion system) has been developed over the past five years at Wits University, intended to be used commercially on small satellites and deep space probes. In this system, thrust is produced via the coupling of the corona ionization and acceleration mechanisms. The thruster consists of two oppositely charged metal needles. A neutral propellant gas emerging from the needles is ionized by the high electric field at the needle-tips. Ions and electrons are generated at their respective needles, and accelerated away. Continuous operation relies on a plasma bridge which forms between the needles. Experiments have shown that although the thruster operates, it is subject to instabilities in the plasma bridge which compromise continuous operation. Based on the previous findings, a new design is being tested. The new design shares some of the major characteristics of the previous Corion system while attempting to sidestep the plasma instability. The redesigned system consists of two tubes shaped into a ‘U’ that are connected to the propellant feed system. Ring electrodes are positioned near the opening of the tubes. The design features of this new system and results of initial tests on a proof of concept system consisting of a single tube open at both ends will be reported on. The results of using different construction materials and different geometries on performance will also be presented. Measurement of two important quantities in these tests, the propellant mass flow rate and the thrust, are challenging within a space-simulation environment. Novel systems have been constructed in both cases. The design, principle of operation and testing of these systems will be reported on.

47 - Spectroscopic and Photometric study of open cluster Trumpler 27

Space - Thursday 10 July 2014 14:20 *[For award: MSc]*

Primary author: OBONYO, Willice (University of Cape Town)
Co-authors: MCBRIDE, Vanessa (University of Cape Town); NAGUERUELA, Ignacio (University of Alicante); AMPARO, Marco (University of Alicante)

Determination of distances to Galactic open clusters is an important way of understanding the nature of the Galactic spiral arms. One of the difficulties involved in accurate determination of Galactic distances is the determination of reddening to the cluster of study. We have done both spectroscopic and photometric study of an open cluster called Trumpler 27 inorder to determine the reddening to the cluster and eventually find its distance from the sun. The cluster is young ~ 107 years. We have found that the cluster is ~ 3.7 kpc away from the sun. The open cluster has majorly massive stars and is located in the obscured part of our Galaxy at l~ 355.06 and b~ -0.74. At its age and the fact that it has O stars, B stars, Wolf Rayet stars and late type stars, the red supergiants makes it an interesting cluster to study.

50 - Characterization of variable stars using the ASAS and SuperWASP databases

Astro - Tuesday 08 July 2014 15:00

Primary author: SMITS, Derck (University of South Africa)

A photographic survey of an area of the sky centred on RA (1900) 12^h 40^m and DEC (1900) -32° 00' made by Harvard Observatory in the 1930s identified 108 variable stars. Many of these variables have not been studied since their identification, and therefore there are no published light curves or accurate periods for them, and the data in the General Catalogue of Variable Stars is based on the original survey. Sources brighter than V = 14 mag can be found in the ASAS and SuperWASP databases, and can be used to check the classifications and parameters of the variable stars. In particular, in the SuperWASP archive there are over 25,000 observations for many of the sources, making it possible to determine accurate periods, maximum and minimum V magnitudes and correctly classify these object. The methods used to determine the parameters of these variable stars will be described, and results presented of the stars that have been studied.

53 - Integrability in Large N super Yang-Mills Theory

Theoretical - Tuesday 08 July 2014 11:10

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

In this talk we argue that certain large N but non-planar limits of maximally supersymmetric Yang-Mills Theory enjoy integrability. By employing constraints that follow from the superconformal algebra, we are able to argue that integrability persists to all loops, that is, to all orders in the Yang-Mills coupling constant. The consequences of this result for the dual gravitational theory are described.

55 - A Steady State Model For Interfacial Reaction And Binary Diffusion In Si-Pd System

DPCMM1 - Tuesday 08 July 2014 14:40 *[For award: PhD]*

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

A steady state model that explains an interfacial interaction and diffusion in binary couple of a-b system is proposed in this article. Within the framework of the model, a-atoms diffuse from a-layer of the binary system toward the b-layer and react with b-atoms to form ab-atoms. The layer of ab-atoms that grows on the b-layer, at first, is initially governed by chemical reaction and as time passes it becomes diffusion controlled. The concentration of a-atoms changes as time progresses because they are the dominant diffusing species in the binary system. But the number of b-atoms per unit volume of b-layer remains unchanged because we assume that they are practically immobile. During the chemical controlled phase of the process, the growth of ab-atomic layer is directly proportional to the annealing time. As diffusion reaction dominates the process, the ab-atomic layer thickness increases parabolically with the annealing time. We, therefore, use our model to estimate the thickness of growth of ab-atomic layer with the corresponding critical annealing time at the point of transition between linear and parabolic growth process of the layer. The interfacial reaction and diffusion in binary Si-Pd system is also discussed in line with the theory of our model.

56 - Granular Flow Modelling of an Annular Shear Cell

Applied - Wednesday 09 July 2014 11:10 *[For award: PhD]*

Primary author: BREMNER, Sherry *(University of Cape Town)*
Co-authors: *GOVENDER, Indresan (University of Cape Town); MAINZA, Aubrey (University of Cape Town)*

An investigation into the relationship between shear rate, shear stress and dispersive pressure within the simple couette geometry of an annular shear cell is presented here. In independent research it has been concluded that shear and normal stresses vary quadratically with shear rate and that the dispersive pressure is approximately three times the shear stress. The shear stress and (centrifugally driven) dispersive pressure distributions are constructed for the simple shear cell. The time-averaged physical ingredients of the stresses are obtained directly from Discrete Element Method (DEM) computational simulations and non-invasive measurements using a nuclear imagining technique: Positron Emission Particle Tracking (PEPT). However, viscous dissipation heating is notable in typical grinding shear cells. In order to capture this degradation of mechanical energy, while maintaining the simplicity of an isothermal formulation, the dispersive term in the mechanical energy balance equation is expanded to incorporate heat dissipation by increasing the proportionality constant between dispersive pressure and shear stress.

57 - Preparation and characterization of poly(vinyl alcohol)/graphene composite nanofibers via electrospinning

Applied - Tuesday 08 July 2014 11:50 *[For award: MSc]*

Primary author: BARZEGAR, Farshad *(University of Pretoria)*
Co-authors: *BELLO, Abdulhakeem (University of Pretoria); DANGBEGNON, Kouadio Julien (Nelson Mandela Metropolitan University); MOMODU, Damilola (University of Pretoria); MANYALA, Ncholu (University of Pretoria)*

We report on the synthesis and characterization of electrospun polyvinyl alcohol (PVA)/graphene nanofibers. The samples produced were characterized by Raman spectroscopy for spectroscopy for composition, scanning electron microscopy (SEM) for surface morphology and Thermogravimetric analysis (TGA) for thermal properties. SEM measurements clearly show uniform fiber formation and excellent graphene dispertion within the fibers, while TGA measurements show the improved thermal stability of PVA in the presence of graphene. The synthesized polymer reinforced nano-fibers have potential to serve in many different applications such as thermal management, electrodes and biomedical materials for drug delivery. We successfully incorporated graphene nanofillers into PVA fibers in order to improve the thermal properties of the resulting fibers. Three different source of graphene were used for that purpose and all show improved thermal properties of the fibers after incorporation of the graphene nanofillers. The relatively simple and economical electrospinning technique was used to fabricate continuous fibers. The growth of the PVA fibers was optimized for this system in term of bead free fibers and thinner fibers. It was realized that the fibers synthesized were hollow.the results show a slow weight loses, meaning enhanced thermal stability of the fibers with increasing graphene loading into the PVA fibers.

58 - Source Structure Effect on Southern Hemisphere VLBI Reference Frame

Space - Wednesday 09 July 2014 14:20 *[For award: PhD]*

Primary author: BASU, Sayan *(UNISA-HartRAO)*
Co-authors: *BERTARINI, Alessandra (MPIfR, IGG-Bonn, Germany); DE WITT, Aletha (HartRAO); QUICK, Jonathan (HartRAO)*

The International Celestial Reference Frame (ICRF) has been adopted by the International Astronomical Union (IAU) in 1997. The current standard, ICRF-2, is based on dual frequency 2.3- and 8.4-GHz VLBI radio observations of 3414 Active Galactic Nuclei (AGN). Extragalactic Radio sources which have been included in ICRF catalog are sources known to have compact source structure and are known as reference sources. An ideal reference source should have an accurate known position and be unresolved at the observed frequency. However, AGN can exhibit spatially extended strutrue that may vary both in time and frequency. This variability can introduce a significant error in the VLBI measurements thereby degrading the accuracy of the estimated source position. Reference source density in the Southern Hemisphere is poor compared to the Northern Hemisphere. One of the main reasons is the limited number of radio telescopes in the south. Another major problem is the few known reference sources in the Southern Hemisphere. Here we report on our effort to monitor the structural evolution of AGN sources in order to evaluate their suitability as reference source for future VLBI observations. Celestial Reference Frame Deep South (CRDS) is a campaign of the International VLBI Service of Geodesy and Astrometry (IVS), where radio telescopes from the Southern Hemisphere participate in astrometric VLBI sessions at 2.3- and 8.4-GHz. Another survey named the Long Baseline Array (LBA) Calibrator Survey (LCS) is also working to increase the reference source density in the Southern Hemisphere below -40 degree declination at 8.4-GHz. We use both LCS and CRDS sessions in our ongoing project.

59 - Study of the radiation damage induced by fast neutron and deuterium ions in graphite and zircaloy-4

DPCMM2 - Tuesday 08 July 2014 10:00 *[For award: MSc]*

Primary author: MAHAFA, Tshepo *(University of Johannesburg)*

In order to reliably predict the service lifetime of nuclear power reactors, nuclear materials damage response to energetic projectiles needs to be thoroughly evaluated and understood. Currently, within the nuclear industry, efforts are greatly focussed on investigating the pivotal role of nuclear materials, as their interaction with highly energetic particles can lead to their non-performance within the nuclear reactor environment. Critical for the optimal performance of these materials is that they maintain their structural integrity when they are under irradiation by energetic particles. One way of investigating their performance is by exposing them to highly energetic particles at pre-determined fluences within an accelerator environment.In our case, 3.5 MeV fast neutrons and 4 MeV deuterium ions at fluences of 10^16 n/cm2 and up to10^20 ions/cm2, respectively, were made to interact with graphite and zircaloy-4 in a radio frequency quadropole (RFQ) accelerator at Necsa. Graphite and zircaloy-4 are in-core reactor materials that are used for neutron moderation and fuel cladding purposes, which are critical functions within the reactor. Failure of these materials in adequately performing their functions can have a disastrous effect on the safe operation of the reactor and its immediate environment.The departure of these materials from their innate structural stability can be inferred from the changes observed in their microstructure after irradiation. To observe these changes, microstructural and crystal structural characterization techniques such as Optical Microscopy (OM), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and X-Ray Diffraction (XRD) were used. The changes observed in the irradiated materials' microstructure are the formation of interstitial dislocation loops and the increase in the density of voids. Graphite presents mostly basal and prismatic dislocation loops after irradiation, while zircaloy-4 reveals the formation of hydrides in the microstructure. Both cases would eventually lead to changes in the physical and mechanical properties of these materials. The preliminaty results of the characterization of these materials after irradiation are reported in this study.

60 - Investigation of ionization temperature as an explicit parameter in C^3 models of nebulae

Astro - Wednesday 09 July 2014 10:00

Primary author: PROZESKY, Andri *(UNISA)*
Co-author: *SMITS, Derck (UNISA)*

The current capture-collision-cascade (C^3) models of photoionized nebulae do not explicitly take into account the ionization temperature governing the level of ionization of species in the gas. I have calculated the departure coefficients for a hydrogen nebula using an ionization temperature instead of assuming that it is equal to the electron temperature. This is being done to investigate the known discrepancy that occurs in nebular abundance determinations that are derived from recombination lines and collisionally excited lines, respectively. Radiative transfer effects need to be dealt with differently in this model than when only the electron temperature is taken into account, for which a simple correction can be made for stimulated emission. Stimulated emission is of little importance for optical/IR lines but it can have a significant effect on the populations of radio recombination lines.

62 - Teaching Physics in isiZulu

Education - Wednesday 09 July 2014 15:00

Primary author: MATTHEWS, Alan *(UKZN)*

The University of KwaZulu-Natal aims to develop isiZulu as a language of scholarship. This paper reports on a project titled "Language Plan Implementation for the School of Physics" that is funded by the University Languages Board. The objective of the project is to develop a bilingual physics teaching text at foundation level, with isiZulu and English side-by-side on the page. In addition to writing the text, the project includes a survey of student attitudes to using isiZulu to teach physics which provides valuable background information to guide text development. This survey is of both isiZulu-speaking and non-isiZulu-speaking students, since both groups will be affected by such an initiative. Also of great importance is the development of physics terms in isiZulu. This paper will describe progress so far in the project.

63 - An investigation of granular rheology using Positron Emission Particle Tracking

Applied - Wednesday 09 July 2014 11:30 *[For award: PhD]*

Primary author: *GOVENDER, Indresan (University of Cape Town)*
Co-authors: *PATHMATHAS, Thirunavukkarasu (University of Cape Town); RICHTER, Maximilian (University of Cape Town)*

We consider the rheological drivers of granular flows comprising mono-sized (5 mm) glass beads in a 300 mm diameter rotating drum operated in the cascading-to-cataracting Froude regime. By combining the inherent frictional nature of particles within a dense flow regime and noting that industrial rotating drums (tumbling mills) are typically characterised by collisional and turbulent stresses, a theoretical expression of the effective friction coefficient is derived, yielding a customised granular rheology for athermal, free surface granular flows. The input data to the model (velocity, solids concentration, pressure and flow depth) are obtained directly from non-invasive measurement using a nuclear imaging technique: Positron Emission Particle Tracking (PEPT). Using the new rheology, we derive the in-situ power dissipation and show that shear stresses drive the energy dissipation in the tumbling mill.

64 - Axial Segregation in Rotating Drum - Extension of the Basic Axial Diffusion Model

Applied - Wednesday 09 July 2014 11:50 *[For award: PhD]*

Primary author: *ELBASHER AHMED, Elbasher Mohamed (University of Cape Town)*
Co-author: *GOVENDER, Indresan (University of Cape Town)*

In the last two decades, two mechanisms for describing axial segregation in granular mixtures have emerged in the context of binary mixtures. While the transient travelling wave picture has been well established, it lacks the physical connection to the well known friction hypothesis: Granular material composed of different frictional properties diffuse(into axial bands) due to concentration fluctuations in the free surface layer caused by friction-limited mobility. In this paper we present an extension to the frictional mechanism based on free surface flow by extending the axial gradient operator to second order in a binomial expansion. Moreover, we have replaced the idealised Newtonian shear stress with a more realistic Bagnoldian-type that is well known to describe inertially dominated flows like that observed (via Positron Emission Particle Tracking experiments) in the free surface layer. The validity of the new model is illustrated in the successful reproduction of axial segregation and banding, and the subsequent coarsening that is experimentally observed with time evolution.

67 - SO(N) restricted Schur polynomials

Theoretical - Tuesday 08 July 2014 11:30 *[For award: PhD]*

Primary author: *KEMP, Garreth (University of the Witwatersrand)*

Restricted Schur polynomials constitute a basis for the 1/4-BPS sector of N = 4 super Yang-Mills theory with a U(N) gauge group. Using the AdS/CFT correspondence, these operators are interpreted as certain D-brane states in the dual gravity theory in the large N limit. It is interesting to study whether or not restricted Schurs constitute a basis for the 1/4-BPS sector of the theory with SO(N) gauge group. I present evidence that the counting of restricted Schurs matches the number of 1/4-BPS states for SO(N). I further discuss the possibility of the SO(N) restricted Schurs being orthogonal.

69 - Kinematics and stellar populations of dwarf ellipticals in the Fornax cluster.

Astro - Thursday 10 July 2014 15:00 *[For award: PhD]*

Primary author: *MENTZ, Jaco (NWU)*
Co-authors: *LOUBSER, Ilani (NWU); PELETIER, Reynier (Kapteyn Institute, Groningen)*

Despite being the most abundant galaxy type in galaxy clusters, the evolution of dwarf elliptical galaxies (dEs) in clusters is not well understood. Galaxy clusters serve as ideal laboratories to address the fundamental question of how environmental influence governs galaxy evolution. So the question of the origin of low surface brightness early-type dwarfs in clusters is key to determining the role of the environment in the formation of galaxies over cosmic time. Recent spectroscopic observations of dwarf galaxies in the Virgo cluster have shown that at least some of the brighter dEs may be descendants of rotationally supported gas-rich systems. A complete magnitude limited sample of 20 dEs in the Fornax cluster will be studied using dynamical modelling, scaling relations and stellar population analysis. We will study both the rotational support and stellar populations as a function of radius in these dwarf galaxies. We will compare the results of our analysis with recently obtained results for dEs in the Virgo cluster and with simulated models of galaxy evolution in clusters. Our spectroscopic survey will be complemented with ultra-deep surface photometry from the FOCUS survey which aims to provide a deep 5-band photometric survey of Fornax using OmegaCAM at VST, ESO at a simmilar depth as the NGVS survey of Virgo.Important constraints on the evolution and amount of rotational support of dEs in the Fornax cluster may be provided.Preliminary results will be presented.

70 - Laser-selective excitation and polarisation studies of BaF_2: Tm^{3+} single crystals

DPCMM1 - Friday 11 July 2014 11:30

Primary author: *MUJAJI, Marjorie (University of the Witwatersrand)*

Site-selective laser excitation studies of BaF_2:Tm^{3+} single crystals performed at temperatures ranging from 10 K to 75 K are reported. There is a single dominant centre at the dopant concentrations of up to 0.1 mole% used. All the crystal-field energy levels for three multiplets ($^3H_6$, $^3H_4$ and $^3F_2$) of the centre and the fluorescence lifetime of the $^3H_4$ multiplet are presented. From polarisation ratio measurements in <111>-oriented crystals the dominant centre is confirmed to be of C_{3v} symmetry, with the charge-compensation interstitial F^- ion in the next nearest neighbour position to the Tm^{3+} ion. Symmetry labels (irrep labels) have been assigned to the crystal-field energy levels. Vibronic coupling is apparent.

72 - Two Proton Stripping via the 115In(3He,n)117Sb reaction and a GEANT4 simulation of the AFRODITE array at iThemba LABS.

NPRP - Thursday 10 July 2014 11:50 *[For award: MSc]*

Primary author: *LI, Kevin (Stellenbosch University, iThemba Labs)*
Co-authors: *PAPKA, Paul (Stellenbosch University); JONES, Pete (iThemba LABS)*

The AFRODITE array at iThemba Labs, together with the ancillary neutron wall detectors, provide high selectivity in viewing the direct two proton stripping reaction, in particular the 115In(3He,n)117Sb and 16O(3He,n)18Ne reactions. The populated states were identified via the gamma spectra from the CLOVER detectors selected by neutron-γ coincident events. The AFRODITE CLOVER array, together with a catalogue of other detectors such as the TIGRESS and LEPS detectors, have been integrated into the simulation and together are utilised to validate and understand our experimental results.

73 - A new probe to detect multiple turn extraction of a beam bunch from Injector Cyclotron 1 at iThemba LABS.

Applied - Friday 11 July 2014 10:00

Primary author: *DE VILLIERS, John Garrett (iThemba Labs)*
Co-authors: *CONRADIE, J. L. (iThemba Labs); BOTHA, A. H. (iThemba Labs); ANTHONY, L. S. (iThemba Labs); DUCKITT, W. D. (iThemba Labs); BROODRYK, J. I. (iThemba Labs)*

A non-destructive capacitive probe was developed to monitor the bunch length of charged particles from the Injector Cyclotron 1, thereby providing instantaneous information whether the cyclotron is set up for single-turn extraction or not, during an energy change.When tuning the injector cyclotron to produce an ion beam of good quality, it is not a straightforward process to ensure that the extracted beam is mono-energetic. The continuous varying performance of the ion source, together with the spiral-shaped beam path in the cyclotron, governed by a precession state due to inherent and variable asymmetrical field conditions, may result in extracting multiple turns. The extracted beam will then have an unacceptable large energy spread and will result in a low intensity beam of poor quality, also causing unwanted activation of beam line components.Numerical field analysis was performed to simulate a beam bunch of a known length and charge distribution moving past a capacitive probe. The geometry of the probe was iteratively varied until the resulting image from the induced current represented the physical length of the bunch.The fundamental (elementary) principles and techniques used in the study will be discussed and some calculated and measured results will be presented.

75 - Ion beam effects in thin metallic films due to Elastic Recoil Detection Analysis using 26 MeV Cu7+ ions.

DPCMM2 - Tuesday 08 July 2014 15:00

Primary author: *MAVHUNGU, Humbulani (NECSA)*
Co-author: *HLATSHWAYO, Thulani (University of Pretoria)*

Heavy Ion Elastic Recoil Detection (Heavy Ion-ERD) analysis is now an established thin film depth profiling analysis technique. But it is not without artefacts.The main aim of this study is to investigate the effects of the probing beam on the structure (i.e. thickness, atomic composition, crystallinity, roughness) of metallic thin films after Heavy Ion ERD analysis using 26 MeV Cu7+ beams. Heavy Ion ERD analysis was carried out to determine the thickness and the depth profile of ZrN and NbN thin films prepared through RF magnetron sputtering deposition on silicon substrates. The structural characterization of these thin films was carried out before and after Heavy Ion ERD analysis to check for beam effects on the films. Possible beam damage on the surface of these thin films was assessed by various techniques such as; Rutherford Backscattering Spectrometry (RBS) which was used to determine (any) changes in film thickness and composition, Atomic Force Microscopy (AFM) used to obtain the surface roughness and morphology of the thin films and X-ray diffraction (XRD) used to determine the crystallinity and the residual stress. This presentation discusses findings made from the measurement results.

80 - Non Planar Integrability in ABJM

Theoretical - Tuesday 08 July 2014 11:50

Primary authors: *DE MELLO KOCH, Robert (University of the Witwatersrand); KREYFELT, Rocky (University of the Witwatersrand); SMITH, Stephanie (University of the Witwatersrand)*

The ABJM model is an N=6 Chern-Simons theory of bifundamental fields with a U(N)xU(N) gauge group. It is AdS/CFT dual to type IIA string theory on an AdS_4x$\mathbf{CP}^3$ background. In this work we study the anomalous dimensions of gauge invariant ABJM operators in a large N non-planar limit in order to explore integrability in certain sectors of the theory.

81 - Auger electron studies using Monte Carlo simulations of I-123 incorporated into human lymphocytes

NPRP - Thursday 10 July 2014 10:00 *[For award: MSc]*

Primary author: FOURIE, Hein (Stellenbosch University)
Co-authors: NEWMAN, Richard (Stellenbosch University); SLABBERT, Kobus (iThemba Labs); BEUKES, Philip (iThemba Labs)

The study involves the determination and quantification of radiation damage on a cellular level and the replication of this energy deposition using Monte Carlo simulations. The relatively short half-life of I-123 (13.2 hours) makes it ideal for studies of Auger electrons which induce biological damage similar to that of high linear energy transfer radiations, when permitted to deposit their energy in close proximity to DNA. Due to small cellular dimensions, direct dose measurements are impossible. Estimates may be made from Monte Carlo simulations. In this investigation the thymidine analogue 5-[I-123]-iodo-2-deoxyuridine (123IUdR) was used to incorporate I-123 into the cellular DNA of T-lymphocytes. This allows nanometer range Auger electrons to irradiate the DNA. Radiation induced micronuclei were numerated in binucleated cells using fluorescence microscopy. In order to compare the biological damage caused by the radioactive iodine to other radiation modalities, the incorporated I-123 activities (Bq) need to be converted in a dose absorbed (Gy) value. The energy deposition per decay of I-123 was calculated within a spherical geometry, having the same size and density as a human lymphocyte, using the Geant4 Monte Carlo toolkit. The absorbed energy per disintegration was used to convert the incorporated I-123 activity into absorbed dose values. A linear relationship between micronuclei frequency and I-123 activity could be established. The linear dose-response noted for Auger electrons in the study is indicative of the high-LET nature of these particles. Using the linear-quadratic dose-response curve noted for micronuclei frequencies following exposure to graded doses of Co-60 γ-rays obtained from previous experiments, preliminary relative biological efficiency values estimated in this work are in agreement with literature values ranging between 7 and 9 for Chinese hamsters V79 cells exposed to 123IUdR and cell survival compared to that from 250 kVp X-rays.

82 - Synthesis and characterization of mixed-valence $LuFe_2O_{4-\delta}$: Effect of stoichiometry δ

DPCMM2 - Tuesday 08 July 2014 11:10 *[For award: MSc]*

Primary author: PECK, Adli (University of Johannesburg)
Co-authors: SIBANDA, Wisdom Nkosilathi (University of Johannesburg); DIGUET, Gildas (UJ); MARTIN, Christine (ENSICAEN); CARLESCHI, Emanuela (UJ); HEARNE, Giovanni (UJ)

$LuFe_2O_4$ exhibits a unique mixed-valence superstructure arising from charge-ordering (CO) within the lattice. The unit cell consists of a characteristic stacking of bi-layers, in which Fe is configured in a triangular network. This results in charge and spin frustration in the material, with a resulting plenitude of degenerate magnetic-electronic ground states. Furthermore the Fe is coordinated with oxygen in a trigonal bi-pyramidal polyhedron, a rather unusual co-ordination geometry for inorganic compounds. This mixed-valence characteristic within the bi-layers has been claimed to give rise to a dipole moment, i.e., ferroelectric effects arising from the CO. However such claims of electronically driven CO are under dispute [1]. Recent work has also demonstrated remarkable oxygen storage capacities in this compound [2]. Previous studies have indeed shown that the Fe^{2+}/Fe^{3+} ratio and magnetic ordering temperature T_N are influenced by the oxygen stoichiometry [3-4]. We will report our investigations of the effect of oxygen stoichiometry on the CO and magnetic-electronic properties of $LuFe_2O_{4-\delta}$, from a comparison of stoichiometric and oxygen deficient samples. Such samples of $LuFe_2O_{4-\delta}$ of varying oxygen stoichiometry, δ, have been synthesised by solid state reaction as a polycrystalline powder. These have been characterised by x-ray diffraction, ^{57}Fe Mössbauer-effect spectroscopy (MES), SQUID magnetometry and TGA chemical analysis. Using different masses for the overall starting mixture has a radical effect on the purity of the as-synthesised $LuFe_2O_{4-\delta}$ sample. Magnetisation measurements show that T_N is confined to 245-250 K for the synthesised samples, albeit with quite significant differences in the magnetisation-temperature envelopes. Variable cryogenic temperature MES measurements are used to compare the effect of oxygen content on both the CO and magnetic hyperfine structure. [1]. Angst M, Phys. Status Solidi RRL 7, 375 (2013). [2]. Hervieu M et al., Nature Materials 13, 74 (2013). [3]. Yang HX et al., J. Phys. Condens. Matter 24, 435901 (2012). [4]. Wang F et al., J. Appl. Phys. 113, 06 (2013).

84 - A GPU Based Polyhedral Particle DEM Transport Code

Theoretical - Thursday 10 July 2014 11:10 *[For award: PhD]*

Primary author: GOVENDER, Nicolin (CSIR, University of Johannesburg)
Co-authors: KOK, Schalk (University of Pretoria); WILKE, Daniel (University of Pretoria)

Discrete Element (DEM) simulations are useful in a number of engineering disciplines such as mining, agriculture, etc. However the computational cost of discrete methods limits the number and detail of particles that can be simulated in a reasonable time frame without the use of a dedicated CPU cluster. This paper introduces a novel DEM based particle simulation code (BLAZE-DEM) that is capable of simulating millions of particles on a desktop computer utilizing a NVIDIA Kepler Graphical Processor Unit (GPU) via the CUDA programming model. BLAZE-DEM is 4 times faster than any other published code and capable of simulating over 50 million polyhedral particles compared to just 256 thousand by other codes.

85 - Analysis of the temperature models for the evaluation of global solar radiation in the coastal and interior regions of South Africa.

Applied - Friday 11 July 2014 11:10

Primary author: MALUTA, Eric (University of Venda)
Co-authors: SANKARAN, Vaith (University of Venda); MULAUDZI, Sophie (University of Venda); NEMANGWELE, Fhulufhelo (University of Venda)

Solar radiation is a crucial parameter in designing solar power devices, installation of solar technologies systems and studying land surface-processes. These data are usually not available for most areas due to the lack of weather stations especially in developing countries. Estimation of global solar radiation (H) from the daily range of air temperature (ΔT) offers an important alternative in the absence of measured H or sunshine duration because of the wide availability of air temperature data. Hargreaves and Samani developed a temperature based model using maximum (Tmax) and minimum (Tmin) temperature data to estimate the global solar radiation, the model is given as, H=H_0 (k_r $\sqrt{}$ T), where H0 is the extra-terrestrial radiation kr is the empirical coefficient and ΔT = Tmax – Tmin. They further proposed that the kr values differ from coastal and inland regions by 0.19 and 0.16 respectively. In the current study the validation of kr value has been performed for the coastal and interior regions of South Africa. The average yearly mean bias error (MBE) and root mean square error (RMSE) have been calculated for different stations over the period of five years. The results will be discussed in the presentation.

91 - Structural,Electrical and Electronic Properties of Diamond Like Carbon (DLC) and Cabon-Based Materials

DPCMM2 - Tuesday 08 July 2014 10:20 *[For award: MSc]*

Primary author: MBIOMBI, Wilfred (University of the Witwatersrand)
Co-authors: RAY, Sekhar (UNISA); BHEKUMUSA, Mathe (University of the Witwatersrand); WAMWANGI, Daniel (University of the Witwatersrand); ERAMUS, Rudoph (University of the Witwatersrand)

ABSTRACTIn this work, the structural and electronic properties of diverse diamond-like carbon (DLC) also known as hydrogenated amorphous carbon (a-C:H), silicon doped DLC (a-C:H:Si) thin films on (001)Si deposited by plasma enhanced chemical vapour deposition (PECVD) are studied under different applied bias voltages (100V<Vb<600V). Silicon doped with DLC thin films was attained by using tetramethysilane (TMS) as a precursor at different standard centimetre cube per minute (sccm). Nitrogen doping in amorphous carbon (a-C:Nx) thin films was achieved by pulsed laser deposition (PLD) process and studied their different properties. Different nitrogen concentration (at.%) of a-C:Nx thin films were deposited on silicon substrate using nitrogen as a precursor gas. The thicknesses of all thin films were ~150■15 nm controlled and monitored during deposition process. Raman spectroscopy of these thin films was measured by using two different laser excitation wavelengths viz 488 nm and 647 nm respectively. The microstructure and electronic property of these samples were investigated by Raman spectroscopy and the electrical property was studied by current-voltage (I-V) characteristics. Finally, a correlation among the electrical properties, electronic properties and micro-structure properties were established based on their sp3 and sp2 concentration in the thin film structure.

93 - Efficient Quantum Simulation of Markovian Quantum Dynamics of a Qubit

Theoretical - Wednesday 09 July 2014 15:00 *[For award: PhD]*

Primary author: SWEKE, Ryan (UKZN)
Co-authors: PETRUCCIONE, Francesco (UKZN); SINAYSKIY, Ilya (NIThep and University of KwaZulu-Natal)

One of the primary motivations for the development of quantum computation is the possibility of efficiently simulating quantum systems, as originally suggested by Feynmann. The natural first step towards this vision is the simulation of closed quantum systems, undergoing Hamiltonian generated evolution, and over the past two decades consistent progress has been made in this field. However, despite this progress, not until recently has much work focused on computation and simulation within the more general context of open quantum systems. In this presentation we focus on presenting methods for the simulation of arbitrary Markovian quantum dynamics, within the conventional unitary circuit model of quantum computation. In particular, we provide an efficient quantum circuit, consisting only of gates from a specified universal gate set, for the simulation of arbitrary Markovian dynamics of a qubit. In order to motivate the results obtained, all necessary background theory will be reviewed. In particular, emphasis will be placed on presenting key concepts and historical developments within quantum information science, in order to locate the results obtained within the current drive for a universal quantum simulator.

94 - Sound Misconceptions in a Science Centre

Education - Thursday 10 July 2014 11:50 *[For award: PhD]*

Primary author: FISH, Derek (Unizul Science Centre)
Co-authors: ALLIE, Saalih (UCT); ANDERSON, Trevor (Purdue University); PELAEZ, Nancy (Purdue university)

Constructivist theory tells us that students come to our Science Centres with pre-existing ideas of how the world works (often called prior-, naïve- or mis-conceptions). When confronted with conflicting ideas from science they are forced to make a “border crossing” (Aikenhead, 1999) from the familiar territory of their cherished beliefs into the “unknown country” of science. How difficult this crossing is and how comfortable a student feels to remain in this new country depends on many factors both internal and external to the student. The challenge for our Science Centres is to assist students to cross these borders more easily and to remain in their new country without feeling threatened.An example will be given of student prior conceptions with regard to sound and waves: a brief literature survey will outline pre-existent conceptions noted around the world. The 4 level framework of (Grayson et al, 2001) is used to classify these conceptions and modify them in the light of data gathered. Student responses to a questionnaire provide multiple mode (MCQ, written and drawings) feedback into this process. The result is a modified table of local students’ prior conceptions with regard to sound and waves. This is useful resource when designing (and improving) science shows, exhibits and other programme materials in this area.While the specific example of sound and waves will be the focus of this presentation, suggestions will be made of how this resource can be used in other subject areas.

95 - Finite N Quiver Gauge Theory

Theoretical - Tuesday 08 July 2014 14:00

Primary author: *DE MELLO KOCH, Robert (University of the Witwatersrand)*
Co-authors: *NOKWARA, Nkululeko (University of the Witwatersrand); KREYFELT, Rocky (University of the Witwatersrand)*

At finite N the number of restricted Schur polynomials is greater than or equal to the number of generalized restricted Schur polynomials. In this note we study this discrepancy and explain its origin. We conclude that, for quiver gauge theories, in general, the generalized restricted Schur polynomials correctly account for the complete set of finite N constraints and they provide a basis, while the restricted Schur polynomials only account for a subset of the finite N constraints and are thus overcomplete. We identify several situations in which the restricted Schur polynomials do in fact account for the complete set of finite N constraints. In these situations the restricted Schur polynomials and the generalized restricted Schur polynomials both provide good bases for the quiver gauge theory. Finally, we demonstrate situations in which the generalized restricted Schur polynomials reduce to the restricted Schur polynomials.

96 - A study of crack formation and its effective internal surface area using Micro-Focus X-ray Tomography (μX-CT) and Fractal Geometry.

DPCMM2 - Tuesday 08 July 2014 14:00 *[For award: MSc]*

Primary author: *SEAKAMELA, Teffo (University of Johannesburg)*
Co-authors: *DE BEER, Frikkie (NECSA); NOTHNAGEL, Gawie (NECSA); DOYLE, Bryan (University of Johannesburg)*

Micro-Focus X-ray Tomography (μX-CT), as non-destructive analytical technique, has been applied to obtain a virtual three dimensional image (tomogram) of material at a scale as low as 3 ∝m. VGStudioMAX and Image-J analytical software have been applied to extract quantitative information from the tomograms at 2D planes inside the samples where natural crack formation occurred due to stresses being applied to the sample. The nature of crack formation has been investigated on different samples and has been tested against known criteria whether the morphology of the cracks follows a fractal geometry pattern. This study focuses on coal,small and large bricks and smooth concrete and investigated the roughness of cracks within these structures to determine its fractal geometry correlation. It was found that the fracture surfaces of the mentioned samples follow fractal behavior in a wide range of length scale. The concept of fractal geometry and results obtained will be presented.

98 - Examining Radio & Gamma-ray correlation of the blazar PKS1424-418 during its flaring state.

Astro - Wednesday 09 July 2014 11:30 *[For award: MSc]*

Primary author: *VAN ZYL, Pfesesani (HartRAO)*

We carried out a multi-frequency cross-correlation analysis of the blazar PKS 1424-418 with data collected by Fermi-LAT and the HartRAO 26m radio telescope between 2012 September 10th and 2013 September 8th during its flaring state. Using the z-transformed discrete cross-correlation function from Alexander (1997), we examined the data for time lags. Our results confirmed the existence of a significant cross-correlation between the gamma-ray and the radio data, with the radio events being delayed relative to the gamma-ray events.

101 - Impact of the γ-Ray Strength Functions on the 138La and 139La Galactic Production

NPRP - Wednesday 09 July 2014 15:20 *[For award: PhD]*

Primary author: *KHESWA, Bonginkosi (iThemba Labs)*
Co-authors: *WIEDEKING, M (iThemba Labs); KLINTEFJORD, M (University of Oslo); LARSEN, A.C. (iThemba Labs); NYHUS, H.T. (University of Oslo); PAPKA, P (University of Stellenbosch); RENSTRØM, T (University of Oslo); ROSE, S (University of Oslo); SAHIN, E (University of Oslo); SEIM, S (University of Oslo); TORNYI, T (University of Oslo); GORIELY, S (Université Libre de Bruxelles); BELLO, F (University of Oslo); ERIKSEN, T (University of Oslo); GÖRGEN, A (University of Oslo); GIACOPPO, F (University of Oslo); GUTTORMSEN, M (University of Oslo); HAGEN, T.W (University of Oslo); KOEHLER, P.E. (iThemba Labs)*

The odd-odd neutron-deficient 138La is very long-lived but one of the less abundant nuclei in the solar system. It is expected to be one of 35 p-nuclei. Most p-nuclei with A>110 are thought to be produced by photodisintegration from s- and r- process seed nuclei. However, this photodisintegration cannot satisfactorily explain the observed abundance of 138La and more exotic processes such as the electron neutrino capture on 138Ba have been called for to explain its synthesis [1,2]. The neutrino reactions can to some extent explain the observed abundance of 138La but the significance of the photodisintegration process cannot be ruled out due to the limited knowledge and uncertainties of nuclear properties entering the 138La production, such as the nuclear level densities (NLD) and γ-ray strength function (γSF) [2]. These are critical model input parameters for the astrophysical reaction rate calculations. Measurements are necessary to place the nuclear properties on a solid footing in order to make statements regarding the importance of neutrino reactions. In this presentation I will discuss our recently measured NLD and γSF of 138, 139La. These quantities were measured using the 139La(3He, 3Heγ)139La and 139La(3He, αγ)138La reactions with a 38 MeV 3He beam at the Cyclotron Laboratory of the University of Oslo. From particle-γ coincidences, measured using the SiRi array (64 silicon channels from particle telescopes) and CACTUS array (26 NaI detectors), the NLD and γSF were simultaneously extracted. Moreover, I will also discuss 137La(n,γ) and 138La(n,γ) cross sections and astrophysical rates, calculated with the combinatorial plus Hartree-Fock-Bogoliubov model of NLD and using our experimental γSF as input parameters, and address the astrophysical implications. [1] S.E. Woosley et al., Ap. J. 356, 272 (1990).[2] S. Goriely et al., A 375, 35 (2001).

104 - Quantum Networking with Graph States

Theoretical - Wednesday 09 July 2014 14:00

Primary author: *TAME, Mark (University of KwaZulu-Natal)*

Distributed quantum communication and quantum computing offer many new opportunities for quantum information processing. Here networks based on highly nonlocal quantum resources with complex entanglement structures have been proposed for distributing, sharing and processing quantum information. Graph states in particular have emerged as powerful resources for such tasks using measurement-based techniques [1]. I will present recent experimental and theoretical work that uses photonic graph states for quantum networking tasks, including quantum secret sharing and robust-to-loss quantum communication. I will show that graph states are a promising approach for sophisticated multi-layered and loss-tolerant protocols in quantum optical networks.[1] B. A. Bell et al., Nature Communications, in press (2014).

107 - Excel IF functions as marking rubrics for assessing physics practicals

Education - Tuesday 08 July 2014 11:10

Primary author: *OELOFSE, Jan (University of Johannesburg)*
Co-authors: *NAIR, Padmanabhan (University of Johannesburg); REDDY, Leelakrishna (University of Johannesburg)*

Close to 1500 undergraduate students are doing various physics practicals per semester in our laboratories at the Doornfontein Campus of the University of Johannesburg. To assess the students' analysis of experimental data (calculations, graphs, etc.) on a weekly basis for such a large group is extremely time consuming. Therefore it became necessary to design an Excel Rubric Marking Scheme (ERMS). This rubric is programmed to award marks based on the student's knowledge of the particular practical topic and calculation skills. Excel IF functions are used very effectively in the rubric spreadsheet programme to provide a very reliable and consistent assessment tool to evaluate student's answers and results.

108 - The development of a general purpose Processing Unit for the upgraded electronics of the ATLAS detector Tile Calorimeter

NPRP - Tuesday 08 July 2014 14:00 *[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 Tile Calorimeter will increase by 200 times to over 40 Tb/s! ARM processors are common in mobile devices due to their low cost, low energy consumption and high performance. It is proposed that a cost-effective, high data throughput Processing Unit (PU) can be developed by using several consumer ARM processors in a cluster configuration to allow aggregated processing performance and data throughput while maintaining minimal software design difficulty for the end-user. This PU could be used for a variety of high-level functions on the high-throughput raw data such as spectral analysis and histograms to detect possible issues in the detector at a low level. High-throughput I/O interfaces are not typical in consumer ARM System on Chips but high data throughput capabilities of greater than 20 Gb/s per PU is feasible via the novel use of PCI-Express as the I/O interface to the ARM processors. An overview of the PU is given and the results for performance and throughput testing of Freescale Semiconductor i.MX6 quad-core ARM Cortex-A9 processors are presented.

109 - Ionospheric Tomography over South Africa: comparison of MIDAS, ionosondes and GPS measurements

Space - Tuesday 08 July 2014 11:30 *[For award: MSc]*

Primary author: *GIDAY, Nigussie Mezgebe (SANSA)*
Co-authors: *KATAMZI, Zama Thobeka (SANSA); MCKINNELL, Lee-Anne (SANSA)*

This paper aims to show the results of an ionospheric tomography algorithm called Multi-Instrument Data Analysis (MIDAS) system over the South African region.Recorded data from a network of around 53 Global Positioning System (GPS) receivers over the South African region was used as input for the inversion. The inversion was made for a few randomly selected days (12 April (autumn), 12 July (winter), 12 October (spring) and 12 December (summer)) representing different seasons of the year 2012. MIDAS reconstructions were validated by comparing NmF2 values predicted by MIDAS to those calculated from the four South African ionosonde stations. Good agreement was found between the two measurements with minimum and maximum root mean squareerrors (rmse) of 0.88 and 1.92 units respectively, and minimum and maximum coefficients of determination (r2) of 0.90 and 0.96 respectively. Also, MIDAS reconstruction had greatest accuracy during the winter and summer months compared to the other seasons.

110 - Computational Study on Advanced Lithium – Sulphur Battery

DPCMM2 - Tuesday 08 July 2014 11:30 *[For award: MSc]*

Primary author: MASEDI, Cliffton (UL and CSIR)
Co-author: SITHOLE, Happy (CHPC)

Energy storage will be more important in the future than at any time in the past. Among the myriad energy-storage technologies, lithium batteries will play an increasingly important role because of their high specific energy and energy density.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. The energy that can be stored in Li–S cells is compared with Li-ion; the operation of the cells is discussed, as are the significant hurdles that will have to be overcome if such batteries are to succeed. Fundamental scientific advances in understanding the reactions occurring in the cells as well as new materials are key to overcoming these obstacles. In the current work we present a comparative study on stability, structural and electronic properties of discharge products formed in Li-S battery, using planewave pseudopotential methods. Structural parameters for the suggested materials were calculated and compare well with experimental results. The elastic constant of all the discharge products Li< sub >2< /sub >S and Li< sub >2< /sub >S< sub >2< /sub > formed in Li-S battery accord reasonably with experimental results, and the corresponding stability conditions are satisfied. Furthermore, the lattice dynamics of the products were calculated. The phonon dispersions also suggested that the structures are stable agree well with experimental studies using from neutron scattering experiments.

115 - Effect of annealing on the photoluminescence characteristics of solution grown ZnO nanorods array

Photonics - Tuesday 08 July 2014 10:00 *[For award: MSc]*

Primary author: MBULANGA, Crispin (Nelson Mandela Metropolitan University)
Co-authors: BOTHA, Reinhardt (NMMU); URGESSA, Zelalem (NMMU); TANKIO DJIOKAP, Stive Roussele (NMMU)

AbstractThe effect of annealing in oxygen and nitrogen on the luminescent properties of ZnO nanorods grown by Chemical Bath Deposition (CBD) has been studied. Special emphasis was given to the visible part of the spectrum. X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) analysis reveal that the as-grown nanorods are well aligned, have good crystalline quality and are orientated along the c-axis. The photoluminescence (PL) spectra of the as-grown ZnO nanorods show strong near band edge (NBE) excitonic emission and weak visible deep-level emission (DLE), which indicate good optical properties and very few structural defects. However, after a sequential annealing of the nanorods in oxygen and nitrogen, the PL spectra reveal DLE that extends into the near infrared (out to ~950 nm). The analysed XRD spectrum shows only the [0002] reflection, which indicates a preferred orientation of the nanorods with the c-axis perpendicular to the substrate. The SEM image confirms this. Based on annealing studies in different environments and annealing temperatures (from 200 to 800 C), three possible DLE transition lines are deduced. More details on the effects of annealing on the photoluminescence characteristics of solution grown ZnO nanorod arrays on the DLE will be discussed.

122 - Selecting high-order modes in solid state laser resonators

Photonics - Wednesday 09 July 2014 11:10 *[For award: MSc]*

Primary author: IHEANETU, Kelachukwu (University of Fort Hare)
Co-authors: FORBES, Andrew (CSIR); MAKAKA, Golden (University of Fort Hare); NGCOBO, Sandile (CSIR)

In resent times Laguerre-Gaussian (LG) laser beam generation has gained a lot of interest from the community because of its numerous applications. In this project we experimentally demonstrate intra-cavity generation of Laguerre-Gaussian modes of radial orders 0 – 3. The technique of using intra-cavity amplitude mask made up of absorbing rings in not new but our approach will employ the use of intra-cavity spatial light modulator (SLM) as a mode selecting element. Our goal is to select pure higher-order LG modes using intra-cavity phase and amplitude techniques, and to consider the mode purity and laser efficiency. We demonstrate that the modes are of high purity and since the mode volume is proportional to the modal order more power extraction from the cavity. Our results show a path to high brightness laser.

126 - Electrostatic supersolitons in plasmas

Space - Tuesday 08 July 2014 15:00

Primary author: HELLBERG, Manfred (UKZN)

In 2012 the term “supersoliton” was coined to describe nonlinear electrostatic solitary waves whose electric field signatures exhibited “wiggles” superimposed on the usual bipolar structures found for solitons.In fact, these structures had been found earlier by us, but not identified in terms of the electric field. Instead, they had been recognised as solitons whose speed exceeded that at which a double layer occurred, the latter speed having previously been regarded as an upper limit on soliton speed. Considering a number of plasma models relevant to space physics, Sagdeev pseudopotential theory will be used to discuss the characteristics of supersolitons and how they relate to conventional solitons and double layers, as well as their existence domains in an appropriate parameter space. Attention will also be drawn to their possibly having been observed in satellite experiments.

129 - Collider Black-Holes: Preliminary Results and Outlook

Theoretical - Thursday 10 July 2014 15:20

Primary author: CARLSON, Warren (University of the Witwatersrand)

Modern particle colliders make possible the production and detection of exotic collision events events as postulated by extra-dimensional models. This presentation will contain preliminary results of Monte-Carlo generated black-hole decay events, and aspects of current theoretical work on black-hole decay signatures with the inclusion of supersymmetric particles and effects

130 - The Excitation of Pulsation Modes in Rapidly Rotating Main Sequence B-Stars

Astro - Tuesday 08 July 2014 14:20 *[For award: PhD]*

Primary author: VAN HEERDEN, Pierre (University of Johannesburg/SAAO)
Co-authors: ENGELBRECHT, Christian (University of Johannesburg); MARTINEZ, Peter (SAAO)

All stars rotate - some quite rapidly, others quite slowly - which causes a breakdown in the spherical symmetry of stars, which (in turn) complicates and reduces the accuracy of stellar models, seeing as most stellar models in use today rely on the assumption of spherical symmetry to simplify the analysis to a manageable level. Stellar rotation also gives rise to various fluid dynamical phenomena, which result in large uncertainties in the rates of stellar evolution and physical stellar parameters in general. Treating rotation consistently in stellar models is unfortunately very difficult and has (until recently) been mostly neglected in studies of the structure and evolution of stars. Good accounts of the scientific problem appear in Maeder and Meynet ("The Evolution of Rotating Stars", ARA 38, 143-190, 2000) and in Zahn ("Effects of rotation on stellar structure: rotation induced mixing", Communications in Asteroseismology 157, 196-202, 2008).An intensive observational study of the internal rotation dynamics of stars can therefore provide a wealth of information to support further theoretical work. Asteroseismology is a unique tool for probing stellar interiors - in this context to determine the internal rotation dynamics of stars using the pulsations that are excited deep within the stellar interior. The Beta Cephei class of pulsating stars are ideal for such a study, since they typically exhibit multiple non-spherical pulsation modes.For the purpose of this study, twelve candidate stars were selected from the list of Beta Cephei pulsating stars that were identified from the All Sky Automated Survey catalog (Pigulski & Pojmanski, personal communication). The candidates have been observed intensively since April 2013 (both photometrically and spectroscopically). Preliminary analysis has yielded some interesting results for individual stars.The presentation will cover a basic summary of the current state of theoretical and observational work regarding stellar structure and evolution and the Beta Cephei class of pulsating stars. The core of the presentation will address the observational work done as part of this project, the data reduction and analysis methods developed in order to efficiently process the large quantities of data collected and the preliminary results produced as part of this project.

131 - The Alan Cousins Telescope - A Multi-Purpose Automatic and Remote Access Telescope

Applied - Wednesday 09 July 2014 15:20 *[For award: PhD]*

Primary author: VAN HEERDEN, Pierre (University of Johannesburg/SAAO)
Co-authors: MARTINEZ, Peter (SAAO); ENGELBRECHT, Christian (University of Johannesburg)

The Alan Cousins Telescope is a 0.75-m telescope at the Sutherland site of the South African Astronomical Observatory station in Sutherland intended for multi-purpose automatic and remote access observing. A failure of the control systems nearly 10 years ago prompted a complete upgrade of the telescope's control systems and related hardware and software. For the last 3 years, intensive work has been done in order to develop the software counterpart for the new control systems and to bring the telescope system (the telescope itself, the science instrument and all supporting hardware and software) to a point where it is ready for regular use.Many factors needed to be considered while developing the control software - including efficient automatic operation, easy access for remote observers, safe operation during all observing modes and any environmental conditions and maximising the amount of science that can be done with the telescope. The new control software for the ACT neatly exemplifies how these ideals can be achieved by employing modern and novel software design and implementation principles.Most of the recent work on the ACT has been concerned with commissioning the telescope system. Some of the major challenges included charecterising and correcting for the pointing and tracking errors in the telescope mount and performing the photometric calibration of the science instrument.The presentation will focus on the recent developments regarding the control software and the rationale behind these changes, the commissioning of the telescope system and potential future upgrades to the telescope system.

132 - First year university physics students’ perceptions of the teaching-learning environment: In search of a coherent pedagogic learning orientation

Education - Tuesday 08 July 2014 14:20

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

Classroom inquiry and reflective activities are central to the improvement of the effectiveness of teaching practices. To this end, the investigation of aspects of teaching and learning in various educational settings is of paramount significance in order to provide insightful elucidation into the nature of teaching-learning environments. As part of this inquiry, the Experiences of Teaching and Learning Questionnaire was administered to first year university physics students at the University of Johannesburg in a bid to unearth their perceptions of the teaching-learning environment using the Teaching and Learning Research Programme’s framework for analysis as the underlying conceptual framework. The Experiences of Teaching and Learning Questionnaire has been produced under the auspices of the Enhancing Teaching-Learning Environments in Undergraduate Courses Project in the United Kingdom. Critical interrogation of responses provided valuable insights into students’ perceived nature of the teaching-learning environment forming an integral part of their academic training. In particular, students’ pedagogic learning orientation appeared to hinge on the approaches they use as well as the extent to which they are well-organised in their study methods, use their time efficiently, and put concentrated effort into their work.

133 - Lesson planning practices of South African Physical Sciences teachers in a new curriculum

Education - Wednesday 09 July 2014 14:20

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

This paper reports findings on the perceptions of South African Physical Sciences teachers on lesson planning. Significant changes to the school science curriculum require that teachers revisit how they plan lessons. We adopted a mixed method approach in collecting and analysing data from a large-scale survey of teachers through a structured questionnaire, and followed this with interviews with 10 teachers in seeking more in-depth explanations of the findings which emerged from the survey. The study revealed that when feasible, teachers work collaboratively in a community of practice when planning lessons. Apart from reducing the planning time, this strategy also leads to creative and innovative ideas that are shared. This is especially the case when teaching topics that are new in the curriculum and also lessons that are inquiry-based. Teachers also believe that writing a lesson plan does have pedagogical value because it serves as a support mechanism in planning deliberately for difficulties they encounter in addressing curriculum implementation challenges. The lesson plan therefore supports teachers in their role as reflective practitioners.

135 - Optical and Electrical properties of solution-grown ZnO nanorods on Si

Photonics - Tuesday 08 July 2014 10:20 *[For award: PhD]*

Primary author: *TANKIO DJIOKAP, Stive Roussel (NMMU)*
Co-authors: *URGESSA, Zelalem (NMMU); MBULANGA, Crispin (NMMU); BOTHA, Reinhardt (NMMU)*

ZnO nanorods have been synthesized on moderately doped (p) and heavily doped (p^+) silicon by a two-step chemical bath deposition process. Current-voltage (I-V) measurements reveal that the electrical behaviour of the heterojunction depends on the dopant density of the silicon. Although post growth annealing improves the photoluminescent properties, the best electrical properties (I-V) are obtained for the as-grown sample. Indeed, the I-V characteristics of the sample grown on p^+ substrate clearly show ohmic behaviour. In contrast the sample grown on (p) substrate is rectifying. Rectification ratios (± 3 V) of ~ 280 and ~30 were measured for the as-grown and annealed (300°C) samples, respectively, indicating that annealing negatively affected the electrical properties of the junction. The effect of dopant density and annealing temperature on the optical and electrical properties of the heterojunction is discussed in detail.

136 - MeerLICHT: Exploration of real-time commensal observing

Astro - Tuesday 08 July 2014 14:40

Primary author: *WOUDT, Patrick (University of Cape Town)*
Co-authors: *GROOT, Paul (Radboud University Nijmegen (NL)); FENDER, Rob (Oxford University (UK)); MCBRIDE, Vanessa (University of Cape Town & SAAO)*

The MeerKAT radio telescope array has enabled commensal access to data obtained during science operations of the MeerKAT Large Survey Projects (LSP). This will open a tremendous window on the transient radio sky, especially when tracking transient events in real-time. To fully explore this new paradigm of real-time commensal observing, the ThunderKAT LSP will construct a small optical telescope (MeerLICHT, to be housed in Sutherland) which will always observe the MeerKAT sky, at the same time and with the same field of view. MeerLICHT in combination with MeerKAT/ThunderKAT is optimised to study astrophysical transients over a range of time scales in the radio and optical. In this talk I will outline the science of ThunderKAT and MeerLICHT, the time scale of both projects and highlight some of the early milestones.

137 - The polar thermospheric neutral density long-term trend using incoherent scatter radar data

Space - Wednesday 09 July 2014 11:10

Primary author: *KOSCH, Michael (SANSA)*
Co-authors: *VICKERS, Hannah (University of Tromso, Norway); OGAWA, Yasunobu (National Institute of Polar Research, Japan)*

We exploit a new technique to estimate the thermospheric neutral density at ~350 km using measurements of ionospheric plasma density, temperature and velocity by incoherent scatter radar. The passive version of the technique is applied to a 13-year long data set from the EISCAT Svalbard Radar. We show that the thermospheric density in the polar cap is decreasing, consistent with satellite drag estimates at lower latitudes as well as climate change. The active version of the technique requires the EISCAT ionospheric modification facility to artificially induce ion up-flow by heating the electrons with high power radio waves. Here we show that ion up-flow is consistent with the plasma pressure gradient. At altitudes above ~400 km, where neutral composition is not always pure atomic oxygen, problems with the technique are discussed. Here we estimate the electric field strength due to anomalous resitivity.

141 - Improving the laser brightness of a commercial laser system

Applied - Wednesday 09 July 2014 14:00 *[For award: PhD]*

Primary author: *NAIDOO, Darryl (CSIR)*
Co-authors: *LITVIN, Igor (CSIR); FORBES, Andrew (CSIR)*

We explore a beam shaping approach inside a laser cavity 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 laser cavity through the use of two spatial light modulators (SLMs), where the first SLM is used to transform a Gaussian beam 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 distributions and we show that we increase the energy extraction while maintaining a beam quality that is comparable to our predictions.

142 - Breaking the intra-cavity degeneracy of vortex modes

Photonics - Wednesday 09 July 2014 11:50 *[For award: PhD]*

Primary author: *NAIDOO, Darryl (CSIR)*
Co-authors: *DUDLEY, Angela (CSIR); LITVIN, Igor (CSIR); FORBES, Andrew (CSIR)*

We investigate an intra-cavity approach for the realisation of arbitrary orbital angular momentum (OAM) mode selection of opposite handedness by implementing a technique of spin angular momentum (SAM) to OAM coupling through a q-plate. It is well known that the spatial intensity distribution of laser modes with opposite handedness (such as +l and -l) in their helicoidal wavefronts are indistinguishable and in the context of a laser cavity they also posses identical intra-cavity losses. The discrimination of either mode thus proves improbable and is accredited to the degeneracy of this set of angular modes. While many studies claim pure OAM mode selection, they suffer from inconclusive confirmation on the state of OAM at the output. In this study we show the controlled intra-cavity selection of pure OAM LG0l modes of opposite handedness and demonstrate it experimentally. With this we also present a direct approach to realise LG0l modes of radial and azimuthal polarisation states, respectively.

143 - Propagation of vortex modes through fibres

Photonics - Thursday 10 July 2014 15:00 *[For award: PhD]*

Primary author: *MCLAREN, Melanie (CSIR)*
Co-authors: *BRUENING, Robert (Friderich Shiller University, Jena); ZHANG, Yingwen (CSIR); FORBES, Andrew (CSIR)*

Spatial light modes that carry orbital angular momentum (OAM) have become popular within a range of optical fields; optical tweezing, microscopy, atom manipulation and quantum entanglement. These OAM modes span an infinite dimensional Hilbert space, offering an increase in the information capacity per photon for quantum communication. This obvious advantage over the 2-dimensional polarisation states is countered by the poor propagation of OAM modes through turbulent media such as the atmosphere. We therefore seek an alternative mode of propagation in the form of optical fibres. Multimode fibres suffer from strong intermodal coupling, which typically destroy the fragile quantum correlations carried by the spatially entangled state. We use classical back-projection as an experimental tool to study the effect of fibre transport on OAM modes. We show that our fibre system has the potential to transport high-dimensional entangled states.

145 - Azimuthal spectrum after parametric down-convertion with radial degrees of freedom

Photonics - Thursday 10 July 2014 14:40

Primary author: *ZHANG, Yingwen (CSIR)*
Co-authors: *ROUX, Filippus (CSIR); MCLAREN, Melanie (CSIR); FORBES, Andrew (CSIR)*

We investigated, theoretically and experimentally the radial degrees of freedom of the bi-photon states that are produced in spontaneous parametric down-conversion (SPDC) in the Laguerre-Gaussian (LG) basis. Theoretically we calculated the azimuthal Schmidt numbers for a range of radial indices combinations of the signal and idler beams and found that a larger azimuthal Schmidt number is obtained for higher radial indices. Moreover, larger azimuthal Schmidt numbers are also obtained when the difference between the two radial indices increases. Comparing these theoretical predictions with the azimuthal Schmidt numbers obtained from experimentally measurements, we found good agreement. Experimentally, we demonstrated that by using LG modes with slightly larger radial indices, it is possible to obtain a 3-fold increase in the azimuthal Schmidt number while maintaining a reasonable coincidence count rate by using.

147 - Ion dose effect on sound velocity in ion-implanted CVD diamond studied using surface Brillouin scattering

DPCMM1 - Wednesday 09 July 2014 15:00

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

Elastic, surface waves occurring in an ion-damaged region of diamond were studied using surface Brillouin scattering (SBS). By observing the Rayleigh-like mode of pure diamond, ion implanted diamonds to doses of 1×1016 ions/cm2 and 1.5×1016 ions/cm2 we noted that pristine diamond has the highest surface wave velocity of ≈12500 m/s, while the heavily implanted diamond has the lowest velocity of ≈12300 m/s. Elastodynamic Green's functions simulation played an important role in predicting and confirming the spectra observed experimentally. This work has shown that a necessary condition for observing Brillouin spectrum is optically smooth surfaces even in transparent media. It has also been observed that the optical flatness of the surface, front and back plays a vital role in surface Brillouin scattering measurements.

148 - Josephson Junctions under external radiation: Devil's Staircases and Continued Fractions

Theoretical - Friday 11 July 2014 11:50

Primary author: SHUKRINOV, Yury (JINR, Dubna)
Co-authors: MEDVEDEVA, Svetlana (JINR, Dubna); BOTHA, Andre (Unisa); KOLAHCHI, Mohammad (IASBS, Zanjan, Iran); IRIE, Akinobu (Utsunomiya University, Japan)

Josephson junctions are regarded as excellent model systems for studying a variety of nonlinear phenomena in different fields of science such as frequency locking, chaos, charge density waves, transport in superconducting nanowires, interference phenomena and others. These phenomena, and especially properties of the Shapiro steps in Josephson junctions are very important for technical applications. In a Josephson system driven by an external microwave radiation, the so-called devil's staircase (DS) structure has been predicted as a consequence of the interplay of the Josephson plasma frequency, and the applied frequency. To stress the universality in the scenario presented, we note that the devil's staircase appears in other systems including the infinite spin chains with long-range interactions, frustrated quasi-two-dimensional spin-dimer system in magnetic fields, systems of strongly interacting Rydberg atoms, and fractional quantum Hall effect.Our detailed numerical simulations of the IV-characteristics of a Josephson junction under external electromagnetic radiation show the devil's staircase within different bias current interval [1]. We have found that the observed steps form very precisely continued fractions. Increasing of the amplitude of radiation shifts the devil's staircase to higher Shapiro steps. The algorithm of appearing and detection of the subharmonics with increasing radiation amplitude is proposed. We demonstrate that subharmonic steps registered in the many different experiments also form continued fractions.[1] Yu. M. Shukrinov, S. Yu. Medvedeva, A. E. Botha, M. R. Kolahchi, and A. Irie. Devil's Staircases and Continued Fractions in the Josephson Junctions, - Phys. Rev. B, 88, 214515 (2013).

149 - Simulating spontaneous parametric down-conversion using classical light

Photonics - Thursday 10 July 2014 14:20

Primary author: ZHANG, Yingwen (CSIR)
Co-authors: MCLAREN, Melanie (CSIR); ROUX, Filippus (CSIR); FORBES, Andrew (CSIR)

Entangled photon pairs can be readily produced through spontaneous parametric down-conversion (SPDC). However such a system can be very difficult to setup due to the low photon count rates. We present a simple method of simulating the effect of the pumping process in SPDC by modulating a classical laser beam with two spatial light modulators (SLM) through a back projection setup. We simulate a large range of pump beams for quantum state engineering and confirm that the results are in agreement with theory. Our approach offers high photon count rates, is quick to yield results and can easily be converted back to a SPDC setup. It is likely to be a useful tool before starting more complicated SPDC experiments with custom pump profiles.

150 - Quantum Optics: Do we need single photons?

Education - Thursday 10 July 2014 10:00 *[For award: PhD]*

Primary author: MCLAREN, Melanie (CSIR)
Co-author: FORBES, Andrew (CSIR)

An experimental measurement of quantum entanglement requires three crucial components: a non-linear crystal to generate entangled photons, avalanche photo-diodes to detect the single photons and a coincidence counter to measure the arrival of a photon pair. These components are not commonly found in an average South African optics laboratory and together with the presumed complexity of quantum theory, the undergraduate experiment course has become quantum-free. Internationally, however, quantum optics labs are receiving ever increasing attention as ground-breaking experiments, such as quantum teleportation, quantum key distribution protocols and quantum computing, are continually being realised. We can prevent ourselves from falling further behind in these technologies, but the solution is not additional funding, the solution is classical light. We show that using simple geometrical optics, the two-photon quantum correlations can be predicted using classical light. This means complex quantum experiments such as quantum ghost imaging can be simulated with only a diode laser, general optical components and a detector.

151 - Molecular dynamics simulation of TiO_2 nanoparticles using DFTB+ code

DPCMM2 - Tuesday 08 July 2014 11:50 *[For award: MSc]*

Primary author: GANDAMIPFA, Mulatedzi (University of Limpopo)
Co-author: NGOEPE, Phuti (University of Limpopo)

Titanium nanoparticles, which are anticipated to a wide range of batteries industries, have been shown to exhibit enhanced properties compared to their bulk counterparts. This enhancement has mostly been attributed to their large surface area-to-volume ratio and has attracted enormous research interest in recent years. In this work, molecular dynamics simulations have been performed on anatase TiO_2 nanoparticles at different temperatures using DFTB+ code. Thermodynamic and structural properties such as total system energies and radial distribution functions are reported for the different nanoparticle sizes. At high temperatures, the structures are seen to transform from a highly crystalline to liquid form. Studies conducted on the change of final structure (after simulation) with respect to the initial structure (before simulation) revealed that after simulation, structural disordering (i.e., change in atom position) is more visible at the surface layer compared to the bulk of the final structure.

152 - Vacuum ultraviolet spectroscopy of calcium fluoride crystals

Photonics - Wednesday 09 July 2014 14:40 *[For award: MSc]*

Primary author: MATINDI, Tresor (University of Stellenbosch)
Co-authors: STEENKAMP, Christine (University of Stellenbosch); ROHWER, Erich (University of Stellenbosch); STAFAST, Herbert (Leibniz-Institute of Photonic Technology)

In this project experimental setups and techniques for measuring the absorption and excitation spectra of pure and lead (Pb) doped calcium fluoride (CaF_2) crystal samples in the vacuum ultraviolet (VUV) spectral range are developed. This study is conducted using tuneable vacuum ultraviolet (VUV) laser light with a narrow spectral bandwidth generated by a 3rd order nonlinear optical process. This is the first spectroscopic study of an alkaline fluoride using tuneable VUV laser radiation and therefore of strategic importance. This spectroscopic study should yield a more complete spectral characterization of the doped and pure CaF_2 which will contribute to the understanding of the different types of defects, their energy levels and formation mechanisms. As first step absorption measurements over the spectral range 115-180 nm have been obtain using a vacuum scanning (McPherson model 225) with a deuterium lamp (McPherson model 632). Our results show that total absorption of the VUV light by CaF_2 can be observed in 115-126 nm range. The observed absorption features in the 126-180 nm range vary in different samples and correlate with information from the supplier. In addition, the effect of vacuum and gas purged conditions and the stray light background in the monochromator have been determined.

153 - Single top channel analysis in association with higgs production at ATLAS: a feasibility study

NPRP - Tuesday 08 July 2014 15:00 *[For award: MSc]*

Primary author: ANTEL, Claire (University of Cape Town)

The Standard Model (SM) is our best current understanding of the nature of matter and energy. It explains almost every fundamental physical phenomenon, but not all. This motivated the construction of The Large Hadron Collider (LHC), the world's highest energy particle collider, atthe European Centre for Nuclear Research (CERN) in Geneva, Switzerland. ATLAS and CMS are two large general-purpose detectors at the LHC. One of their most important goals was the discovery of the elusive Higgs boson, the missing particle predicted by the Standard Model. This was concurrently achieved and announced in July 2012. What has now become a priority is the measurement of the Higgs boson properties to find possible deviations from what is predicted by the Standard model. The most massive of all observed elementary particles is the top quark. High energies are thus needed to create it. The high energy proton-proton collisions at the LHC have for the first time lead to a large production of top quarks, allowing analyses of its properties. Its presence at high energies means it is also a good probe for physics beyond the Standard Model.The top Yukawa coupling is a Higgs property of which the measurement, although consistent with SM so far, is not yet precise enough to exclude non-SM values [ATLAS-CONF-2013-034, CMS-HIG-12-028]. The single top production in association with a Higgs boson affords a unique opportunity to study the relative sign of the top Yukawa coupling constant: There exists an almost completely destructive interference between the Higgs-to-W and the Higgs-to-top coupling. This leads to an enhancement in the cross-section in the Wb → tH process if the couplings to the W boson and the top are opposite in sign [JHEP, 1305:022, 2013]. The dominant Higgs decay is the bbbar channel. Looking at the tHj → Wb + bb +j and W → lv process, gives a signature of 1 lepton + 3 b-jets + 1 forward jet + missing transverse energy. Monte Carlo samples where the vector boson and fermion coupling scale factors are set, respectively, to cV=1 and cF = 1 (SM value) or cF= -1 (non-SM value with a cross-section that is a magnitude greater compared to SM) are compared to background. It is investigated whether the signal could reach a high enough significance value to be feasibly detected in real data from the ~21fb-1 integrated luminosity of the LHC 8 TeV run.

154 - DC Circuits: Context dependency of students' responses

Education - Tuesday 08 July 2014 11:30

Primary author: JOHN, Ignatius (UCT & CPUT)
Co-author: ALLIE, Saalih (UCT)

We probe the effect on student responses when fine grained contextual changes are made to questions in the area of simple DC circuits. The instrument developed for the study comprised a series of questions based on an open circuit showing a battery, a wire and a single resistive element. Variations in presentation included the following: (a) three circuit elements were interchanged with each other (resistor, light bulb and a heating element), (b) the orientation of the circuit was rotated between vertical and horizontal and (c) small changes were made to the words describing current. Each question was presented as a situation involving a discussion among a group of students who are posited to be discussing issues relating to the particular circuit in question. A number of different points of view are articulated by the students and offered as options for which (a) a particular choice has to be made and (b) the reason for the choice has to be provided in detail. We (a) summarise the results obtained (detailed in previous SAIP talks) showing the high level of sensitivity to the contextual changes and (b) focus on recent results obtained from follow-up interviews that show how features presented in the questions trigger ideas that make sense in the everyday world but can end up causing students to appear as if they have "misconceptions" relative to the canonical physics world. The negative implications of using light bulbs to introduce circuits or to probe student conceptions of DC circuits are discussed in the light of these findings.

160 - Fourier Plane Modeling and Jet Physics in the Galaxy M81

Space - Wednesday 09 July 2014 15:00 *[For award: MSc]*

Primary author: RAMESSUR, Arvind *(UNISA/HartRAO)*
Co-authors: *LEEUW, Lerothodi (UNISA); BIETENHOLZ, Micheal (HartRAO)*

In the majority of Active Galactic Nuclei (AGNs) that can be resolved with Very Long Baseline Interferometry (VLBI), the jet is brighter on one side and often shows curvature. However, there are many AGNs which are only marginally resolved, such as the low-luminosity AGN (LLAGN) in Galaxy M81, for which it is difficult to reliably extract the basic parameters of the jet such as its length, orientation and degree of bending. To extract jet parameters in such sources, we developed an asymmetric Fourier-plane model which is more appropriate than the typically used symmetric Gaussian models. This model is used to fit the VLBI data for the LLAGN in M81 directly in the u-v plane for our extensive high resolution data set (5.0GHz and 8.4GHz) over the period from 1993 to 2003. This Fourier Modeling technique allows us to dig out information at the resolution limit, providing a comprehensive picture of the structure and a systematic evolution of the jet coupled to changes in the overall flux density at the different frequencies.

161 - Computer Assisted Proof of the Global Existence of Periodic Orbits in the Rössler System

Theoretical - Thursday 10 July 2014 11:50

Primary author: BOTHA, André *(UNISA)*
Co-author: *DEDNAM, Wynand (UNISA)*

A recently developed numerical method [1] is employed to study the existence of periodic orbits in the well-known Rössler syste m [2]. This system was originally conceived as a simple prototype for studying chaos and it continues to provide new insights into chaotic and other nonlinear phenomena. To within the uncertainty of the numerical method, it is found that the three (real) parameters of the Rössler system can always be chosen so that there exists *at least* one periodic orbit through *any* point in the space $\mathbf{R}^3$-{z=0}. After a discussion of the result it is concluded that the construction of its analytical proof poses an interesting challenge to theoreticians in the field of nonlinear dynamics. A Python implementation of the numerical method for finding the periodic orbits is provided as an Appendix.[1] Dednam W and Botha A E 2014 Communicated to Engineering with Computers[2] Rössler O E 1976 Phys. Lett. A **57** 397

162 - Pressure induced charge order collapse in Fe_2OBO_3

DPCMM1 - Tuesday 08 July 2014 10:00 *[For award: PhD]*

Primary author: SIBANDA, Wisdom Nkosilathi *(University of Johannesburg)*
Co-authors: *CARLESCHI, Emanuela (University of Johannesburg); DIGUET, Gildas (University of Johannesburg); PISCHEDDA, Vittoria (University of Lyon); ATTFIELD, John Paul (University of Edinburg); HEARNE, Giovanni R (University of Johannebsurg)*

Charge order (CO) refers to the spatial localization of charge carriers on lattice sites with a certain periodicity, resulting in a mixed-valence superstructure within the crystal lattice [1, 2]. Recent work has found evidence of a superstructure in Fe_2OBO_3, with Fe^{2+} and Fe^{3+} valence states close to integer values [3]. This makes Fe_2OBO_3 the archetypal ionic CO compound. In this study the effect of pressure on the magneto-electronic and structural properties of Fe_2OBO_3 have been investigated by ^{57}Fe Mössbauer spectroscopy (MS) and synchrotron x-ray diffraction (XRD) at room temperature [4, 5]. CO is drastically altered at about 11 GPa with a concomitant electron hopping relaxation, Fe^{2+}<-> Fe^{3+}, as evidenced by MS. Above 16 GPa, the CO has completely 'melted' and electron hopping between distinct Fe sites is dominant. Temperature dependent resistivity measurements up to 22 GPa demonstrate that the electronic structure remains gapped up to this pressure [4]. Analysis of the in-situ XRD data indicates that the ambient pressure $P2_1/c$ monoclinic crystal structure gradually transforms into the high pressure (HP) *Pmcn* orthorhombic phase, starting at 6 GPa to completion at 22 GPa[4]. Moreover, the unit cell is found to be more compressible along the *a*-axis (10% over the pressure range up to 30 GPa) compared to the other directions in the unit cell with 3% compressibility over the same pressure range. The change in volume for the $P2_1/c$ ->*Pmcn* phase transition is limited to 1% and the bulk moduli of the two structures are quite similar. The CO phase transition at HP was found to be reversible from decompression measurements. We present our rationalization of the magnetic-electronic ground state of the HP phase where CO is disrupted: MS results, the anisotropic compression and separate resistivity pressure measurements suggest the existence of an 'exotic' dimer Mott insulator phase.[1] D. Reznik et al., Nature 440, 1170 (2006).[2] Y.-D. Chuang et al., Science 292, 1509 (2001).[3] M. Angst et al., PRL 99, 086403 (2007).[4] G. Diguet et al., PRB 89, 035132(2014).[5] G. R. Hearne et al. , PRB 86, 195134 (2012).

166 - Can Shapiro step subharmonics be "charged"?

DPCMM1 - Thursday 10 July 2014 14:40

Primary author: AZEMTSA DONFACK, Hermann *(University of South Africa)*
Co-authors: *SHUKRINOV, Yury (JINR, Dubna); RAHMONOV, Ilhom (Joint Institute for Nuclear Research)*

The system of superconducting layers found in high temperature superconductors (HTSC) such as $Bi_2Sr_2CaCu_2O_{\{8+\delta\}}$ (Bi-2122) represent intrinsic Josephson junctions (IJJs). The locking of the Josephson oscillations (ω_J) of each junction of the IJJ to the frequency (ω_{ext}) of external electromagnetic radiation leads to the appearance at quantized voltages of the so-called Shapiro steps in the current voltage characteristics (IV-characteristics). Many devices in existence exploit this effect, notably voltage standards. Therefore, a detailed study of the Shapiro steps and their subharmonics in the intrinsic Josephson junctions at different resonance conditions presents important research questions with potential for different applications.Using the capacitively coupled Josephson junction with diffusion current (CCJJ + DC model), we performed precise numerical study of phase dynamics of intrinsic Josephson junctions under external electromagnetic radiation. We survey the different Shapiro steps (SS) subharmonics found in these systems. We establish a link between the "charging" of superconducting layers in bias-current interval corresponding to SS subharmonics, and the existence of longitudinal plasma waves (LPW) in the system.

169 - Quasi-Newtonian and anti-Newtonian universes in f(R)-gravity

Space - Friday 11 July 2014 10:20

Primary author: ABEBE, Amare *(North-West University)*

We investigate a class of shear-free and irrotational perfect fluid cosmological models in the context of modified (higher-order) gravitational theories. In particular, we generalize the potential and acceleration terms of the quasi-Newtonian formulation of General Relativity. We also show the existence of ``anti-Newtonian" cosmological models based on a consistency analysis of Einstein's field equations applied to f(R)-gravity models.

170 - Attitudes and expectations of first year students towards physics labs

Education - Wednesday 09 July 2014 11:10 *[For award: MSc]*

Primary author: TLOWANA, Munene *(University of Cape Town)*
Co-author: *ALLIE, Saalih (UCT)*

While most first physics courses have a laboratory component the reasons for including this can vary. In some cases the laboratory course is set up so as to demonstrate aspects of the theory being covered while in other cases the course is meant to develop experimental skills independently of the content being covered in the class. However, in either case it is not clear that the expectations of the students are aligned with those of the lecturers. As part of a broader study on student attitudes and expectation with regard to first year laboratory work we report on a pilot study in which we probe students' perceptions of the first year lab course at the end of the first term with regard to: expectations, enjoyment, learning, relation to course content, and assessment. The instrument that we developed comprises 5 questions. Each question is framed as a debate positing different points of view. The respondents are asked to choose the view with which they most closely agree (answer choice) and more importantly, are requested to explain their choice in detail (free response writing). We report on some of the findings from the preliminary analysis of both the answer choice and the free response writing.

171 - Structural and Electronic Properties of Fe dopped Technetium Sulphide

Theoretical - Thursday 10 July 2014 14:40 *[For award: PhD]*

Primary author: ABDULSALAM, Mahmud *(University of the Witwatersrand)*

In this research Density Functional Theory is used to study the effect of Fe doping on the structural and electronic properties of TcS$_2$ in the aP1 structure. The layered nature of the system requires the inclusion of long range van der Waals dispersion forces to yield reasonable results, comparable to experiment. Substitutional doping of Fe at the Tc sites. Fe doping can change the electronic structure of the system from semiconductor to metal.

172 - Modelling the Cumulative Spectrum Expected from a Population of Globular Clusters

Astro - Friday 11 July 2014 11:50

Primary author: VENTER, Christo *(North-west University)*
Co-author: *KOPP, Andreas (North-West University)*

There are nearly 160 Galactic globular clusters (GCs) known. They consist of hundreds of thousands of stars held together by their mutual gravity. GCs are typically about ten gigayears old and are therefore expected to harbour many evolved stellar objects, since the latter should have had ample time to complete their evolutionary processes. The high stellar densities in the cores of GCs also enhance stellar encounter rates, facilitating the formation of objects such as low-mass X-ray binaries, cataclysmic variables, white dwarfs, and pulsars. Millisecond pulsars (MSPs) indeed occur abundantly in GCs: 28 of the Galactic GCs contain more than 144 confirmed radio pulsars, the bulk of these being MSPs. Such a population of cluster MSPs is expected to radiate several spectral components in the radio through gamma-ray waveband (e.g., involving synchrotron and inverse Compton emission), as have been seen by Chandra, Fermi, and H.E.S.S. in the case of Terzan 5 (with fewer spectral components seen for other GCs). H.E.S.S. has recently performed a stacked analysis involving 15 GCs and obtained quite constraining cumulative upper limits in the TeV band. We will present a model that assumes MSPs as sources of relativistic particles and predicts multi-wavelength emission from GCs. We will apply this model to the population of GCs mentioned above to predict an average cumulative spectrum with errors, and compare this to the H.E.S.S. upper limit. This should allow us to test whether the model is viable, and to constrain various ensemble-averaged cluster parameters within this framework.

173 - Computational study of structural, thermal and electronic properties of the chalcopyrites AlAgX2 (X=S,Se,Te)

Theoretical - Thursday 10 July 2014 14:20 *[For award: PhD]*

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

First principles DFT calculations of structural, thermal and electronic properties of the bulk chalcopyrites AlAgX2 (X=S,Se,Te) are performed using LDA, GGA and MettaGGA-MBJ approximations. The optimized structure and lattice constants are obtained after a full relaxation of the structure while equilibrium volume,bulk moduli and its derivatives are extracted by fitting the Birch Murnanghan equation of state. Cohesive and formation energies and phonon frequencies are used to predict the stability of the structure. Thermal properties including free energy, heat capacity and entropy are also discussed. A systematic study of the density of st ate, the bandgap and the band structure is done for the different approximations. We found that the MettaGGA-MBJ calculations give the most accurate fundamental gaps when compared to the experimental data.

174 - Radio Astronomy in Africa: The Case Of Ghana

Astro - Tuesday 08 July 2014 10:20 *[For award: PhD]*

Primary author: *ASABERE, Bernard Duah (University of Johannesburg)*
Co-authors: *GAYLARD, Michael (Hartebeesthoek Radio Astronomy Observatory (HartRAO)); WINKLER, Hartmut (University of Johannesburg); HORELLOU, Cathy (Onsala Space Observatory/ Chalmers University of Technology); JARRETT, Thomas (University of Cape Town)*

On the African continent, South Africa has been the pacesetter for Radio Astronomy, with the long established Hartebeesthoek Radio Astronomy Observatory (HartRAO). The current seven-dish MeerKAT precursor array (KAT-7) leading to the up and coming 64-dish MeerKAT and the giant Square Kilometer Array (SKA), will be used for transformational and unprecedented radio astronomy researches that will lead to new discoveries. Ghana which had not been known in the area of radio astronomy, has been mentored by South Africa over the past six years and will soon stand tall in the field of radio astronomy on the continent. The country will soon have a science-quality 32m dish converted from a redundant satellite communication antenna. It will initially be fitted with 5 GHz and 6.7 GHz receivers to be followed later by a 1.4 - 1.7 GHz receivers. It will be designed for use as a single dish Observatory and for participation in the developing African Very Long Baseline Interferometry (VLBI) Network and the European VLBI network. As an African partner to the SKA, Ghana is planned to host a remote station during SKA Phase 2. Ghana's location of 5 degree north of the Equator gives it the advantage of viewing the entire Milky Way and almost the entire sky. In this piece, we present Ghana's story in the radio astronomy scene and the science/technology that will soon be done from there.

175 - Neutrino Events at IceCube and the Fermi Bubbles

Astro - Wednesday 09 July 2014 14:00 *[For award: PhD]*

Primary authors: *LUNARDINI, Cecilia (Arizona State University); RAZZAQUE, Soebur (University of Johannesburg); YANG, Lili (University of Nova Gorica)*

The IceCube Collaboration recently announced twenty-eight events were observed with energies above ~ 30 TeV, more than expected from atmospheric backgrounds. We discuss the detectability of the Fermi Bubbles at IceCube and show that up to 4 − 5 of the 28 events could originate from the Fermi Bubbles (FB). If the observed gamma rays from the FB are created due to the baryonic mechanism, high-energy (> GeV) neutrinos should be emitted as a counterpart. These neutrinos should be detectable as shower or track-like events at a Km3 neutrino detector. For a hard primary cosmic-ray proton spectrum $E^{-2.1}$ and cutoff energy at or above 10 PeV, the Fermi Bubble flux substantially exceeds the atmospheric backgrounds. For a steeper spectrum $E^{-2.3}$ and/or lower cutoff energy, to observe the neutrino flux at high significance, longer running time will be required.

177 - Vacuum Energies and Frequency Dependent Interactions

Theoretical - Friday 11 July 2014 10:20

Primary author: *WEIGEL, Herbert (Stellenbosch University)*

In the case of static field configurations that have frequency independent interactions with the quantum fluctuations, the vacuum polarization (or Casimir) energies are straightforwardly computed from scattering data. In particular the derivative of the phase shift with respect to the frequency is central because the analytic properties of scattering data relate this derivative to a spatial integral of the Green's function at coincident points. In more complicated frameworks, however, the interaction of the quantum fluctuations is frequency dependent. Such a scenario is actually typical for effective models. Then the above mentioned relation must be modified. This modification may or may not additionally contribute to the vacuum polarization energy. In this presentation I will discuss several examples that naturally induce frequency dependent interactions. (I) Scalar electrodynamics with a static background potential. (II) An effective theory that emerges from integrating out a heavy degree of freedom. (III) Quantum electrodynamics coupled to a frequency dependent dielectric material[1]. In cases (II) and (III) any omission of the frequency dependence would severely violate the renormalizability of the theory. For case (III) I will point out an ambiguity that arises because the introduction of a dielectric function comes at the expense of lacking a canonical Lagrangian formulation for the interaction of the photons with the constituents of the material[2]. The physically motivated choice for the Hamiltonian leads to an attractive self-stress of a dielectric sphere[1].[1] N. Graham, M. Quandt and H. Weigel, Phys. Lett. B726 (2013) 846.[2] N. Graham, M. Quandt and H. Weigel, in preparation.

178 - Polarity changes of small-amplitude ion-acoustic and electron-acoustic solitons in multi-fluid space plasmas

Space - Tuesday 08 July 2014 10:20

Primary author: *OLIVIER, Carel (South African National Space Agency)*
Co-authors: *MAHARAJ, Shimul Kumar (South African National Space Agency); BHARUTHRAM, Ramesh (University of the Western Cape)*

The properties of ion-acoustic and electron-acoustic solitons are studied for fluid models describing three-component and four-component space plasmas. Each plasma model is composed of one or two (different temperatures but same mass) ion species and one or two (different temperatures) electron species. We use a reductive perturbation method to derive Korteweg- deVries equations that describe small-amplitude solitons for each model. The results are shown to be in good agreement with arbitrary amplitude soliton results available in the literature. A comparison of the results for the different models will provide insight into how polarity changes in the observed soliton structures are related to the plasma composition.

179 - Octupole correlations and Collective Couplings in the rare earth nucleus ^{154}Dy

NPRP - Tuesday 08 July 2014 11:30 *[For award: MSc]*

Primary author: *ZIMBA, George (University of Johannesburg)*
Co-authors: *BVUMBI, Suzan Phumudzo (University of Johannesburg); JONES, Pete (iThemba LABS); MASITENG, Paulus (University of Johannesburg); MAJOLA, Siyabonga (UCT/ iThemba Labs); DINOKO, Tshepo (iThemba Labs); SHARPEY-SCHAFER, John F (UWC); LAWRIE, Elena (iThemba LABS); LAWRIE, Kobus (iThemba LABS)*

There is currently less information available on the structure of ^{154}Dy at low spins. The question still remains whether at low spins the structure exhibits permanent octupole deformation [1] or aligned tidal wave octupole phonons [2]. Intermediate spins of the nucleus ^{154}Dy were populated via the ^{155}Gd (3He, 4n) ^{154}Dy reaction at 45 MeV at iThemba LABS using AFRODITE array spectrometer. The even-even nucleus ^{154}Dy with 6 neutrons and 2 protons outside the closed shell is nearly spherical. The N = 88 isotones have remarkable features; They are at a peak in the |M(E3)| ^{2} transition strength of $0^{+}_{1} \rightarrow 3^{-}_{1}$ transitions for even-even nuclei as a function of neutron number usually called octupole vibration [34]. This was first stated by Chasman theoretically [1] whereby the first excited states in some nuclei have an octupole deformed first excited state with a quadruple deformation in the ground state and shown experimentally for $^{154}Gd_{88}$ [4]. The strong E3 properties have been described and explained as due to the nearness of $\Delta J^{\pi}=3^{-}$ shell model orbits to the Fermi surface. They also have very strong E0 transitions from the band built on the 0^{+}_{2} states to the ground state bands [3, 5]. The measurements we have made on ^{154}Dy are motivated by the findings from our studies of the isotones ^{152}Gd and ^{150}Sm from [6] where we observed octupole correlations between the 0^{+}_{2} states and the lowest-lying negative parity band, commonly known as the octupole band.References [1] R. R. Chasman, Phys. Rev. Lett. 42, 630 (1979).[2] S. Frauendorf, Phys. Rev. C77, 021304(R) (2008).[3] S. P. Bvumbi et al., Phys. Rev. C 87, 044333 (2013).[4] S P Bvumbi, “Spin and Parity Assignment in 152Gd Investigating Octupole Structures”; MSc thesis, University of Western Cape (2008).[5] S. Frauendorf, Y. Gu, J. Sun, Tidal waves as yrast states in transitional nuclei (2007).[6] S. P. Bvumbi, “Investiga tion of octupole correlations and collective couplings in the rare earth nucleus 150Sm” PhD thesis, University of Johannesburg, (2013).

181 - A New Technique to Electro-Optically Q-switch Uniaxial Gain Materials.

Photonics - Thursday 10 July 2014 10:20 *[For award: PhD]*

Primary author: *MAWEZA, Loyiso (CSIR)*
Co-authors: *DU PREEZ, Neil (CSIR); KING, Gary (CSIR); STRAUSS, Hencharl (CSIR)*

We introduce a new technique of Electro-Optic Q-switching which exploits the polarization dependence of a uniaxial gain medium. Conventional Electro-Optic Q-switched cavities require both a polarizer and a wave plate in addition to an Electro-Optic Modulator (EOM) which rotates the beam polarization within a few nano-seconds. The new technique eliminates the need for a polarizer, which is an advantage for short pulse, high peak power Q switched lasers. This is because polarizers are susceptible to damage and can significantly lengthen the cavity, which increases the output pulse length. Uniaxial gain materials like Nd:YVO4 have different thermo-dioptric constants in two crystallographic directions, which causes the two polarization states to experience different thermal lens strengths for a-cut crystals. The cavity can be switched between stable and unstable states by rotating the polarization with a Pockels cell. The results in a rapid change in the cavity quality, which Q-switches the resonator. The pres entation will first review conventional Electro-Optic Q-switched methods after which the new technique will be introduced. It will then be shown how the new technique was implemented in a short Nd:YVO4 cavity. The experiments confirmed that the new technique is viable and operating regimes, advantages and disadvantages of the new technique will be presented.

183 - The properties of radio relics and the connection with radio halos in galaxy clusters and their correlation with non-thermal phenomena

Astro - Tuesday 08 July 2014 11:30 *[For award: PhD]*

Primary author: *PAULO, Claudio Moises (University of the Witwatersrand)*
Co-author: *COLAFRANCESCO, Sergio (University of the Witwatersrand)*

Galaxy clusters are the largest gravitationally bound structures and the largest storage rooms for cosmic rays and magnetic fields in the Universe. They have been successfully observed in radio, mm., optical, soft and hard X-ray wavelengths. Radio observations, show the evidence of relativistic particle from diffuse synchrotron radio emissions in a growing number galaxy clusters. The origin of these diffuse emissions (radio relics & radio halo) is still unknown and is one of the hot topics on the discussion table of radio astronomy today. Basically, two main scenarios have been proposed for the origin of relativistic particle in galaxy cluster: i) the primary models, which predict that electrons are accelerated by shocks and or turbulence induced during cluster mergers; ii) the secondary models, in which relativist electrons are continuously injected by hadronic collisions between the thermal ions of the intracluster medium (ICM) and relativistic protons. In order to investigate the properties of radio relics and the connection with radio halos in galaxy cluster, and then analyse their correlation with non-thermal phenomena, it’s important i) to provide a self-consistent theoretical modelling for the interpretation of the available and future observations in the context of leptonic and hadronic model for the origin of relativistic particle; ii) to provide a consistent scenario for the origin of magnetic fields in large-scale structures of the universe. We discuss here theoretical and data analysis procedures on existing radio relics and halos, following by the establishment of reference cluster samples which will be used for theoretical predictions and simulations for future experiments (MeerKAT and SKA). A specific galaxy that we observed with KAT-7 is at the focus of our analysis as a starting point.

184 - Accretion and outflow in black hole X-ray binaries

Astro - Friday 11 July 2014 10:00 *[For award: MSc]*

Primary author: *DUSOYE, Avishek (University of Cape Town)*
Co-authors: *CORIAT, Mickael (University of Cape Town); WOUDT, Patrick (University of Cape Town)*

Black hole X-ray binaries (BHXBs) are stellar binary systems comprising of a black hole (BH) and a main sequence star (M < 2 M_Sun). They are known to emit X-ray emission through the accretion of mass onto the compact core, as well as radio emission from a collimated jet. My thesis literally splits into two projects. On one hand, we focus on the connection between the X-ray emitting accretion disc and the radio jets of BHXBs, by studying the quasi-simultaneous evolution of the radio fluxes and the X-ray fluxes for 21 BHXBs. This connection, also known as the radio/X-ray correlation has been studied and updated over past years. New observations published in the literature have shown that another population of BHXB exists (dubbed outliers), lying below the standard radio/X-ray correlation. We investigate whether the mass of these BHXBs can play role for the existence of these outliers. On the other hand, we focus on an exotic source, SS433, which has a supercritical accretion disc and displays precessing relativistic jets. Through new observations of the circular polarised fluxes using the Australia Telescope Compact Array (at 2- 36 GHz), we attempt to estimate the energy content of the jets and aim to constrain the composition of its jets to be baryonic or leptonic.

185 - The methodology of extracting kinemtaical properties and mass profiles from BCGs.

Astro - Thursday 10 July 2014 15:20 *[For award: MSc]*

Primary author: *BRANKEN, Henri (North West University)*

Brightest cluster galaxies (BCGs) constitute a very unique class of early-type galaxies. This is highlighted, amongst others, by their extremely high luminosities, extended envelopes and special locations in galactic clusters. To date, however, there is no global theoretical consensus on their formation mechanisms. Another difficulty arises in trying to explain the rising velocity dispersion profile of a subsample of BCGs above a transitioning redshift. One interpretation for this feature is that for larger radii, a strong rising mass-to-light ratio comes into play. In other words, dark matter becomes a more important contributing factor to the dynamical mass of the BCG. A second possible interpretation is has been ascribed to increasingly tangential stellar orbits at larger radii. One main question becomes whether the rising velocity dispersion reflects the gravitational potential of the BCG, or whether it is a snapshot of a dynamical system that has not reached equilibrium.Due to lack of theoretical consensus, BCG studies studies are dominantly driven by observational studies. In this presentation, a pedagogic approach is taken in explaining how important kinematical properties and mass profiles can be obtained from BCGs. Emphasis is placed on how the line of sight velocity distribution (LOSVD) and velocity dispersion profile follows from spectroscopic measurements. Surface photometry will be elaborated on when explaining how it is used to constrain stellar mass estimates of BCGs in connection with spectral energy distribution fits. Furthermore, a method for constraining the dynamical mass of the BCG from velocity dispersion measurements will also be elaborated on. Lastly, this presentation will conclude with how these newly derived quantities can be exploited for understanding the dynamics of BCGs. Prominent avenues of discussion include how the formation mechanisms of BCGs can be inferred from the available data and what the various mass density profiles really convey. Finally, an epilogue is given on how the current knowledge will be applied in a subsequent study that will investigate the properties of a sample of BCGs, as well as the particular goals that will be pursued.

186 - Characterisation of plume and thrust for the corona ionisation space propulsion system

Applied - Thursday 10 July 2014 14:40

Primary author: *FERRER, Phil (University of the Witwatersrand)*

The corona ionization space propulsion system (Corion) is a miniaturized plasma thruster intended to work on small satellites and space probes. It operates by ionizing a neutral gas fed through thin needles via corona ionization at the needle tips and creating a positive and negative stream of plasma, which provides thrust. Analytic descriptions of this system have not taken electrons into account, and we use a fluid simulation to include these effects. The simulation yields information about the local electric fields, local mobility constant, ion and electron currents, charge densities, power transfer into the gas of the neutral plume by both ions and electrons and thrust densities. A description for the thrust is presented next, which is the sum of a number of different contributions from cold gas thrust, ion acceleration, ion/neutral drag forces and Joule heating of the plume.

187 - Analysis of SALT Medium Resolution Fabry-Perot data

Astro - Thursday 10 July 2014 14:40 *[For award: MSc]*

Primary author: *TAPSOBA, Wendyam Blaise (University of Cape Town)*
Co-author: *WILLIAMS, Ted (SAAO)*

The RSS in Fabry-Perot medium-resolution mode on the SALT has been used for the Hα observations of two of the MHONGOOSE's 30 galaxies sample : NGC 7424 and NGC 7361. The Hα data of these two spiral galaxies combined with the lower spatial resolution HI provide a ideal database for mass models's analysis. This is important since those models are mainly constrained by the rising part of the rotation curves that is better sampled by the present Fabry-Perot Hα data. In many galaxies, especially the Sps and dIrrs, the HI emission extends much further out than the HII emission. Since the HI rotation curves probe the gravitational potential in the dark matter dominated region, they are best suited to derive the parameters of the mass distribution and specially of the dark matter halo.I will be talking about the velocity maps of NGC 7424 and NGC 7361 obtained thanks to Prof Ted Williams's FORTRAN routines and also the kinematical analysis (rotation curves determination) using the program DISKFIT.

188 - Arbitrary amplitude ion-acoustic and electron-acoustic solitons in two-ion space plasmas revisited

Space - Tuesday 08 July 2014 15:20

Primary author: *MAHARAJ, Shimul Kumar (South African National Space Agency)*
Co-authors: *BHARUTHRAM, Ramesh (University of the Western Cape); SINGH, Satya Vir (Indian Institute of Geomagnetism); LAKHINA, Gurbax Singh (Indian Institute of Geomagnetism)*

In the present study we will broaden the scope of the studies in [1] by investigating why upper velocity limits occur for slow and fast ion-acoustic and electron-acoustic solitons for a plasma model composed of cool and hot ions (of equal mass) and cool and hot electrons. All species will initially be treated as adiabatic fluids. Not only will we be able to present the admissible soliton velocity ranges for much broader regions in parameter space than those found in [1], our results will also provide useful insights into the properties of the observed solitons such as whether polarity changes can be induced in the observed structures and if double layers are possible. In addition, we will establish how retaining (as opposed to neglecting) inertial effects of the hot electrons in the model affects the results. [1] G. S. Lakhina, S. V. Singh, A. P. Kakad, F. Verheest and R. Bharuthram, *Nonlin. Process Geophys.* **15**,903-913 (2008).

192 - Phase evolution of vanadium oxides obtained through temperature programmed annealing of ammonium vanadate in hydrogen atmosphere

DPCMM2 - Tuesday 08 July 2014 14:20 *[For award: MSc]*

Primary author: *AKANDE, Amos (University of Limpopo)*
Co-authors: *RAMMUTLA, Erasmus Koena (University of Limpopo); MWAKIKUNGA, Bonex (CSIR)*

The possibility of obtaining vanadium dioxide (VO2) [wherein the vanadium ionic state is 4+] from a precursor of ammonium metavanadate (NH4VO3) bearing the ion V5+ is investigated.The reduction is carried out by annealing the NH4VO3 powders in similar concentrations of H2 flow at varying temperatures. The resulting powders have been studied by several techniques including X-ray diffraction (XRD), Raman spectroscopy, Fourier transform infrared spectroscopy (FTIR), Transmission electron microscope (TEM), Brunauer-Emmiter-Teller (BET) and Differential scanning calorimetry (DSC). It is found that remnants of bright yellow V5+ still exist up to annealing temperatures of 100 0C after which the sky-blue VO2 dominates at annealing temperatures of 150 0C to 250 0C. There is a population surge of metastable dark-blue V6O13 (where V is in between V4+ and V5+ ionic states) between 250 0C and 300 0C. However above 350 0C the material reverts to the stable V5+ in the yellow-orange V2O5.

194 - Influence of Spark Plasma Sintering parameter on Cu-CNT composites for thermal management

DPCMM1 - Tuesday 08 July 2014 10:20 *[For award: PhD]*

Primary author: *SULE, Rasidi (Tshwane University of Technology)*
Co-authors: *OLUBAMBI, Peter (Tshwane University of Technology); ASANTE, Joseph (Tshwane University of Technology); SIGALAS, Iakovos (University of the Witwatersrand); GARRETT, Jethro (University of the Witwatersrand)*

As technological development is advancing towards increasing chip performance with continuous downscaling of complementary metal oxide semiconductor (CMOS) devices, power density has posed a challenge for advanced electronic system. Thermal management in the electronics package has become the major concern in the development of the microelectronic components. The purpose of thermal management devices is to cool the hotter integrated circuit component by dissipating the heat which is then conveyed out of the assembly by air to avoid overheating.Copper reinforced with carbon nanotube has emerged as a material of choice for thermal management due to its attractive properties such as high thermal conductivity (400 W/m-K Cu and 3000 W/m-K carbon nanotubes (CNTs)), low coefficient of thermal expansion (CTE) of approximately zero for CNTs and ease of fabrication of copper powders. However, achieving a homogenous distribution of CNT in Cu matrix without damaging the CNT is still a challenge. In addition, achieving full densification of the feedstock powder is also a challenge due to the oxidation of copper at room temperature. The aim of this study is to develop an improved method of fabricating Cu-CNT composite with good densification without damage to the nanotube in the Cu matrix using Spark Plasma Sintering (SPS) technique. In this study, 1 and 2 vol% multiwalled CNTs were dispersed into sub-micron sized copper powders using a mechanical stirring technique, and the admixture was annealed and sintered using SPS at 600 and 650oC with a pressure of 50 MPa. The microstructure of the sintered sample was investigated using high resolution scanning electron microscopy (HRSEM). Raman spectroscopy was used to differentiate the CNTs from pores since both appear black on a SEM image. Density, porosity, thermal conductivity will be measured to evaluate the performance of the sintered samples.

196 - A single DFB laser for multilevel directly modulated signal for high speed optical fibre communication system

Applied - Wednesday 09 July 2014 14:20 *[For award: PhD]*

Primary author: *CHABATA, Tichakunda Valentine (NMMU)*
Co-authors: *GAMATHAM, Romeo (NMMU); ROTICH KIPNOO, Enoch (NMMU); GIBBON, Tim (NMMU); LEITCH, Andrew (NMMU)*

Abstract: Multilevel modulation format that meets the high bandwidth requirements and increases the bit rate is experimentally investigated. A single distributed feedback (DFB) laser at 1550 nm is used to transmission a total of 20 Gb/s of data over an optical fibre link. The data rate is doubled from binary 10 Gb/s by employing a multilevel technique. An economical, all electrical multi-level signal generation technique was designed. The multilevel format transmitter codes two bits in one symbol. This enables an increase in the bit rate of the system, though at the expense of receiver complexity. The two bits coded in a single symbol generate a four level signal that has to be decoded at the receiver. The designed complex receiver section utilizes the offline digital signal processing algorithms to evaluate the system performance through bit error rate (BER) measurements. The system performance was experimentally evaluated on back-to-back transmission.Key terms:MultilevelDigital signal processingBER

197 - Using a VCSEL to Accurately Measure the Chromatic Dispersion in Single Mode Fibre by the Phase Shift Technique

Applied - Tuesday 08 July 2014 14:40 *[For award: MSc]*

Primary author: WASSIN, Shukree (NMMU)
Co-authors: ROTICH, Enoch (Nelson Mandela Metropolitan University); GAMATHAM, Romeo (Nelson Mandela Metropolitan University); LEITCH, A. W. R. (Nelson Mandela Metropolitan University); GIBBON, Timothy (NMMU)

Abstract – The demand for high-speed data transmission and higher bandwidth is increasing rapidly due to the growing consumer need for advanced telecommunication technology. All fibre optic cables have an inherent factor limiting transmission, known as chromatic dispersion. Chromatic dispersion results in the broadening of an optical pulse with respect to time as it propagates along the fibre, leading to a rise in bit errors. In this paper, a method for characterizing the chromatic dispersion in single mode fibre is described. Our approach is based on the phase shift technique, in which the change in phase of sinusoidal modulated signals at varying wavelengths is measured. A vertical cavity surface emitting laser (VCSEL) source was implemented to characterize the chromatic dispersion along different lengths of G.652, G.655 (+) and G.655 (-) single mode fibre, around the 1550nm wavelength region. A dispersion coefficient D, between 16.5 ps/nm.km to 19.1 ps/nm.km for the G.652 single mode fibre, 2.6 ps/nm.km to 4.2 ps/nm.km for the G.655 (+) single mode fibre and -2.8 ps/nm.km to -3.2 ps/nm/km for the G.655 (-) single mode fibre was measured. The experimental results are in close agreement to those obtained in literature related to the characterizing of chromatic dispersion in single mode fibre.

202 - Numerical studies of non-thermal processes in galaxy clusters

Space - Wednesday 09 July 2014 15:20 *[For award: PhD]*

Primary author: MEKURIA, Remudin Reshid (University of the Witwatersrand)
Co-authors: COLAFRANCESCO, Sergio (University of the Witwatersrand); FALTENBACHER, Andreas (University of the Witwatersrand)

Galaxy clusters are the largest gravitationally bound structures consisting of 85 % dark matter, and ~15 % baryons. The hot and dense central parts of galaxy clusters contain an intra-cluster medium of ionized gas, high energy photons, relativistic particles, cosmic rays, magnetic fields, that are manifesting the non-thermal processes taking place in a galaxy cluster. Using numerical simulations we study the non-thermal processes in galaxy clusters.Based on large number of high resolution dark matter density maps of simulated clusters, we develop analytical models in order to determine the dark matter annihilation flux and predict the gamma-ray emission as well as the cosmic rays distribution in a galaxy clusters.

206 - Quantum feedback control of a harmonic oscillator

Theoretical - Wednesday 09 July 2014 11:50 *[For award: PhD]*

Primary author: BASSA, Humairah (University of KwaZulu-Natal and CSIR)
Co-author: KONRAD, Thomas (UKZN)

We formulate a theory of quantum feedback control of a single quantum particle in a harmonic potential. By continuously monitoring a combination of position and momentum we can feedback an appropriate force proportional to the measured signal to cool and confine the system. We derive a master equation which describes the feedback control in order to calculate the final temperature as a function of the feedback gain and measurement strength.

210 - Comparison of photometric and spectroscopic parameters of eclipsing contact binary stars

Astro - Tuesday 08 July 2014 14:00 *[For award: PhD]*

Primary author: SKELTON, Patricia (UNISA)

To model an eclipsing contact (EC) binary star requires the temperature of at least one of the components, usually T_1, and the mass ratio q. Other parameters are determined by minimizing residuals between the model and phase-magnitude data. Rucinski *et al*. (2005) have pointed out that model solutions of EC stars obtained from photometric data are unreliable because the photometrically determined mass ratios are different to those determined from spectroscopic data. The temperatures determined from colour indices are also found to differ from those determined spectroscopically. Clearly, in order to produce reliable models of these stars requires a combination of photometric and spectroscopic data. Using the SpCCD spectrograph on the 1.9m telescope at the South African Astronomical Observatory in Sutherland, spectroscopic data were obtained for selected EC stars. The results of the observations and a comparison of the photometrically and spectroscopically determined temperatures and mass ratios are presented.

211 - A Boost to Astronomy in Southern Africa

Astro - Tuesday 08 July 2014 10:00

Primary author: SIMPEMBA, Prospery C (Copperbelt University/University of Witwatersrand)
Co-authors: CHINYAMA, Kaumba (Copperbelt University); PAULO, Claudio M. (University of Witwatersrand); GOVENDER, Kevin (IAU Office of Astronomy for Development); BACKES, Michael (University of Namibia); DAVIDS, Isak D. (University of Namibia); SIMFUKWE, Joseph (Copperbelt University); COLAFRANCESCO, Sergio (University of Witwatersrand)

Southern Africa is home to world class astronomical research on the African continent. We explore the new developments that give the region a boost in advancing astronomy. The Office of Astronomy for Development (OAD) has been established in South Africa to coordinate global astronomy developments. A bid to host the Southern Africa Regional Office of Astronomy for Development (SAROAD) in Zambia at the Copperbelt University has been successful. The Square Kilometer Array (SKA) Project has taken shape and is already adding immense value to human capital development and research. We also highlight the High Energy Stereoscopic System (HESS) in Namibia and the proposed hosting of Cherenkov Telescope Array (CTA). These developments put Southern Africa in the lime light, providing many possibilities for regional economic and human capital development.

213 - First look at Data Acquisition system for a fixed target experiment at the NICA complex at JINR and its connection to the ATLAS TileCal readout electronics

NPRP - Tuesday 08 July 2014 14:20 *[For award: MSc]*

Primary author: TOMIWA, Kehinde (University of the Witwatersrand)

Today's large-scale science projects have been always encountered challenges in processing large data flow from the experiments, the ATLAS detector records proton-proton collisions provided by the LHC at CERN every 50 ns which results in a total data flow of 10 Pb/s, the SKA is a radio telescope consisting of several thousand antennae, the data rates from the individual antenna at SKA results in a total data flow of up to 9 Pb/s. These data must be reduced to the science data product for further analysis, thus a very fast decisions need to be executed, to modify this large amounts of data at high rates. The capabilities required to support this scale of data movement is involving development and improvement of high-throughput electronics.The upgraded LHC will provide collisions at rates that will be at least 10 times higher than those of today due to the luminosity increasing by a factor of ten at 2022, however, this will require a complete redesign of the read-out electronics (ROD) in the Tile-calorimeter (TileCal) of the ATLAS experiment. The ROD system is a high-throughput system, it is capable of handling large data throughputs and to apply advanced operations at high rates, ROD system are functionally decomposed in two building blocks: the Field Programmable Gate Arrays (FPGA) and Digital Signal Processors (DSP). The aim of this work is to have a first look at the ROD architecture for the fixed target experiment at the NICA complex at JINR, by compiling the data-flow requirements of all the subcomponents. Furthermore, the FPGAs boards characteristics to control, triggering and data acquisition will be described in order to define data acquisition system (DAQ) with maximum readout efficiency, no dead time and data selection and compression.

214 - Novel Rattling Dynamics Explain Low Thermal Conductivity in Aluminium-Doped Potassium Tungstate Defect Pyrochlore

DPCMM1 - Thursday 10 July 2014 14:00

Primary author: SHOKO, Elvis (University of the Witwatersrand)
Co-authors: PETERSON, Vanessa (Australian Nuclear Science and Technology Organisation); KEARLEY, Gordon (Australian Nuclear Science and Technology Organisation)

In a recent study, we reported an unusual quasielastic inelastic neutron scattering (INS) signal in the K analogue of the Al-doped series of cage compounds with the β-pyrochlore structure, AAl0.33W1.67O6 (A = K, Rb, Cs) [1]. We are studying this family of compounds because the rattling modes of the alkali metal atoms [2, 3] are similar to those found to enhance thermoelectric performance in both clathrates [4] and skutterudites [5]. This talk will discuss our recent thermal conductivity [6] and specific heat data in terms of the vibrational density of states calculated from ab initio molecular dynamics (MD) simulations validated against experimental INS spectra and show the significance of the novel K dynamics for these properties. I will conclude with a tentative sketch of the prospects of these compounds for thermoelectric development. References[1] E. Shoko, G. J. Kearley, V. K. Peterson, H. Mutka, M. M. Koza, J.-I. Yamaura, Z. Hiroi, G. J. Thorogood, submitted to Phys. Rev. B, (arXiv:1310.8137).[2] K. Oshiba and T. Hotta, J. Phys. Soc. Jpn. 80, 094712 (2011).[3] J. Yamaura and Z. Hiroi, J. Phys. Soc. Jpn. 80, 054601 (2011), Z. Hiroi, J.-I. Yamaura and K. Hattori, J. Phys. Soc. Jpn. 81, 11012 (2012).[4] B. C. Sales, B. C. Chakoumakos, R. Jin, J. R. Thompson and D. Mandrus, Phys. Rev. B 63, 245113(2001).[5] M. M. Koza, M. R. Johnson, R. Viennois, H. Mutka, L. Girard and D. Ravot, Nature Mater. 7, 805 (2008).[6] E. Shoko, V. K. Peterson, and G. J. Kearley, J. Appl. Phys. 115, 033703, (arXiv:1310.8382v2)

215 - Octupole Excitations in U isotopes

NPRP - Tuesday 08 July 2014 11:10

Primary author: NTSHANGASE, Sifiso Senzo (University of Zululand)
Co-authors: BARK, Robert (iThemba LABS); NYAKO, Barna (ATOMKI, Hungary); BVUMBI, Suzan Phumudzo (University of Johannesburg); MAJOLA, Siyabonga (UCT/ iThemba Labs); LAWRIE, Elena (iThemba LABS); LAWRIE, Kobus (iThemba LABS); ROUX, David (Rhodes); MULLINS, Simon (iThemba LABS (Gauteng)); PAPKA, Paul (Stellenbosch University); SHARPEY-SCHAFER, John F (UWC)

The actinide region attracts considerable interest due to the rich variety of octupole phenomena encountered both theoretically and experimentally [1]. These include octupole vibrational bands which, as a function of neutron number an angular momentum, develop into alternating parity bands that have been interpreted as the onset of octupole deformation, or more recently, in terms of refection-asymmetric tidal waves [2]. The most spectacular example of octupole shape may well be the hyperdeformed bands known from fission resonances. A new possibility is the existence of the triaxial octupole shape, which in its purest form has a tetrahedral structure and is characterized by a zero quadrupole moment [3]. Thus negative parity bands in even-even nuclei with unobserved in-band E2 transitions are often regarded as candidates for the rotation of a tetrahedral shape. In the actinides, 230U and 232U fall in this category. These nuclei have been populated at iThemba LABS, using 232Th(■,xn) reactions at 61 and 42 MeV, respectively. Here we report the results of these measurements, which include the first observation of in-band E2 transitions in the negative parity bands in these nuclei, using the AFRODITE array in conjunction with the iThemba LABS recoil detector. The results are discussed and compared to Skyrme-Hartree-Fock calculations and systematics throughout the region.1. P.A. Butler and W Nazarewicz, Rev. Mod. Phys. 68, 349 (1996).2. W. Reviol et al., Phys. Rev. C 74, 044305 (2006).3. J. Dudek et al, Phys. Rev. Lett. 88, 252502 (2002).

217 - Thermal measurements on epoxy-expandable graphite composite material

Applied - Tuesday 08 July 2014 14:00 *[For award: MSc]*

Primary author: MODIBA, Fortunate (TUT)
Co-authors: *MWAKIKUNGA, Bonex (CSIR); ASANTE, Joseph (TUT)*

Polymer-based materials are competing with metallic alloys in terms of cost and functionality (durability, strength, and other physical and chemical properties). Organic polymers with inorganic reinforced composites are in daily use both domestically and industrially- in coating, adhesives, primers, aeronautic utilities, electro-optical devices and sensors, among others. The effect of heat on some of these polymer-based composites, however, brings some undesirable changes that affect product functionality. Inorganic intumescent additives such as expandable graphite (EG) to organic epoxy resin have shown promising flame retardant effects. One particular epoxy polymer, PrimeTM 20LV, with EG inorganic filler of different weight percentages, is the focus of this study. Heat measurements such as heat release rate, critical flux, time-to-ignition, thermal inertia and kinematics – activation energy as well as pre-exponential factor - of the composites were performed with the Dual Cone Calorimeter and the Thermogravimetric analysis (TGA). It was found that increasing the amount of EG in this epoxy leads to reduction in the following parameters: critical flux, the time-to-ignition, and the thermal inertia of the composite samples. There was, however, increase in the heat of gasification with increasing EG content while the activation energy was not significantly affected. Explanations to these findings will be presented.

218 - Propagation characteristics control by variation of PCF structural parameters

Photonics - Thursday 10 July 2014 11:10 *[For award: MSc]*

Primary author: JENA, James (National University of Science and Technology)
Co-authors: *BARICHOLO, Peter (National University of Science and Technology); BUAH-BASSUAH, Paul (University of Cape Coast, Ghana); DLODLO, Themba (National University of Science and Technology,)*

A photonic crystal slab was designed in COMSOL using gallium arsenide (GaAs) pillars placed equidistant from each other in air. A defect was created by removing some GaAs pillars across the crystal slab geometry to form a 90 degree bend through the structure. Structural parameters; the pillar diameter and inter-pillar spacing were separately varied and waves were propagated through the created defect at different wavelengths within the photonic crystal's bandgap. It was observed for the air filling fraction that, when the factor given by the ratio of the air space size to the pitch is less than 0.43, a fewer number of lobes having greater physical dimensions can be confined within the waveguide with minimum losses. Higher order modes were also observed when the air filling fraction factor was greater than 0.43. These exhibited increased confinement and bend losses. The diameter and pitch also affected the core resonance resulting in selected wavelength bands being propagated through the created defect in the waveguide. Only those bands whose value coincides with the photonic bandgap were allowed to propagate.

223 - Compact stars for NITheP internship programme

Theoretical - Friday 11 July 2014 11:10

Primary author: MURONGA, Azwinndini (University of Johannesburg)
Co-authors: *PHUTHU, Lutendo (NITheP); THUSINI, Xolile (NITheP); NYALUNGA, Gezekile (NITheP)*

We report on an undergraduate and Honours student project conducted in the November/December 2013 NITheP internship programme. The aim of the project is to establish equations of state for white dwarfs and neutron stars for computing mass-radius relations as well as corresponding maximum masses. First, white dwarfs are described by a Fermi gas model of degenerate electrons and neutrons and effects from general relativity are examined. For neutron star matter, the influence of strong nucleon-nucleon interactions is studied. Finally, masses and radii of neutron stars are computed for given central pressure.

224 - Simulation of the Egyptian 2nd Testing Research Reactor (ETRR-2) experimental benchmark in aid of verification and validation of the OSCAR-4 system.

Applied - Tuesday 08 July 2014 15:00 *[For award: MSc]*

Primary author: MASHAU, Maurice (University of Johannesburg)
Co-authors: *ERASMUS, Bernard (NECSA); PRINSLOO, Rian (NECSA)*

Recently, the IAEA published a set of experimental benchmarks for research reactors. Previously, such results had only been published for power reactors, which limited the benchmark tests to code-to-code comparisons, for research reactors. Since these results are now available, it is possible to validate reactor codes against experimental data. The published benchmarks include neutronics and thermal-hydraulic benchmarks for the ETRR-2 reactor. For the purpose of this work, ETRR-2 was of particular interest since some of its components are similar in design as compared to the research reactor operated by Necsa and the focus was on the neutronics benchmark. Most importantly, ETRR-2 was chosen as a test case on the strength of the proven capabilities of the Overall System for the CAlculation of Reactors, generation 4 (OSCAR-4) to simulate the research reactor at Necsa. OSCAR-4 is a nodal diffusion based code which is used to perform day-to-day reactor calculations in support of the research reactor at Necsa. As a means of improving the capabilities of the OSCAR-4, there is a need to solve more benchmark problems in aid of verifying and validating the code system for research reactor applications. From the experimental benchmarks of ETRR-2, Core SU-29 was chosen as the basic core configuration. As a starting point, an OSCAR-4 model was built to model the aforementioned core. As a reference model, a more accurate Monte Carlo code, Serpent, was used to model the same core. Relative errors were calculated for the core power distributions generated from these two independent models, with a maximum error of 6.36%. To further analyze the accuracy of the OSCAR-4 model, a comparison was done between the models by calculating the effective multiplication factor for cases where control rods were fully inserted, half-way inserted and fully extracted from the core. After establishing the correct model, control rod worth experiments were simulated and the results were compared with the experimentally measured results. .

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

Space - Wednesday 09 July 2014 11:30 *[For award: MSc]*

Primary author: MATAMBA, Tshimangadzo Merline (SANSA/Rhodes University)
Co-authors: *HABARULEMA, John Bosco (SANSA/Rhodes University); MCKINNELL, Lee-Anne (SANSA/Rhodes University)*

The presentation discusses the statistical analysis of ionospheric response over Madimbo (22.4° S,30.9° E) and Grahamstown (33.3° S, 26.5°E), South Africa using ionosonde and GPS data duringthe time interval 1996 - 2011. A comprehensive analysis on the critical frequency of F2 layer(foF2) and Total Electron Content (TEC) was performed using the Disturbance storm time (Dst)index with a storm criteria of Dst <= -50nT to identify the disturbed days. There were 3 categoriesof ionospheric disturbances identified in this study namely: single disturbance, double disturbanceand not significant (NS) ionospheric storms. Single disturbance include positive (P) and negative(N) ionospheric storms separately, while in double disturbance category both negative and positiveionospheric storms are observed during the same storm period. The statistics reveal the dependenceof ionospheric storms on geomagnetic storms and also the negative ionospheric effects follow thesunspot cycle. In general few ionospheric storms (0.11%) were observed during solar minimum.Positive ionospheric storms occurred most frequently (47.54%) during the declining phase of thesolar cycle 23.

229 - A strategic independent geodetic VLBI network for Europe.

Space - Wednesday 09 July 2014 14:40 *[For award: MSc]*

Primary author: DALE, Denise (Hartebeespoorthoek Radio Astronomy Observatory)

The main point of Very Long Baseline Interferometry (VLBI) is to observe the same object (quasars) at the same time from various and as many as possible locations on the Earth. Geodesists use radio telescopes in VLBI networks to determine the positions of each station relatively to each other in the network. Geodetic VLBI provides the link between the celestial reference frame and the terrestrial reference frame, necessary for determining the Earth's orientation in inertial space. Furthermore, it is the only technique that provides the full set of Earth orientation parameters (EOPs), which are indispensable for positioning and navigation on Earth and in space. We aim to investigate the stability of a proposed independent geodetic VLBI network for Europe and the accuracy of EOP measurements from observations of the proposed network. In particular, the Vienna VLBI Software (VieVS) is used to analyse the results. The proposed stations that will be used to investigate an independent geodetic VLBI network for Europe are the WETTZELL radio telescope in Germany, as well as two other German owned radio telescopes, TIGOCONC in Concepcion, Chile and OHIGGINS in Antarctica, as well as the HartRAO radio telescope in South Africa. To test the stability and the accuracy of the EOPs for this above mentioned network, we have processed existing T2 IVS sessions that include the four proposed stations and we present EOP results of the proposed network against all stations.

231 - Field theory formulation for active network

DPCMM1 - Tuesday 08 July 2014 11:30 *[For award: PhD]*

Primary author: MEBWE PACHONG, Stanard (Stellenbosch University)
Co-author: *MÜLLER-NEDEBOCK, Kristian (University of Stellenbosch)*

We develop a model of a polymer network made of both permanent and reversible cross-links (such as myosin II clusters). The formalism of Edwards for a permanent network is used and, was adapted by Fantoni et al to describe clustering. The combination of these two ideas comprises the model of network resembling a natural network. The interesting point here is that the cross-linkages are random and this constraint is ensured by the field theory. As is well known, the randomness causes severe mathematical challenges. Fortunately, many tools have been developed in order to circumvent this. The network is made by mixing many chains of identical lengths, and two different types of cross-linkers with fixed functionality each. The field theory used for polymer network developed by Edwards provides various approaches to dealing with this kind of cross-linkage problem. Edwards used the well known properties of Gaussian integration over the fields defined for each specific type of cross-linker and solved the field-theory using the saddle point approximation method. We expand the field theoretic model and compute the average density of reversible cross-links along the polymeric chain. The behaviour of the network formed has also been investigated including the activity of the linkers (i.e. when the reversible linker can move and when the permanent linker exerts a force). The result of the calculations lead to derivation of the bulk elastic properties for such systems.

232 - Ultrafast charge transfer processes in organic-dye sensitised solar cells

Photonics - Tuesday 08 July 2014 11:10 *[For award: MSc]*

Primary author: *MINDA, Iulia (Stellenbosch University)*
Co-authors: *ROHWER, Egmont (Stellenbosch University); TAUSCHER, Gabriele (Stellenbosch University); SCHWOERER, Heinrich (Stellenbosch University)*

Dye sensitised solar cells (DSSCs) convert solar energy to electrical energy through the use of a light absorbing dye sensitised onto the surface of a semiconductor. The semiconductor is a highly porous electrodeposited ZnO nanoparticle thin film. An indoline dye is adsorbed to the ZnO as a monolayer. The working cell is sandwiched between two FTO coated glass slides and the circuit is closed with a liquid electrolyte consisting of an iodide/triiodide redox couple. Electrons are photoexcited in the dye and then injected into the conduction band of the ZnO. Three different indoline dye derivatives DN285, DN216 and DN91 were examined in order to compare their electron injection times. They differ from one another in terms of the alkyl chain length of the second carboxyl anchor group. The electron injection dynamics were measured in the context of fully operational organic-DSSCs with the use of transient absorption spectroscopy in a femtosecond laser pulses pump-probe setup. All the samples were pumped at 530 nm, near their maximum absorption wavelength, and probed with a white light supercontinuum. In addition, the cells were also probed with a compressed pulse of a nonlinear parametric optical amplifier (NOPA) at 650 nm and 700 nm wavelength in order to achieve a better time resolution. Additional measurements were taken under short circuit conditions and with applied external potentials of 1V and -1V in order to stop the electron current. In macroscopic measurements, such as IV curves, the DSSCs sensitised with different organic dyes produce different short circuit currents. With the help of the transient absorption spectroscopy measurements, more insight can be gained into the fundamental charge transfer processes taking place after photoexcitation for the DSSCs sensitised with the three different dyes.

234 - Spectral modelling of H.E.S.S.-detected PWNe

Astro - Wednesday 09 July 2014 11:10 *[For award: MSc]*

Primary author: *VAN RENSBURG, Carlo (North West University)*
Co-authors: *VENTER, Christo (North-west University); KRUGER, Paulus (NWU)*

In the last decade ground-based Imaging Atmospheric Cherenkov Telescopes (IACTs) have discovered almost 150 very-high-energy (VHE; E > 100 GeV) γ-ray sources. Roughly 30 of these are confirmed pulsar wind nebulae (PWNe), while other source classes include supernova remnants, active galactic nuclei, or unidentified sources. A subset of latter may eventually turn out to be PWNe. It has been noted that the TeV flux of PWNe does not correlate with the spin-down luminosity of their embedded pulsars and it is currently unclear whether there is any correlation between the TeV surface brightness of the PWNe and the spin-down luminosity of the associated pulsar. We will present first results from an emission code that models the spectral energy density (SED) of a PWN by solving the Fokker-Planck transport equation. Although models such as these have been developed before, most of them model the geometry of a PWN as that of a single sphere. We have created a time-dependent, multi-zone model to investigate changes in the particle spectrum as the particles diffuse through the PWN, as well as the predicted radiation spectrum at different positions in the PWN. We will use the model to fit observed spectra of several PWNe that are not point sources, incorporating data from the High Energy Stereoscopic System (H.E.S.S.) as well as radio and X-ray experiments. Once the model has been calibrated, we will perform a population study to probe a potential relationship between the TeV surface brightness and the spin-down luminosity of the embedded pulsar.

236 - Resonance features of stack of long Josephson junctions

Theoretical - Thursday 10 July 2014 15:00 *[For award: PhD]*

Primary author: *RAHMONOV, Ilhom (Joint Institute for Nuclear Research)*
Co-author: *SHUKRINOV, Yury (JINR)*

The layered high-Tc anisotropic superconducting materials as $Bi_2Sr_2CaCu_2O_{\{8+\delta\}}$ can be considered as a stack of coupled Josephson junctions (JJ) [1]. Recently discovered quite intense coherent terahertz electromagnetic radiation from the system of intrinsic JJ provides wide possibilities for various applications [2,3]. The radiation is associated with a certain region in the current–voltage characteristic where parametric resonance has been observed [4,5]. Until now parametric resonance was investigated for the stack of short JJ, which length is a less then Josephson penetration depth. Most of the experimental results are connected with long JJ, (for long JJ its length is more than Josephson penetration depth). Therefore, the investigation of stack of long JJ is an actual problem.We investigate the phase dynamics of the stack of long JJ with inductive and capacitive couplings. The current--voltage characteristics (CVC) of JJ stack and the spatiotemporal dependence of electtric charge in superconducting layers and magnetic field in the JJ were calculated. We have shown that in the system of long JJ arises longitudinal plasma wave and realize parametric resonance too. It has been demonstrated that in the stack of long JJ LPW and fluxons arises simultaneously.[1] R. Kleiner, F. Steinmeyer, G. Kunkel and P. Muller, Phys. Rev. Lett. **68**, 2394 (1992).[2] A. A. Yurgens, Supercond. Sci. Technol. **13**, R85 (2000).[2] L. Ozyuzer et al, Science **318**, 1291 (2007).[3] T. M. Benseman, A. E. Koshelev et al, Phys. Rev. B **84**, 064523 (2011).[4] Yu. M. Shukrinov, F. Mahfouzi, Phys. Rev. Lett. **98**, 157001 (2007).

238 - Cluster Model Analysis of Exotic Decay in Actinide Nuclei

NPRP - Friday 11 July 2014 10:00 *[For award: MSc]*

Primary author: *DU TOIT, Erasmus (Stellenbosch University)*

The binary cluster model is used to investigate the properties of exotic structures and decays in various nuclei. Cluster structures in nuclei are currently being investigated throughout the field of nuclear physics, and although alpha-like structures are well-known to form, the investigation into the formation of exotic clusters are equally important in understanding the nuclear force and nuclear structure.A simple method is described to determine the possible exotic clusters forming within the parent nucleus, by assuming the nucleus consists of a mixture of up to four different core-cluster pairs. A phenomenological potential is then used, with optimized parameters, to calculate exotic decay half-lives, reduced electromagnetic transition probabilities, and energy spectra by making use of a previously published description of the binary cluster model. The range of nuclei tested includes the even-even nuclei $^{222\text{-}232}$Th, $^{230\text{-}234}$U, $^{236\text{-}240}$Pu and $^{222\text{-}224}$Ra. We found that almost all experimentally observed heavy ion emissions are predicted within the model, with calculated half-lives within a factor 3 of the experimental half-lives for at least half of the nuclei. Good agreement in the calculated values were also found for the other structure observables.

243 - Quark-Gluon Plasma Physics from String Theory

Theoretical - Tuesday 08 July 2014 15:20

Primary author: *MORAD, Razieh (University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

The goal of high-energy nuclear physics is to create and study quark-gluon plasma (QGP), the predicted deconfined state of QCD matter at energy densities greater than ~1 GeV/fm^3 that permeated the universe a microsecond after the Big Bang. Contrary to original expectations, the properties of the QGP seem best described by the strong-coupling, phenomenological string theory methods of the AdS/CFT correspondence instead of the usual weak-coupling, Feynman diagram methods of perturbative QCD (pQCD). In particular, the AdS/CFT paradigm predicts a very small value for the viscosity to entropy ratio of the QGP, in remar kable agreement with data collected from the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC). In search of a consistent description for all observables related to QGP, we extend the AdS/CFT theory to that of high-momentum probes of the plasma and compare our results to data from RHIC and LHC.

247 - Spectral studies of Flat Spectrum Radio Quasars: constraining models at GeV energies

Astro - Wednesday 09 July 2014 11:50

Primary author: *BRITTO, Richard (University of Johannesburg)*
Co-authors: *RAZZAQUE, Soebur (University of Johannesburg); LOTT, Benoit (Centre Etudes Nucléaires de Bordeaux Gradignan)*

Active Galactic Nuclei (AGNs) at the centres of distant galaxies are understood to be powered by the gravitational energy of supermassive black holes accreting matter from their surroundings and releasing extraordinary amounts of energy through two symmetric jets of ultrarelativistic particles and photons. Blazars are a class of AGNs with one jet directed towards us. A subclass of them are called Flat Spectrum Radio Quasars (FSRQ), which are among the brightest AGNs and have been detected up to redshift z > 3. We have analysed 5.5 years of data (2008-2014) from the Large Area Telescope (LAT) of the Fermi gamma-ray space observatory and performed spectral analysis of bright FSRQs in the 100 MeV-200 GeV energy range. Our studies focus on the spectral features in the GeV domain in connection with different models of gamma-ray emission. This emission might be produced inside the so-called broad line region, filled with gas clouds. We investigate the constraints given by the opacity of radiation fields inside the broad line region.

252 - SHELS - Separator for Heavy ELement Spectroscopy. First results.

NPRP - Tuesday 08 July 2014 11:50

Primary author: *POPOV, Yury (JINR)*
Co-authors: *JONES, Pete (iThemba LABS); NTSHANGASE, Sifiso Senzo (University of Cape Town / iThemba LABS); MULLINS, Simon (iThemba LABS (Gauteng))*

Within the past 15 years, the recoil separator VASSILISSA has been used for the investigations of evaporation residues (ERs) produced in heavy ion induced complete fusion reactions. In the course of the experimental work a bulk of data on ERs formation cross sections, synthesized in asymmetric reactions was collected.With γ and β detector arrays, installed at the focal plane of the VASSILISSA separator, detailed spectroscopy of Fm - Lr isotopes was performed during last 5 years.Accumulated experience allowed us to perform ion optical calculations and to design the new experimental set up, which will collect the base and best parameters of the existing separators and complex detector systems used at the focal planes of these installations.New experimental set up (SHELS, the velocity filter) on the basis of existing VASSILISSA separator was developed for synthesis and studies of the decay properties of heavy nuclei. In May - July 2013 first test experiments were performed. At the focal plane of the separator GABRIELA set up was installed. Beam of ^{22}Ne from U400 cyclotron and Au, ^{198}Pt, ^{206,208}Pb and ^{238}U targets were used in test experiments. For evaporation residues from reactions with Au and ^{198}Pt targets transmission efficiency about 5 % was obtained.In November 2013 test experiments with accelerated 50Ti were performed. With ^{164}Dy and ^{208}Pb targets transmission efficiency for evaporation residues and suppression factors for scattered Ti beam were studied.

255 - Effect of xenon (Xe) 167 MeV Irradiation on Un-implanted 6H-SiC and Poly-SiC implanted with iodine (I), krypton (Kr) and xenon (Xe) at room temperature

DPCMM2 - Tuesday 08 July 2014 14:40 *[For award: MSc]*

Primary author: *MABENA, Chemist (University of Pretoria)*

The effect of swift heavy ion (Xe+26 167 MeV) irradiation on unimplanted 6H-SiC and polycrystalline SiC, implanted with 360 keV I, Kr and Xe ions at room temperature was investigated using Raman spectroscopy, Rutherford backscattering spectrometry (RBS) and RBS in channelling mode (RBS-C). Unimplanted and implanted samples were irradiated with 167 MeV Xe+26 ions to fluences of 5x1012 cm-2, 1x1013 cm-2, 5x1013 cm-2, 2x1014 cm-2, 3x1014 cm-2, 6.3x1014 cm-2, 8.3x1014 cm-2 at room temperature. Irradiating the unimplanted sample at these fluences created point defects while slight annealing of the amorphised layer (due to the implantation of the 3660 keV ions) took place on the initially implanted sample. No diffusion of the implanted diffusion fission products was observed. Shifts of the implanted fission product profiles towards the surface were observed at higher fluences.

256 - Validation of the performance of Geant4 in the simulation of neutron induced reactions relevant to reactor studies.

NPRP - Friday 11 July 2014 11:30 *[For award: MSc]*

Primary author: *MUDAU, Rotondwa (UJ)*
Co-authors: *CONNELL, Simon (UJ); MURONGA, Azwinndini (UJ)*

Geant4 is a Monte Carlo simulation toolkit that is used for the simulation of particles through matter. It was developed at CERN for high energy physics. The Evaluated Nuclear Data File, ENDF/B-VII database is included in the simulation toolkit, making it feasible to use the Geant4 toolkit for low energy neutron-physics simulations. The ENDF/B-VII database is a database that stores evaluated nuclear reaction data files from the major evaluated libraries. In this presentation Geant4 was used to perform simple single event neutron scattering simulations on materials that are typical for a nuclear reactor. Specifically, the materials used are found in the SAFARI1 reactor that at Necsa, Pelindaba. These include Aluminium, Carbon, Beryllium, Uranium and Water. This was done in order to validate the Geant4 implementation of primary processes relevant to reactor studies within the ENDF/B-VII database of reaction cross sections.

257 - Elastic constants of Cr3C2 thin films by surface Brillouin scattering investigations

DPCMM1 - Friday 11 July 2014 10:20

Primary author: *WAMWANGI, Daniel (University of the Witwatersrand)*
Co-authors: *SUMANYA, Clemence (Chinhoyi University of Technology); WITTKOWSKI, Thomas (I.E.E. Luxembourg); COMINS, John Darrell (University of the Witwatersrand)*

Thin hard films of transitional metal carbides have continued to be extensively investigated due to their widespread application as protective coatings. This is made possible by their excellent properties such as high hardness, high melting temperature, and chemical inertness under extreme environments. In this work, we investigate the propagation of surface acoustic wave and determine the elastic constants of Cr3C2 films on (001) Si. Cr3C2 thin films were deposited on etched (001) Si at a working gas pressure of 1.0 x10-3mbar and sputter power of 175W. The deposition rate, film density and interfacial roughness have been determined using X-ray Reflectometry (XRR). Surface Brillouin studies have shown the presence of Sezawa waves which indicate high film quality and low surface roughness as confirmed by X-ray Reflectometry. The dispersion curves have been used to extract the elastic constants to C11 = 275GPa, C33= 370GPa, C55= 86.9GPa and C13= 101GPa. The low values of the elastic constants are attributed to the microstructure of sputtered thin film which is less dense than the single crystal. The elastic anisotropy of the film shows that it is stiffer in direction perpendicular than parallel to the film (c11/c33 < 1) which is characteristic of thin films that have a columnar growth structure based on the zone structure model [1-2].Keywords: elastic constants, transitional metal carbides, surface Brillouin scattering.References1.T. Wittkowski, J. Jorzick, K. Jung, B. Hillebrands, Elastic properties of thin h-BN films investigated by Brillouin light scattering, Thin Solid Films, 353 (1999) 1372.J.A. Thornton, J. Vac. Sci. Technol. 11 (1974) 666.

261 - Twisting photons: The role of POAM in Astrophysics

Astro - Wednesday 09 July 2014 10:20

Primary author: *NICOL, Peter (University of Johannesburg)*
Co-author: *COLAFRANCESCO, Sergio (University of the Witwatersrand)*

The total angular momentum of a photon field can be decomposed canonically into spin and an orbital parts. This decomposition is gauge invariant. Methods are now available for measuring the orbital angular momentum of light. These allow measurement the orbital angular momentum of a single photon, as well as of a beam. Little use has been made of the techniques in astrophysics. If used, they might unlock an as yet untapped source of information about distant sources.Orbital angular momentum can be produced in a beam of light of known polarisation by passing the beam through a spiral phase plate in the direction of its with optical axis. It has been suggested that inhomogeneous media may produce orbital angular momentum in an analogous way. A simple spiral phase plate model may thus be useful in studying plasma vortices in cosmic structures such as astrophysical jets, AGN's, turbulent plasma in galaxies and galaxy clusters, and the vorticity field of the CMB. This paper discusses some general features of POAM, gives a mathematical description of the action of a spiral phase plate and shows how it might be used as a model in astrophysical studies.

263 - Laser spectroscopy studies of the recrystallization of an amorphous layer in GaAs produced by argon ion implantation at ~77 K

DPCMM1 - Tuesday 08 July 2014 11:50 *[For award: PhD]*

Primary author: *JAKATA, Kudakwashe (University of the Witwatersrand)*
Co-authors: *ERASMUS, Rudolph (University of the Witwatersrand); WAMWANGI, Daniel (University of the Witwatersrand); NAIDOO, Shungamun Ramsammy (University of the Witwatersrand); COMINS, Darrell (University of the Witwatersrand)*

Recrystallization of an amorphous layer of GaAs on a crystalline GaAs substrate formed by argon-ion bombardment at 100 keV has been investigated using surface Brillouin scattering and Raman spectroscopy. Two samples were implanted at doses of 1×10^{15} ions/cm^2 and at 2×10^{14} ions/cm^2, both at a temperature of ~77 K. Surface Brillouin scattering (SBS) and Raman scattering have been used to study the isochronal annealing of these two samples. It has been found that the stiffening of the elastic constants as measured with SBS begins at around 120 ^{o}C and reaches a maximum at 260 ^{o}C for both samples. Using the Raman technique, it has been observed that the recrystallization of the higher dose implanted sample occurs at around 260 ^{o}C compared to 240 ^{o}C for the 2×10^{14} ions/cm^2 implant. These measurements are compared to previous results obtained on implantations at temperatures of ~ 65^{o}C.

264 - Exploring the spectroscopy of vibrational levels in the trasitional rare earth region

NPRP - Thursday 10 July 2014 11:30 *[For award: PhD]*

Primary author: *MAJOLA, Siyabonga (UCT/ iThemba Labs)*
Co-authors: *BARK, Robert (iThemba LABS); MAKHATHINI, Lucky (University of Zululand, stellenbosch and iThemba labs); MULLINS, Simon (iThemba LABS (Gauteng)); JONES, Pete (iThemba LABS); NONCOLELA, Sive (UWC); BVUMBI, Suzan Phumudzo (University of Johannesburg); NTSHANGASE, Sifiso Senzo (University of Zululand); DINOKO, Tshepo (Student); SHIRINDA, OBED (iThemba LABS); LAWRIE, Elena (iThemba LABS); KHESWA, Bonginkosi (iThemba LABS)*

Vibrational levels are well known in atomic nuclei but despite many decades of research, some of their properties still remains elusive. In particular, the low-lying rotational bands based on the second 0+ state, which are traditionally understood as beta-vibrational bands nevertheless show properties at odds with this interpretation. For example, neutron transfer reactions in the N~90 region do not support this interpretation. An alternative is that they can better be described as a "second vacuum", or a coexisting minimum in the pairing degree of freedom. In a search for the picture that best describes the nature of the first excited 0+ states in the 160 mass region (N~90), a comprehensive analysis is being undertaken on thedata taken using the Jurogam II array in Jyvaskyla, Finland for 157Dy. The status of the analysis and results from this experiment will be discussed.

265 - Dynamics of processive and non-processive molecular motors on filaments

Theoretical - Friday 11 July 2014 10:00

Primary author: *MÜLLER-NEDEBOCK, Kristian (University of Stellenbosch)*

Molecular machines can move along biological filaments in specific directions. This can result in transportation of cargo but also in the motion of the filaments themselves. Such active systems have been the object of intense study in recent years. We present a formalism that is able to address the collective motion of motors along filaments accounting for motors that stay predominantly attached and moving in a certain direction but also motors that detach individually after the power stroke. The model allows for characterisation of the effects when motors might interact with each other on the filament. As an interesting case we also address the possibility of motors in an assay causing twirling of the filament,

266 - Accretion processes in cataclysmic variables: Insights from optical transient surveys

Space - Thursday 10 July 2014 15:00 *[For award: PhD]*

Primary author: *MOTSOALEDI, Mokhine (South African Astronomical Observatory)*
Co-authors: *BUCKLEY, David (Southern African Large Telescope); WOUDT, Patrick (University of Cape Town); WARNER, Brian (University of Cape Town); POTTER, Stephen (SAAO)*

Cataclysmic variables (CVs) are mass transferring binary stars consisting of a low mass main sequence (MS) donor star and an accreting white dwarf star. AM CVn stars are a subclass of cataclysmic variables which have helium-rich donors (a white dwarf, a helium star or an evolved MS star). Their most defining features are their ultra-short orbital periods and helium-dominated spectra. The presence of a strong magnetic field would affect the trajectory of the mass flow, causing it to follow a stream along the magnetic field lines on to the magnetic poles of the white dwarf. An intermediate polar would truncate the accretion disc on the inside whereas a polar prevent an accretion disc from forming at all. The Catalina Real-time Survey (CRTS) is a synoptic transient survey which detects transients that vary in brightness over 2 mags over a large area of sky. In the past 15 years, wide area surveys such as the CRTS have greatly increased the number of known CVs (> 1000). The nine year observing baseline of the CRTS makes it suitable for identifying magnetic CVs from their low-to-high state transistions, or vice versa. I observed sources from the CRTS at the South African Astronomical Observatory in Sutherland. I've discovered 3 new AM CVns (~10% of the known AM CVns) and I'm currently exploring ways to identify and characertise magnetic CVs from the CRTS.

268 - Homogeneous Open Quantum Walks on a Line

Theoretical - Wednesday 09 July 2014 14:20

Primary author: *CABALLAR, Roland Cristopher (NIThеP, University of KwaZulu-Natal, and University of the Philippines, Diliman)*
Co-authors: *SINAYSKIY, Ilya (NIThеP/University of KwaZulu-Natal); PETRUCCIONE, Francesco (UKZN)*

We examine homogeneous open quantum walks along a line, wherein each forward step is due to one quantum jump operator, and each back- ward step due to another quantum jump operator. These two quantum jump operators may or may not commute with each other. We show that if the system has N internal degrees of freedom, we can obtain exact probability distributions which fall into two distinct classes, namely Gaussian distributions and solitonic distributions. The resulting probability distribution allows us to analytically determine the asymptotic behavior of the system undergoing this open quantum walk.

273 - Characterization of Potentially Hazardous Near-Earth Asteroids

Astro - Thursday 10 July 2014 11:10

Primary author: THROOP, Henry (University of Pretoria)
Co-author: MORRIS, Daniel (University of Pretoria)

In recent years, automated surveys have discovered several thousand near-earth asteroids (NEAs) whose orbits cross that of the Earth. Many of these are potentially hazardous due to their collision risk with Earth, as evidenced by the K-T impactor 65 Mya, and the Chelyabinsk impactor over Russia in February 2013. However, very little is known about the size, composition, or history of the vast majority of these discovered objects. Here we report on results of 7 night of observations of NEAs from the SAAO 1m telescope at Sutherland. We expect to present light curves and inferred physical properties for roughly 10 never-before studied NEAs, and present improved orbital elements for a similar number of objects.Our results will help inform future NASA-SA collaboration on NASA's 'Asteroid Grand Challenge' program. This work is supported by NASA.

277 - Study of the Isovector Giant Dipole Resonance across the neodymium and samarium isotope chains from spherical to deformed nuclei using (p,p') scattering at 200 MeV

NPRP - Wednesday 09 July 2014 14:00 *[For award: PhD]*

Primary author: DONALDSON, Lindsay (University of the Witwatersrand)
Co-authors: BUTHELEZI, Zinhle (iThemba LABS); STEYN, Deon (iThemba LABS); TAMII, A (Research Center for Nuclear Physics, Osaka University); CARTER, John (University of the Witwatersrand); USMAN, Iyabo (University of the Witwatersrand, Johannesburg.); SWARTZ, Jacobus (Stellenbosch University); COOPER, G. R. J. (University of the Witwatersrand); FEARICK, Roger (University of Cape Town); FÖRTSCH, Siegfried (iThemba LABS); FUJITA, Hiro (Research Center for Nuclear Physics, Osaka University); FUJITA, Y (Department of Physics, Osaka University); MIRA, Joele (iThemba LABS); JINGO, MAXWELL (UNIVERSITY OF THE WITWATERSRAND); KUREBA, Chamunorwa Oscar (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa); NEMULODI, Fhumulani (University of Cape Town); VON NEUMANN-COSEL, P (Institut fur Kernphysik, Technische Universitat Darmstadt); NEVELING, Retief (iThemba LABS); PAPKA, Paul (Stellenbosch University); RICHTER, A (Institut fur Kernphysik, Technische Universitat Darmstadt); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); SMIT, Frederick David (iThemba LABS)

Fine structure in the energy region of the Isovector Giant Dipole Resonance (IVGDR) from spherical to deformed neodymium isotopes ($^{142, 144, 146, 148, 150}$Nd) has been observed in high energy-resolution proton inelastic scattering experiments for E_p = 200 MeV at zero degrees using the K600 magnetic spectrometer of iThemba LABS. This investigation is being extended to include the samarium isotope chain. The analysis of the (p,p■) scattering data on 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. 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. As such, comparisons between ^{148}Nd and ^{150}Sm as well as between ^{150}Nd and ^{152}Sm, which are isotones in the transitional region, will provide further insight into the nature of the transition region itself and will allow for an investigation into the change in characteristic energy scales in the region where the onset of deformation is seen. Double differential cross-sections have been obtained for the neodymium isotope chain, paying particular attention to the reliability of the instrumental background subtraction. A comparison to photo-absorption data has been made and a preliminary wavelet analysis has been completed. These results will be presented, along with some theoretical aspects with respect to the comparison between neodymium and samarium isotopes.

278 - The evaluation and simulated performance of the potential current produce from Multi-junction cells.

Applied - Thursday 10 July 2014 10:00 *[For award: PhD]*

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

Concentrator photovoltaic (CPV) devices comprise of a number of semiconductor materials, with multiple series-connected junctions monolithically integrated. These devices offer a higher absorption of energy from a wider spectral range than that of conventional photovoltaic (PV) cells. This is achieved by means of the monolithically stacked junctions having there own specific spectral response absorbing in different wavelength regions. However, due to a CPV device consisting of series-connected junctions, it can become current limited by the underperformance of any of the junctions. Under standardized operating conditions, most of the device's junctions current densities are well matched. However, under operation in the field, the influence of the optical system as well as the dynamic change of the solar spectrum can result in varying amounts of current mismatch due to different junctions producing uneven currents. In this paper, the influence of the optical components used in a High Concentrator Photovoltaic (HCPV) module employing a commercial Concentrator Triple Junction (CTJ) cell while operation under outdoor conditions will be discussed. From the performance analysis of the CTJ cells, recommendations will be made to offset the loss mechanisms and to optimize the performance of a multi-junction cell. Additionally, simulations preformed on other multi-junction devices will also be discussed and shown how the CTJ device's performance can be improved.

280 - Influence of lightning on electron density in the ionosphere using WWLLN lightning data, Ionosonde data and GPS data

Space - Tuesday 08 July 2014 11:50 *[For award: MSc]*

Primary author: AMIN, Mahmud Mohammed (SANSA/UCT)
Co-authors: CILLIERS, Pierre (SANSA/UCT); INGGS, Michael (UCT)

Lightning data from World-Wide Lightning Location Network (WWLLN) and GPS datafrom Trignet have been analysed to ascertain the influence of lightning on total electroncontent (TEC) in the F2 region of the ionosphere over southern Africa. In this study,data from four dual frequency GPS reference stations in regions with different lightningactivity levels within South Africa have been used. The analysis reveal periods of TEC en-hancement between 3-12 TECU on geomagnetic "quiet" days which correspond to periodsof intense lightning activity in the regions. One of the hypotheses for this link betweenatmospheric weather and ionospheric activity is that the enhancement of TEC is causedby the infiltration of energy dissipated by lightning discharges in the troposphere into theF2 region.

281 - Characterization of BiFeO3 thin films for Surface Brillouin Scattering Investigation

DPCMM1 - Wednesday 09 July 2014 10:00 *[For award: MSc]*

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

BiFeO3 is a multiferroic material that exhibits magneto-electric coupling well above room temperature. 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 to determine the effect of stress evolution and relaxation in BiFeO3 thin films. X-ray Reflectometry and Grazing incidence X-ray diffraction have been used to determine film thickness, interfacial roughness and film density for extraction of velocity dispersion curves and phase determination. Atomic force microscope (AFM) has yielded low surface roughness values 0.2to 2.5nm indicating high film quality. 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

283 - Enhanced light harvesting and conversion efficiency by plasmonic Ag nanoparticles incorporated in organic photovoltaics

Applied - Friday 11 July 2014 11:50

Primary author: RANGANATHAN, Kamalakannan (University of the Witwatersrand)
Co-authors: WAMWANGI, Daniel (University of the Witwatersrand); COVILLE, Neil (University of the Witwatersrand)

Energy harvesting by photovoltaic (PV) solar cells is a promising technology for future energy requirements. In the energy harvesting process, organic PVs (OPVs) show promising potential because of their capability to be incorporated with various nanomaterials in a cost effective way when compared to present day inorganic based PVs. The main bottle-neck for OPVs are to achieve higher power conversion efficiency (PCEs), which is a trade-off between the amount of light absorption, efficient photo-generation of electrons/holes and their charge transport to the respective electrodes. To overcome these difficulties nanoplasmonics has emerged recently as a new frontier in OPV research [1]. Noble metal nanostructures that can concentrate, scatter and guide light have demonstrated great capability for dramatically improving the PCE. In the present study Ag nanoparticles are incorporated with hole transport layer (HTL). Here, commercially available PEDOT: PSS and as synthesized reduced graphene oxide (rGO) are used as HTL for OPV devices. Plasmonic absorption of Ag nanoparticles are studied by UV-Vis spectroscopy. The absorption wavelength was found to be tuned by size, coverage and geometry of the Ag nanoparticles. To demonstrate the effect of plasmonics in OPVs, a photoactive layer (P3HT:PCBM blend) has been spin coated on HTL layer followed by thermally evaporated Al electrode. The device properties are analysed by J-V measurements and the results are discussed with evaluated parameters and compared against a pristine device. Reference[1] M. Gu, Z. Ouyang, B. Jia, Nicholas Stokes et al., Nanophotonics 1 (2012) 235

285 - The effect of an offset-dipole magnetic field on the Vela pulsar's gamma-ray light curves

Astro - Friday 11 July 2014 11:10

Primary author: BREED, Monica (North-West University)
Co-authors: HARDING, Alice (NASA); JOHNSON, Tyrel (Naval Research Laboratory, USA); VENTER, Christo (North-West University)

The field of gamma-ray pulsars has been revolutionized by the launch of Fermi Large Area Telescope in June 2008. Over the past six years, Fermi has detected 147 gamma-ray pulsars and measured their light curve profiles and spectral characteristics. Fermi has recently released its Second Pulsar Catalog describing the properties of some 117 of these pulsars in the energy range 100 MeV to 100 GeV. Increased statistics are enabling the discovery of a variety of light curve trends and classes. Such diversity hints at distinct underlying magnetospheric and/or emission geometries. We implemented an offset-dipole magnetic field, with an offset characterized by a parameter epsilon, in an existing geometric pulsar modelling code which already includes static and retarded dipole fields. We used these different B-field solutions in conjunction with standard emission geometries, namely the two-pole caustic (TPC) and outer gap (OG) models, and constructed phase plots and light curves for several pulsar parameters. We compared our model light curves with the newest Vela data. We refined our chi-squared method to search for best-fit light curves for each of the different models with four free model parameters, including inclination angle, observer angle, zero phase and normalization (with epsilon chosen beforehand), in order to assess the significance of our best-fit light curve and the inferred geometric parameters. Using this method, we infer the most probable configuration, thereby constraining Vela's high-altitude magnetic structure and system geometry.

287 - Fine structure of the Isovector Giant Dipole Resonance from light to heavy-mass nuclei and 1^- level densities using (p,p') scattering at zero degrees

NPRP - Wednesday 09 July 2014 14:40

Primary author: JINGO, Maxwell *(University of the Witwatersrand)*
Co-authors: *KUREBA, Chamunorwa Oscar (University of the Witwatersrand); MURRAY, Sean (iThemba LABS); NEUMANN-COSEL, P. von (Technische Universitat Darmstadt); NEVELING, Retief (iThemba LABS); NEWMAN, Richard (Stellenbosch University); PAPKA, Paul (Stellenbosch University); POLTORATSKA, I. (Technische Universitat Darmstadt); RICHTER, A. (Technische Universitat Darmstadt); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); SMIT, Frederick David (iThemba LABS); SWARTZ, Jacobus (Stellenbosch University); BUTHELEZI, Zinhle (iThemba LABS); TAMII, A. (Osaka University, Japan); COOPER, G. R. J. (University of the Witwatersrand); STEYN, Deoin (iThemba LABS); USMAN, Iyabo (University of the Witwatersrand); CARTER, John (University of the Witwatersrand); CONRADIE, Lowry (iThemba Labs); FEARICK, Roger (University of Cape Town); FÖRTSCH, Siegfried (iThemba LABS); FOURIE, D. T. (iThemba LABS) ; HEILMANN, A. M. (Technische Universitat Darmstadt); MIRA, Joele (iThemba LABS)*

A survey of the fine structure phenomenon of the Isovector Giant Dipole Resonance (IVGDR) was carried out, using proton inelastic scattering for an incident energy of 200 MeV separated sector using the cyclotron at iThemba LABS and the K600 magnetic spectrometer at zero degrees for a wide target-mass range of closed and near-closed shell nuclei: ^{27}Al, ^{40}Ca, ^{56}Fe, ^{58}Ni and ^{208}Pb. A background subtraction procedure which eliminates the contributions due to the Isoscalar Giant Quadrupole Resonance (ISGQR), Isovector Giant Quadrupole Resonance (IVGQR), quasi-free scattering and the phenomenological background effects was implemented before the experimental cross-section data were converted into equivalent photo-absorption cross-sections. The obtained equivalent photo-absorption cross-sections were then compared with photo-nuclear data available in the literature. Characteristic energy scales from both the experimental data and state-of-art QPM calculations of the IVGDR were extracted using the wavelet analysis technique. In addition, experimental level densities of $J^{\pi} = 1^-$ states were extracted using the fluctuation analysis method. The method utilises the autocorrelation function which is a key tool in obtaining a measure of the cross-section fluctuations with respect to a stationary mean value. It also makes use of the Discrete Wavelet Transform (DWT) analysis which is crucial in removing the remaining physical background from other multipoles excited and any remaining instrumental background. The experimentally extracted level densities were then compared with different theoretical parameterisations of the Hartree Fock-Bogoliubov (HFB), Hartree Fock-Bardeen-Cooper-Schrieffer (HF-BCS) and Back shifted Fermi Gas model (BSFG). Capabilities and limitations of the recently commissioned zero-degree facility of the K600 magnetic spectrometer will be discussed.

288 - A Different Approach to the Perturbation of Astrophysical Fluids

Astro - Wednesday 09 July 2014 14:40

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

We show that Eulerian and Lagrangian perturbations can be interpreted as finite differences that arise from suitably defined differential operators. These operators lead to exact rather than to approximate perturbation relations and equations. The equations obtained are more general than those usually encountered, and are de facto linear. No approximation is thus needed to linearise them. We also explore the possibility of extending this formalism to the description of stellar pulsations of arbitrary amplitude without using power series expansions.

289 - Nuclear deformation effects on fine structure of the Isoscalar Giant Quadrupole Resonance and 2^+ level densities from (p,p') scattering at 200 MeV

NPRP - Wednesday 09 July 2014 14:20

Primary author: KUREBA, Chamunorwa Oscar *(University of the Witwatersrand)*
Co-authors: *CARTER, John (University of the Witwatersrand); FOURIE, Dirk (iThemba Labs); HEILMAN, Anna-maria (TU Darmstadt); KRUGMANN, Andreas (TU Darmstadt); MABIALA, Justin (Stellenbosch University/iThemba LABS); MIRA, Joele (iThemba LABS); MURRAY, Sean (iThemba LABS); VON NEUMANN-COSEL, Peter (TU Darmstadt); NEWMAN, Richard (Stellenbosch University); PAPKA, Paul (Stellenbosch University); SMIT, Frederick David (iThemba LABS); NEVELING, Retief (iThemba LABS); STEYN, Deoin (iThemba LABS); SWARTZ, Jacobus (Stellenbosch University); TAMII, Atsushi (Osaka University, Japan); RICHTER, Achim (TU Darmstadt); COOPER, Gor don R. J (University of the Witwatersrand); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); USMAN, Iyabo (University of the Witwatersrand); JINGO, Maxwell (University of the Witwatersrand); BUTHELEZI, Zinhle (iThemba LABS); CONRADIE, Lowry (iThemba Labs); FEARICK, Roger (University of Cape Town); FÖRTSCH, Siegfried (iThemba LABS)*

A systematic experimental investigation was performed of the phenomenon of fine structure, with emphasis on the region of the Isoscalar Giant Quadrupole Resonance (ISGQR), for nuclei across the neodymium isotope chain. The 200 MeV proton beams were delivered by the Separated Sector Cyclotron (SSC) facility of iThemba LABS. Measurements were made using the state-of-the-art K600 magnetic spectrometer, where unique high energy-resolution ($\Delta E \approx$42 - 48 keV FWHM) proton inelastic scattering results were obtained on ^{142}Nd, ^{144}Nd, ^{146}Nd, ^{148}Nd and ^{150}Nd targets. The stable even-even neodymium (Z = 60) isotopes are used to investigate the influence of the onset of deformation on the excitation energy spectra in the ISGQR region ($9 \leqslant E_x \leqslant 15$ MeV), since they extend from the semi-magic N = 82 nucleus (^{142}Nd) to the permanently deformed N = 90 (^{150}Nd) nucleus. In order to emphasize the ISGQR in the measured excitation energy spectra, a Discrete Wavelet Transform (DWT) background subtraction was carried out. A comparison of the resonance widths extracted shows a systematic broadening of the ISGQR (Γ = 3.220 MeV to 5.100 MeV), moving from spherical ^{142}Nd to highly deformed ^{150}Nd nuclei as has already been observed for the Isovector Giant Dipole Resonance (IVGDR) excited by γ-capture.; State of the art theoretical microscopic Quasiparticle-Phonon Model (QPM) calculations were performed for the ISGQR and for ^{142,144,146}Nd. Characteristic energy scales, extracted using the Continuous Wavelet Transform (CWT) technique, allowed a comparison to be made between the experimental data and theoretical predictions in order to determine the dominant damping mechanisms. In addition, experimental level densities of $J^{\pi} = 2^+$ states were extracted from the measured data using the fluctuation analysis technique. Comparisons will be made with the latest theoretical models with reference to the limitations of the method.

290 - The influence of backwash on problem-solving

Education - Tuesday 08 July 2014 14:00

Primary author: CLERK, Douglas *(University of the Witwatersrand)*
Co-author: *NAIDOO, Deena (University of the Witwatersrand)*

Over the last few years there has been much tea-time talk and inter-university debate about the poorly developed problem-solving skills of new first-year Physics students. This supposed deficiency in problem-solving ability begs three questions: the first is 'what is problem solving?' A definition has been adopted from the literature. The second is: 'is there evidence supporting the reality of the student's deficient problem solving skills?' The third is: 'what could be causing the deficiency?' An on-going study has both produced evidence for the problem-solving deficiency and a suggested possible causal mechanism. The candidate mechanism proposed here is the feedback called variously 'backwash', 'washback', and the 'testing effect' in the relevant body of literature. These terms refer to a feedback mechanism in which past assessment influences future teaching and learning and hence also future assessment. First year tests and examinations in physics have for the past several years been subjected to a detailed analysis in which each question is classified according to a typology currently under development. The mark awarded to the student in each question is averaged as a measure of the group performance for that question. This allows one to deduce the type of question commonly probed and the students' average performance for each question type. The most commonly used question type has consistently been the routine operation which has yielded consistently good results. By contrast, true problem solving has regularly accounted for a smaller fraction of each examination resulting in weaker performances. A parallel analysis of the Matric examination over the same period revealed similar patterns i.e. routine operation is examined more extensively than the true problem. This feeds back the message to students and teachers alike that the most important type of question is the routine operation for which the bulk of the marks are awarded hence candidates can pass comfortably or even well, by focusing on this approach. Limited - if any - proficiency at true problem solving is necessary, hence there is no real necessity to learn or teach it.

292 - Unique magnetic properties in simple metals

DPCMM1 - Wednesday 09 July 2014 11:10

Primary author: PRINSLOO, Aletta *(University of Johannesburg)*
Co-author: *SHEPPARD, Charles (University of Johannesburg)*

Antiferromagnetic (AFM) spin-density-wave (SDW) systems exhibit a wide range of characteristics and phase transitions making them extremely interesting to study. Features include quantum critical behaviour, superconductivity, proximity induced magnetism, spin-glass properties, negative giant magneto resistance (GMR), as well as invar and el-invar qualities. The richness of characteristics makes these materials useful for application in many modern industries using novel materials that can easily be tailored and structured. In addition, many of the fundamental properties of SDW AFM materials can only now be probed further by considering measurements at extreme conditions, such as low temperature, high magnetic fields and pressure. Cr and its alloys are archetypical in the investigation of compounds with an itinerant AFM SDW formation because of electron-hole condensation during the nesting of electron-hole Fermi sheets [1]. The recent discovery that this relatively 'simple' AFM SDW metal can be driven to a quantum critical point by alloying and/or by pressure [2,3,4] reignited investigations into these alloys. Correlations are seen between the relatively simple AFM Cr-alloys and other more complex AFM compounds. One such property is the incommensurate (I) SDW fluctuations seen in the paramagnetic phase in Cr that correlates with the ISDW fluctuations in high temperature superconducting cuprates such as $La_{1-x}Sr_xCuO_4$ [5]. This contribution aims to discuss the richness in the variety of magnetic phases observed in the magnetic phase diagrams of AFM SDW alloy systems, superconducting properties, as well as critical points. Furthermore work on thin films and heterostructures, with reference to Cr and Cr-alloys will be briefly introduced. From recent discoveries it is evident that several areas of research regarding itinerant AFM SDW systems are still developing and more stimulating research on these systems can still be done in future.References:[1] Fawcett et al. Rev. Mod. Phys. 66 (1994) 25 [2] Yeh et al. Nature 419 (2002) 459 [3] Lee et al. Phys. Rev. Lett. 92 (2004) 187201-1 [4] Jaramillo et al. PNAS 107 (2010) 13631 [5] Mason et al. Phys. Rev. Lett. 68 (1992) 1414

299 - Hamiltonian approach to open quantum Brownian motion.

Theoretical - Thursday 10 July 2014 10:00

Primary author: SINAYSKIY, Ilya *(University of KwaZulu-Natal and National Institute for Theoretical Physics)*
Co-author: *PETRUCCIONE, Francesco (UKZN)*

The microscopic derivation of Open Quantum Brownian Motion (OQBM) is presented [1,2]. OQBM is obtained as a special limit (scaling limit) of the recently introduced Open Quantum Walks [3,4]. The quantum master equation for OQBM is derived for a weakly driven system interacting with the decoherent environment. Examples of the dynamics for initial Gaussian and non-Gaussian distributions are presented. [1] M. Bauer, D. Bernard and A. Tilloy, Phys. Rev. A 88(2013), 062340.[2] M. Bauer, D. Bernard and A. Tilloy, The Open QuantumBrownian Motion, math-ph/1312.1600.[3] S. Attal, F. Petruccione and I. Sinayskiy, Phys. Lett. A 376 (2012), 1545.[4] S. Attal, F. Petruccione, C. Sabot and I. Sinayskiy, J. Stat. Phys. 147 (2012), 832.

300 - Digital detection of Bessel-Gauss beams

Photonics - Thursday 10 July 2014 14:00 *[For award: MSc]*

Primary author: *MHLANGA, Thandeka (University of KwaZulu-Natal)*
Co-authors: *TRICHILI, Abderrahmen (University of Carthage); ISMAIL, Yaseera (University of KwaZulu-Natal); ROUX, Filippus S. (CSIR); FORBES, Andrew (CSIR)*

High-order Bessel-Gauss beams (BG) are beams of helical wave front, described by their ■-azimuthally varying phase and their radial wave vector kr. Bessel beams have been extensively studied due to their interesting properties, as they are known to be non-diffractive over a finite region, and their ability to self-reconstruct after encountering an obstruction. These beams carry orbital angular momentum of light of ■ ■ per photon; as a result these modes can be used as a basis for encoding information. The tools to extract the azimuthal information carried by these beams have been introduced, but not much work has been done in the two-dimensional detection of these modes. We illustrate a new method for the two-dimensional detection of the BG modes of arbitrary radial and azimuthal mode indices using digital axicons. We also apply this tool to observe the radial and azimuthal spectrums of the self-reconstructing Bessel beam after encountering an obstruction, and also through optical turbulence. Keywords: orbital angular momentum, two-dimensional detection, digital axicon

301 - Experimentally measured pulse shape signals of the iThemba LABS segmented clover detector.

NPRP - Wednesday 09 July 2014 11:30

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

The iThemba LABS detector is made up of four end-closed coaxial, front tapered, electrically segmented n-type germanium crystals, packed closely together in one cryostat. The dimensions of each crystal are: 60 mm width before shaping and 90 mm long. The cathode of each crystal is electrically segmented into 8 contacts with depth segmentation at 35 mm, implying that the back segments are 55 mm long. This results in a total of 36 electronic channels of which 32 are associated with the outer contacts and 4 with the inner core contacts of the detector. The core contacts provide high resolution measurements of gamma-ray energy whilst the outer contacts yield information about the location of the gamma-ray interaction inside the detector. Trace data showing the shape of the signals on the 36 contacts of the iThemba LABS segmented clover detector can now be acquired using the Pixie 16 digital data acquisition system. A computer program is developed at iThemba LABS to read these complex data. It utilises CERN ROOT [1] environment to visualize traces from the core and segment contacts. Interesting data, showing traces that correspond to different types of gamma-ray interactions will be shown and discussed in this presentation. For example, single-hit events produce charge collection signals, induced signals and cross-talk. The double-hit events though generate signals with more complex features. These signals are often a convolution of charge collection and induced signals in addition to the modification due to the cross talk. In this presentation interesting examples of such measured traces will be discussed.1. Rene Brun and Fons Rademakers, ROOT - An Object Oriented Data Analysis Framework, Proceedings AIHENP'96 Workshop, Lausanne, Sep. 1996, Nucl. Inst. & Meth. in Phys. Res. A 389 (1997) 81-86. See also http://root.cern.ch/

302 - An evaluation of students' understanding of Newtonian Mechanics

Education - Thursday 10 July 2014 10:20

Primary author: *NAIDOO, Deena (University of the Witwatersrand)*
Co-authors: *GOLDSTEIN, Kevin (University of the Witwatersrand); CLERK, Douglas (University of the Witwatersrand)*

The Force Concept Inventory (FCI) pretest comprising of 30 multiple choice questions was administered at the commencement of the academic year to ~950 Engineering students registered for a full-year Mechanics I course. The purpose of the diagnostic assessment was to acquire information on students' prior knowledge of their understanding of basics concepts of Newtonian Mechanics. In addition, this instrument has been utilized to ascertain areas of weakness in students' understanding which could be targeted during the academic year and to evaluate the possibility of applying the test to assess the effectiveness of instruction. The class attained a weak average mark of 33% which is similar to results reported previously. In order to ascertain whether the FCI data gives evidence of any correlation to interactive classroom activities, the results of the first class test based on dimensional analysis, force vectors and vector operations in vector geometry and vector algebra formulation were compared with the FCI responses. We found a roughly linear correspondence with R2~0.16. The classroom activities included the use of "clickers" in the majority of lectures coupled with more focused co-operative group work in tutorial sessions. The class average for the test was ~53% and the pass rate in the region of 56%. Although the test coverage was limited to a very small basic component of Mechanics, a refined analysis shows that students who performed well in the FCI test also produced good class test results – amongst students who got 60% or more for the FCI, the pass rate for the class test was ~88% and of the students who failed the class test, only ~3% got 60% or more for the FCI. Conversely, competence in the class test was not strongly correlated with the FCI test – of the students who passed the class test, only ~16% got 60% or more for the FCI while the class test pass rate amongst students who got less than 60% for the FCI was 52%. It should be noted that students in general performed much better in the class test. In order to validate these preliminary findings, upcoming class tests and examinations scores will be compared with the FCI test results. The impact of teaching and learning will be re-evaluated by conducting a FCI post-test after the completion of the syllabus on statics and dynamics.

304 - Re-evaluation of the cosmic-ray parameters

Space - Tuesday 08 July 2014 14:00 *[For award: MSc]*

Primary author: *MOSOTHO, Moshe Godfrey (North-West University)*
Co-authors: *KRUGER, Helena (North-West University); MORAAL, Harm (North-West University)*

The modulation of galactic cosmic rays at Earth can be calculated using approximate solutions of the Parker Transport equation, as described by the modulation potential φ. Usoskin et al. (2005) calculated φ for a given interstellar spectrum (LIS), by using the force field solution and neutron monitor data since 1951. In reconstructing the cosmic-ray intensity in the distant past, McCracken and Beer (2007) used these modulation potential as well as 10Be data and ionization chambers data and neutron monitor data. In this project we re-evaluate these modulation parameters using updated atmospheric yield functions, as well as the most recent estimates of the LIS derived from Voyager observations.

310 - Seasonal variation of Ionospheric TEC over South Africa during the recent unusual solar minimum between cycle 23 and 24

Space - Tuesday 08 July 2014 11:10

Primary author: *MOEKETSI, Daniel (CSIR)*
Co-author: *VAN DE HEYDE, Valentino (UWC)*

The recent solar minimum between solar cycle 23 and 24 was the unusually long most since 1913. This complexity resulted in many observations effects observed from Sun to Earth by various instruments aboard space exploration missions. In particular, the Sunspot number almost disappeared for the duration of the year-2009. In this paper we report on work in progress to investigate the effects of this on the Earth's Ionosphere parameters over South Africa. For this task, the MAGIC code is applied using data from south African dual frequency Global Navigation Satellite System (GNSS) networks to investigate seasonal variation of ionospheric Total Electron Content (TEC) over the region. The model results will be compared with TEC determined from Ionosonde measurements.

311 - Representation of the Few-Group Homogenized Cross Sections of a MOX Fuel Assembly

NPRP - Friday 11 July 2014 11:10 *[For award: MSc]*

Primary author: *CHIFAMBA, Saymore (University of Johannesburg)*
Co-authors: *MURONGA, Azwinndini (University of Johannesburg); BOTES, Danniëll (NECSA); BOKOV, Pavel M. (NECSA)*

Nodal diffusion methods are often used to calculate the distribution of neutrons in a nuclear reactor core. They require few-group homogenized neutron cross sections for every heterogeneous sub-region of the core. The homogenized cross sections are pre-calculated at various reactor states and represented in a way that facilitates the reconstruction of cross sections at other possible states. In this study a number of such representations were built for the cross sections of a MOX (mixed oxide) fuel assembly via hierarchical Lagrange interpolation on Clenshaw-Curtis sparse grids. Traditionally, nodal reactor core simulators have employed cross sections with two energy groups, but there is evidence that more energy groups are needed to simulate reactor cores that contain MOX. Representations were therefore constructed for both the traditional two energy groups and a six energy group structure. Both the rate at which the representation accuracy improves with the number of samples and the complexity of the cross section dependence on individual state parameters were examined. The anisotropy feature of the representation procedure, which allows more samples to be taken for state parameters that are known to be more important to the representation accuracy than others, was applied throughout. The results show that the representation method allows both two-group and six-group cross sections to be represented in a computationally efficient manner to an industrially acceptable level of accuracy, despite additional complexity in the dependence of six-group cross sections on the state parameters.

314 - Thermodynamics of open quantum systems

Theoretical - Wednesday 09 July 2014 11:10

Primary author: *SEMIN, Vitalii (University of KwaZulu-Natal)*
Co-author: *PETRUCCIONE, Francesco (University of KwaZulu-Natal)*

In this work we study methods of the non-equilibrium thermodynamics. A modification of the methods allows to apply them to open quantum systems. The main feature of these methods is the connection thermodynamical properties and dynamical properties of an open system. The indicated connection is an internal characteristic of the methods and does not depend on details of the dynamical evolution of the system. Thus, the methods allow to study the thermodynamics of an open quantum system with non-markovian evolution. The main ideas of the new approach are illustrated on two open quantum systems, namely, the damped oscillator and the driven two- levels system.

315 - X-ray reflectivity and surface Brillouin studies of rf magnetron sputtered NbN thin films

DPCMM1 - Thursday 10 July 2014 14:20 *[For award: PhD]*

Primary author: *KURIA, Jonah (University of the Witwatersrand)*
Co-authors: *WAMWANGI, Daniel (University of the Witwatersrand); COMINS, John Darrell (University of the Witwatersrand); MSIMANGA, Mandla (iThemba Labs); BILLING, Dave (University of the Witwatersrand)*

NbN thin films have been extensively used as protective coating for cutting tools due to their excellent properties of high melting temperature, and high resistance against oxidation and wear and tear. In this work, NbN thin films were deposited on etched Si(100) at room temperature using rf magnetron sputtering to establish the role of stoichiometry and microstructure on the elastic constants based on zone structure model. X-ray reflectivity (XRR) has been used to extract the deposition rate for velocity dispersion curves, the interfacial roughness and the mass density of the NbN films. The dependence of stoichiometry on the ad atom energy (sputter powers) was determined by heavy ion elastic recoil detection analysis (HI-ERDA). Surface Brillouin scattering studies on NbN films have shown the propagation of Rayleigh and Sezawa peaks indicative of high film quality. The elastic constants of NbN at various powers will be extracted from the velocity dispersion curves using numerical approaches.

316 - Effect of growth temperature on structural and luminescence properties of ZnO nanoparticles by Sol-Gel method

DPCMM1 - Wednesday 09 July 2014 10:20 *[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 by Sol-gel method at different temperatures. The effects of growth temperature on the structure and optical properties of ZnO nanostructures were investigated in detail. Temperature is an important thermodynamic factor that plays a key role in controlling the growth rate of a crystal, the morphology and aspect ratio of ZnO nanostructures. The characterization of the nanoparticles with Scanning Electron Microscopy (SEM) showed that at low temperatures (35 °C and 45ºC) densely packed conglomerates of ZnO nanoparticles were observed. As the growth temperatures increases to 65 °C and 75°C, ZnO nanoparticles, hexagonal in cross-section and with needle-shaped tips were produced. The X-ray Diffraction (XRD) patterns, for samples grown at 35ºC, a peak at 33■ related to zinc hydroxyl double salts (Zn(OH)2) was observed in addition to peaks related to the wurtzite structure of ZnO [1], indicating that growth at temperatures lower than 40 °C resulted in the formation of both ZnO and Zinc hydroxide . A highly crystalline nanoroparticles were grown at temperatures greater than 45°C. Using UV–Vis absorption measurements the spectra showed the existence of peaks related to ZnO for temperatures as low as 35 °C.

317 - Search for chirality in 193Tl

NPRP - Thursday 10 July 2014 11:10 *[For award: PhD]*

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

Based on the theoretical description of chiral symmetry in nuclear system by Fauendorf and Meng, some chiral doublet bands were suggested in different mass regions. It was revealed at iThemba LABS that Tl isotopes form a new regionwhere chirality could develop. In particular 194Tl was found to be perhaps the best chiral candidate up to date. 193Tl as a neighbour of 194Tl is thus likely to be a very good chiral candidate. In order to search for possible chiral doublet bands in 193Tl, an experiment was performed using the 160Gd(37Cl,4n) reaction. The analysis showed that two aside bands could be chiral partners to Band 2. However, statistics were not enough to determine the linking transitions and theirspin and parity assignments. Thus, another experiment was performed using the reaction of 181Ta(18O,6n) which has much larger cross-section for production of 193Tl. The faster digital electronics was also employed. Alternatively:The new data set has much larger statistics. Analysis for these new data is in progress. The results obtained so far will be presented.

319 - Towards the Fabrication of All-Fibre Laser Systems

Photonics - Thursday 10 July 2014 11:50

Primary author: *WU, Lorinda (CSIR)*

Fibre lasers are receiving increasing interest due to its many advantages over other laser technologies. These laser systems are both compact and robust, provide excellent beam quality and offer high efficiency. In addition to the design of the optical fibre itself, key factors in the fabrication of high power fibre lasers are low-loss fusion splicing and fused fibre components. Optical losses that are considered tolerable in typical telecom applications can lead to catastrophic failures from localised heating. An overview of the various building blocks of fibre lasers (e.g. mode-field adaptors, fibre tapers, fused couplers, pump combiners and end-caps) will be presented and the various challenges to the successful fabrication of low-loss optical components will be discussed.

320 - Performance analysis of a 3.2 kWp grid-connected PV system in the Eastern Cape, South Africa

Applied - Friday 11 July 2014 11:30

Primary author: *OKELLO, Denis (NMMU and Makerere University)*
Co-authors: *VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU)*

This paper analyzes and compares the actual and simulated performance of a 3.2 kWp grid-connected photovoltaic system. The system is located at the Outdoor Research Facility (34.01oS, 25.67oE) in the Nelson Mandela Metropolitan University (NMMU), South Africa. The system consists of 14 poly crystalline silicon modules connected in two strings of 7 series-connected modules, each facing north at a tilt of 34o. The data presented in this study was measured in the year 2013 where the system supplied 5756.7 kWh of energy to the grid. The performance of the system was simulated using PVsyst software with measured climate data (solar radiation, ambient temperature and wind speed) at the site for the same year. The measured annual irradiance on the solar plane was 2119.8 kWh/m2, and the measured specific energy yield is 1787.8 kWh/kWp/year, while the predicted value is 1741.6 kWh/kWp/year. The results of estimation of energy yield using PVsyst software are in agreement with actual measured value with difference of 2.6%. The performance ratio ranges from 81 to 86% with an annual mean value of 84%. This paper discusses the difference between measured and simulated energy yield and the validity of assumptions.

321 - The Large-N Limit Of Matrix Models And AdS/CFT

Theoretical - Tuesday 08 July 2014 14:20

Primary author: *MULOKWE, Mbavhalelo (University of the Witwatersrand)*

Random matrix models have found numerous applications in both Theoretical Physics and Mathematics. In the AdS/CFT correspondence, for example, the dynamics of the half-BPS states can be fully described in terms of the holormorphic sector of a single complex matrix model which is related to (1+1)-dimensional free fermions in a harmonic potential. In this work, we consider the strong-coupling limit of multi-matrix models coupled via Yang-Mills interactions. In particular, we consider the significance of rescaling the matrix fields. In order to investigate the role played by such a rescaling, we consider the matrix quantum mechanics of a simple Hermitian system. The system is compactified on a circle, and using the Das-Jevicki-Sakita Collective Field Theory approach we obtain the exact ground-state energy of the system.We then fully compactify N=4 SYM on the four-sphere. A radial sub-sector is readily identified and the eigenvalue spectrum obtained for an arbitrary number of matrices. For two matrices we parametrize the system using matrix valued polar coordinates. A closed form (using the Harish-Chandra-Itzykson-Zuber formula) for the saddle point equations at strong-coupling is derived. A complementary approach to the saddle point equations technique - based on the Dyson-Schwinger equations - is given. The system is then regulated with a Penner-type potential and the density of eigenvalues is obtained.

323 - Femtosecond electron diffraction on organic crystals

Photonics - Tuesday 08 July 2014 11:30 *[For award: MSc]*

Primary author: *SMIT, Bart (Stellenbosch University)*

Femtosecond electron diffraction is an exciting field in experimental laser physics which allows to direcly look at structural changes of matter on an atomic scale. More specifically, we look at changes in structural atomic assembly of crystals as they undergo a metal-to-insulator transition under photo-excitation. Real time movies of atoms moving in crystals are acquired within a picoseconds (10^-12s) timescales.Ultrashort timescales and molecular resolutions are achieved by using an 150fs (10^-15s) short pulsed laser beam. We divide our beam into a ‘pump’ and ‘probe’ path. The pump directly irradiates the crystal under investigation, initiating the metal-to-insulator transition. The ‘probe’ takes snapshots of the atomic structure at a time resolution that is determined by the duration of the probe pulse.A suitable candidate for such a probe is an 30keV kinetic energy electron beam, which can resolve diffraction patterns of the crystal, revealing its structural composition. Short electron pulses are accelerated towards the crystal from an -30kV thin film golden cathode after photo-excitation by the pump beam. Diffraction patterns are observed on our detection system after Coulomb interaction with the crystal. Patterns are acquired for the whole timescale of the transition by simply tuning the path length between pump and probe pulse.Our current organic Cu(DCNQI)2 crystal demands improvements in our experimental techniques due to condensation of matter onto the sample when at its phase transition temperature (78K). Secondly, this crystal takes relatively long to relax back to its ground state after excitation, demanding us to perform the experiments on a low ‘repetition rate’. To maintain feasible signal-to-noise ratios, the electron number per electron probe pulse needs to be increased drastically, destroying our temporal resolution due to Coulomb repulsion within such a pulse. Improvements to our current system are a new ultra high vacuum chamber and electron pulse recompression.

324 - Radiometric Survey at A Heavy Mineral Separation plant near Koekenaap

NPRP - Wednesday 09 July 2014 10:00 *[For award: MSc]*

Primary author: *SEHONE, Alfred Mogotsi (Stellenbosch University)*
Co-authors: *NEWMAN, Richard (Stellenbosch University); MALEKA, Peane Peter (iThemba LABS); MKAZA, Noel Mkululi (Stellenbosch University)*

Operations at the West Coast open-pit mines and mineral separation plants include mining of heavy minerals to produce titanium dioxide feedstock, zircon, rutile and high purity iron products. These products are used in various applications which include the production of metals ceramics and foundries. Mine operations require a carefully structured environmental management and radiation monitoring processes. One of the devices used in these processes are hand held gamma-ray spectrometers and dose meters. These devices are used to monitor radiation levels in and around the plant as per requirements of the National Nuclear Regulator. This study focuses on the comparison of activity concentration results obtained with the use of a hand-held gamma-ray detector (RS-230 BGO Super-SPEC) and a MEDUSA (Multi-Element Detector for Underwater Sediment Activity) system at a mineral separation plant. The RS-230RS-230 gamma-ray spectrometer and MEDUSA system comprises of bismuth germanate (BGO) crystal scintillator and a CsI scintillator, respectively. Both detectors can be linked to a GPS device for mapping radio activity concentrations of 40K, 232Th- and 238U-series as function of position. Measurements were made on ten locations of which four were on the reject piles and one close to reject piles. Preliminary results show a good correlation for uranium and thorium concentrations between the BGO and CsI, while the correlation was not clear on the potassium concentration. ReferencesNewman, R.T. et al. (2008). Determination of soil, sand and ore primordial radionuclide concentrations by full-spectrum analyses of high-purity germanium detector spectra. Applied Radiation and Isotopes, 66 (2008): 677–1066. Hlatshwayo, I.N. 2007. In-situ gamma ray mapping of environmental radioactivity at iThemba labs and associated risk assessment. Unpublished Master's thesis. University of Zululand. Dawid de Villiers. 2011. Characterisation of heavy mineral sands and soils by radiometry and its use in mineral beneficiation and agriculture. PhD thesis. Stellenbosch University.

325 - Effects of Cr3+ mol% on the structure and optical properties of the ZnAl2O4:Cr3+ nanocrystals synthesized using sol-gel process

DPCMM1 - Tuesday 08 July 2014 14:00 *[For award: PhD]*

Primary author: *MOTLOUNG, Setumo (University of the Free State)*
Co-authors: *DEJENE, Birhanu (University of the Free State); SWART, Hendrik (University of the Free State); NTWAEABORWA, Martin (University of the Free State)*

Zinc aluminate (ZnAl2O4) hosts and ZnAl2O4:Cr3+ doped were successfully prepared at a relatively low temperature (~80 °C) using the sol–gel method. The dopant (Cr3+) mol% was varied at a range of 0 – 0.3 mol%. The main aim was to produce phosphor material that can be used for the down-conversion in UV devices. The annealed powder samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), UV and photoluminescence (PL). The XRD data revealed that all annealed samples consist of the cubic ZnAl2O4 structure. The estimated crystallites sizes were in the range of 22 – 23 nm in diameter. The results showed that there is an optimum Cr3+ mol% for the system to deviate from Vergard's law. The surface morphology of the phosphors was influenced by the Cr3+ mol%. UV results showed that the Cr3+ mol% affects the band gap of the host. The PL results showed that the host and the Cr3+-doped nanoparticles exhibit violet emission slightly at different peak positions. Slight peak shifts suggests that the luminescence can originate from the host or Cr3+ ion. Emission from the host is attributed to the band-gap defects in the host material, while the emission from the Cr3+ is attributed to the 4T1 → 4A2 transition. At the higher mol% there is an emission at 692 nm, which is attributed to the 2E → 4A2 transition in Cr3+. The incorporation of the foreign atoms (Cr3+) at the lower mol% seems to be affecting the defects level and population. Both the luminescence enhancement and quenching behaviours were observed. The 0.01% Cr3+ is the optimum concentration.

327 - A four-year foundation degree programme. Do we really need it?

Education - Tuesday 08 July 2014 14:40

Primary author: *MOLEFE, Paul (University of Johannesburg)*
Co-author: *SONDEZI, Buyisiwe (University of Johannesburg)*

It has been recognized that knowledge and innovation are critical contributors to national economic prosperity and welfare. As a result, undergraduate education has assumed greater significance within the higher education system to increase the enrolment of postgraduate studies. However, the status quo remains, as the country still suffers from an acute shortage of trained personnel in science-related fields notwithstanding difficulties experienced by students coming from disadvantaged backgrounds. The high failure rate in university first year has placed universities under considerable pressure to in particular adapt undergraduate science curricula in order to provide students with adequate foundation required to navigate the first year curricula. As a consequence of this dilemma, the duration of the three-year undergraduate science programs at the University of Johannesburg (UJ) were elevated to four years in order to make provision for additional tuition. This study examines the impact of an additional year in the undergraduate curriculum. To establish the impact of this option, the comparative analysis of the performance of students from the four-year foundation program and their counterparts in the three-year mainstream curricula was performed. The investigation looked at the adequacy in knowledge, understanding, confidence and performance of these two groups in the physics first year course.

328 - Research projects Utilising Penetrating Radiation: What to Expect when using Radiation Beams for Imaging

Applied - Friday 11 July 2014 10:20

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

The perception that penetrating ionising radiation, when used as an investigating probe, could be dangerous, hazardous, and uncontrollable and could induce damage to your research object or to your body as researcher is still valid today. This talk will discuss these perceptions, including safety, and what to expect when embarking on a research project that requires the technique of radiography and/or tomography and eventually access onto the site of the South African Nuclear Energy Corporation (Necsa). The radiation beams for imaging, which are integrated into the research infrastructure and facilities of the Radiation Science Laboratories at Necsa, are being made available for free to post graduate students and researchers but questions are always asked about these specific safety aspects. If you are a post graduate student and want to evaluate your sample in a non-destructive manner through tomography (CT scanning), this talk is not to be missed as basic physical concepts will also be dealt with.

329 - Nitrogen dioxide and Ammonia Gas Sensing by Tungsten Trioxide Film

DPCMM1 - Tuesday 08 July 2014 14:20 *[For award: PhD]*

Primary author: *GOVENDER, Malcolm (CSIR)*
Co-authors: *KUNERT, Herbert (University of Pretoria); MATHUR, Sanjay (University of Cologne, Germany); SINGH, Trilok (Univeisity of Cologne , Germany); GOENUELLUE, Y (University of Cologne, Germany); MWAKIKUNGA, Bonex (CSIR); MACHATINE, Augusto (University of Pretoria)*

Tungsten oxide film was reactively-sputtered on alumina substrate with Pt-contacts from a pure W target and argon/oxygen-plasma. The synthesized and annealed tungsten oxide was characterized with XRD, XPS, Raman spectroscopy, UV/Vis spectroscopy and Resistance as a function of Temperature, and found to be stoichiometric triclinic phase tungsten trioxide. The pure film was used to sense ppm concentrations of nitrogen dioxide and ammonia at room-temperature and 100^{o}C. At 100^{o}C, The sensitivity of the film towards nitrogen dioxide increased, and decreased significantly towards ammonia. This was due to tungsten trioxide being an n-type metal-oxide semiconductor which preferred the reaction with the oxidizing gas over the reducing gas.

330 - Efficiency and dead time measurements of the iThemba LABS segmented clover detector

NPRP - Wednesday 09 July 2014 11:10 *[For award: phD]*

Primary author: *EASTON, Jayson Lee (iThemba LABS)*
Co-authors: *NONCOLELA, Sive (UWC); SHIRINDA, OBED (iThemba LABS); LAWRIE, Elena (iThemba LABS); BUCHER, Thifhelimbilu Daphney (iThemba LABS)*

The iThemba LABS segmented clover detector is a new generation high purity germanium detector. The detector has four crystals and each crystal has eight electrical contacts on the outside and a central core contact. This detector can be used either as a standard clover detector or in a gamma-ray tracking mode. To develop gamma-ray tracking, the characteristics of the detector need to be measured. As part of the testing of the detector the depletion voltages, energy resolutions, preamplifier rise and decay times and efficiencies were initially measured using Pixie-4 digital electronics. Pixie-4 parameters were optimised for the best energy resolution of the detector. Although it was expected that the dead time with the digital data acquisition system should be small, we did measure it in order to quantify individually the impact on the efficiency by the dead time and by the coincidence summing. The dead time associated with the Pixe-4 digital electronic was measured with a pulse generator. A dead time of about 20 % at a counting rate of 4 kHz per channel was found. The effects of coincidence summing as a function of distance could then be identified. Similar measurements, performed with Pixie-16 digital electronics and using different shaping parameters are in progress. All these results will be presented and discussed.

331 - Magnetic nanoparticles as polarity-sensors: a Molecular Dynamics study on the effect of solvent interactions with surface atoms on iron oxide nanoparticles' magnetization.

DPCMM1 - Friday 11 July 2014 10:00

Primary author: *HARRIS, Richard (Mintek)*

Iron oxide magnetic nanoparticles have unique physical and chemical properties due to their extremely small size and large specific area. Applications for these nanoparticles range from contrast agents in magnetic resonance imaging (MRI) in the biomedical field through to heating agents in hyperthermia for cancer therapy. In all of these applications the magnetic particles are coated with surfactants and polymers to enhance biocompatibility, prevent agglomeration and add functionality. However the surfactants interact with the surface atoms of the nanoparticles leading to the formation of a magnetically disordered layer, which in turn reduces the effective magnetic phase. The magnetic phase reduction can also be attributed to the interaction between the surfactant and the solvent. In this study the interactions between the surfactant, iron oxide nanoparticle and the suspension media were investigated to understand their effect on magnetization of magnetic iron oxide nanoparticles. A molecular mechanics model was developed to investigate the mechanism that leads to the relative magnetic phase variation when suspending the oleic acid coated magnetite nanoparticles in three different solvents: heptanes, hexane and acetone. Various minimized system geometries were calculated and the optimized binding energy configurations were obtained for three iron oxide nanoparticles stabilized with oleic acid as surfactant. The potential application as a polarity sensor is discussed.

334 - Evidence for Higgs Boson Decays to Tau Lepton Pairs from the ATLAS Experiment at the CERN Large Hadron Collider

NPRP - Thursday 10 July 2014 14:00

Primary authors: BRISTOW, Kieran *(University of the Witwatersrand); VICKEY, Trevor (University of the Witwatersrand)*

The results from a search for the Higgs boson with a mass of about 125 GeV decaying into a pair of tau leptons is reported. The analysis, exploiting all tau lepton decay combinations (hadronic and leptonic), is based on a proton-proton collision data sample collected by the ATLAS experiment at the CERN Large Hadron Collider and corresponds to an integrated luminosity of 20.3 fb-1 recorded at a center-of-mass energy of 8 TeV. Evidence for the existence of Higgs boson decays to pairs of tau leptons, consist ent with Standard Model expectations, is shown.

335 - An all printed LRC resonant circuit

Applied - Tuesday 08 July 2014 14:20 *[For award: MSc]*

Primary author: ASHEBIR, Getinet *(UCT)*
Co-authors: *MANNL, Uli (UCT); WALTON, Stanly (UCT); ZAMBOU, Serges (UCT); MAGUNJE, Batsi (UCT); HARTING, Margit (UCT); BRITTON, David (UCT)*

Passive devices such as resistors, capacitors and inductors are the essential components in resonant wireless communications. Integrating these components into a resonant circuit with reduced cost using a robust method is vital for wireless sensors and radio frequency identification (RFID) technology if the “internet of Things” is to become a reality. In this work prototype LRC resonant circuits, as well as the individual components, were fabricated on paper substrates using screen printing and characterized using impedance analyzer. An air core square spiral and a parallel plate design were used for the inductor and capacitor respectively. Equivalent circuit models for the individual printed components were investigated from the fits of impedance measurement data. The results show that the printed components are equivalent to conventional discrete components and that the inductance and capacitance values were reproducible for given designs of the components.

338 - Control of CO2 vibrational dynamics via shaped-pulse Coherent Anti-Stokes Raman Spectroscopy

Photonics - Tuesday 08 July 2014 11:50 *[For award: PhD]*

Primary author: HENDRIKS, Attie *(CSIR)*
Co-authors: *UYS, Hermann (CSIR); STEENKAMP, Christine (University of Stellenbosch); DU PLESSIS, Anton (Stellenbosch University)*

We investigate control of the vibrational dynamics of CO2 molecules in gas phase using Coherent Anti-stokes Raman Scattering (CARS). During CARS, a pump and Stokes pulse excite a vibrational mode via a Raman process. This is followed by a probe pulse which indicates the extent of mode occupation through Anti-Stokes fluorescence. In our experiment we simultaneously excite the bend and stretch modes of CO2, and observe coherent temporal oscillations in the Anti-Stokes signal, at the beat-note of the two modes. Using a learning algorithm we execute time-frequency shaping of the pump pulses in our CARS experiment. This provides selective excitation between the stretch and bend modes. We compare the experimental outcomes to a perturbative model that simulates the nonlinear dynamics.

339 - Construction of a Terahertz time domain spectrometer

Photonics - Thursday 10 July 2014 10:00 *[For award: MSc]*

Primary author: SMITH, Shane *(Stellenbosch University)*
Co-authors: *HISSEN, Huzifa (Stellenbosch University); NEETHLING, Pieter (University of Stellenbosch); ROHWER, Erich (University of Stellenbosch)*

Terahertz time domain spectroscopy (THz-TDS) is still a relatively new research field. It has only recently through technological advances become relatively easy to produce coherent terahertz radiation. This easy access has opened up many new areas of research with THz radiation finding application in fields as diverse as communication, biophysics and security. It is especially the field of biophysics or biophotonics that is gathering significant interest. This is because many large biological molecules (proteins, DNA, etc.) show ro-vibrational absorption states in this region of the electromagnetic spectrum. THz-TDS therefor allows for a relatively easy method of investigating these molecules in different environments.This talk will focus on the technical aspects concerning the construction and alignment of a THz-TDS setup which has been built at the Laser Research Institute, Stellenbosch University. The setup employs a femtosecond laser to trigger a biased photoconductive antenna as THz emitter. A second unbiased photoconductive antenna is used as detector. The electric field of the generated broadband THz pulse is measured in the time domain through a cross-correlation technique. Preliminary results recorded with this setup will be shown and compared to those obtained with a commercial setup. Examples of spectra recorded with a commercial system will also be shown and discussed as further examples of THz-TDS.

340 - Saddle point analysis within a vector-like SU(2) ‘QCD’ model

Theoretical - Tuesday 08 July 2014 14:40 *[For award: MSc]*

Primary author: JOHNSON, Celeste *(University of the WItwatersrand)*
Co-author: *RODRIGUES, Joao (University of the Witwatersrand)*

At low energies, QCD (quantum chromodynamics) requires non-perturbative solutions. We consider an SU(2) model which is a scaled down version of SU(3), simpler to work with because of its Pauli matrix basis, yet retaining key features such as its being a non-abelian theory. A compactified SU(2) gauge theory may be written as an O(3) vector model; within this context we find an ex act non-perturbative solution using a saddle point analysis, making use of an already known Jacobian.

341 - Ptychographic reconstruction of temporal objects

Photonics - Tuesday 08 July 2014 14:40 *[For award: PhD]*

Primary author: SPANGENBERG, Dirk-Mathys *(University of Stellenbosch)*
Co-authors: *NEETHLING, Pieter (University of Stellenbosch); ROHWER, Erich (University of Stellenbosch); FEURER, Thomas (University of Bern)*

Ptychography a technique used in the X-ray regime to reconstruct objects in space with atomic scale resolution by recording the far field diffraction patterns after translating either the illumination source with respect to the object or the object itself can be readily applied in the optical regime to reconstruct so called temporal objects by interacting a temporal object with a probe pulse in a sample. The spectrum is recorded after shifting the probe pulse in time. In the analogy, the recorded spectra is equivalent to the recorded far field diffraction pattern and the temporal shift is equivalent to the translation of the object or beam. The novelty of this technique is that one is able to resolve detail of the temporal object which is much shorter than the probe pulse. We present the ptychographic iterative method for reconstruction in the optical regime and show the results from our experiments.

344 - Tidal Effects on Pulsation Modes in Close Binaries

Space - Thursday 10 July 2014 14:00 *[For award: MSc]*

Primary author: PREDIERI, Massimo *(University of the Witwatersrand)*
Co-authors: *FRESCURA, Fabio (University of the Witwatersrand); ENGELBRECHT, Christian (University of Johannesburg)*

Light curve data from the Kepler satellite on pulsating eclipsing Algol-type binary systems display a peculiar feature: the primary shows preferential excitation of putative pulsation modes with frequencies resonant with the orbital frequency of the binary system. A proposed explanation of this phenomenon is tidal driving of pulsations by the secondary. This paper presents a preliminary calculation of the effects of linear representations of tides on the pulsation frequencies of a polytropic primary.

346 - Shaping coherent light

Photonics - Tuesday 08 July 2014 14:00 *[For award: PhD]*

Primary author: SPANGENBERG, Dirk-Mathys *(University of Stellenbosch)*
Co-authors: *NEETHLING, Pieter (University of Stellenbosch); FORBES, Andrew (CSIR); ROHWER, Erich (University of Stellenbosch); DUDLEY, Angela (CSIR)*

Light can be shaped both in space and time. Temporal shaping of light has a wide range of applications, spectroscopy, coherent control, pulse characterization to name but a few. Spatial shaping of light equally so with applications in telecommunication, wave-front correction and optical tweezing and more. To shape light, spatial light modulators have been developed which allows us to modify the phase and in some cases also the amplitude of incident light. There is a definite coupling between time and space when shaping light which makes accurate shaping of light a challenge. In this presentation an overview is given of shaping techniques both spatial and temporal highlighting how these difficulties can be surmounted and what the trade-offs are.

347 - Monte Carlo simulation of secondary gamma production during proton therapy for dose verification purposes – Part I

NPRP - Thursday 10 July 2014 10:20

Primary author: PETERSON, Stephen *(University of Cape Town)*
Co-author: *JEYASUGITHTHAN, Jeyasingam (University of Cape Town)*

Cancer treatment through the use of gamma radiation has a long history and is a well-defined treatment modality. The recent growth of radiation therapy by attacking the tumor with accelerated protons presents an unprecedented level of control over the dose deposition and a great reduction in treatment side-effects. These benefits are a direct result of the gradual rise and then steep decline of the energy deposited by the protons traveling in the patient. This benefit can quickly become a detriment if the dose is not delivered to the correct location. Unfortunately, there is no device to determine where the dose has been deposited within the patient during treatment, only estimates calculated from treatment planning. Proton-nucleus collisions during treatment could be the solution to this problem. Secondary (prompt) gammas produced in these reactions have been shown to correlate well with the energy deposited by the protons and could be used to produce an in-vivo dose image. These prompt gammas also provide additional information about the elemental composition of the patient due to their characteristic energies. Recent Monte Carlo studies have shown the feasibility of a three-stage Compton camera for detecting the prompt gammas during patient treatment. The limitation of these design simulations was the accuracy of the simulated prompt gammas production numbers. Due to holes in the proton inelastic cross-section data and inaccuracies in the physics models in Geant4, it is very hard to get an idea of the absolute number of the prompt gammas produced during a typical patient treatment. This work takes a look at the accuracy of these simulated prompt gamma production numbers for a typical treatment at the Proton Therapy Center in Houston, TX USA and at iThemba LABS in Somerset West, WC South Africa. The uncertainty in these results has prompted a more detailed look at the physics surrounding the proton inelastic collisions in Geant4 and a series of experimental measurements of prompt gamma production to further validate the Monte Carlo results.

348 - Looking for an influence of antineutrinos on a beta plus source- long term measurements at Koeberg power station.

NPRP - Tuesday 08 July 2014 10:20

Primary author: SMIT, Frederick David *(iThemba LABS)*
Co-authors: *DE MEIJER, R. J. (EARTH); VAN ROOY, Milton (NMISA); STEYN, S. W. (Eskom)*

Using radioactive sources as detectors for neutrinos has the advantage of being thresholdless. The decay of a 22Na beta plus source some 17 m from a reactor core at the Koeberg power station has been observed for more than a year and over two outages. Results will be presented from these measurements.

349 - TeV Gamma-Ray Observations of the Large Magellanic Cloud

Astro - Friday 11 July 2014 11:30

Primary author: KOMIN, Nukri *(University of the Witwatersrand)*

The Large Magellanic Cloud (LMC) is a satellite Galaxy of the Milky Way at a distance of about 48 kpc. It harbours many potential gamma-ray sources: One of the youngest supernova remnants - SN 1987A, the most energetic pulsar - PSR J0537-6910, and the most massive star forming region in the neighbourhood of the Milky Way - the Tarantula Nebula.The High Energy Stereoscopic System (H.E.S.S.) is currently the only instrument capable of observing the LMC in gamma-rays above several 100 GeV. The part of the LMC harbouring the mentioned objects has been observed with H.E.S.S. on a yearly basis since 2003. In this talk I will present the status and recent results of the H.E.S.S. LMC observations.Gamma-ray emission has been detected from the pulsar wind nebula powered by PSR J0537-6910. From a multi-wavelength modelling it can be shown that the pulsar's progenitor star must have been very rapidly spinning, of the order of several milliseconds. Such short periods are known only for pulsars which have been spun up by a binary star. No gamma-ray emission from SN 1987A has been detected so far, which challenges models for Cosmic Ray acceleration in this object. The LMC remains an interesting target for future observations with the now extended H.E.S.S. telescope array.

350 - Simulation of Thermal Processes in a Hot Mirror Parabolic Trough Solar Receiver

Applied - Thursday 10 July 2014 10:20 *[For award: PhD]*

Primary author: KALUBA, Victor Siuluta *(University of the Witwatersrand)*
Co-author: *FERRER, Phil (University of the Witwatersrand)*

Parabolic Trough Solar Technology is one of the most proven solar thermal power technology available today. Using linear parabolic mirrors, a Parabolic Trough Solar Collector focuses sunlight onto an absorber surface. A heat transfer fluid is passed through the absorber tube and heated, and then either used directly or passed through heat exchangers for conversion to other energy forms. Existing systems use a selective coating on the absorber surface to enhance solar energy absorption. However, thermal radiation losses are high and the selective coating material on the absorber decomposes at high temperatures. Efforts to improve the performance efficiency have largely been directed towards chemically stabilizing the selective coating at high temperatures. In our study, we replaced the absorber selective coating with an Infrared reflecting material (Hot Mirror) on the inner surface of the glass envelope enclosing the absorber. This eliminates the problem of thermal degradation of the absorber selective material and reduces radiation losses resulting in an increased working temperature. The Infrared selective material transmits in all wavelength bands in the incident solar radiation, but reflects Infrared radiation in the thermal emission from the absorber surface back onto it. The Hot Mirror traps the thermal emissions within the receiver tube through multiple reflections and absorptions on the glass envelope inner surface and absorber outer surface respectively. In our work, we simulate the heat transfer processes in the receiver tube, namely conduction, convection and radiation and determine the useful heat gain by the heat transfer fluid. The simulation also models the effects on the overall energy gain by changes in the HTF flow rate, type of fluid, solar flux, absorber and glass envelope diameters and length, and the Hot Mirror material properties. The simulation answers questions regarding an increase in the performance efficiency and characterizes temperature profiles and spectral-thermal processes on the circumference and along the longitudinal axis in the flow direction of the heat transfer fluid.

354 - Polarization alignment system for quantum key distribution

Applied - Wednesday 09 July 2014 14:40 *[For award: PhD]*

Primary author: MARIOLA, Marco *(UKZN)*
Co-authors: *MIRZA, Abdul (UKZN); PETRUCCIONE, Francesco (UKZN, National Institute for Theoretical Physics)*

Quantum cryptography uses a private key shared between the transmitter and receiver. The transmitter (ALICE) sends a secret key as a series of single photons to the receiver (BOB). The value of the bit depends on the quantum state of each single photon. If an eavesdropper is present in the channel, after the measurement the quantum state of the single photon may change and BOB receives a different key. In order to recognize if an eavesdropper is present in the channel different protocols are used [1]. Quantum key distribution (QKD) can be done in free space using polarization states of single photons. Different experiments have shown the feasibility of QKD in free space for long distances [2]. Quantum cryptography in free space represent a flexible communication method in order to transmit a secret message between two stationary points located on the Earthy surface or for two non-stationary points as well as aircraft, satellite and terrestrial transport. Quantum cryptography is an optical communication system and for that reason it is necessary that the transmitter follows the trajectory of the receiver and the polarization bases of the transmitter and the receiver must be aligned. In this paper a tracking system for polarization alignment is presented. The system uses a polarized laser beacon sent to the transmitter. The laser beacon is polarized according to the polarization bases of the quantum channel. The transmitter measures the laser beacon and aligns its bases with the bases of the receiver. [1] Bennett C and Brassard G 1984 Quantum cryptography: public key distribution and coin tossing Proc. of IEEE International conference on computer systems and signal processing 175-179[2] Ursin R 2007, Entanglement-based quantum communication over 144 km, Nature Physics 3, 481 – 486.

356 - Entanglement of two distant nitrogen-vacancy-center ensembles under the action of squeezed microwave field

Theoretical - Wednesday 09 July 2014 14:40 *[For award: PhD]*

Primary author: TEPER, Natalia *(University of KwaZulu-Natal, National Institute for Theoretical Physics)*
Co-authors: *MBENZA, Lucien Nzuzi (University of KwaZulu-Natal); SINAYSKIY, Ilya (University of KwaZulu-Natal and National Institute for Theoretical Physics); PETRUCCIONE, Francesco (UKZN)*

We consider a known circuit consisting of two distant nitrogen-vacancy-center ensembles coupled to separate transmission line resonators, which interact by means of a current biased Josephson junction. Our investigation is focused on transitions and dissipation in the Josephson junction leading to entanglement. In our approach the Josephson junction is regarded as a reservoir, whose variables are eliminated from the system dynamics. We include in this scheme also superconducting quantum interference devices, flux-driven Josephson parametric amplifiers, which are the sources of a squeezed microwave field. The entanglement was studied in terms of the logarithmic negativity. The logarithmic negativity was considered for different regimes: weak coupling and strong coupling of transitions of the Josephson junction, and under action of squeezed microwave fields. We show that different degrees, time and duration of entanglement can be reached for various parameters choices.

358 - The iThemba LABS Radioactive Beam Project

NPRP - Thursday 10 July 2014 15:20

Primary author: BARK, Robert *(iThemba LABS)*

iThemba LABS proposes to acquire a new cyclotron for production of radioactive beams using the ISOL method. In 2013, the NRF awarded a Strategic Research Infrastructure Grant to iThemba LABS to build a radioactive beams test facility for the production of low-energy (50 keV) beams and to conduct a technical design study for a larger facility. A status report on the project will be given.

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

NPRP - Tuesday 08 July 2014 10:00 *[For award: PhD]*

Primary authors: NGCOBO, Zipho *(iThemba LABS & University of Cape Town)*; *BARK, Robert (iThemba LABS)*
Co-author: *BUFFLER, Andy (University of Cape Town)*

iThemba LABS (iTL) proposes to install a proton accelerator with energies of up to 70 MeV to produce neutron-rich radioactive ion beams (RIBs) by the fission of uranium. The literature shows that neutron induced fission gives enhanced production of neutron-rich fission fragments compared to proton induced fission. Thus the problem becomes one of finding the most efficient way of producing the neutrons from protons (converter target). Higher fission rates may be achieved by increasing the beam current of protons hitting the converter. Cooling might be achieved in a natural way, by for example using water target. Oxygen-16 is unfortunately a poor converter, but it could be possible to use enriched oxygen-18 water (H218O). This necessitates the measurement of oxygen-18 neutron yields. While oxygen-18 (p,n) cross sections have been measured up to 25 MeV, there is no data above this on the literature. Neutron yields of lithium-7 and oxygen-18 water (97% enrichment) have been measured at iThemba LABS using the time of flight (ToF) technique. Proton beams of different energies (66, 54, 42 and 30 MeV) were used to bombard 3mm and 1mm thick targets of 7Li and 18O respectively. The neutron ToF measurements were done using the fast neutron detector (NE213) at angles 0■ and 16■ relative to the incoming proton beam. For both targets, energy spectrums and absolute cross sections were derived and compared.As oxygen-18 water is considered to be used as a converter, the neutron yields from a thick 66 MeV proton stopping length target of 40 mm depth has also been measured. These measurements are compared to MCNPX calculations in which the MCNPX input file uses the cross sections that have been measured.

361 - Coupled Optical Resonance Laser Frequency Stabilization

Photonics - Wednesday 09 July 2014 14:20 *[For award: MSc]*

Primary author: BURD, Shaun *(CSIR)*
Co-authors: *UYS, Hermann (CSIR); DU TOIT, Pieter (University of Pretoria / iThemba LABS)*

We have demonstrated simultaneous laser frequency stabilization of a UV and IR laser, to coupled transitions of ions in the same spectroscopic sample, by monitoring only the absorption of the UV laser. Separate signals for locking the different lasers are obtained by modulating each laser at a different frequency and using lock-in detection of the single photodiode signal. Error signals can be generated for both lasers using phase modulation transfer . Experimentally, we simultaneously lock a 369nm and a 935nm laser to the $^2S_{1/2}$ -> $^2P_{1/2}$ and $^2D_{3/2}$ -> $^3D3/2_{1/2}$ transitions respectively, of 174Yb^+ ions generated in a hollow cathode discharge lamp. Stabilized lasers at these frequencies are required for cooling and trapping Yb^+ ions in quantum information and precision metrology experiments. We use a rate equation model incorporating velocity changing collisions to explain the experimental results. This technique should be readily applicable to other ion and neutral atom systems.

362 - The effects of particle drifts on cosmic-ray modulation in the heliosphere – progress and challenges

Space - Tuesday 08 July 2014 14:20

Primary author: BURGER, Renier *(North-West University)*

The transport of cosmic rays in the heliosphere (that region of space dominated by solar plasma and solar magnetic field) are governed by diffusion, convection, adiabatic energy changes, and gradient- and curvature drift in the non-uniform heliospheric magnetic field. Cosmic-ray intensities at Earth are lower than the interstellar value outside of the heliosphere, and this decrease is referred to as modulation. The atmosphere of the Sun (the corona) cannot be in static equilibrium and rapidly expands to form the supersonic solar wind, which becomes subsonic at the termination shock. The turbulent heliospheric magnetic field that originates on the Sun is frozen into the solar wind due to its high conductivity, and is drawn into spirals due to the rotation of the Sun. Inside of the termination shock the two hemispheres of the heliosphere with oppositely directed magnetic field are separated by the so-called wavy neutral sheet, across which the magnetic field changes direction. Particle drifts, especially along the wavy neutral sheet, play a key role in modulation, and the lack of a realistic theoretical expression for the drift coefficient is a major drawback in an ab initio approach to cosmic-ray modulation. I will give an overview of recent developments to describe drifts in the heliosphere, and how turbulence is taken into account (or not). Recent observations by the two Voyager spacecraft, one of which may (or may not) have entered interstellar space beyond the heliosphere, pose significant challenges to modelers. If certain predictions of MHD models turn out to be correct, describing drifts in the so-called heliosheath will become much more complicated that anything we had to deal with in the supersonic solar wind. I will discuss the observations, predictions and implications for drifts briefly. I will also outline a collaborative approach aimed at gaining a better understanding of the elusive drift coefficient.

364 - The Higgs as a portal to the “hidden sector” via an analysis of H->Z’Z’->4l

NPRP - Thursday 10 July 2014 14:40 *[For award: PhD]*

Primary author: UNWUCHOLA, D A *(University of Johannesburg)*
Co-authors: *CONNELL, Simon (University of Johannesburg); ASSAMAGAN, Ketevi (Brookhaven National Laboratory); AUROSSEAU, Mathieu (University of Johannesburg); CASTANEDA, elizabeth (University of Johannesburg); NTSOELE, Phineas (University of Johannesburg)*

The Standard Model (SM) has well known deficiencies, and there is clearly need for new physics beyond the SM. The particles manifesting the new physics would interact at most weakly with the SM particles, and hence they are termed “dark”. The Higgs boson is potentially a favourable route for the production of the dark particles. There are a large class of theories where couplings or mixings at the Higgs level leads to exotic Higgs decays, which nonetheless do not significantly disturb the known physics below the Higgs level. This is therefore a significant potential discovery opportunity. We present studies which have been carried out as part of designing the search for the exotic decay of the SM Higgs which proceeds via a dark force back to SM four leptons, H->Z’Z’->4l.

367 - The experiences of four-year program degree students

Education - Thursday 10 July 2014 11:30

Primary authors: *SONDEZI, Buyi (University of Johanneburg); HASSALL, Emery Sky (University of Johanneburg); MYERS, Kevin Michael (University of Johanneburg)*
Co-author: *MOLEFE, Paul (University of Johannesburg)*

Pure BSc and engineering students at University of Johannesburg undertake a standard calculus based physics course as an introduction to their degree major. Failure to attain satisfactory pass mark of 50% in such course renders the students ineligible to embark upon the course for their major and postgraduate studies. This leads to the low of number students enrolling for physics major. The introduction of the four-year foundation program is seen as a possible gateway to increase the physics major student cohort. This paper presents and discusses the experiences of some of students in physics four-year program degree.

370 - Investigation of the involvement of specific carotenoids in the major plant light harvesting antenna during photoprotection

Applied - Tuesday 08 July 2014 11:30 *[For award: PhD]*

Primary author: PARADZAH, Alexander *(University of Pretoria)*

Under high irradiation levels, photosynthetic organisms harvest more light than they can utilise in the process of photosynthesis. The excess light is often harmful and has to be dissipated through a process of photoprotection, also known as non-photochemical quenching (NPQ). NPQ is a complex and not well understood process. The pigments responsible for light harvesting consist of carotenoids and chlorophylls. The interaction between these pigments plays an important role in NPQ by producing thermal dissipative channels which compete with the efficient transfer of excitation energy. Energy transfer within light-harvesting antenna complexes can be probed using a technique known as femtosecond pump-probe spectroscopy. In this study the involvement of specific carotenoids in the major component of NPQ has been investigated for the light harvesting complex II (LHC II) of a mutated Arabidopsis species. Mutation of the species was done to control the carotenoids content to thereby have a better understanding of the role of specific carotenoids in NPQ. The main results of the study will be presented.

373 - Recent Development in the Physics III Laboratory Module at WITS

Education - Wednesday 09 July 2014 11:50

Primary author: KEARTLAND, Jonathan *(University of the Witwatersrand)*

The Physics III Laboratory module at WITS has undergone several developments over the last three years. These developments include infrastructure upgrades, additions and changes to the curriculum, and development of new experimental activities. Infrastructural changes have largely centred on the development of the venue for the laboratories, with a state-of-the-art senior teaching laboratory having been designed and built in the last 18 months. Additions and changes to the curriculum were prompted by a student survey that was conducted at the end of 2011, which highlighted some of the deficiencies in the existing curriculum. Several teaching initiatives have been introduced that allow the students to develop skills that are vital for those who intend pursuing a career in experimental physics and related activities. This paper will report on what has occurred over the last two years, and will provide a strong case that the changes have improved the image of experimental physics among the 3rd Year students.

376 - Properties of Charney-Hasegawa-Mima zonal turbulence

Space - Tuesday 08 July 2014 14:40

Primary author: BOTHA, Gert *(University of Northumbria at Newcastle Upon Tyne, UK)*
Co-author: *ANDERSON, Johan (Chalmers University of Technology, Sweden)*

Turbulence with strong zonal flows occurs on all scales in nature, the most famous is the flow streams in Jupiter’s atmosphere. In fusion plasmas zonal turbulence is a feature of drift waves. The governing equation in geophysical fluid dynamics and in plasma physics has the same form and this equation and the properties of the flow will be discussed in the context of plasmas. In the model sheared flow is imposed by prescribing the background density gradient. Of the known solutions of bipolar and monopolar vortices only monopolar vortices survive due to the interaction between vortices and the destructive effects of the sheared flow. The longevity of the monopoles in different zonal flow configurations will be discussed and analysed.

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

Applied - Tuesday 08 July 2014 10:20 *[For award: MSc]*

Primary author: BOTHA, Joshua *(University of Pretoria)*
Co-authors: *KRÜGER, Tjaart (University of Pretoria); STOLTZ, Herman (University of Pretoria); GRUBER, Michael (Vrije University Amsterdam); VAN GRONDELLE, Rienk (Vrije University Amsterdam)*

It is not surprising that photosynthesis is a ‘hot topic’ in the field of Biophysics as it is both a beautiful example of where physics can be used to better understand the mechanisms at work in a biological system, and could also provide an alternative energy source for biofuels and photovoltaic electricity. Photo-protection processes, often referred to as Non Photochemical Quenching (NPQ), protect the plant in high light intensity conditions and consist of a range of mechanisms working at different timescales. We look at the very first step of NPQ in plants thought to take place in the main light harvesting pigment-protein complex LHC2. The change of pH and the resulting pH gradient across the membrane in which most of photosynthesis takes place have been proposed to be the trigger for the first step of NPQ. In this presentation an investigation will be shown of the NPQ pH dependency of LHC2 trimers by using single molecule spectroscopy combined with fluorescence lifetime analysis. The pH dependence of fast fluorescence intensity fluctuations will also be shown.

378 - Finite-size key security of Phoenix-Barnett-Chefles 2000 quantum-key-distribution protocol

Theoretical - Thursday 10 July 2014 10:20

Primary author: MAFU, Mhlambululi *(UKZN)*
Co-authors: *GARAPO, Kevin (UKZN); PETRUCCIONE, Francesco (UKZN)*

Based on the post-selection technique which was introduced by Christandl, Ko ■ nig and Renner [Phys Rev. Lett. 102, 020504 (2009)] in order to simplify the security of quantum key distribu- tion schemes, we study the security of the Phoenix-Barnett-Chefles 2000 quantum key distribution protocol. The postselection technique has been proposed and some examples have been shortly described in the literature. Therefore, we present the details of the security proof for a specific realistic protocol. We also give bounds on the secret key rates for the Phoenix-Barnett-Chefles 2000 protocol by using the post selection technique when given a finite amount of resources.

381 - The role of low-energy fluorescence bands in the photoprotection of the major plant light harvesting complex.

Applied - Tuesday 08 July 2014 11:10 *[For award: MSc]*

Primary author: STOLTZ, Herman *(University of Pretoria)*
Co-authors: *KRÜGER, Tjaart (University of Pretoria); VAN GRONDELLE, Rienk (Vrije University Amsterdam); GRUBER, Michael (Vrije University Amsterdam); BOTHA, Joshua (University of Pretoria)*

Most photosynthetic organisms are designed to function optimally in low light conditions. However the typical daily incident irradiation is higher than the energy that a plant requires. Therefore it can lead to lethal consequences for the organism if the amount of light energy absorbed is not regulated efficiently. This regulation of the light energy is a major function of the light harvesting complexes in the Photosystem II (PSII) of the plants, a process known as non-photochemical quenching (NPQ). NPQ has been strongly linked to large, rapid intensity variations in the fluorescence; known as fluorescence intermittency or blinking. A major component of the thermal dissipation process, known a qE, is characterised by the appearance of low energy absorption and fluorescence bands. By mimicking the in vivo qE states of the major light harvesting complexes (LHCII) the protein dynamics under qE conditions can be monitored via changes in the absorption and fluorescent spectra. By using single molecule spectroscopy (SMS) it is possible to study a single antenna complex at a time in order to understand the molecular dynamics involved with qE. In this presentation the relationship between the fluorescence blinking and the low energy fluorescence bands (redshifts) is investigated.

383 - Computational study of supported Pd catalyst for methane oxidation

DPCMM1 - Wednesday 09 July 2014 14:00 *[For award: MSc]*

Primary author: CHUMA, Moyahabo Hellen *(University of Limpopo)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); CHAUKE, Hasani (University of Limpopo); JONES, Glenn (Johnson Matthey Technology Centre)*

Supported metal nanoparticles are at the heart of many industrial catalytic processes. Of particular significance are precious metal catalysts, which include the platinum group metals (PGM) for example Pt, Pd, Rh and noble metals such as Ag and Au. These metals find their way into processes as diverse as methane oxidation catalysts and emissions control technology [1-3]. A catalyst nanoparticle has a number of surface features, and it is important to know the relative activity of these different surface sites if predictions are made for improved materials. A pure metallic form of Pd was used to study the thermodynamics of the methane oxidation reaction over the flat Pd(111), Pd(100) and stepped Pd(211) surface. The calculations were carried out using the density functional theory (DFT) implemented within the GPAW code [4]. Reaction profile for methane oxidation on Pd(100), Pd(111) and Pd(211) shows similar trend indicating that both partial and complete oxidation are exothermic. It was also found that for all the possible reactions, the reaction profile of Pd(211) exhibit less adsorption energy and therefore the most preferred surface than Pd(100) and Pd(111) surfaces.References [3] C. Mateos-Pedrero, S.R. González-Carrazán, M.A. Soria and P. Ruíz, Catal. Today 203 (2013) 158-162[2] C.R.K. Rao and D.C. Trivedi, Coord. Chem. Rev. 249 (2005) 613[3] Y. Shao, J. Liu, Y. Wang and Y. Lin, J. Mater. Chem. 19 (2009) 46[4] W. Kohn and L.J. Sham, Phys. Rev. A 140 (1965) 1133-1138

387 - Pulse Shape Analysis: Simulations with ADL and MGS codes

NPRP - Wednesday 09 July 2014 11:50 *[For award: PhD]*

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

Evaluation of the tracking capacity of the iThemba LABS segmented clover detector requires a detailed analysis of shapes of the traces registered on the 36 electrodes of the detector. The different shapes reflect different interaction positions of the incident gamma ray. In order to determine these interaction positions, raw experimental pulses are compared to a set of simulated ones, each corresponding to a specific position of the interaction. Accurate parameterization of the crystal geometry, space charge distribution, electron and hole mobilities among other things are needed for simulations to reproduce well the response of the real detector. In addition other factors that result from the response of the detector electronics have to be corrected for.This work aims at performing realistic simulations for the traces of the segmented clover detector. In particular simulations with a second code ADL (AGATA Detector Libraries) [1] were performed and compared with the results from the MGS (Multi-Geometry Simulation) code [2]. The two codes use different approaches to simulate the mobilities of charges, thus it is important to employ and compare both of them. The simulated pulses, generated with the two codes, showed very similar shapes, but they do have slightly different rise times. This difference is attributed to the different parameterization techniques. Experimentally measured pulses will be used for fine tuning the parameterization in the two codes. Such measurements are in progress. Simulations made with the two codes will be presented and discussed in comparison with experimentally measured traces. [1] B. Bryuneel, private conversations[2] P. Medina et al., Inst.and Meas. Tech. Conf., Como, Italy, 18-20 May 2004

392 - Importance of mergers in the growth of brightest cluster galaxies

Astro - Thursday 10 July 2014 14:00 *[For award: PhD]*

Primary author: GROENEWALD, Daniel *(North-West University)*

Brightest cluster galaxies (BCGs) are the most massive galaxies in the Universe and found at the centre of galaxy clusters. The unique position of BCGs make them ideal probes to study massive galaxy formation. Models of hierarchical galaxy formation indicate that these massive galaxies grow through the repeated mergers of less massive galaxies and the merger histories of BCGs provide a critical test for current galaxy formation models. The most direct way to determine the importance of mergers in the growth of BCGs is to look for mergers that will take place in the near future. This is done by searching for nearby galaxies that are likely to merge with the BCGs. I will present early results from an unprecedented sample consisting of tens of thousands of galaxy clusters (over a factor of ~100 larger than previous samples) looking back in cosmic time to a third the age of the Universe (z<0.45)

393 - Investigation of plasma dynamics effect on the properties of the vanadium oxide thin films

DPCMM1 - Thursday 10 July 2014 10:00 *[For award: PhD]*

Primary author: MASINA, Bathusile *(CSIR, University of KwaZulu-Natal)*
Co-authors: *LAFANE, Slimane (Centre de Developpment des Technologies Avanciees Cite); ABDELLI-MESSACI, Samira (Centre de Developpment des Technologies Avanciees); WU, Lorinda (CSIR); FORBES, Andrew (CSIR); KERDJA, Tahar (Centre de Developpment des Technologies Avanciees Cite)*

This study presents the influence of the plume expansion dynamics on the properties of the vanadium oxide thin films. The plume expansion dynamics study have been carried out on vanadium-oxygen plasma generated using 248 nm, 25 ns pulses from an excimer KrF laser under oxygen atmosphere at the laser fluence of 2 Jcm-2 using VO2 pellet. Vanadium oxide thin films have been deposited on a corning glass substrate by ablating a VO2 pellet at the same conditions of oxygen pressure and laser fluence used for the plasma study. The substrate temperature was fixed at 500 oC and target-substrate distance was determined using the plasma plume results. We successfully deposited pure monoclinic rutile-typed VO2 (M) phase at 0.05 mbar for 30 mm and 0.01 mbar for 30 and 38 mm. A pure orthorhombic V2O5 phase was successfully deposited at 0.1 mbar of 27 and 34 mm. A mixture of vanadium oxide phases was found at 0.2 mbar for 29 mm and at 0.05 mbar for 35 mm. Scanning electron microscopy and atomic force microscopy indicated nanostructures for the monoclinic rutile-typed VO2 (M) phase and nano-wire and nano-plate for the V2O5 phase.

395 - Raman spectroscopy of biofilms

Photonics - Wednesday 09 July 2014 15:00

Primary author: NEETHLING, Pieter *(University of Stellenbosch)*
Co-authors: *ROHWER, Erich (University of Stellenbosch); LOOTS, Ruenda (Stellenbosch University); SWART, Pieter (Stellenbosch University)*

In this study the chemical composition of the extracellular polymeric substance (EPS) matrix of specific biofilms was characterized non-invasively using Raman spectroscopy. Biofilms are groups of microorganisms in which cells stick to each other on a surface. These cells are usually contained within a self-produced matrix of extracellular polymeric substance (EPS). This biofilm EPS, which is often referred to as slime, is a polymeric conglomeration, composing of extracellular DNA, proteins, and polysaccharides. Biofilms may form on many different surfaces, both living and non-living, and are found in natural, industrial and even hospital settings. The microbial cells growing in a biofilm are physiologically distinct from planktonic cells of the same organism, which, by contrast, are single-cells that may float or swim in a liquid medium. In situ Raman measurements from biofilms will be presented with tentative band assignments made. The use of silver nanoparticles for performing Surface Enhanced Raman Scattering (SERS) of compounds commonly found in the EPS of biofilms will also be shown. The nanoparticles were synthesized following established published protocols. Measuring the chemical composition i.e. carbohydrate and protein expression in biofilms, as a function of growth conditions should lead to an improved understanding of biofilm formation. This information can be used in future treatments of potable water as well as in biofuel production.

396 - Search for Very High Energy candidate sources using South African observatories

Astro - Friday 11 July 2014 10:20

Primary author: VAN SOELEN, Brian *(University of the Free State)*
Co-authors: *MEINTJES, Pieter (University of the Free State); KLINDT, Lizelke (University of the Free State); BOETTCHER, Markus (North-West University); VÄISÄNEN, Petri (South African Astronomical Observatory); HANLON, L.H. (University Colledge of Dublin); TOPINKA, Martin (University College of Dublin); VAN DER WESTHUIZEN, Izak (University of the Free State)*

The multi-wavelength South African observatories are ideally located to complement the very high energy (VHE) observations undertaking with the H.E.S.S. telescope located in Namibia. We are undertaking a long term multi-wavelength campaign and a literary search to identify potential VHE energy extra-galactic sources which may be observable with the H.E.S.S. telescope. The early stages of this project have focussed on identifying candidate sources and undertaking optical photometric observations with the UFS/Boyden 1.5-m and Watcher telescopes located at the Boyden observatory, and optical spectroscopy observations with the South African Large Telescope and the SAAO 1.9m telescope located at the South African Astronomical Observatory (SAAO). We present an overview of the proposed observational programme, the different possibilities available for multi-wavelength observations and initial results from this project.

398 - How does the Cosmic Web Shape Galaxy Formation?

Astro - Tuesday 08 July 2014 11:10

Primary author: GILBANK, David *(South African Astronomical Observatory)*

Galaxy formation is at the same time both remarkably simple and remarkably complicated! Although the key physical processes responsible for shaping galaxies are not worked out in detail, they do however follow well-definedscaling relations. Recent work has shown that, in order to predict a galaxy's key properties, it is apparently sufficient to know only its stellar mass and the environment in which it resides. However, such approaches may ``smooth over" key details, such as the galaxy's place in the vast web of cos mic structure. I will present early work from a study of a statistical sample of galaxies in the nearby Universe to examine how this larger structure affects a galaxy's key observables, such as star formationrate and gas content.

400 - Structural and Optical Characterisation of Double-Doped TiO2 Nanoparticles

DPCMM1 - Thursday 10 July 2014 15:20

Primary author: *NUBI, Olatunbosun (University of Limpopo)*
Co-authors: *MOSUANG, Thutho (University of Limpopo); RAMMUTLA, Erasmus (University of Limpopo)*

With titanium isopropoxide as the precursor, single and double doped nanosized powders of TiO_2 were synthesised by the sol-gel process. The metal dopants used were Ag, Cu and Fe at doping levels of 5% (molar weight). The post annealing of the samples was done at 300 °C, 600 °C and 900 °C after drying them at 100 °C in air. Structural characterisation of the samples was carried out by X-ray Diffraction (XRD), Raman and scanning Electron Microscopy (SEM) techniques. The results suggests that the co-doped TiO_2 powders are constituted by both the anatase and brookite phases (with the dopant particles incorporated into the TiO_2 matrix) whereas only anatase is observed in the case of pure and singly doped samples (with the dopants residing on the TiO_2 surface). The co-existence of brookite with anatase in the co-doped sample is thought to be responsible for the enhancement of anatase to rutile transformation. Photoluminescence (PL) and UV-visible measurements were done to study the optical properties of the TiO_2 nanoparticles. This revealed the active PL band at around 440 nm. Double doping was found to enhances the narrowing of the band gap, over single doping.

402 - Electrical properties of Hg/n-Si (MS) and Hg/PO3/n-Si (MIS) Schottky Diodes

DPCMM1 - Thursday 10 July 2014 10:20 *[For award: PhD]*

Primary author: *NAMBALA, Fred Joe (University of Zambia)*
Co-authors: *DIALE, Fred (University of Pretoria); CAHEN, David (Weizmann Insitute of Science)*

Metal-semiconductor (MS) and metal- insulator-semiconductor (MIS) Schottky barrier diodes were studies using 4-cyanobenzyl phosphonate (PO3) monolayer. The insulator was deposited on n-Si(111) through a chemical process. Electrical parameters of the Hg/n-Si(111), MS and Hg/PO3/n-Si, MIS contacts were obtained from the forward and the reverse bias current-voltage (I-V) and capacitance-voltage (C-V) measurements performed using a mercury (Hg) probe at room temperature. Experimental results show no rectification behavior for the MS and rectification for MIS diodes. The ideality factor (n) and the zero-bias barrier height (■Bo) were determined as 5 and 0.44 eV for the MS. In addition, the values of n and ■Bo for MIS were determined as 1.2 and 0.68 eV using I-V measurements and then the ■Bo of 0.64 eV was measured with C-V. C-V measurements for the MS diodes did not yield results due to low barrier height.

403 - Fast neutron measurements with dueterated liquid organic scintillator NE230

NPRP - Friday 11 July 2014 11:50 *[For award: MSc]*

Primary author: *MASONDO, Vusumuzi (University of the Western Cape)*

Neutron measurements such as response functions and efficiency of the detector are of importance in detector development for fast neutrons. A number of detectors such as proportional counters and plastic, liquid, and crystal organic scintillators have been developed for such measurements, however liquid organic scintillators have been favoured owing to their excellent pulse shape discrimination, relative cheapness and that they can be suitably manufactured. Widely used liquid scintillators such as NE123 are based on proton recoil, however the challenge presented by such recoil spectrometers is that protons have a long range, thus some protons tend to escape the detector without depositing all their energies, this distort the response function and in turn affect the measured efficiency of the scintillator. Additionally for in phantom measurements such as in water, the detector cannot discriminate between protons from water and those arising from the detector. In light of the above mentioned reasons organic scintillators such as NE230 have been suggested as an alternative since they are based on deuteron recoil which has shorter range compared to protons and can be used for in phantom measurements since it offers a way to discriminate against the protons. Experiments were carried out at the neutron beam facility at iThemba LABS in Cape Town. Neutron beams of energies up to ~64MEV were produced by bombarding either Li (1.0mm), Be (10.0mm), or C (10.0mm) targets with 66MeV protons from the separated sector cyclotron. Measurements were carried out with NE230 detector using time of flight method (ToF). Data was used to obtain the detector efficiency of NE230 and results obtained will be compared to theoretically calculated detector efficiency.

404 - Search for the Higgs boson in fermionic channels using the ATLAS detector

NPRP - Thursday 10 July 2014 14:20 *[For award: PhD]*

Primary author: *LEE, Claire (UJ & Academia Sinica)*

Since the discovery of the Higgs boson by the ATLAS and CMS experiments at the LHC, the emphasis has shifted towards measurements of its properties. Of particular importance is the direct observation of the coupling of the Higgs boson to fermions. In this presentation a comprehensive review of ATLAS results in the search for the Higgs boson in tau, muon, and b-quark pairs will be given.

405 - DFT, LS or GLS? - A 'road test' of various Fourier-based period-finding algorithms for astronomical observations

Astro - Wednesday 09 July 2014 15:00

Primary author: *ENGELBRECHT, Chris (University of Johannesburg)*

The mathematical properties of harmonic functions have made Fourier-based algorithms very popular in searches for periodic behaviour in stellar light curves and other astronomical data. The Discrete Fourier transform (DFT) and the Lomb-Scargle periodogram (LS) have been in common use for many decades, as methods particularly suitable for the non-equally-spaced time data that are typical of astronomical measurements. More recently, Cumming (1999) and Zechmeister and Kuerster (2009) have introduced refinements to the LS method that embody the 'Generalised Lomb-Scargle" or GLS method. Various recent tests of these methods (e.g. Vio et al. (2013) and Graham et al. (2013)) have emphasised the strengths and deficiencies that accompany each of them. These test results demonstrate that certain methods are distinctly unsuitable for certain types of data and could lead to erroneous conclusions about the types of periodic behaviour present in measured data. 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, the recent developments in the study of period-finding algorithms are significant. In this presentation, the main findings of the above-mentioned tests will be discussed and summarised, with a view to offering guidance in choosing an appropriate period-finding method for particular sets of observational data.

413 - The ATLAS Trigger/DAQ system and its system administration aspects

NPRP - Tuesday 08 July 2014 14:40

Primary authors: *BALLESTRERO, Sergio (University of Johannesburg); LEE, Christopher Jon (University of Johannsburg and CERN)*

The ATLAS Trigger and Data Acquisition (TDAQ) system is responsible for the online processing of live data streaming from the ATLAS experiment at the Large Hadron Collider (LHC) at CERN. The system processes the direct data readout from ~100 million channels on the detector through multiple trigger levels, selecting interesting events for analysis with a factor of 10^7 reduction on the data rate with a latency of less than a few seconds. After its first shutdown, the LHC will provide pp collisions with increased luminosity and energy, and upgrades to the Level1 trigger, dataflow and High Level Trigger are under way to deal with the expected increase of the event rates. The computing system that supports TDAQ and other ATLAS Online functions is also undergoing a significant revision, with the upgrade to Scientific Linux 6, the convergence to Puppet as a single Configuration Management system, and a complete overhaul of the tools for health and performance monitoring. In this paper we describe the basic structure of the TDAQ system, and focus on the computing and Systems Administration aspects and their evolution.

416 - Generation of Coherent and Incoherent Superpositions of Laguerre–Gaussian Beams using a Diode-Pumped Solid-State Digital Laser

Photonics - Wednesday 09 July 2014 11:30 *[For award: PhD]*

Primary author: *NGCOBO, Sandile (CSIR)*
Co-authors: *NAIDOO, Darryl (CSIR); LITVIN, Igor (CSIR); FORBES, Andrew (CSIR)*

In this paper we demonstrate experimentally the methods of intra-cavity generating superposition of Laguerre–Gaussian modes of zero radial order but opposite azimuthal order. The superpositions are created with a simple technique such as intra-cavity loss lines, multi-rings and circular apertures which are implemented on digital laser using a phase-only spatial light modulator. We show that we can produce very pure coherent superposition of petal modes of up to azimuthal order 25 and also incoherent superposition of petal modes that form a doughnut that do not carry any orbital angular momentum (AOM). We further demonstrate a technique that could be used to distinguishing between an incoherent doughnut mode from a coherent doughnut mode that does not carries OAM.

417 - Particle number dependent discontinuities in density functional derivatives.

Theoretical - Friday 11 July 2014 11:30

Primary author: *JOUBERT, Daniel (University of the Witwatersrand)*

The best known particle number dependent discontinuity of a functional derivative in density functional theory is the discontinuity in the exchange-correlation potential, first highlighted by Perdew et al. (Phys. Rev. Lett., 49, 1691, (1982)) and Sham and Schlüter (Phys. Rev. Lett., 51, 1888, 1983)). In this paper it is formally shown that the functional derivatives of the exchange-correlation energy, the interacting kinetic energy, the non-interacting kinetic energy, the mutual Coulomb interaction energy and the correlation part of the kinetic energy can all have spatially independent jumps at integer particle numbers. Formal expressions for the derivative discontinuities are derived and it was shown that the jump exchange-correlation potential can be expressed in terms of a coupling constant integral over the difference in the mutual Coulomb energies of the (J + 1)- and (J - 1)-electron systems.

418 - Numerical modelling of the generation of Gaussian graph state

Theoretical - Thursday 10 July 2014 14:00

Primary author: *NZUZI MBENZA, Lucien (UKZN)*
Co-authors: *TEPER, Natalia (UKZN); SINAYSKIY, Ilya (UKZN); PETRUCCIONE, Francesco (UKZN)*

We present the results of a numerical modelling of a system of two distant nitrogen vacancy ensembles (NVEs) embedded in separated transmission line resonators (TLRs) with identical length coupled to a current biased Josephson Junction (CBJJ). The TLRs are connected at both ends to the Josephson Parametric amplifiers (JPA) as they are sources of a squeezed microwave field. The fluctuation of the current bias provokes dissipation in the junction which leads to entanglement. We analyse the fidelity of two modes gaussian graph (cluster) state and two entangled bosonic modes of NVEs.

419 - Using cooperative learning to improve students' problem solving in physics

Education - Wednesday 09 July 2014 14:00

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

This paper reports on work done in the Physics Department at the University of the Western Cape using cooperative learning to improve students' problem-solving in physics. The first Semester mechanics module of the mainstream physics first year program focuses on a student-centered teaching and learning approach. Cooperative learning is used in this approach as a tool to promote student participation in their learning and to improve their problem solving in physics. The mainstream mechanics module teaching and learning approach and use of cooperative learning to improve students' problem solving in physics will be presented and discussed.

420 - Magnetic interactions in 3*d* transition metal-doped diamond

DPCMM1 - Friday 11 July 2014 11:10

Primary author: BENECHA, Evans (University of South Africa)
Co-author: LOMBARDI, Enrico (University of South Africa)

Ferromagnetic ordering of dopants in semiconductors offers a possible route towards the development of hybrid devices capable of incorporating the conventionally separate functionalities of semiconductor structures and magnetism in one material system for applications in the emerging field of spintronics. However, achieving high ferromagnetic stabilization energies in these materials has posed the main challenge for development of devices capable of operating at room temperature. We present density functional theory calculations on the magnetic interactions of 3*d* transition metal-doped diamond and show that ferromagnetic ordering can be achieved in diamond with significant ferromagnetic stabilization energies than has been achieved in the archetypal dilute magnetic semiconductor Mn doped GaAs up to now.In *p*-type diamond, we find that ferromagnetic ordering is likely to be achieved for Cr^{+2} at the divacancy and Fe^{+1} at substitutional lattice sites, with magnetic stabilization energies of 16.9 meV and 33.3 meV, respectively. In *n*-type diamond, we find that V^{-2} and Cu^{-2} exhibit ground state ferromagnetic ordering when occupying the divacancy lattice site, with ferromagnetic stabilization energies of 21.6 meV and 27.5 meV, respectively, while ferromagnetic ordering occurs in intrinsic diamond only in divacancy Co^{0}, with a magnetic stabilization energy of 13.8 meV. These results indicate that semiconductor diamond may sustain ferromagnetic ordering with both *n*-type and *p*-type carriers in the same material host, which is crucial in realizing bi-polar spin-polarised transport.

421 - First year students' beliefs about physics

Education - Thursday 10 July 2014 11:10

Primary author: TAYLOR, Dale (UCT)

Students' success in physics courses depends in part on their beliefs and assumptions about physics and about learning physics. This investigation explored the opinions of first year students enrolled in three physics service courses at a local university: a course for engineers (n = 416), a course for medics (n= 189) and a course intended for other students not wishing to continue with physics (n= 230). The response rate was 84 % overall. The survey instrument was a modified version of the Maryland Physics Expectations survey , a Likert-scale (agree–disagree) survey [1]. 20 of the original 34 items were used (with appropriate modifications of the language) plus a further ten items derived from a previous local study. Although the majority of students exhibited views regarded as favourable by their lecturers, a significant number expressed beliefs which may be counter-productive to effective learning in physics. For example, 36 % of the sample agreed with the statement "If the physics lecturer gives really clear lectures, then most students can learn physics without doing lots of practice problems on their own." There are also interesting similarities and differences between the different cohorts. These results were compared with those of successful mainstream physics students. The instrument was also used with students at the start of the second year physics course (n=26). A limitation of the results of this study is that students are likely to report their beliefs more favourably than their learning practices attest. [1] Redish, E. F., Saul, J. M., & Steinberg, R. N. (1998). Student expectations in introductory physics. American Journal of Physics, 66(3), 212-224.

424 - Study of superconducting gap in boron doped nanodiamond through differential resistance

DPCMM1 - Wednesday 09 July 2014 14:20 *[For award: MSc]*

Primary author: SANDERS, Kirsty (University of the Witwatersrand)
Co-authors: MCINTOSH, Ross (University of the Witwatersrand); CHIMOWA, George (University of the Witwatersrand); NESLADEK, Milos (Hasselt University); BHATTACHARYYA, Somnath (University of the Witwatersrand)

Unconventional superconductors which are a possible route to high temperature superconductivity are widely studied as they offer interesting correlated systems; yet they still pose a variety of unanswered questions. In particular studies of the superconducting gap through differential conductance measurements may yield valuable insight into the mechanism responsible. Here we study differential conductance over various magnetic fields of a set of boron doped nanocrystalline diamond samples. The granular microstructure of these nanocrystalline samples results in a difference between local properties (such as boron concentration) and bulk properties. It is generally believed that the grain boundaries separating the grains are non-superconducting. The temperature dependence of all samples showed a superconducting transition with Tonset ~ 2.5 K. For the sample with lower boron doping, current-voltage measurements showed a metallic normal state with a decrease in temperature and magnetic fields shifting the sample into a second metallic state of much lower resistance. This local superconductivity (where some grains become superconducting and do not contribute to the resistivity of the sample which is now made up of the metallic properties of the remaining grains) is believed to arise from inhomogeneity between the grains. in the highly doped samples we found a complete change in the current-voltage characteristics at the transition resulting in a minimum in the differential resistance, with the minimum resistance increasing rapidly in the presence of a magnetic field. Magneto resistance measurements in these samples confirmed the breakdown of superconductivity at low magnetic fields with an additional peak (not seen in low boron concentration samples) in the magneto resistance at the transition. These results offer valuable insights into the mechanism behind unconventional superconductivity in carbon systems.

425 - Modelling Flow Phenomena in Time Dependant Store Release from Transonic Aircraft

Applied - Thursday 10 July 2014 11:30

Primary author: MACLUCAS, David (CSIR)
Co-author: GLEDHILL, Irvy (Igle) (CSIR)

In the Mach number range between 0.8 and 1.2, aerodynamic loads on aircraft and launch vehicles are very sensitive to the presence of shocks. While numerical models in the subsonic and supersonic ranges rely on a range of assumptions and can run relatively fast, transonic models are very sensitive to geometry and are computationally demanding.Computational Fluid Dynamics (CFD) is a useful tool in addition to wind tunnel test and flight test. Testing is required in order to predict carriage loads, and release safety.Validation of relevant public domain cases in CFD is a rigorous requirement. The case of a double-ogive finned store dropped from a pylon beneath a delta wing has been studied experimentally (R. Heim, Arnold Engineering Development Centre Report, 1991) and using CFD (L.E. Lijewski, N.E. Suhs, J. Aircraft, 31, 886-891, 1994). At free-stream Mach number M = 0.95, the flow structures directly under the wing include shocks at the fore and aft limits of the pylon. A shock-wake interaction occurs downstream of the pylon. The interaction between the aft pylon shock and the spanwise shock usually found on delta wings is explored. The shock system of the parent body interacts with that of the moving store and with its associated expansion fans. In the simulations, the sting supports of the wing and the store are neglected. The flow field developing between the wing and the store for the first 500 ms of release under gravity is of considerable significance in the overall trajectory of the store.Inviscid tests of the parent body alone indicate that modelling of the flow over the parent body displays time dependence in which the shock parallel to the delta wing trailing edge oscillates fore and aft, displacing the shock system around the pylon.

426 - Aliasing in Atomic Clocks

Theoretical - Wednesday 09 July 2014 11:30 *[For award: PhD]*

Primary author: AKHALWAYA, Ismail (University of Johannesburg)
Co-authors: UYS, Hermann (CSIR); BIERCUK, Michael (University of Sydney, Australia); SASTRAWAN, Jarrah (University of Sydney, Australia)

Atomic clocks execute periodic corrections of a 'classical' quartz crystal oscillator, by comparison to an atomic quantum reference, namely a precise hyperfine transition frequency. This periodic calibration has a surprising noise-inducing effect called **aliasing**. In fact, this sampling effect is mathematically identical to visual digital aliasing. Many of the standard visual anti-aliasing techniques are not applicable to the atomic clock problem or experimentally tenable. A new technique is proposed where previous samples are incorporated to boost correction on certain portions of the noise spectral density and dampen sensitivity on the aliased portion. We find scenarios for realistic parameters where our multiple window technique improves the accuracy of the atomic clock correction by reducing aliasing. Ultimately, this may help your GPS tell you to "turn right now" more accurately.

430 - Discrete Element Models applied to Aggregate Properties in Pavement Design

Applied - Thursday 10 July 2014 15:00

Primary author: GLEDHILL, Irvy (Igle) (CSIR)
Co-authors: MGANGIRA, Martin (CSIR); ANOCHIE-BOATENG, Joseph (CSIR)

The shape of rock particles in gravel affects the bulk properties of aggregate material, and the effects are in the process of being well quantified for South African materials. Current practice in pavement and rail engineering is to discard quarry output or recycled material which does not conform to angularity, elongation ratios, and surface texture specifications which are relatively conservative. The proof of the dependence of bulk properties on angularity, in particular, may allow better use to be made of recycled material and mined material.In previous work (Gledhill, Greben and de Villiers, SAIP Annual Conference 2013) a physics engine was adapted to perform uniaxial testing, and the resulting stress-strain curves were presented for a set of regular shapes. It was demonstrated, within the applicability of this model, that the elastic modulus of the aggregate increases with the angularity index for regular polyhedra, with the exception of cubes, in which the strain reaches a maximum value after which the particle packing is fixed. The method has the advantage that it is faster than Discrete Element Methods (DEM), but the disadvantage that stress within the particles is not modelled. The Combined Finite-Discrete Element method (Munjiza, Computational Mechanics of Discontinua, Wiley, 2011) offers the significant advantage of providing a Finite Element model of internal elements within each particle. A Combined Finite-Discrete Element model of particles of different angularity has been constructed and the results, in the form of stress-strain curves, are presented here. The simulation is extended to particle models based on laser-scanned surfaces of particle aggregate samples. Laboratory testing of compression has been performed (Anochie-Boateng, Komba and Mvelase, Int. Road Congress 2011) and comparisons with these experimental results will be shown.

431 - Real Space Lensing Reconstruction using CMB Temperature and Polarisation

Space - Thursday 10 July 2014 15:20 *[For award: MSc]*

Primary author: RIDL, Jethro (University of KwaZulu-Natal)
Co-authors: MOODLEY, Kavilan (University of KwaZulu-Natal); BUCHER, Martin (University of Paris); PRINCE, Heather (UKZN)

Gravitational lensing of the cosmic microwave background (CMB) probes the distribution of matter in our universe, of which dark matter forms a large part. It also allows us to delens the CMB and obtain an accurate picture of its primordial fluctuations. We explore methods of reconstructing the lensing field from the lensed CMB temperature and polarisation in real space, as an alternative to the harmonic space estimators currently in use. Real space estimators have the advantage of being local in nature and they are thus equipped to deal with the nonuniform sky coverage, galactic cuts and point source excisions found in actual data. These estimators can be applied to temperature and polarisation maps from CMB data to reconstruct the lensing convergence and shear.

432 - X-ray reflectivity and surface Brillouin studies of rf magnetron sputtered NbN thin films

Applied - Wednesday 09 July 2014 10:20 *[For award: PhD]*

Primary author: *KURIA, Jonah (University of the Witwatersrand)*
Co-authors: *WAMWANGI, Daniel (University of the Witwatersrand); COMINS, Darrell (University of the Witwatersrand); MSIMANGA, Mandla (iThemba Labs); BILLING, Dave (University of The Witwatersrand)*

NbN thin films have been extensively used as protective coatings for cutting tools due to their excellent properties of high melting temperature, and high resistance against oxidation and wear and tear. In this work, NbN thin films were deposited on etched Si(100) at room temperature using rf magnetron sputtering to establish the role of stoichiometry and microstructure on the elastic constants based on zone structure model. X-ray reflectivity (XRR) has been used to extract the deposition rate for velocity dispersion curves, the interfacial roughness and the mass density of the NbN films. The dependence of stoichiometry on the ad atom energy (sputter powers) was determined by heavy ion elastic recoil detection analysis (HI-ERDA). Surface Brillouin scattering studies on NbN films have shown the propagation of Rayleigh and Sezawa peaks indicative of high film quality. The elastic constants of NbN at various powers will be extracted from the velocity dispersion curves using numerical approaches.

434 - Influence of a science enrichment programme on the views of the nature of science of a group of grade 10 learners.

Education - Tuesday 08 July 2014 10:00 *[For award: PhD]*

Primary author: *BALOYI, Vonani Michael (University of Pretoria)*
Co-authors: *NORDHOFF, HI (University of Pretoria); GAIGHER, E (University of Pretoria); BRAUN, MWH (University of Pretoria)*

This paper presents results of the study conducted with a group of 82 grade 10 applicants to a science enrichment programme at the University of Pretoria. The Views on the Nature of Science (VNOS) questionnaire composed of eleven open-ended questions was used in examining learners' views on seven aspects of the nature of science. The initial study investigated the influence of students' social background on their views of nature of science (NOS). We discuss the results obtained and investigate the correlations between the students' performance on the test and parents' level of education, school performance, and marks in school subjects, home language, and culture. Findings showed no significant difference in the test scores between genders. The strongest influence on the scores was found to be the educational background of the parents. Also, learners with English as a home language performed better. A follow up study was performed on the same group of learners two years later. This group included students that had attended the science enrichment course (the experimental group) as well as students that had not done so (the control group). The second study provided the opportunity to investigate the effect of attending the science enrichment on the students' views on the NOS. The follow-up study showed that both groups had a more informed view on the nature of science. There was a small difference in the scores obtained between the students that attended the science enrichment programme and those that did not. This is in agreement with results obtained by Abd-El-Khalick & Akerson (2004), Akerson, Abd-El-Khalick, and Lederman (2000) and Khishfe & Abd-El-Khalick (2002) who found that students' scores on VNOS were not significantly influenced if the NOS was not explicitly taught.

440 - The XENON100 Dark Matter Experiment

Astro - Tuesday 08 July 2014 11:50 *[For award: PhD]*

Primary author: *PIENAAR, Jacques (Purdue University)*

The XENON100 experiment, situated in the Laboratori Nazionali del Gran Sasso, aims at the direct detection of dark matter in the form of weakly interacting massive particles (WIMPs). It uses liquid xenon (LXe) in a time projection chamber (TPC) to search for xenon nuclear recoils resulting from the scattering of WIMPs. The active region of XENON100 contains 62kg of LXe, surrounded by a LXe veto of 99kg, both instrumented with photo multiplier tubes (PMTs) operating inside the liquid or or in xenon gas. The LXe target and veto are contained in a low-radioactivity stainless steel vessel, embedded in a passive radiation shield. I report on a search for particle dark matter for 13 months during 2011 and 2012 using XENON100. XENON100 features an ultra-low electromagnetic background of (5.3±0.6)×10^-3 events/(kg×day×keVee) in the energy region of interest. A blind analysis of 224.6 live days × 34 kg exposure has yielded no evidence for dark matter interactions. The two candidate events observed in the pre-defined nuclear recoil energy range of 6.6-30.5 keVnr are consistent with the background expectation of (1.0±0.2) events. A Profile Likelihood analysis using a 6.6-43.3 keVnr energy range sets the limit on the spin-independent elastic WIMP-nucleon scattering cross section for WIMP masses above 8 GeV/c^2, with a minimum of 2 × 10^-45 cm^2 at 55 GeV/c^2 and 90% confidence level.

443 - Investigation of the Isovector Giant Dipole Resonance (IVGDR) strength in the selected neutron-rich calcium isotopes 42, 44, 48Ca

NPRP - Wednesday 09 July 2014 15:00 *[For award: PhD]*

Primary author: *LATIF, Mouftahou (University of the Witwatersrand)*
Co-authors: *USMAN, Iyabo (University of the Witwatersrand); SIDERAS-HADDAD, ELIAS (University of the Witwatersrand); JINGO, Maxwell (University of the Witwatersrand); KUREBA, Chamunorwa Oscar (University of the Witwatersrand); DONALDSON, Lindsay (University of the Witwatersrand); NEMULODI, Fhumulani (Stellenbosch University); SWARTZ, Jacobus (Stellenbosch University); PAPKA, Paul (Stellenbosch University); PONOMAREV, Vladimir (TU Darmstadt); FUJITA, Hiro (Osaka University); VON NEUMANN-COSEL, Peter (TU Darmstadt); CARTER, John (University of the Witwatersrand); NEVELING, Retief (iThemba LABS); SMIT, Frederick David (iThemba LABS)*

Experiments were performed at the cyclotron of iThemba LABS together with the K600 magnetic spectrometer. High energy-resolution zero-degrees proton inelastic-scattering data were obtained for 42Ca, 44Ca and 48Ca at Ep = 200 MeV and fine structure has been observed in the region of the Isovector Giant Dipole Resonance (IVGDR) lying between 17 to 24 MeV excitation. In an excitation energy region below the IVGDR lies the so-called Pygmy Dipole Resonance (PDR), resulting from the oscillation of excess neutrons against a stable proton-neutron core with Z ≈N. An additional aim of the experiment is to identify the PDR and to investigate the nature and systematics of this resonance which are presently not well understood. Preliminary data will be presented and future prospects will be discussed.

444 - A numerical investigation of the evolution OAM entanglement in turbulence

Photonics - Thursday 10 July 2014 15:20

Primary author: *HAMADOU IBRAHIM, Alpha (CSIR)*
Co-authors: *ROUX, Filippus S (CSIR); KONRAD, Thomas (University of KwaZulu-Natal)*

The orbital angular momentum (OAM) states of light can potentially be used to implement higher dimensional entangled systems for free-space quantum communication. Unfortunately, the refractive index fluctuation of the atmosphere gives rise to random phase aberrations on a propagating optical beam. To transmit quantum information successfully through a free-space optical channel, one needs to understand how atmospheric turbulence influences quantum entanglement. Some studies has in the past been done on the effect of atmospheric turbulence on entangled OAM states. However the majority of these studies assumed that the overall effect of the turbulence over the propagation path can be modelled by a single phase distortion on the beam. This is the single phase screen approximation. Under this approximation, one finds that the evolution of the OAM entanglement in turbulence can be describe by a single dimensionless parameter, w0/r0, where w0 is the radius of the beam and r0 is the Fried parameter. Here we use numerical simulations to study how the evolution of entanglement depends on the various dimension parameters (which include the propagation distance, the wavelength, the beam radius and the strength of the turbulence) of the system in the regime where the single phase screen approximation is not valid. It is found that the evolution of entanglement cannot always be described by a single dimensionless parameter. The turbulence atmosphere is modelled by a series of consecutive phase screens based on the Kolmogorov theory of turbulence and the quantum entanglement is quantified in terms of Wooter's concurrence.

449 - Rapid Photometric variability of magnetic Cataclysmic Variables

Space - Thursday 10 July 2014 14:40 *[For award: PhD]*

Primary author: *BREYTENBACH, Johannes (University of Pretoria)*
Co-author: *BUCKLEY, David (Southern African Large Telescope)*

Magnetic Cataclysmic Variables (mCVs) are semi-detached binary star systems consisting of a degenerate White Dwarf (WD) primary and a lower Main Sequence donor star. Material in these objects accretes from the donor star through a truncated disc where it eventually becomes channelled in the innermost regions by the strong (mega Gauss) magnetic field. As such, mCVs, and the extreme physical conditions they command, offer a unique probe into the properties of magnetically confined, supersonic plasma flows. The rapid photometric variability observed in these objects is thought to originate within the accretion column as the shock front - formed by material impacting on the WD surface - oscillates radially. By studying such Quasi-Periodic Oscillations (QPOs) - their relative stability, orbital phase- and system state dependencies - one may gain insight into the geometry of the accretion flow and magnetic field of the host star. This work represents the systematic study of the optical variability of a large number of southern hemisphere Polars with the goal of better understanding how magnetism affects accretion.

451 - Conceptual resources for learning kinematics graphs

Education - Wednesday 09 July 2014 14:40 *[For award: MSc]*

Primary author: DJJAN, Grace *(North-West University)*
Co-authors: *LEMMER, Miriam (North-West University); MORABE, N (North-West University)*

Learners' difficulty in the application of basic concepts in graphs to solve kinematics graphs problems leads to underperformance in physical sciences. Their ability to handle problems in kinematics graphs is enhanced if they have an effective conceptual resources on graphs. In South Africa there seems to be a gap between the GET [General Education and Training] and FET [Further Education and Training] band's requirements on graphs. A smooth learning progression is needed. For this reason this study selected to investigate the conceptual resources acquired by grade 10 learners from grade 9 that can be used productively for the learning of kinematics graphs in grade 10. The use of mixed method approach was considered appropriate for this study. The mixed method depended on the quantitative method to produce precise and measurable data, while a qualitative method was to enhance the understanding of the data produced by the quantitative method. Patterns and trends in learners' reasoning were probed with the aid of qualitative method. In the study it was reported that the quantitative data in the form of a questionnaire was completed by 201 learners. Qualitative data was obtained by interviewing three learners with varying abilities. The results showed that many learners could answer mathematics questions, but struggled with similar questions in kinematics. The results further showed that learners did not answer the questionnaire consistently, but their responses depended on the context of the questions. In the interviews learners used everyday applications to explain scientific concepts, instead of using scientific principles. From the results it can be deduced that learners' conceptual resources can influence their understanding of kinematics graphs in physics. These resources are gained from everyday experiences and previous learning in mathematics and the natural sciences. A constraint is that many learners do not efficiently integrate their mathematics and physics knowledge.

452 - Residual stress in polycrystalline thin Cr films deposited on fused silica substrates

DPCMM1 - Wednesday 09 July 2014 14:40 *[For award: MSc]*

Primary author: MUDAU, Z P *(University of Johannesburg)*
Co-authors: *PRINSLOO, A R E (University of Johannesburg); SHEPPARD, C J (University of Johannesburg); VENTER, A M (NECSA); NTSOANE, T P (NECSA); FULLERTON, E E (University of California, San Diego)*

The Néel temperature (T_N) in thin film Cr coatings is strongly influenced by dimensionality effects, as well as strain and stress [1]. In an investigation of Cr thin films with thickness (t) varied between 20 and 320 nm deposited on fused silica substrates, the T_N values obtained from resistivity measurements indicate an increase with thickness as expected [1]. However, it is noted that the $T_N \approx 460$ K obtained for the t = 320 nm sample, is considerably higher than the transition temperature of 311 K obtained in bulk pure Cr. This behavior is unexpected, but incidentally corresponds with T_N = 475 K obtained for the CSDW-P Néel transition in bulk Cr when influenced by stresses introduced by cold working [3,4]. Since stresses are well known to influence the physical properties of materials [1,2], amongst others the magnetic properties, this study is now extended to investigations of the in-plane stresses in these thin films. This is done using the specialised X-ray diffraction $\sin^2\psi$–method [2,5,6]. With this technique, variations in the lattice plane spacing is accurately determined from the precisely measured (310) Bragg peak position as function of systematically increased tilt angles, ψ, from the surface normal to as close as achievable to the in-plane direction. The in-plane residual strain present in the coating (ε) is determined from the slope of a linear plot through the fractional change in the plane spacing (or Bragg peak position) versus $\sin^2\psi$ plots. Residual stress (σ) are calculated from the ε versus $\sin^2\psi$ data by incorporating the elastic properties of the coating material. The results indicate tensile stresses in all the samples. Results will be used to correlate the T_N values to the stresses in the coatings.References:[1] Zabel H 1999 *J. Phys. Condens. Matter* 11 9303 [2] Genzel CH 2004 *J. of Neutron Research* 12 233 [3] Fawcett E 1988 *Rev. Mod. Phys.* 60 209 [4] Prinsloo ARE et al. 2010 *J. Magn. Magn. Mat.* 322 1126[5] Society for Automotive Engineering, Residual Stress Measurement by XRD, 2nd edition 1971 SAE J748a[6] Noyan IC, Cohen JB, Residual Stress, Measurement by Diffraction and Interpretation, Springer-Verlag, New York, 1987

453 - Analytical technique to measure radon generation from Gauteng river water samples using solid state detector

NPRP - Wednesday 09 July 2014 10:20 *[For award: MSc]*

Primary author: MASEVHE, Livhuwani *(UJ)*
Co-author: *MAVUNDA, Risimati (NECSA)*

Radon is a radioactive noble gas of a natural origin that may be found anywhere in soil, air and in different types of water. Researchers have realized that human exposure to radon can lead to healthy-risks. Since radon and its progeny produce many alpha and beta particles, its inhalation or ingestion may cause cancer in human organs, particularly in the lungs. Therefore, assessing radon in natural water and soil is an important step towards the reduction of potential exposure to it.In this investigation, the concentration of Rn-222 was measured and a Kinetic Theory of an Ideal Gas technique to measure radon generation in river water sample using Solid State Alpha Detector (RAD-7 radon monitoring device). The mathematical model of the measurement technique provides the radon concentration response of RAD-7 as a function of the sample volume. For experimental validation of the technique, radon concentration was measured at twenty different volumes. Fitting the parameters of the model to the measurement results, with the generation rate and diffusion length of radon being estimated. The optimal sample volume for estimating the radon generation from a single measurement was also determined. The effect of the sqmpl temperature to the release of radon gas from water was also explored experimentally.

454 - Modeling physical phenomena with permanent magnets

Education - Tuesday 08 July 2014 15:00

Primary author: *JARVIS, Leigh (UKZN)*
Co-author: MICHAELIS, Max *(Rutherford-Appleton Laboratories)*

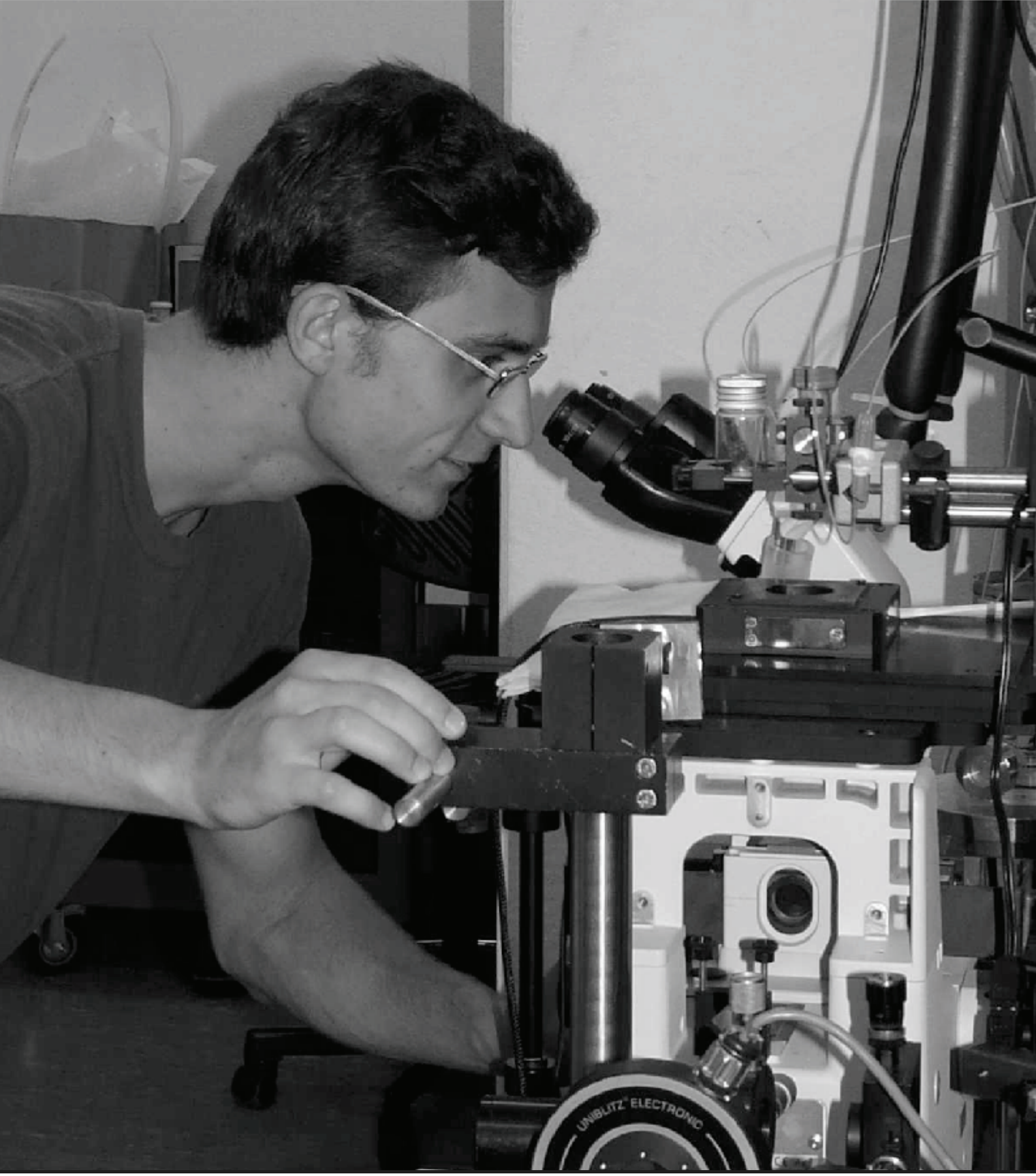
Although permanent magnets are magnetic dipoles, by carefully orienting them, a number of electrostatic as well as magnetic, monopolar, and dipolar phenomena can be modeled for teaching purposes. The simpler ones involve particle collisions. However, it is also possible to model Electron Spin Resonance, Nuclear Magnetic Resonance, and to illustrate the principles of Magnetic Resonance Imaging. Particle trapping, sound waves, shock waves, and dynamic stabilization can also be visualized for purposes of teaching and learning.We describe several magnetic simulations and explain their educational potential.

463 - Non Specialist lecture: Does God play dice with angles?

Photonics - Tuesday 08 July 2014 15:00

Primary author: PADGETT, Miles *(University of Glasgow)*

Quantum mechanics is one of the most successful theories every produced, making highly accurate predictions in fundamental science and underpinning of many of today's technologies. However, although highly accurate as a predictive tool, some aspects of quantum mechanics are not without their opponents. The fact that light has both particle-like and wave-like properties seems odd, but all scientist and philosophisers agree these are simply convenient models used to describe the way that light behaves. The concerns over quantum mechanics and its implications lie much deeper, relating to the role played by probability and chance. Niels Bohr championed a form of quantum mechanics where random chance meant that, even if perfectly repeated, the same experiment could give different outcomes. Albert Einstein's concerns with the potential role of random chance in the universe were summarised in the quote that "God does not play dice with nature". As a resolution to this debate, this lecture will endeavour to explain to the non-specialist how experiments performed over the last 30 years by the likes of Alain Aspect and Anton Zeilinger have shown that random chance is indeed central to the way our universe works.



Book of Abstracts

POSTER PRESENTATIONS

1 - Spectral comparison between AGN at z = 0.1, 0.2 and 0.3

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D1.1)*

Primary authors: WINKLER, Hartmut *(Dept. Physics, University of Johannesburg); TSUEN, Jessica (Dept. Physics, University of Johannesburg)*

We identified three samples of ROSAT sources with Sloan Digital Sky Survey spectra, one at redshift z = 0.1, a second one at z = 0.2 and a third one at z = 0.3. 822 sources in total were examined. We determined the nature and spectral sub-types of the sources by visual inspection. The fraction of each sub-type at each of the three redshifts are then calculated. We consider selection biases caused by the luminosity cut-off threshold to determine whether any systematic trends in AGN type are evident with increasing redshift. We hence probe if an evolution effect is detected in our sample.

4 - Calculating solar irradiance to determine yield from solar cells for De Aar

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.4) [For award: MSc]*

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

Solar energy harvesting is a growing industry in South Africa. De Aar is a favoured location for solar power stations, as it has high potential yield and is close to some of South Africa's largest power lines. This paper uses standard methods of solar irradiance estimation to calculate the potential yield with respect to wavelength for De Aar. It is necessary to take wavelength into account as light is not extinguished uniformly with respect to wavelength. De Aar was chosen for this paper because there are many years of total surface irradiance data available and some data for irradiance in specific wavelength bands. Comparison of these values with actual data collected in De Aar and calculated by PVGIS was done to determine the accuracy of these models for the conditions in De Aar. These estimations where done for a typical midsummer's day and a typical midwinter's day. A standard silicon photovolta ic cell response curve is used to calculate the energy harvested from these estimations. The model solar panel orientation is varied to find the optimum fixed orientation for a solar panel. This was compared with the optimum orientation calculated for De Aar by PVGIS.

10 - Reconstructing vector Bessel beams

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: C.10)*

Primary author: DUDLEY, Angela *(CSIR)*
Co-authors: *FORBES, Andrew (CSIR); MILIONE, Giovanni (City University of New York, USA); ALFANO, Robert (City University of New York, USA)*

We demonstrate the reconstruction of a vector Bessel beam after propagation through an obstruction. Not only does the spatial profile of the optical field reconstruct, but we show that its polarization profile also possesses this self-healing characteristic. We experimentally verify this new attribute with the use of radially and azimuthally polarized Bessel beams. By being able to extend this self-healing nature to an additional degree of freedom, in the case of polarization, this will advance the applications of Bessel beams in areas such as optical trapping and quantum entanglement.

11 - Dosimetric characterization of synthetic diamond detectors of various types and sizes under small high-energy photon field conditions

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.11) [For award: PhD]*

Primary author: ADE, Nicholas *(University of the Witwatersrand)*
Co-author: *NAM, Tom (University of the Witwatersrand)*

Selection of a suitable detector for small-field dosimetry within a 3% accuracy is challenging due to the volume effect of detectors in small fields. Although it is known that the safest way to exclude the volume effect is to choose a detector which is small enough, the experimental relationship between detector and field size is yet to be established. This contribution investigates the influence of detector size relative to field size by analyzing output factors (OFs) measured with a reference diode detector, an ion chamber and synthetic diamond crystals of various types and sizes in the dosimetry of a 6 MV photon beam with small fields down to 0.3x0.3 cm^2. The examined diamonds included two HPHT samples (HP1 and HP2) and six CVD crystals of optical grade (OG) and detector grade (DG) qualities with sizes between 0.3 and 1.0 cm. Each diamond was encapsulated in a tissue-equivalent probe housing which can hold crystals of various dimensions up to 1.0x1.0x0.1 cm^3 and has different exposure geometries ('edge-on' and 'flat-on') for impinging radiation. For fields below 4x4 cm^2, the relative differences between the OFs measured with the detectors and the diode were found to increase with increasing detector size. It was observed that the HPHT samples showed an overall better performance compared to the CVD crystals with the 'edge-on' geometry being a preferred geometry for OF measurement especially for very small fields. For instance, down to a 0.4x0.4 cm^2 field a maximum dose difference of 1.9% was observed between the OFs measured with the diode and HP2 in the 'edge-on' geometry compared to a 4.6% difference in the 'flat-on' orientation. It was approximated from a relationship between the dose difference and the ratio of detector to field size for the detectors that the dose difference would be > 3% when the detector size is > 3/4 of the field size. A sensitivity of 313 nC/Gy/mm^3 was obtained in a 1x1 cm2 field with HP2 compared to a value of 206.2 nC/Gy/mm^3 established with the diode. This study therefore concludes that with careful selection of a suitable crystal type of a given size and orientation the OFs measured with the diamond probe in small fields would agree favourably within 2% with that measured with a small-field detector but with a higher sensitivity value.

14 - Search of anomalous Higgs to invisible decays with the ATLAS detector at CERN's Large Hadron Collider.

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.14)*

Primary author: CARRILLO-MONTOYA, German David *(University of the Witwatersrand)*

Decays of the recently found Higgs boson into non detectable invisible-particles would be a extraordinary sign of new physics. Direct searches such decays are performed by using sub-products created together with the Higgs boson. Data taken by the ATLAS detector at center of mass energies of 7 and 8 TeV is analysed and in the absence of evidence upper limits on the branching ratio to invisible decays are set and within Higgs-portal dark matter models, limits on the dark matter-nucleon cross sections are also calculated.

15 - Latest measurements of Higgs boson properties with the ATLAS detector.

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.15)*

Primary author: CARRILLO-MONTOYA, German David *(University of the Witwatersrand)*

The scalar particle found in the data collected in 2011 and 2012 was a trophy for the physics program of the CERN's Large Hadron Collider. Although the topologies and production rates were consistent with the ones predicted by the Standard Model theory of particle physics, dedicated analyses were needed to measure the various properties of the new boson.This talk gives details of the analyses designed to measure the mass, width, spin and coupling strengths of the 125~GeV Higgs boson, using the entire 25fb-1 of data collected by the ATLAS experiment during the first phase of operations. The various measurements consolidate the particle discovered as a very Standard Model like Higgs boson.

28 - Reproducing observed solar radiation characteristics in Rwanda using theoretical models

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.28) [For award: PhD]*

Primary author: CYULINYANA, Marie Chantal *(University of johannesburg)*
Co-author: *WINKLER, Hartmut (University of Johannesburg)*

In this paper we discuss the framework for developing a theoretical model that characterises solar radiation at ground level in Rwanda. Such a model would also assist in determining the feasibility of employing solar power in that country. We explore the results of previous studies that have provided broad band solar irradiance measurements at specific locations, and that have developed empirical relationships between a series of solar parameters appropriate for conditions in that part of Africa. We seek to reproduce these relationships using a theoretical modelling approach that incorporates radiative transfer processes, as well as Rayleigh and Mie scattering. This paper presents an overview of the methodology and calculations required for such a study, including the effect aerosols and water vapour have on irradiance. We present wavelength-dependent techniques that characterize the various components of solar radiation using theoretical models, and evaluate their suitability in this context. The application of Monte Carlo based atmospheric radiative transfer models is also briefly discussed.

29 - Ex-situ Ni-Al Double Hydroxide Microspheres on a Nickel foam-Graphene Template as Electrode Material for High Performance Supercapacitors

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.29) [For award: PhD]*

Primary author: MOMODU, Damilola *(University of Pretoria)*
Co-authors: *MANYALA, Ncholu (University of Pretoria); ABDULHAKEEM, Bello (University of Pretoria); DANGBEGNON, Julien (University of Pretoria); BARZEGAR, Farshad (University of Pretoria); TAGHIZADEH, Fatimeh (University of Pretoria)*

Nickel-Aluminum double hydroxide microspheres (NiAl-DHMs) are a promising electrode material for supercapacitor applications. In this paper, we demonstrate an ex-situ coating method of the active material on Nickel foam-Graphene (NF-G) template serving as a current collector. The structure and surface morphology are studied by scanning and transmission electron microscopies, Raman Spectroscopy and X-ray diffraction analysis. The supercapacitive performance of the microspheres is investigated by cyclic voltammetry (CV), constant charge-discharge (CD) and electrochemical impedance spectroscopy (EIS) measurements. Results show a better surface interaction of the Ni-Al DHM material with the surface of the NF-G template compared with bare Nickel foam (NF) due to an increased contact area. The composite electrode with graphene gives a specific capacitance of 1252 F g-1 at a current density of 1 A g-1. The capacitance retention is about 97 % after 1000 charge-discharge cycles which provides a promising electrode material applicable in the design of energy storage devices.

31 - Calculation of atomic-based electron-positron annihilation momentum density in superionic barium flouride

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.31)*

Primary author: JILI, Thulani *(University of Zululand)*
Co-authors: *SIDERAS-HADDAD, Elias (University of the Witwatersrand); WAMWANGI, Daniel (University of Witwatersrand); SEFAGE, Percy (University of Zululand); KIBIRIGE, Betty (University of Zululand)*

Theoretical calculations based on the Generalized Gradient Approximation, which takes into account the variation nature of charge density, are performed to retrieve the contributions of atomic core and valence towards positron-electron annihilation momentum density in BaF2. The annihilation momentum of the 6s state electrons with positrons is prominent between 2.5 mrad to 26.8 mrad corresponding to normalized positron-electron annihilation momentum density between 4.6E-2 and 9.0E-5. The 4d dominates the 5p in the momentum range, 3 mrad to 17 mrad. Positron annihilation rates are also calculated within the Independent Particle Model and Generalized Gradient Approximation. Resultant positron-electron annihilation momentum density is compared with experimental results.

33 - The design of a light-emitting-diode pulsing system for measurement of time-resolved luminescence

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.33) [For award: MSc]*

Primary author: URIRI, Solomon A. *(Rhodes University)*
Co-author: *CHITHAMBO, Makaiko L. (Rhodes University)*

A new light-emitting-diode (LED) pulsing system for measurement of time-resolved luminescence will be presented. The system has been designed for use with a set of blue light-emitting diodes as the stimulation light source. The LEDs are pulsed at various pulse width by signals from a 555-timer wired as a monostable multivibrator. The output pulse from the 555-timer is fed into an N7000 MOSFET to produce a pulse current of 500 mA to drive a set of 16 LEDs. This amount of current is sufficient to drive four sets of 4 LEDs with each LED driven at a maximum pulse current of 110 mA. A multichannel scaler (Ortec MCS-plus ^{TM}) is used to trigger the pulsing system and to record data at selectable dwell times. The system is designed for use on wide band gap insulators.

34 - Determining the Richardson constant of Ni/4H-SiC and W/4H-SiC Schottky diodes via Current-Voltage-Temperature (IVT) characteristics

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.34) [For award: Hons]*

Primary author: SINGH, Asmita *(University of Pretoria)*

In this project the Richardson constant (A^*) for metal-semiconductor contacts on 4H-SiC was investigated by means of current-voltage measurements as a function of temperature in the range of 300 K to 700 K. Multiple *n*-type 4H-SiC-based metal-semiconductor contacts, having an estimated carrier concentration of 3.70 x 10^{14} cm^{-3} were considered. The current-voltage-temperature (IVT) characteristics of Ni/4H-SiC and W/4H-SiC Schottky barrier diodes were studied, based on the thermionic emission model. The samples were prepared using various deposition techniques, (viz. Ni – resistive evaporation and electron-beam deposition (EBD); and W – RF sputtering and EBD) and diode parameters (such as ideality factor (η), Schottky barrier height ($\blacksquare_B$), series resistance (R_s) and saturation current (I_s)) obtained were compared and found to be strongly dependent on temperature. The Richardson constant for 4H-SiC obtained from the intercept of a least squares fit through the Arrhenius plot data resulted in 3.72 x 10^{-6} $A.K^{-2}.cm^{-2}$ for W and 5.41 $A.K^{-2}.cm^{-2}$ for Ni – both deposited via EBD; 2.63 x 10^{-3} $A.K^{-2}.cm^{-2}$ for Ni deposited resistively, and lastly 6.31 x 10^{-12} $A.K^{-2}.cm^{-2}$ for sputtered W. It was concluded that A^* is dependent on the metal contact as well as the type of deposition technique utilized for the Schottky metal contacts.

38 - Wave Instability of Intercellular Ca(2+) Oscillations

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.38)*

Primary author: TABI, Conrad Bertrand *(University of Stellenbosch)*

Modulational instability is exclusively addressed in a minimal model for calcium oscillations in cells. The cells are considered to be coupled through paracrine signaling. The endoplasmic recticulum and cytosolic Ca (2+) equations are reduced to a single differential-difference amplitude equation. The linear stability analysis of a plane wave is performed on the latter and the paracrine coupling parameter is shown to deeply influence the instability features. Our analytical expectations are confirmed by numerical simulations, as instability regions give rise to unstable Ca(2+)-wave patterns. We also discuss the possibility of perfect intercellular communication via the activation of modulational instability.

49 - Octupole correlations in the rare earth N = 88 isotones

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.49)*

Primary author: BVUMBI, Suzan Phumudzo *(University of Johannesburg)*

Three experiments have recently been performed at iThemba LABS using the AFRODITE array spectrometer with the digital electronics. The reactions 150Nd (4He, 4n) 150Sm, 150Sm (4He, 2n) 152Gd and 155Gd (3He, 4n) 154Dy have been studied at lower spins in order to investigate the collective and quasi-particle structures of the N = 88 nuclei 150Sm, 152Gd and 154Dy respectively. Structures built on the 02+ states in these isotones are being investigated. The reaction 150Nd (4He, 4n) 150Sm fills a gap in two of our previous studies of 150Sm; 148Nd (4He, 2n) 150Sm to low spin states and 136Xe (18O, 4n) 150Sm at high spins [3, 4]. The difference in the structures populated in 150Sm in these two reactions is most unusual and needs to be understood. Of particular importance is the detailing of the structure of the Kπ = 2+ γ-vibrational band which is only known to the first few states in 150Sm. The properties of such bands indicate if the nucleus is axially symmetric or not and how γ-soft it is. We are also looking for the Kπ = 2+ γ-vibrational band built on the 02+ 2p-2h neutron state which possesses octupole characteristics [5]. The measurements we have made to 152Gd and 154Dy are motivated by the same considerations as our study of 150Sm and with the intention of determining the role that deformation plays in these isotones. [1] R. R. Chasman, Phys. Rev. Lett. 42, 630 (1979).[2] S. Frauendorf, Phys. Rev. C77, 021304(R) (2008).[3] S. P. Bvumbi et al., Phys. Rev. C 87, 044333 (2013).[4] S. P. Bvumbi, PhD thesis, University of Johannesburg, (2013)[5] J. F. Sharpey-Scahafer, proceedings of INPC 2013 (in press).[6] W. Urban, J. C. Bacelar and J. Nyberg, Acta. Phys. Pol. B32, 2527 (2001).

51 - Synthesis of ZnO Nanostructures via zinc air cell system

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.51) [For award: MSc]*

Primary author: MALEVU, Thembinkosi Donald *(University of The Free State)*

Zinc-air batteries have high specific energy, are environmentally friendly and use low-cost materials. They are considered to be potentially attractive power sources for electronics applications. Zinc oxide (ZnO) is formed as a byproduct in their operation. The present study investigates the feasibility of producing ZnO nanostructures using a zinc-air electrochemical voltage cell. Existing methods of synthesizing such nanostructures are expensive, involve complex chemistry, and require good vacuum and high temperatures. These methods are also generally corrosive and toxic. The electrolyte used in the study is lye or sodium hydroxide (NaOH), for reasons of ready availability. The measured parameters are electrolyte concentration, zinc plate size, open-circuit cell voltage and discharge time into a calibrated load. The experimental has two aspects. First, the output cell voltage as a function of the electrolyte concentration and also the cell-performance at a constant Ohmic load are measured. Second, SEM and XRD techniques are used to characterize the zinc electrode surface for the formation of ZnO as a function of the electrolyte concentration. Conclusions are then drawn by correlating the electrical performance of the cell in the first part versus the surface products formed in the second part. The potential outcomes of the study are twofold. First, a suggested alternative to large scale manufacture of ZnO and secondly, a possible method to optimize the power output of the cell as a function of the surface products formed. In this paper, we present the basic theory and our preliminary results to date. This includes the behavior of cell electrical power output correlated to the concentration of the electrolyte. We also present an estimation of yield, surface effects and actual resulting particle sizes.

52 - An efficient and reliable model develop and employ in a simulation application to compute the coefficient of performance of an air source heat pump water heater

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.52)*

Primary author: TANGWE, Stephen *(Fort Hare Institute of Technology)*
Co-author: *SIMON, Michael (Fort Hare Institute of Technology, UFH)*

ASHP water heaters are renewable energy devices for sanitary hot water production and this technology is fast gaining maturity in the South Africa market especially in the residential sector. The paper focused on the design and building of DAS to measure the power consumption, ambient temperature, relative humidity, initial inlet and the final outlet water temperature of the ASHP as well as the volume of water heated up and that drawn off into the building. A mathematical model of the COP was developed whereby the predictor parameters are the electrical energy use, the difference between the final outlet and initial inlet ASHP water temperature, the volume of water drawn off, average ambient temperature and the relative humidity during a heating up cycle. The predictors were further rank by their weight of importance. The results depict that both average ambient temperature and relative humidity as primary factors to the COP. The experimental result shows that a COP of 2.80 was achieved when the average ambient temperature was 27.3oC, relative humidity of 25.9%, initial inlet and out water temperature of 22.6oC and 55.4oC, volume of water drawn off was 49L while the average power used was 1.43 kW and the heating up cycle took 0.83 hour. Conclusively the model predictor sensors are cost effective and easy to be implemented.The build and develop model can predict the Cop with very high accuracy.

54 - Magnetic and transport studies on $Cr_{100-x}Ir_x$ alloy single crystals

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.54) [For award: PhD]*

Primary author: FERNANDO, Pius Rodney *(University of Johannesburg)*
Co-authors: *PRINSLOO, Aletta (University of Johannesburg); SHEPPARD, Charles (University of Johannesburg)*

An investigation of the physical properties of $Cr_{100-x}Ir_x$ alloy single crystals, with x = 0.7, 1.5, 2.0 and 2.5, were previously used to establish the magnetic phase diagram of $Cr_{100-x}Ir_x$ alloy system around triple point concentration [1] where the various magnetic phases co-exist. The present study extends these results by considering the temperature (T) dependence of the Seebeck coefficient (S), specific heat (C_p) and Hall coefficient (R_H) measurements, in addition to the electrical resistivity (ρ) [1]. Well defined anomalies were observed in the electrical resistivity ρ(T) curves of all the samples, due to the antiferromagnetic to paramagnetic phase transition on heating through the Néel temperature (T_N). The $S(T)$ curves of the samples with x = 0.7, 1.5 and 2.0 also exhibit anomalies associated with T_N in the temperature range below 380 K. As the upper limit of temperature for the measurements was 380 K, the anomaly associated with T_N could not be observed for x = 2.5 alloy (T_N = 391.5 K). Contrary to what is normally expected [2] it is noted that the anomaly related to T_N is more prominent in the (ρ) curves than in the $S(T)$ curves. (R_H) measurements carried out from 380 K down to 2 K in a constant magnetic field of 6 T, shows only weak anomalies at T_N for certain samples. The Sommerfeld coefficient (γ) is obtained by fitting $C_p/T=\gamma + (\beta)T^2$ to the low temperature C_p/T versus T^2 data. The γ values found for the present single crystal samples fits in well with the γ versus electron-to-atom (e/a) ratio curve previously published [3, 4] for certain Cr alloys. [1].Martynova J *et al.* 1998 J. Magn. Magn. Mat 187 345[2].Fawcett E *et al.*1994 Rev. Mod. Phys. 66 25[3].Heiniger F 1966 Phys. Kondens. Materie 5 285[4].Heiniger F *et al.* 1966 Phys. Kondens. Materie 5 243

61 - Iron coated ZnO nanorods catalysed growth of carbon nanostructures

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.61)*

Primary author: *MBUYISA, Puleng (University of Zululand)*
Co-authors: *SEFAGE, Amanda (University of Zululand); NDWANDWE, Muzi (University of Zululand); CEPEK, Cinzia (CNR Laboratorio TASC)*

The growth of carbon nanostructures (CNs) on vertically aligned zinc oxide nanorods (ZnO NRs) was investigated, usingbare and iron coated ZnO NRs as the catalysts. The chemical vapour deposition (CVD) temperatures of 580 and 630 degreeCelsius were used to synthesis the CNs. The CNs/ZnO hybrids were characterised by ex-situ scanning electron microscopyand in-situ X-ray and ultraviolet photoemission spectroscopy. The carbon nanostructures grown directly on the bare ZnONRs changed from an amorphous graphitic carbon coating at 580 degree Celsius to a nanostructured carbon coating withthe NRs partially etched at 630 degree Celsius. The carbon nanostructures grown with the aid of a Fe catalyst changedfrom vertically oriented on the NRs tips at 580 degree Celsius to dense and randomly oriented CNTs at 630 degree Celsiuswith the NRs completely etched. The etching of the NRs with acetylene chemical vapour deposition was observed toincrease with the increasing temperature and was accelerated by the presence of the Fe catalyst allowing for the completeetching of the NRs at lower temperatures when an Fe catalyst was used. By growing the carbon nanostructures with theaid of an Fe catalyst we have grown a new hybrid structure of CNTs and nanostructured porous carbon.

65 - A new foundation for the quantization of field theory:why it is necessary and why it matters

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.65)*

Primary author: *GREBEN, Jan (CSIR-retired)*

It is generally believed that the techniques of quantum field theory (QFT) are well-established and that the successes of the Standard Model prove them to be correct. However, there are a number of principle shortcomings which show that QFT is incomplete. First,it is not possible for the classical world to emerge from QFT, as the state vectors do not contain any reference (direct or indirect) to the location of particles, an essential requirement to make contact with the classical macroscopic world. In this respect QFT is inferior to non-relativistic quantum mechanics (NRQM) where each particle is assigned a spatial coordinate in the (many-body) Hamiltonian, explaining why most efforts to study the quantum-classical transition are based on NRQM. Secondly, QFT does not incorporate the limit on time induced by the big bang. Thirdly, the Pauli Exclusion Principle cannot be extended to all particles in the universe as the space of quantum numbers is too restricted.In this paper we suggest a generalization of the standard quantization which exploits gauge invariance to introduce phase factors in the quantum fields that link QFT to the environment without affecting the calculation of microscopic quantum processes. This amounts to the introduction of a new continuous positional quantum number that cannot be measured microscopically (i.e. is hidden), but emerges indirectly in a macroscopic context as a relative variable. Its presence also enables a universal formulation of the Pauli Principle. We show that this formulation can only be made consistent if we assume a unique origin of time. We realize this by embedding the quantum fields in a conformal cosmological background that observes the conservation of total energy of the universe and is dominated by dark (vacuum) energy. In this way a certain measure of unification of QFT with general relativity is accomplished. Various other elegant and desirable properties of this description are discussed. We suggest that the study of the quantum classical transition should now be carried out starting from this new formulation of QFT, rather than from NRQM.

68 - First principle study: adsorption of molecular hydrogen sulphide on transitional gold cluster (Aun=1-5)

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.68) [For award: PhD]*

Primary author: *IGUMBOR, Emmanuel (University of Pretoria)*

We present theoretical results of the study of H2S adsorption on gold cluster Aun(n = 1- 5) using density functional theory with Perdew-Burke-Ernzerhof (PBE) exchange-correlation energy functional. Minimum energy structures of the gold cluster along with their isomers are considered in the optimization process. H2S molecule is observed to adsorb on to the gold cluster. However, the adsorption energy decreases with increasing cluster size. The structures of the gold clusters are similar before and after adsorption of H2S molecule. The structures of gold cluster remain planar. The adsorbed molecules get adjusted in a way that their center of mass lie on the plane of the gold cluster. The adsorbed molecules get attached to a single gold atom and there is no preference to get adsorbed in between the gold. H2S dissociation is not favoured on the Au clusters since it demands extra energy to dissociate which is costly.

74 - Probing the antiferromagnetism in $(Cr_{84}Re_{16})_{100-y}V_y$ alloys using neutron diffraction

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.74) [For award: PhD]*

Primary author: *JACOBS, Bincy Susan (University Of Johannesburg)*
Co-authors: *PRINSLOO, Aletta (University of Johannesburg); SHEPPARD, Charles (University of Johannesburg); VENTER, Andrew (Necsa Limited); MAYNARD-CASELY, Helen (Australian Nuclear Science and Techonology Organisation, Australia)*

Sommerfeld coefficient (γ), obtained from fitting the low temperature specific heat (C_p) data to the equation $C_p = \gamma T + \beta T^3$, has previously been used to identify the region of critical concentration in $Cr_{1-x}V_x$ [1] and in $(Cr_{84}Re_{16})_{100-y}V_y$ [2] alloys. The effects of spin fluctuations and nature of the nesting bands on physical properties of $Cr_{1-x}V_x$ alloys were explored using specific heat measurements and the corresponding trends in the γ–x curve [1]. In the $(Cr_{84}Re_{16})_{100-y}V_y$ alloy system, γ shows anomalous trends close to the critical concentration as well as at $y \approx 4$ [2]. The decrease in γ observed at $y \approx 4$ may correspond to the transition from one magnetic phase to another. At $y = 0$, the alloy system is expected to be in the commensurate spin-density-wave (CSDW) phase [3]. On increasing the V concentration, the incommensurate (I) SDW phase may prevail due to the mismatch between the electron and hole sheets. In order to clarify this conjecture, neutron diffraction studies are proposed. Neutron diffraction is an ideal tool to explore the magnetic phases in an alloy and was successfully used in the $Cr_{1-x}Ru_x$ system to establish the types of antiferromagnetic order in the system [4]. This paper reports on the preliminary results of neutron diffraction on the $(Cr_{84}Re_{16})_{100-y}V_y$ alloy system, with y = 0, 4.2 and 6.2. Results indicate that at room temperature, the $Cr_{84}Re_{16}$ alloy is in the CSDW phase. Possible magnetic satellites indicative of the ISDW phase were observed in the alloys with y = 4.2 and 6.2 as envisaged. [1] Takeuchi J *et al*., *J. Phys. Soc. Japan* **49**, 508 (1980) [2] Jacobs B S *et al*., *J. Appl. Phys.* **113**, 17E126 (2013) [3] Fawcett E *et al*., *Rev. Mod. Phys.* **66** 25 (1994) [4] Papoular R *et al*., *J. Magn. Magn. Mater.***24** 106-110 (1981)

76 - Effect of Mo content on the Structural and Physical Properties of $Cr_{100-x}Mo_x$ Alloys

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.76)*

Primary author: *CHAVAN, A (University of Johannesburg)*
Co-authors: *PRINSLOO, ARE (University of Johannesburg); SHEPPARD, C (University of Johannesburg); MUCHONO, Blessed (University of Johannesburg)*

Antiferromagnetic order in Cr is attributed to the formation of a spin density wave (SDW) when the electron and hole Fermi sheets overlap on cooling through the Néel temperature (T_N). This nesting effect is sensitive to changes in the electron-to-atom (*e*/*a*) ratio and is influenced by the diluent materials used with Cr. Alloying with elements to the left of Cr on the periodic table reduces the size of the electron sheet and results in lowering T_N with increasing diluent concentration, while elements to the right of Cr have an opposite effect. Considering this, investigations into the physical properties of Cr alloys with isoelectronic elements is important, as it rules out this effect of *e*/*a*. Alloying Cr with Mo, which is isoelectric with Cr, shows an unexpected decrease in T_N with increasing Mo concentration [1]. This is attributed to the delocalization of the 3-d bands in Cr through the introduction of the 4-d electrons of Mo [1]. In the present investigation the effect of Mo concentration on the structural, magnetic and electrical properties of Cr is systematically studied. A series of $Cr_{100-x}Mo_x$ alloys, with x = 0, 3, 7, 15 and 25, was prepared and the actual concentrations established using electron microprobe analysis. XRD studies confirm the bcc structure of these alloys and indicate an increase in lattice constant with increase in Mo concentration. The crystallite sizes calculated from these results for the $Cr_{100-x}Mo_x$ alloys ranges between 15 to 30 nm. The physical properties of these alloys were investigated through susceptibility (χ), Seebeck coefficient (S), resistivity (ρ) and Hall coefficient (R_H) as function of temperature (T) measurements. T_N-values obtained from these measurements are comparable. Interestingly, for sample x = 3, χ(T) shows a spin-flip transition at $T_{SF} \approx 65$K and $R_H(T)$ indicates a change in mobility carriers at $T \approx$ 100K.[1] Fawcett E *et al.* 1994 *Rev. Mod. Phys* . **66**25.

77 - An open quantum systems approach to magnetoreception

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.77) [For award: MSc]*

Primary author: *ADAMS, Betony (UKZN)*
Co-authors: *PETRUCCIONE, Francesco (UKZN); SINAYSKIY, Ilya (University of KwaZulu-Natal and National Institute for Theoretical Physics)*

The emerging field of Quantum Biology centres on the possibility that living things might employ nontrivial quantum effects in their day to day behaviour. This surprising result has given rise to the investigation of such quantum effects in areas as diverse as photosynthesis and magnetoreception. In the case of avian magnetoreception, experiment supports the role of a radical pair mechanism in how birds sense the magnetic field. Following from radical pair theory and using the theory of open quantum systems we have completed the analytical derivation of the master equation in the Born-Markov approximation for the simple case of two electrons, each interacting with an environment of N nuclear spins as well as the external magnetic field, then placed in a boson bath and allowed to dissipate. We have then solved the master equation and analysed the dynamics of the radical pair.

78 - On the presence of stopbands in acoustic soliton existence domains

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D2.78)*

Primary author: *NSENGIYUMVA, Francois (University of KwaZulu-Natal)*
Co-authors: *HELLBERG, Manfred (University of KwaZulu-Natal); VERHEEST, Frank (Universiteit Gent, Belgium); MACE, Richard (University of KwaZulu-Natal)*

A fully nonlinear Sagdeev pseudopotential approach is used to study the existence domain of fast ion-acoustic solitonsin a plasma composed of cold and warm adiabatic positive ion species and Boltzmann electrons. It is shown that, perhaps surprisingly, for appropriate values of the ion mass ratio and the electron-warm ion temperature ratio, there is a range in cold-to-warm ion density ratio over which a stopband in soliton speed exists. Solitons do not propagate in the stopband, although they can occur for both higher and lower speeds.

79 - Properties of the Quark-Gluon Plasma Observed at RHIC and LHC

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.79)*

Primary author: HOROWITZ, William *(University of Cape Town)*

Puzzles and discoveries abound in the results from the Relativistic Heavy Ion Collider (RHIC) and from the relativistic heavy ion collisions at the Large Hadron Collider (LHC) including what seems to be the creation of the world's most perfect fluid and the stunning disappearance of large momentum particles into a dense, opaque quark-gluon plasma (QGP). Surprisingly, the methods of string theory appear to provide a better description of the QGP for observables associated with lower momentum particles while the completely opposite approach with an application of perturbative quantum chromodynamics (pQCD) works best for particles at the highest momenta. We present work attempting to bridge the divide between these two opposing descriptions of the properties of the QGP, the state of the universe a microsecond after the Big Bang.

83 - Firmware development for the upgrade of the Tile Calorimeter of the ATLAS detector

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.83)*

Primary author: KUREBA, Chamunorwa Oscar *(University of the Witwatersrand)*
Co-author: *MELLADO, Bruce (University of the Witwatersrand)*

At CERN, the European Organization for Nuclear Research, the fundamental structure of the universe is being probed by scientists and engineers. The Large Hadron Collider (LHC) accelerates and collides protons, and also heavy lead ions. The “A Toroidal LHC Apparatus” (ATLAS) is one of two general purpose detectors used for detecting the sub-atomic particles produced during these high-energy collisions. The Tile Calorimeter (TileCal) is the central hadronic calorimeter of the ATLAS detector. The year 2022 has been scheduled to see an upgrade of the LHC in order to increase its instantaneous luminosity. The High Luminosity LHC, also referred to as upgrade Phase-II, means an inevitable complete re-design of the read-out electronics in the TileCal. The completed new read-out architecture is expected to have the front-end electronics transmit full digitized information of the full detector to the back-end electronics system. The back-end system will, thus, provide digital calibrated information with greater precision and granurality to the first level trigger, thereby resulting in improved trigger efficiencies. An evaluation of this new proposed architecture will be carried out in the demonstrator project in 2014, where a small fraction of the detector (1/256) will be used in real conditions. In Phase II, the current Mobidick4 test bench will be replaced by the next generation test bench for the TileCal super-drawers, the new Prometeo (A Portable ReadOut ModulE for Tilecal ElectrOnics). The Prometeo is designed to certificate the TileCal front-end electronics by performing multiple tests. Its main board is a V707 evaluation board mounted with a QSFP board. The Prometeo’s prototype has been designed and assembled by the University of the Witwatersrand and installed at CERN for further developing, tuning and tests. A presentation will be made of the design of the Prometeo, with particular emphasis on its firmware development.

86 - A PEPT study of the quadratic en masse granular flows in rotating drums

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.86) [For award: MSc]*

Primary author: BALOYI, Bongani *(University of Cape Town)*
Co-author: *GOVENDER, Indresan (University of Cape Town)*

There has been a considerable amount of work done in understanding the flow of granular material in a rotating drum fitted with radial baffles. Aimed at mathematically deducing the S-shape of the flowing layer, the usual approach assumes that the material in the rising en-masse region flows like a plug and thus follows a linear velocity profile. Positron Emission Particle Tracking (PEPT) measurements of the trajectory fields in this region suggests a non-linear velocity field. We report on an extensive experimental program aimed at elucidating the velocity field in the presence of radial baffles. Without the motivation to calculate the shape of the free surface (we measure it), a simple granular flow model is built from the idea that this non-linearity in the velocity profile results from solid friction between the granules caused by the buildup of hydrostatic pressure and a granular viscosity that appears to originate from an angular momentum interpretation of grain dynamics.Applied Physics Group, Department of Physics, Centre for Minerals Research, University of Cape Town, P/Bag Rondebosch, 7701

87 - Radiation hardness of plastic scintillators for the Tile Calorimeter of the ATLAS detector

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.87) [For award: Hons]*

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)*

The Tile Calorimeter of the ATLAS detector is a hadronic calorimeter responsible for detecting hadrons that result from the p-p collisions within the LHC. Plastic scintillators form an integral component of this calorimeter and are specifically chosen for their properties of high optical transmission and fast rise and decay time. This enables efficient data capture since fast signal pulses can be generated. The main problem encountered by plastic scintillators however, is radiation damage incurred due to their interaction with the highly ionizing particles to be detected. This damage causes a significant decrease in the light yield of the scintillator and introduces an error into the time-of flight data acquired. In lieu of the recent planned upgrade of the Tile Calorimeter, a comparative study was conducted into the radiation hardness of several grades of plastic scintillators available on the market.In this talk, we present an analysis on the damage undergone by three PVT based plastic scintillators, EJ200, EJ208 and EJ260 obtained from ELJEN Technologies which have been subjected to 6 MeV proton irradiation using the tandem accelerator of iThemba LABS, Gauteng. The degradation in light transmission is assessed for doses over a range of kilo Grays to Mega Grays, and a Raman characterization of the change to bonding structure are presented.

88 - Effect of annealing temperature on vanadium dioxide thin films prepared by sol gel method

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.88)*

Primary author: MADIBA, Itani Given *(iThemba Labs, UNISA)*
Co-author: *MAAZA, Malik (iThemba Labs)*

Vanadium dioxide (VO2) is a functional material that undergoes a reversible metal-insulator phase transition (MIT) at a critical temperature (Ttr) of 68 ■C, accompanying the structural transition from high-temperature rutile to low-temperature monoclinic phases. The semiconductor to metal transition exhibits abrupt changes in optical, electrical and magnetic properties. Therefore, these characteristics make VO2 a promising material for a wide variety of applications including thermal sensors, uncooled microbolometers, and electrochromic switching devices. Many methods have been developed to deposit VO2 thin films with high performance, including physical vapor deposition, chemical vapor deposition and sol–gel method. Sol–gel method is used widely because of many advantages. It can be coated on complex shape or large substrate surface. It is easy to introduce other elements for doping. Furthermore, special organic–inorganic multiple coating can be obtained by sol–gel method. Inorganic sol–gel method makes use of ordinary raw materials. However, it needs rigorous experimental condition because of high annealing temperature. Meanwhile, organic vanadium alkoxides were used as precursors to prepare VO2 thin films in organic sol–gel method. The setback is that such precursors are expensive by commercial purchase. In order to solve this problem, the Vanadium pent oxide powder, isobutyl alcohol (IBA) and benzyl alcohol (BA) have been utilized to prepare organic precursor sol and vanadium oxide thin films. For this study we illustrate the realization of VO2 thin films on glass substrate and mica substrates ad different annealing temperatures by this organic sol-gel method.

89 - Computational modelling of temperature dependence of $Ti_{50}Pt_{50}$ shape memory alloys

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.89) [For award: MSc]*

Primary author: MASHAMAITE, Mordecai *(University of Limpopo)*
Co-authors: *CHAUKE, Hasani Richard (University of Limpopo); NGOEPE, Phuti (University of Limpopo); MAHLANGU, Rosinah (University of Limpopo)*

Shape memory alloys (SMAs) have attracted considerable attention and interest in recent years in a broad range of commercial demands due to their unique and superior thermodynamic properties. Their shape memory effect and pseudoelasticity has drawn significant interest in commercial development. SMAs are a group of metallic alloys with unique characteristics, have the ability to return to their original form or shape or size when exposed to a memorisation process between martensite and austenite phase, which is temperature dependent. The first-principle density functional theory was employed to investigate the temperature effect of equiatomic B2, B19 and B19’ TiPt SMAs. We observed a martensitic transformation when Ti 50 at.% Pt is exposed to extreme temperatures of up to 1573K. However, the temperature dependence of TiPt shows potential martensitic change for B19 and B19’ as compared to B2 phase. Moreover, molecular dynamics studies of martensitic transformation temperature for titanium platinum alloys were carried out using CASTEP code. The NPT ensemble was used to determine the properties of these systems and we found good comparisons with recent experimental work.

90 - Computer simulation study of spinel $LiMn_2O_4$ nanotubes as a cathode material for lithium-ion batteries

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.90) [For award: MSc]*

Primary author: TSHWANE, David Magolego *(University of Limpopo)*
Co-authors: *MAPHANGA, Rapela (University of Limpopo); NGOEPE, Phuti (University of Limpopo)*

Improvement of the energy density and power density of the lithium-ion batteries is urgently required with the rapid development of electronic devices. Developing nanostructured electrode materials represented one of the most attractive strategies to dramatically enhance battery performance. Spinel $LiMn_2O_4$ is one of the most important promising cathode materials due to its nontoxicity and its low cost. In these paper, computer simulation methods are used to generate various structures of spinel $LiMn_2O_4$ nanotubes, where index, size, symmetry and diameter are varied. Molecular dynamics simulation is used to investigate the local structure of spinel $LiMn_2O_4$ nanotubes and the effect of temperature on the generated systems. It was found that diameter, symmetry, size, orientation and miller index have a direct control on nanotube morphology and stability depends on surface and termination. The nanotube structures are described using the radial distribution functions and XRD patterns. The calculated XRD patterns are in agreement with experimental results.

92 - Equilibration properties of hadronic matter

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.92) [For award: MSc]*

Primary author: THENDO EMMANUEL, Nemakhavhani *(University of Johannesburg)*
Co-author: *AZWINNDINI, Muronga (University of Johannesburg)*

The equilibration properties of hadron matter are studied through a microscopic transport model, the Ultra-relativistic Quantum Molecular Dynamics (UrQMD). Molecular dynamics simulations are performed for a system of light mesons in a box with periodic boundary condition. This paper reports on particle number density, energy spectra, rapidity distribution of various hadrons at fixed energy density ε in a box. Particle multiplicity equilibrates after some time t (fm/c). Energy spectra of different hadronic species have the same slope after some t (fm/c). Rapidity distributions of different hadronic species is found to have maximum value at mid-rapidity. The results obtained indicate that the system has reached equilibrium.

100 - Production of electricity from eucalyptus wood

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.100) [For award: MSc]*

Primary author: *NWOKOLO, Nwabunwanne (Fort Hare Institute of Technology)*
Co-authors: *MAMPHWELI, Sampson (Fort Hare Institute of Technology); MEYER, Edson (Fort Hare Institute of Technology)*

There is a growing need for alternative renewable energy due to environmental concerns and the depletion of fossil fuels. The continuous climate change in particular, which is caused by the world's reliance on fossil fuels for its energy needs, has created a desperate situation. The conversion of biomass materials into a suitable form of energy such as electricity and fuel holds a great potential. This is because it is a renewable source of energy, abundant and environmentally friendly. This conversion can be achieved via different routes of which gasification is one. Biomass downdraft gasifier is a viable technology for generation of electricity. This is supported by its low tar concentration, low ash carryover and high char conversion. In this study, the performance of a Johansson Biomass Gasifier System coupled to a 150KVA Generator was evaluated. A custom-built gas and temperature profiling system was used to measure the gas profiles from which the gas heating value was calculated. A measuring scale was used to measure the quantity of wood fed into the gasifier. A load bank was constructed using twelve 12 kW water heating elements connected such that they draw maximum power from each of the three phases. A power meter was used to measure the current, voltage, power as well as energy from the generator during operation. A cold gas efficiency of 88.11 % was obtained and the overall efficiency from feedstock to electrical power was found to be 20.5% at a specific consumption rate of 1.075 kg/kWh.

102 - Synthesis and characterization of binary phase NiS nanostructures

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.102)*

Primary author: *LINGANISO, Ella (CSIR)*

Nickel and sulphur form various polymorphs which include NiS, NiS2, Ni3S4, Ni9S8, Ni7S8 and Ni3S2. Nickel monosulphide (NiS) exhibit hexagonal and rhomboherdal phases which have interesting electrical and catalytic properties. As such, NiS has been studied for potential applications in lithium ion batteries, hydrodesulfurization catalyst and in IR detectors. NiS is one of the materials that show a metal to insulator transition at approximately 260 K. Soft chemical routes are being employed extensively to synthesize inorganic nanomaterials. Methods that have been used to make NiS nanomaterials include slow precipitation method, single source precursor route and microwave-assisted hydrothermal route. In this paper we report NiS nanostructures that were synthesized using a microwave-assisted hydrothermal technique. Solvent type as well as NiS precursors were varied in order to investigate their effect on the various structures as well as phase distribution of Ni:S at 1:1 ratio. Both XRD and HR-TEM techniques were employed to investigate the phase and the size distribution of the products. Hexagonal nano-size platelets, nano-spheres, nano-sheets, nano-wires and nano-rods were obtained when different precursors and/or solvents were used

106 - Computational modelling studies of Pd tellurides

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.106) [For award: Hons]*

Primary author: *SELOWA, Phatholo Fredy (University of Limpopo)*
Co-authors: *NGOEPE, Phuti Esrom (University of Limpopo); MANGWEJANE, Samuel (university of limpopo)*

Telluride minerals are minor or trace components in ore deposits from a wide variety of geological environments. They are also important carriers of precious metals, especially of Pt, Pd, Au and Ag. In nature, tellurides of palladium are most widely spread. Metal tellurides are applicable mainly in optical devices such as solar cells, but also in thermoelectrical devices. Density functional theory study is used to investigate structural stability in terms of heats of formation, elastic constants and phonon dispersion for the PdTe, $PdTe_2$ and Pd_3Te_2 structures. In order to investigate the mechanical stability, we evaluated their phonon dispersion curves along symmetry direction within the first Brillouin zones. The elastic properties of the PdTe, $PdTe_2$, and Pd_3Te_2 satisfied all necessary conditions for mechanical stability. Thus, all the systems are predicted to be mechanically stable.

111 - An ATCA framework for the ATLAS TileCAL Front to Back End Electronics for the Phase II Upgrade at the LHC

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.111) [For award: PhD]*

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

The Large Hadron Collider at CERN is scheduled to undergo another major upgrade in what is called Phase II in the year 2022. During this upgrade the ATLAS collaboration will do major modifications to the detector to account for the increased luminosity by a factor of ten. A large proportion of the current front end electronics will be upgraded and relocated to the back end of the detector. In order to achieve this the TileCal has set up a demonstrator program to integrate these two aspects. A radically new system will be required to house, manage and connect this new hardware. The proposed solution will be an Advanced Telecommunication Computing Architecture (ATCA) which will not only house but also allow advanced management features and control at a hardware level through the Intelligent Platform Management Interface. The details and current setup of the ATCA and how it will be part of the TileCal upgrade Demonstrator program will be presented in full.

112 - Affordable and power efficient computing for High Energy Physics: synthetic CPU performance and Fast Fourier Transform benchmarks of ARM processors.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.112) [For award: MSc]*

Primary authors: *COX, Mitchell (University of the Witwatersrand); REED, Robert (University of 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 Tile Calorimeter will increase by 200 times to over 40 Tb/s! ARM processors are common in mobile devices due to their low cost, low energy consumption and high performance and may be an affordable alternative to standard x86 based servers where massive parallelism is required. High Performance Linpack and CoreMark are used to test ARM Cortex-A7, A9 and A15 System on Chips CPU performance while their power consumption is measured. Comparisons are made between the ARM processors and an Intel i7-4770 CPU. In addition to synthetic benchmarking, the FFTW library is used to test the Fast Fourier Transform performance of the ARM processors and the results obtained are converted to theoretical data throughputs for a range of FFT lengths.

113 - Computational studies of olivine $NaMPO_4$ (M: Mn, Fe, Co)

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.113) [For award: PhD]*

Primary author: *LETHOLE, Ndanduleni Lesley (University of Limpopo)*
Co-authors: *CHAUKE, Hasani (Materials Modelling Centre); NGOEPE, Phuti (University of Limpopo)*

Efforts to deal with environmental pollution and exhaustion of oil resources have been the centre of attention throughout the research industry. Hybrid electric vehicles powered by the lithium ion battery have been developed. However, the scarcity of lithium and the possibility of using much safer aqueous electrolytes in sodium ion batteries have shifted interest on sodium ion batteries to ensure sustainability and optimal safety. However, the major drawback for the sodium materials has been their low charge/discharge capacities. Previous studies have shown that $NaFePO_4$ and $NaCoPO_4$ offer charge/discharge capacities of 12 mAh/g and 2.0 mAh/g, respectively, which is very less compare to $LiFePO_4$ (170 mAh/g), $LiMnPO_4$ (70 mAh/g) and $LiCoPO_4$ (70 mAh/g). In this study, we investigate the structural, thermodynamic, electronic and mechanical properties of the olivine $NaMPO_4$ to determine their capabilities as future cathode materials for sodium ion batteries. Calculations have been performed within DFT+U method as implemented in the Vienna Ab initio Simulation Package code. The calculated cell parameters for $NaFePO_4$ and $NaCoPO_4$ were found to be in good agreement to the experimental to within 3%. The heats of formation suggested that $NaMnPO_4$ is the most stable olivine structure, due to the lowest formation energy (-1292 kJ/mol).

116 - Memory performance of ARM processors and its relevance to High Energy Physics

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.116) [For award: Hons]*

Primary authors: *WRIGLEY, Thomas (University of the Witwatersrand); HARMSEN, Gerhard (University of the Witwatersrand)*

'Big Science' projects such as the to-be upgraded ATLAS detector at the Large Hadron Collider at CERN are expected to produce data in volumes which far exceed current system data throughput capacities. In addition, cost considerations for large-scale computing systems remain a source of general concern. A potential solution involves using low-cost, low-power ARM processors in large arrays in a manner which provides massive parallelisation and high rates of data throughput (relative to existing large-scale computing designs). Giving greater priority to both throughput-rate and cost considerations increases the relevance of primary memory performance and design optimisations to overall system performance. Using several primary memory performance benchmarks to evaluate various aspects of RAM and cache performance, we provide characterisations of the performances of three different models of ARM-based SoC, namely the Cortex-A9, Cortex-A7 and Cortex-A15. We then discuss the relevance of these results to high throughput-rate computing and the potential for ARM processors. Finally, applications to the upgrade of the on-line and off-line data processing at the ATLAS detector are also discussed.

118 - Advanced CPU benchmarking of ARM processors for applications in High Energy Physics

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.118)*

Primary author: *PIMENTA, Wade (University of the Witwatersrand)*

The ATLAS experiment at the Large Hadron Collider plans to accommodate the sheer amount of data that will be obtained after raising the current energy levels to 13TeV, with increased luminosity, thus, current processors will need to be changed in a cost effective manner. An ARM cluster is currently being researched as a viable option as a high throughput computer due to its impressive throughput performance versus its cost, however, its processing capabilities must be tested to gain an understanding of its computational limits. An introduction to the SU3 AHiggs benchmark, based on the MILC code (a quantum chromodynamic calculation using an effective field theory for high temperatures) will be given as well as the performance results of the benchmark across various ARM processors versus a selection of modern computers.

120 - Automation, characterisation and application of a spectrometer for UV and Vacuum UV

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: C.120) [For award: Hons]*

Primary author: DE BRUYN, Andre *(Stellenbosch University)*
Co-authors: *STEHMANN, Timo (Synertronic, Stellenbosch, South Africa); RIGBY, Charles (Stellenbosch University); STEENKAMP, Christine (Stellenbosch University)*

This project was aimed at firstly developing a computer control system for automation of a scanning monochromator (McPherson model 218). Secondly,the monochromator was characterised through use of an ultra violet (VU) light source. Lastly, the monochromator was applied to characterise the vacuum ultraviolet (VUV) laser source (142.40 nm to 146.73 nm). For the computer control system, a program was developed in order to control a stepper motor driver with acquisition functions (Uragan-μ developed by Synertronic) which was customized to control both the stepper motor that rotates the grating and to acquire data from a photomultiplier tube. Some of the key features of the program are mechanisms to eliminate the mechanical backlash of the system, to automatically save data after readings and to incorporate additional safety limitations which are independent of the mechanical safety switches. Characterisation using the mercury lamp demonstrated that the spectra were accurately reproducible when using the computer control system and that the monochromator has a spectral resolution of 0.5 nm with an entrance slit of 0.35 mm and an exit slit of 0.15 mm. The spectral resolution is expected to change when applying the monochromator to the VUV source as the slit size for this system can be set narrower due to the higher intensity yielding a higher-resolution. The monochromator was applied to investigate the generation of VUV light by third harmonic and sum frequency generation in a phase matched non-linear medium consisting of magnesium-vapour and krypton gas. The sum frequency VUV is used as a tunable VUV source in our laboratory. The third harmonic light is an unwanted byproduct. For the first time in our laboratory it is possible to measure the sum frequency and the third harmonic power separately and to optimise the sum frequency power independently from the third harmonic signal by using a monochromator. The monochromator will be used to investigate the phase matching conditions for VUV generation and to observe how the VUV power varies with experimental conditions.

121 - Magnetic susceptibility studies of the $(Cr_{98.4}Al_{1.6})_{100-x}Mo_x$ alloy system

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.121) [For award: PhD]*

Primary author: MUCHONO, Blessed *(University of Johannesburg, National University of Science and Technology)*
Co-authors: *SHEPPARD, C.J (University of Johannesburg); PRINSLOO, A.R.E (University of Johannesburg); ALBERTS, H.L (University of Johannesburg)*

The magnetic behaviour of the $Cr_{100-y}Al_y$ alloy system around the triple point concentration $y_t \approx 2$ has recently attracted renewed interest amongst Cr alloys [1]. The temperature of the triple point concentration on the $Cr_{100-y}Al_y$ magnetic phase diagram can be suppressed to below 2 K by the addition of Mo for y fixed at 1.6 at.% Al to form a $(Cr_{98.4}Al_{1.6})_{100-x}Mo_x$ ternary alloy system. Previous studies on the $(Cr_{98.4}Al_{1.6})_{100-x}Mo_x$ alloy system through electrical resistivity (ρ), Seebeck coefficient (S) and specific heat (C_p) showed the existence of a possible quantum critical point around 4.5 at.% Mo [2]. The present study was undertaken in order to extend the previous findings on this alloy system, through magnetic susceptibility (χ) measurements. Samples in the form of cylindrical discs were cooled from 300 K to 4 K in a zero magnetic field. Measurements were then taken from 4 K to 300 K in a constant magnetic field of 100 Oe. Alloys in the concentration range $0 \leqslant \xi \leqslant 3.0$ depict anomalous $\chi(T)$-behaviour in the temperature range of the Néel transition. This is attributed to local magnetic moments formed around the impurity atoms [3]. Néel temperatures obtained from $\chi(T)$ measurements decrease with Mo concentration and disappear near a critical concentration x_c = 4.5, where antiferromagnetism is suppressed to below 4 K. The present results corroborate the previous findings on this alloy system [2].[1] Sheppard C J, Prinsloo A R E, Alberts H L, Muchono B and Strydom A M 2014 J. Alloys and Compounds 595 164[2] Muchono B, Prinsloo A R E, Sheppard C J, Alberts H L and Strydom A M 2014 J. Magn. Magn. Mater. 354 222[3] de Oliveira L M, Ortiz W A and de Oliveira A J A 2003 J. Appl. Phys. 93 7154

123 - Exploring the tensor structure of the Higgs Boson couplings

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.123) [For award: Hons]*

Primary authors: VON BUDDENBROCK, Stefan *(University of the Witwatersrand); AMAR, Gilad (University of the Witwatersrand)*

The study of Higgs production in e+e- collisions presents us with an avenue for studying Higgs to WW coupling in the t-channel. Our understanding of the tensor structure of the Higgs boson is furthered by learning the phenomenology of how it couples to the WW pair in these reactions. This can be done by applying effective coupling strength constants to an effective Lagrangian as Beyond Standard Model (BSM) terms and performing Monte Carlo studies with these terms present. We can then extract meaningful information from these resulting hypotheses and use a statistical analysis to determine the cross section which a detector would need in order to fully realise these BSM parameters.

124 - Electron paramagnetic resonance analysis of plastic scintillators for the Tile Calorimeter of the ATLAS detector

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.124) [For award: Hons]*

Primary authors: *MELLADO, Bruce (University of Witwatersrand);* PELWAN, Chad *(University of Witwatersrand)*

In an attempt to understand the effects of ionizing radiation on various scintillation plastics, a number of studies are currently underway with a hope that favourable properties of scintillator plastics, such as high light output and fast decay time, can be optimized. The Tile Calorimeter (TileCal) is a hadronic calorimeter able to detect hadrons. In this investigation, irradiated plastic scintillators that were situated on the TileCal of the ATLAS detector at CERN were sent to the University of Witwatersrand where they were prepared for electron paramagnetic resonance (EPR) analysis. EPR spectroscopy allows for the study of unpaired electrons within these scintillators and offers a deeper insight into the organic or inorganic free radicals present. This technique was used to validate the assumption that dangling bonds in the plastics were as a result of ionizing radiation damage caused in the testing phase. This was done by detecting the existence of paramagnetic centres and, in addition, magnetic properties of these centres could be characterized. Three Eljen scintillator plastics, EJ200, EJ208, and EJ260 were used in this investigation as well as one Dubna scintillator plastic. These samples were irradiated at the iThemba Labs in Gauteng. The Dubna samples that were irradiated on the TileCal detector were compared to the unirradiated samples as well as irradiated and unirradiated Eljen samples. Experimental results thus far show a stronger signal detected for irradiated samples compared to unirradiated ones, and that a higher radiation dose produces a stronger signal in the irradiated samples. It was observed that, over time, certain bonds would re-form within the plastics and further investigation is required to understand this effect. Over all, the results from the EPR analysis thus far form a small, yet vital, contribution into understanding the various the effects of ionizing radiation in plastic scintillators.

127 - Search for intermediate states in the rare earth nucleus ^{150}Sm

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.127) [For award: MSc]*

Primary author: MSEBI, Lumkile *(University of Johannesburg)*
Co-authors: *BVUMBI, S.P (University of Johannesburg); MASITENG, L.P (University of Johannesburg); JONES, Pete (iThemba Labs); MJOLA, SNT (iThemba Labs); SHARPEY-SCHAFER, J.F (iThemba Labs)*

In nuclear science, things that may seem trivial such nuclear shape, size, collective and individual motions of nucleons give very useful information about the structure of the nucleus.Quantum numbers are important in nuclear science since they are characteristic of excited states and how they decay to other states [1]. The collective motion of the nucleus can either be vibrational or rotational.The collective motion of the nucleus can either be vibrational or rotational. When the collective motion changes from vibrational to rotational rapidly the nucleus is said to be in the transitional region [2]. The N=88 rare earth neutron rich nuclei lie in this region. ^{150}Sm is one such nucleus and it is the focus of this work. The low lying $\mathbf{0}_2^+$ state of ^{150} Sm has octupole correlations that is related to the low lying negative parity states $\mathbf{K}^{\pi}=0^-$ [2]. Studies have already been done on the lower states of the nucleus ^{150} Sm with the ^{150} Nd(α,2n) ^{150} Sm reaction at 25 MeV, a self-supporting target of 5 mg cm^{-2}, and the Jyväskylä JUROGAM II escape-suppressed γ –ray spectrometer array [3] consisting of 24 clover and 15 tapered HPGe detectors all in BGO shields. We also studied the higher spin states using the ^{136} Xe (^{18} O, 4n) ^{150} Sm reaction at 75 MeV using the iThemba LABS AFRODITE spectrometer employing a cryogenic frozen xenon target.We report our findings on the experiment that was performed recently at iThemba LABS using the reaction ^{150} Nd (^{4} He, 4n) ^{150} Sm and the AFRODITE array spectrometer with the digital electronics. The specific focus of this work is on the structure and deformation of the intermediate spins of ^{150}Sm and to gain insight on the collective and quasi-particle structures of ^{150} Sm.[1] Ntshangase SS DEVELOPMENT OF A RECOIL DETECTOR AND THE STUDY OF EXOTIC ASYMMETRIC SHAPES IN NUCLEI (PhD Thesis, University of Cape Town)[2] Bvumbi S P Investigation of octupole correlations and collectivecouplings in the rare earth nucleus (PhD Thesis, University of Johannesburg)[3] www.jyu.fi/research/accelerator/nucspec/jurogam

128 - The modification and the development of the polarized ion source at iThemba LABS

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.128)*

Primary authors: NDLANGAMANDLA, Cebo *(iThemba Labs); THOMAE, Rainer (iThemba Labs); CONRADIE, Lowry (iThemba Labs); DE VILLIERS, John Garrett (iThemba Labs)*

Since 1994 the atomic beam source at iThemba LABS delivers nuclear spin polarized protons for physics experiments. The source is composed from a dissoziation, a polarization, and an ionization unit. The DC ionization unit consists of a hot cathode and an electrode system with a potential distribution to optimize the ionization process. This potential distribution produces a high energy spread which results in a poor transmission through the cyclotron.The beam performance is expected to improve drastically when the DC ionizer is replaced by an ionizer using Electron Cyclotron Resonance (ECR) ionization with a triode extraction system. iThemba LABS had the opportunity to obtain such an ionizer from the ion source group at PSI, Switzerland. The paper describes measurements of the magnetic field distribution of the ionizer, the integration of this unit in our source and first experimental beam results.

139 - The effect of silver (Ag) dopant on the structural properties of cadmium oxide (CdO) nanoparticles

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.139) [For award: Hons]*

Primary author: *MASWANGANYE, Mpho (University of Limpopo)*
Co-authors: *RAMMUTLA, Erasmus (University of Limpopo); MOSUANG, Thuto (University of Limpopo)*

The samples of undoped CdO and 5% Ag doped CdO nanoparticles have been prepared by sol-gel method and they have been annealed at 400■ and between 100■ - 600■ respectively for 1 hour. The prepared samples have been characterized by XRD and SEM. The XRD results showed that for 5% Ag doped CdO nanoparticles the CdO nanoparticles were completely crystallized at the annealing temperature of 400■. The lattice parameters for the undoped and 5% Ag doped CdO nanoparticles have been found to be similar to the recorded values of CdO in the JCPDS cards. The grain sizes for the 5% Ag doped CdO nanoparticles increased as the annealing temperature was increasing.The grain size of the of the 5% Ag doped CdO nanoparticles decreased as compared to the grain size of the undoped CdO nanoparticles. The strains for the 5% Ag doped CdO nanoparticles decreased as the annealing temperature was increasing. The SEM results showed that as the annealing temperature was increasing the grain sizes increased.The optical studies of the samples are currently under way.

144 - Self-healing of quantum entanglement

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: C.144) [For award: PhD]*

Primary author: *MCLAREN, Melanie (CSIR)*
Co-authors: *MHLANGA, Thandeka (CSIR); ROUX, Filippus (CSIR); PADGETT, Miles (University of Glasgow); FORBES, Andrew (CSIR)*

Bessel-Gaussian (BG) beams have been the subject of great interest for many years, particularly due to their non-diffracting nature. The ability of BG beams to self-heal their fields after encountering an obstruction has typically been used in classical light applications, such as optical trapping. However, we show that this property extends to the quantum regime. An obstacle placed in the propagation path of the entangled photons causes a loss in the measured entanglement. By comparing two different bases, the Laguerre-Gaussian and BG, we show that recovery of the measured entanglement only occurs when the photons are projected into the BG basis.

146 - High-pressure electrical-transport behaviour in charge-ordered Fe_2OBO_3 and $LuFe_2O_4$

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.146) [For award: PhD]*

Primary author: *MUSYIMI, Philip (University of Johannesburg)*
Co-authors: *DIGUET, Gildas (University of Johannesburg); CARLESCHI, Emanuela (University of Johannesburg); PISCHEDDA, Vittoria (Université de Lyon); ATTFIELD, Paul (University of Edinburgh); HEARNE, GlOvanni (University of Johanneburg)*

Fe_2OBO_3 and $LuFe_2O_4$ are Fe-based 3d compounds known to be mixed-valence (Fe^{2+} and Fe^{3+}) insulators at ambient conditions. These are relatively new charge ordering (CO) compounds that evidence strong magneto-electric coupling, besides offering the best potential for establishing the CO mechanism. Fe_2OBO_3 has monoclinic and orthorhombic crystal structures at ambient conditions and high pressure (HP) respectively. The compound orders ferrimagnetically at T_M ~ 155K and has a CO temperature T_{CO} ~ 320K. Whereas, $LuFe_2O_4$ has T_M and T_{CO} as 240K and 330K, respectively. At HP, these are anticipated to show new ground states (i.e., CO collapse, valence fluctuations or new CO states). For instance, in recent work on Fe_2OBO_3, a CO instability occurs at P ~16 GPa [1]. In $LuFe_2O_4$, a pressure-induced structural transition (rhombohedral to orthorhombic) occurs in the range 5 – 10 GPa with indications of a new CO state occurring in the fully transformed sample at P > 8 GPa [2]. Our interest is to explore in further detail the magneto-electronic ground-states of the HP phases of these two topical CO compounds, e.g., to check whether an insulator-metal transition ensues. This would provide crucial complementary information to our Fe Mössbauer-magnetic and XRD-structural probes of the new HP stabilized electronic phases. The pressure response of electrical transport properties of polycrystalline powdered Fe_2OBO_3 and $LuFe_2O_4$ samples have been investigated by way of resistivity measurements at variable cryogenic temperatures from ambient pressure up to ~20 GPa in a diamond anvil cell. The DC four-probe resistivity was determined using the Van der Pauw method. At low pressure (LP) both samples display semiconducting behaviour, anticipated in the CO state which is prevalent below ambient temperatures. We are able to monitor the band-gap evolution of the LP (CO stabilized) phase. We will present our results on how the systems evolve towards their new electronic HP phases, as well as provide information on the nature of the carrier transport.[1] G.R. Hearne et al., PRB 86, 195134 (2012).[2] J. Rouquette et al., PRL 105, 237203 (2010).

156 - Structural changes associated with the differential expansion of coal during rapid heating - a preliminary study

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.156)*

Primary author: *HOFFMAN, Jakobus (NECSA)*
Co-author: *DE BEER, Frikkie (NECSA)*

Coal is a major energy source and is widely used in industrial processes such as synthetic gas production and numerous research projects concern the optimal utilization of this limited natural resource. Char formation or devolatilization is the precursory step in many industrial important processes where the coal is prepared for subsequent processing in order to exhibit certain desired characteristics like fracture surfaces for maximum reactivity in combustion or carbon monoxide production to name but a few. Thermal cracking occurs easily in processes that entail a steep temperature gradient and high pressure (like blast furnaces and gasifiers) and merits further investigation since the alteration of the coal structure during these conditions will consequently affect the behavior of the resulting char. The fractures that develop during these initial phases of reaction open up pathways to reaction sites and consequently affect the reactivity of the coal. Micro-focus X-ray tomography is a very attractive method to investigate these processes in a quasi dynamic manner since the non-destructive nature of this analytical technique permits using the same sample during numerous stages of a process. Investigating the process of thermal shock requires developing a suitable experimental method to induce and track the induced fractures and consequently an experimental setup and procedure is proposed by utilizing a RF coil to induce a very steep temperature gradient within a graphite cylinder which encapsulates the sample under investigation, whilst micro-focus X-ray tomography will be utilized to quantify the associated alteration in the coal structure after cooling.

157 - Characteristics of statistical noise of the sCMOS based Neutron Computed Radiography Images- A simplified measurement approach

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.157)*

Primary author: *RADEBE, Mabuti Jacob Radebe (NECSA)*
Co-authors: *KAESTNER, Anders (Paul Scherrer Institute); DE BEER, Frikkie (NECSA)*

The statistical noise affects the contrast lower boundary sensitivity by contribution of average base noise such that the dynamic range cannot be improved beyond this noise component [1]. It also negatively affect contrast between materials of an object and spatial resolution by adding false fine defects which can be removed by averaging electronic filters and thereby also removing the fine features of the object under investigation. Statistical noise is a noise component that cannot be corrected for without negatively impact in images due to that possess a stochastic nature. Even if the absolute value of the fluctuations is finite according to Poisson distribution but the accurate prediction of the absolute value at a specific time is not possible [2]. Measurements to prove the behaviour of statistical noise, especially distribution of the statistical sample, is important. It is for reason that the current study is under taken to establish a simplified approach towards extracting the statistical noise component from images of a computed neutron radiography system. CCD and CMOS camera based detection systems are common in this field and the CMOS camera will be the focus of this study. It is a complex task to extract the gray value (intensity) contribution of the statistical noise in neutron computed radiography images because of the noise contribution of all signal conversions in the signal chain – initial neutron fluence, generated photons in the scintillation screen per original neutron (including detection probability and multiplication if more than one secondary photon generated per neutron), generated photo electrons in the CCD or CMOS (Including detection probability), noise of the readout amplifier on the CCD or CMOS, noise in the first amplification stage of the analog signal, quantification noise in the ADC. This work presents preliminary results of a simplified method towards extracting the statistical noise characteristics from computed radiography images.

158 - A quantum circuit modeling toolkit for high performance computing

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.158) [For award: PhD]*

Primary author: *SENEKANE, Makhamsia (University of KwaZulu-Natal)*
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Theoretically, quantum computers are known to solve a certain class of problems more efficiently than their classical counterparts. This is due to parallelism which is inherent in quantum algorithms. However, a full-scale quantum computer has not been realized as yet. Therefore, in order to validate and debug quantum circuits, a classical computer is used. Since most of these circuits are simulated using personal computers (PCs), quantum circuits with a limited number of quantum bits (qubits) can only be simulated, due to computational limitations of PCs. In this work, we report the simulation of quantum circuits on a high performance platform using message passing interface for the Python (mpi4py) package.

159 - PGAS Model for the Processing Unit of the Upgraded Electronics of the Tile Calorimeter of the ATLAS Detector

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.159) [For award: PhD]*

Primary author: OHENE-KWOFIE, Daniel *(University of The Witwatersrand)*
Co-authors: *OTOO, Ekow (University Of The Witwatersrand); MELLADO GARCIA, Bruce (University Of the Witwatersrand)*

Advances in new technologies, high speed and more accurate instrumentation for data acquisition, advanced high performance computing technology and better simulation modelling have given rise to the accumulation of massively large amount of data typically referred to as Big-Data.The ATLAS detector, for instance, operated at the Large Hadron Collider (LHC) records proton-proton collisions at CERN every 50ns resulting in a sustained data flow up to Tb/s. The upgraded Calorimeter will, however, sustain Pb/s of digital throughput. These massive data rates requireextremely 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 canimplement an I/O subsystem infrastructure capable of meeting the computational speeds of the advanced computing systems at the petascale and exascale level. Recent advances in database management technologies are shifting to in-memory (or DRAM) data storage systems since in-memory data processing results in about 100 to 1000X increased throughput.This paper proposes a system architecture 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 throughtput data processing. The physical memory of the PUs are aggregated into a large global logical address space using RDMA-capable interconnects such as PCI-Express to enhance data processing throughput. Research challenges concern memory-to-memory data copying, fault-tolerance, as well as optimisations for high throughput data processing.

164 - Prometeo: The new test bench for the electronics in ATLAS tile calorimeter in the upgrade.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.164)*

Primary author: RUAN, Xifeng *(University of the Witwatersrand)*

The ATLAS detector is a general purpose detector at the LHC, which consists of several sub-detectors, such as the inner detector, the electromagnetic calorimeter, the hadronic calorimeter and the muon spectrometer. The tile-calorimeter is one of the most important part of the hadronic calorimeter in ATLAS. The signals in the tile calorimeter are collected by the front-end electronics and sent to the readout driver. In 2022, the elect ronics will be upgraded to fit the new technologies and have better performance. Prometeo is a portable test-bench for the full certification of the front-end electronics of the ATLAS Tile Calori meter upgrade phase-II during that time. It is a high throughput electronics system designed to simultaneously read-out all the samples from 12 channels at the LHC bunch crossing frequency. The core of the system is a Xilinx VC707 evaluation board extended with a dual QSFP FMC module to read-out and control the front-end boards. The rest of the functionalities of the system are provided by a HV mezzanine board that to turn on the gain of the photo-multipliers, an LED board that sends light to illuminate the them, and a 12 channel ADC board that samples the analog output of the front-end. The system is connected by ethernet to a GUI client from which QA tests are performed on the electronics such as noise measurements and linearity response to an injected charge.

165 - Measure the properties of Higgs boson in vector boson fusion production mode in the ATLAS detector

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.165)*

Primary author: RUAN, Xifeng *(University of the Witwatersrand)*

The ATLAS detector is one of the general purpose detector at the LHC. It has several sub-detectors, the inner detector, the electromagnetic and hadronic calorimeter and the muon spectrometer which providing track and energy measurement. The high performance and full coverage of the ATLAS detector allow the reconstruction of particles like electrons, photons, muons and candidates like jets. All of these show the possibility to reconstruct the Higgs boson. The standard model Higgs boson like particle has been observed in July 2012 in both the ATLAS and CMS detector at the LHC. The measurement of the Higgs properties is performed in Higgs decay to diphoton channel after the discovery. The Higgs mass spectrum can be well reconstructed in this channel. The Higgs boson produced via vector boson fusion process was also measured in this channel, which is a pure electroweak interaction not verified yet and has the potential to discover the new physics beyond the standard model. The multivariate analysis(MVA) method is critical to extract the Higgs boson in such case, in which the events should have at least two forward jets as well as large invariant mass of jets. The MVA method has the ability to exploit the subtle kinematic characteri stic of VBF production mode and suppress the background.

167 - Hydrogen storage in ZnO-CNF hybrid nanostructures

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.167) [For award: MSc]*

Primary author: THETHWAYO, Charles *(University of Zululand)*
Co-authors: *MBUYISA, Puleng (University of Zululand); NYAWO, Thembinkosi (University of Zululand); NDWANDWE, Muzi (University of Zululand); SEFAGE, Amanda (University of Zululand)*

In this work, we study zinc oxide carbon nanofibers hybrid (ZnO-CNFs) for hydrogen storage. Zinc Oxide thin films have been deposited using DC magnetron sputtering. We have then grown aligned ZnO nanorods on the ZnO thin films, and then synthesis ZnO-CNFs by Chemical vapour deposition (CVD), using acetylene (C_2H_2) as a source of carbon. The characterisation techniques involved in this work are: Scanning electron microscopy (SEM) for the structure and morphology of ZnO nanorods and ZnO-CNFs, energy dispersive X-rays spectroscopy (EDS/EDX) for chemical composition, Atomic force microscopy (AFM) for surface morphology, X-ray diffraction XRD for crystal structure. Carbon nanofibers have small diameters, a pore-size distribution which leads to excellent adsorption capacity. Elastic Recoil Detection Analysis (ERDA) results are presented and they show promise that these ZnO-CNFs are promising candidates for hydrogen storage. The results show that the temperature has an effect on the amount of hydrogen absorbed, at lower temperatures hydrogen is detected most on the surface and at higher temperatures hydrogen is detected on the surface and on the bulk which yield a higher hydrogen sorption. SEM images shows that the thickness of the ZnO-CNFs decreases with the increase in temperature.

176 - Geyser heating cycle of 2kW tank domestic solar water heater under varying loads

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.176) [For award: MSc]*

Primary author: NDLOVU, Nothando *(University of Fort Hare)*
Co-authors: *SIMON, Michael (FHIT); MEYER, Edson (University of Fort Hare)*

Electric geysers are very important for providing a constant supply of hot water in the household. Water in a tank is kept at the thermostat set point temperature by the element which results in continuous heating throughout the day. In South Africa, over 50% of total household electricity use in the home is attributed to water heating. Solar water heaters provide a sustainable and environmentally friendly way to heat water, while reducing consumers' overall electricity consumption. By using the geyser element only as a backup, peak demand can be significantly reduced, relieving pressure on the national utility. Integrating a geyser timer into the system allows occupants to control element heating to suit household hot water use pattern. This study presents the results of a series of experiments carried out to compare the electrical energy consumption of a 2kW element installed as a backup for a domestic solar water heater (DSWH), under different loads. For comparison, a morning peak load was used. High, medium and low water loads were drawn, for 6 different days on a domestic solar water heater with a tank capacity of 200litres. The geyser heating cycle was investigated in order to determine the instantaneous electrical energy demand. Comparisons were made with the heating cycle when the geyser is controlled using a geyser timer. Results show that over a period of 24hours 3.54 kWh of energy were used when a low morning peak load was used. Activating a timer reduced total daily energy to 2.33kWh. Incorporating a timer into the system prevents heating when solar radiation is available thereby reducing electrical energy consumption. The solar contribution to the total heating load is also increased. Complete results will be presented in the final presentation.

180 - Atomistic Simulation Studies of $LiMn_2O_4$

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.180) [For award: MSc]*

Primary author: LEDWABA, Raesibe Sylvia *(University of Limpopo)*
Co-authors: *NGOEPE, Phuti (University of Limpopo); MATSHABA, Malili (University of Limpopo)*

The spinel $LiMn_2O_4$ is a promising cathode material for use in lithium-ion batteries. To identify the effects of temperature on this system, molecular dynamics simulations were carried out in the NVE ensemble using the supercell approach, on a supercell system consisting 12096 atoms. The radial distribution functions, diffusion coefficients, total energy and x-ray diffractions were analysed. The findings of this study indicated Li-Li bond shortening on the rdf plots, which was due to lithium ions hopping from 8a to 16c vacancies. Lithium diffusion plot indicates no diffusion when the structure is heated up to 280 K, just before the Verwey transition takes place (Tv =285 K). Immediately above the transition, the plot shows an increase at 290 K and then goes back to ~0nm2/s at 300 K. The lithium diffusion then increase until it starts decreasing above the melting point of the system (~2000 K). This shows that the lithium diffusion capacity of the battery material can withstand high temperatures without any compromise.

182 - Synthesis and characterization of doped perovskite oxides (CaTiO3: Pr, Al) nanophosphors by using sol-gel method.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.182) [For award: MSc]*

Primary author: LOTHA, Thandikhaya Lungisa *(University of the Free State)*

Perovskite calcium titanate (CaTiO3) nanoparticles were successfully prepared by wet-chemical method (sol-gel route), using calcium nitrate and titanium (IV) isopropoxide as starting material and acetic acid as complexing reagent. A sol was obtained and then oven heated to form a gel which was calcined at high temperature (800 °C for 2hours) to obtain a crystalline CaTiO3 powder. Red emitting nanophosphors of CaTiO3:Pr3+ with various particle sizes were prepared by sol-gel methods and structurally characterized by X-ray diffraction and the particle size, morphology, optical properties of calcined nanoparticles was investigated by scanning electron microscopy and photoluminescence. XRD spectra confirm a crystal system of CaTiO3 to be orthorhombic structure and a particle size in nanometer scale, the PL spectrum has a strong peak at 613 nm for the excitation at 310 nm originating from 1D2-3H4 transition of Pr3+. SEM micrograph indicates the shape of the crystals and the morphology of the nanomaterial. This study shows that various properties can be tuned for suitable advanced applications. Perovskite phosphors are widely used in plasma display panels (PDPs), and field emission displays (FEDs), luminous paint as well as safety indicator. The results suggested that the calcination temperature plays an important role in the particle size effect of nanocrystalline, enhancement of the red emissions of Pr3+ doped CaTiO3 with addition trivalent aluminium ions (Al3+) as co-dopant.

190 - Growth of FeSi nanowires by Chemical Vapour Deposition for Gas Sensing Applications

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.190)*

Primary author: *THABETHE, Sibongiseni (CSIR)*
Co-author: *ARENDSE, Chris (University of the Western Cape)*

FeSi belongs to a class of narrow band gap semiconductors. It has been studied for more than 30 years because of its unusual properties such as its metal to insulator transition (MIT) at temperatures near 300 K [1,2]. We report on the synthesis of FeSi nanowires using chemical vapor deposition for gas sensing applications. Anhydrous FeCl3 powder was used as the precursor. N2 gas was used to carry the precursor vapors to the silicon substrates which were placed in a horizontal quartz tube furnace at a temperature of 1100oC. XRD and TEM results confirm that the nanowires are FeSi with a cubic crystal structure.References[1]J.R Szczech, S. Jin. Journal of Material Chemistry. 2010, 20, 1375-1382.[2]S. Jang, Y. Lee, S. Kim, J. Seo, D. Kim, Material Letters, 2011, 65, 2979-2981.

191 - Numerical modeling of the power output of a plain conical diffuser

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.191)*

Primary author: *MASUKUME, Peace-Maker (University of Fort Hare)*
Co-authors: *MAKAKA, Golden (University of Fort Hare); TINARWO, David (University of Venda)*

Wind power for a bare wind turbine is estimated by the formula: P=Cp1/2ρAV^3, where Cp is the coefficient of performance of the turbine, ρ is the density of the air and V is the wind velocity at that particular site. It follows that given the rotor cross-sectional area of the turbine and the average wind velocity at any site; one can estimate the wind power produced by that turbine at that particular site. However this formula does not work for ducted wind turbines because the power output of the turbine also depends on the geometrical parameters of the duct. This study presents a numerical model to estimate the power output of a plain conical diffuser which has been developed. It is shown that the power output of a plain conical diffuser also depends on the non-dimensional length, L/D (where L is the characteristic length of the diffuser, D is the diameter of the diffuser at the throat) and the divergent angle θ. Results from numerical simulations show that there is no specific angle for optimum performance of the diffuser, rather each ratio L/D has its own corresponding optimum angle. It is shown that the ratio of the free stream velocity and the wind velocity at the throat (U/U∞) increases with angle up to the maximum after which it decreases. It is therefore imperative to always give the ratio L/D used whenever a divergent angle is given.

193 - Assessing continuum postulates for tumbling mills

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.193) [For award: PhD]*

Primary author: *POVALL, Timothy (University of Cape Town)*
Co-authors: *GOVENDER, Indresan (University of Cape Town); MCBRIDE, Andrew (University of Cape Town)*

Dense granular flow is qualitatively similar to fluid flow. Given the high computational cost of simulating discrete problems with large numbers of particles, this qualitative similarity is often exploited and the problem is modelled as a viscous fluid. A crucial aspect of this process is the parametrisation of the constitutive response of the material. This can be argued by considering the micromechanical properties. The purpose of this work is to investigate the validity of the continuum fluid approximation of granular systems in the context of tumbling mills.At the continuum level, the viscosity of a fluid relates the velocity gradient to the shear stress. In contrast to fluids however, no single interpretation of viscosity for granular systems using micromechanical arguments exists. Recent work has shown that under certain conditions a continuum approximation may be inapplicable. In [Rycroft et al., JMPS, 57 (2009) 828-839] the continuum postulate was assessed by analysing large-scale discrete element method simulations of dense, confined granular flow. This was done by viewing the macroscopic flow as an ensemble of Eulerian and Lagrangian representative volumetric elements. The material evolution of these elements was then tracked during the simulation. This work will use the methods described by Rycroft et al. to investigate the material evolution in simulations of tumbling mills.

199 - Phase Noise Analysis of a 1.712 GHz Clock Signal Transmitted over Optical Fibre for MeerKAT Time and Frequency Reference (TFR)

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.199) [For award: PhD]*

Primary author:*ROTICH KIPNOO, Enoch K. (Nelson Mandela Metropolitan University)*
Co-authors: *GIBBON, Tim (Nelson Mandela Metropolitan University); MALAN, Sias (Square Kilometre Array); KRIEL, Henno (Square Kilometre Array); KAPP, Francois (Square Kilometre Array); GAMATHAM, Romeo (Nelson Mandela Metropolitan University); LEITCH, Andrew (Nelson Mandela Metropolitan University)*

MeerKAT telescope demands highly accurate and stable clock distribution over up to 12 km of optical fibre to remote dishes. The clock is required for digitization of radio astronomy signals. Phase stability is critical both for short term and long term requirements. The long term stability is important for very long baseline interferometry (VLBI) while the short term is vital for digitization process. The short term clock stability also known as clock jitter can be measured by analysing the phase noise performance of a signal. In this work, phase noise measurements were performed on optical transmitters used to distribute the clock signals so as to ascertain their contribution to the overall clock jitter of the system. A directly modulated distributed feedback (DFB) laser was shown to meet the maximum jitter requirement of 130 fs for a 1.712 GHz clock signal transmitted over 25 km of fibre. We further demonstrate that with optimized modulation depth, additional passive optical components in the link do not significantly degrade the phase noise response. Thus, A DFB laser was proven to be a suitable optical source that will meet the performance and link budget requirements for the MeerKAT telescope.

200 - Imaging of Dense Minerals in Rocks Using Micro-CT

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.200)*

Primary author: *BAM, Lunga (NECSA)*

High contrast visualization and thus correct identification of high density materials within rocks and drill cores without line, ring and other artifacts is a challenge – e.g. high quality visualization and quantification of gold particles embedded within the rock matrix is important in the mining industry to enhance processes for higher yield in gold extraction. Micro CT was successfully used to visualize and identify gold particles according to its morphology and attenuation coefficient. The associated minerals with gold were studied to get a better understanding of gold deposition, distribution and associations. Due to high density of gold special parameters of a Micro-CT system were optimized to minimize beam hardening to obtain better image quality and contrast. Different filter materials with varying thicknesses were used to increase transmission to aid to the successful reconstruction and higher quality results.

201 - Performance Comparison of SMF-Reach and SMF-RS Optical Fibres for Raman Amplification

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.201) [For award: MSc]*

Primary author:*ISOE, George (University of Eldoret)*
Co-authors: *MUGURO, Kennedy (University of Eldoret); WASWA, David (University of Eldoret); ROTICH KIPNOO, Enoch (Nelson Mandela Metropolitan University); GIBBON, Tim (Nelson Mandela Metropolitan University); LEITCH, Andrew (Nelson Mandela Metropolitan University)*

Fibre Raman amplifiers are currently being adopted in many long-haul systems due to their ability to offer longer amplification spans and high bandwidths. In this work, co- and counter pumping schemes have been analyzed experimentally. The pump and signal powers were maintained at 23 dBm and -10 dBm respectively throughout the experiment. Two fibre types, SMF-reach and SMF-RS each of length 25 km were considered. An on-off gain of 6.3 dB and 4.1 dB was achieved for co- and counter pumping schemes respectively for SMF-reach fibre. For a similar length of SMF-RS, an on-off gain of 4.8 dB and 3.9 dB for different pump configurations was obtained. Pump reflection power was noticed to vary inversely with gain. Therefore SMF-reach fibre is more suitable for Raman amplification in long-haul systems.

203 - Computational modelling studies of Ti_{50}-Pt_{50-x}-Nb_x alloys

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.203) [For award: Hons]*

Primary author: *MALEBATI, Magoja Martinus (University of Limpopo)*
Co-author: *CHAUKE, Hasani Richard (University of Limpopo)*

Shape Memory Alloys (SMAs) are materials which have the ability to return to the initial shape when heated beyond certain temperatures. The behaviour is unique due to the superelasticity and shape memory effect which is possessed by the materials. NiTi is one of the materials that have received wide technological applications but it is limited by its low transformation temperature of 100°C. This has called for the growing demand of SMAs which can be used at high temperatures in the transportation, energy, and systems and control industries, TiPt was found to be amongst the potential high temperature shape memory alloys (HTSMAs) which can be used since its transformation temperature is around 1000°C. In this work Nb was substituted on the Pt sublattice to check its effect on the martensitic transformation temperature. The Ti_{50}-Pt_{50-x}-Nb_x ternaries were determined using the virtual crystal approximation. The investigated structures were optimized and their equilibrium lattice parameters and formation energies were calculated. The lattice parameters were found to be fluctuating minimally with an increase in the Nb concentration. The elastic properties and the density of states for the Ti_{50}-Pt_{50-x}-Nb_x ternaries were also calculated.

204 - Electronic structures of oxygen adsorption on {110} nickel-rich pentlandite ($Fe_4Ni_5S_8$) mineral surface

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.204) [For award: MSc]*

Primary author: *MKHONTO, Peace Prince (University of Limpopo)*
Co-authors: *NGOEPE, Phuti E. (University of Limpopo); CHAUKE, Hasani R. (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; one of the processes is oxidation. The oxidation plays a significant role in forming air bubbles that float the pentlandite mineral. Despite reports that oxidation tend to depress the sulphide minerals, it has good preferential oxidation of iron. The present study investigated the clean and oxidised nickel-rich {110} pentlandite surface using ab-initio density functional theory (DFT). The Bader analysis have been evaluated for clean and oxidized surfaces and suggests that both Fe and Ni have 2+ and 3+ oxidation state, respectively. Furthermore, when oxygen is adsorbed at the (fcc hallow site, on Fe-top site) and on Ni-top site, it was found that the {110} pentlandite surface oxidises as (Fe-O-Fe) and Ni-O-O, respectively. Oxidation had also shown preferential oxidation of iron and we noted a charge transfer from the metals to the oxygen molecule. We also observed that the oxygen (O1) coordinated to the Fe accepts electrons to σ_s and Π_p bonding orbitals, while the oxygen (O2) coordinated to O1 only occupies the Π_p^* antibonding for the fcc hallow site and Fe-top site adsorption. The Ni-top site adsorption is observed to occupy similar to the just mentioned case however, we noted that the Π_p^* antibonding orbital is occupied on O1 atom. This study gives an understanding of oxidation of pentlandite naturally and during flotation.

207 - Understanding radiation damage of the MBTS detector at ATLAS using Raman scattering

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.207)*

Primary author: *MAPHANGA, Linah (University of the Witwatersrand)*

Ukrainian Polystyrene-based plastic scintillator (UP923A) samples manufactured by the Institute of Scintillating materials in Ukraine were investigated using Raman scattering techniques. Three irradiated samples of the same type (UP923A) from the Minimum Bias Trigger scintillator (MBTS) taken from three different positions: Top (T1), Bottom 1 (B1) and Bottom 2 (B2) in the ATLAS detector were investigated. And compared to an un-irradiated sample (D1) of the same type and a 40 MegaGray UP923A irradiated sample. The aim of this investigative project was to understand how the molecular structures of plastic scintillators are damaged due to high energy collisions at LHC using Raman scattering techniques. It was also to observe if there are any variations in molecular damage of the plastic at different positions in the MBTS. It was found that the Raman spectra of the irradiated samples at three different positions in MBTS are similar in shape and have similar peaks, thus the extent of the molecular damage at this positions is not easily distinguishable between the samples. It was also observed that the intensities of the Raman spectra peaks of irradiated samples are smaller in magnitude than the intensities of the peaks in the un-irradiated sample, thus bond breaking occurred during radiation interactions to decrease the amount of specific species in the molecular structure of the plastic. The 40 MegaGray irradiated sample Raman spectrum shows extensive molecular damage. Using Raman scattering analysis, it was observed that the benzene rings in UP923A molecular structure was damaged due to radiation. This study was done with collaboration between the ATLAS team at Wits University and iThemba labs in Gauteng, South Africa.

208 - Interpretation of Spectral Electroluminescence Images of Photovoltaic Modules

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.208) [For award: PhD]*

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

Electroluminescence (EL) is a useful solar cell and module characterisation technique as it is fast, non-destructive and sensitive to the effects of shunt and series resistance and recombination parameters. A solar cell in normal operation receives an optical input in the form of the incoming light and outputs an electrical current. EL occurs when a solar cell is forward biased receiving an electrical input and outputs an emission spectrum. The emission spectrum from indirect band-gap materials like silicon is in the infrared region of light. The intensity of the luminescence emitted is related to the applied voltage and the quantum efficiency of the cell material. The spectrum of the emitted luminescence is related to cell material properties such as surface reflectance, minority carrier diffusion length and carrier lifetime. For EL imaging a silicon CCD camera is commonly used because it has very good spatial resolution, however, this sensor is only sensitive to wavelength in the range of 300-1200 nm. There is an overlap in wavelengths from about 900 to 1100 nm allowing the EL to be detected. The spectrum of the detected EL is thus dependant on the sensitivity of the camera, the transmission of the filters and the emitted photon flux. In this study the voltage is assumed to be constant across a cell and the spectrum of the emitted EL is investigated. Short pass filters are used to cut off the emitted EL spectrum at 900nm and 1000nm. The ratio of images obtained with different filters provides a spectrally defined EL image. The effect of different short pass filters and minority carrier diffusion length on the EL spectrum is theoretically modelled. These results are compared with the experimentally obtained EL images.

209 - Optimization of a Computed Tomography Scan Using Swarm Intelligence

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.209) [For award: PhD]*

Primary author: *NSHIMIRIMANA, Robert (NECSA)*
Co-author: *ENGELBRECHT, Andries (University of Pretoria)*

Computed tomography (CT) is a non-destructively analytical technique using penetrating radiation (Neutrons, X-rays or Gamma-rays) as a probe. As the technique is being used as a diagnostic probe in medical applications, it is being used by the scientific community to retrieve qualitative and quantitative information from laboratory scale samples under investigation.The quest of achieving good results (quality images) in CT, is most of the time met with challenges due to instrument liability, algorithm performance and human decision. With time, some of the challenges are solved using human intuition. As time goes by, experience is gained and as the old challenges become easy to solve the new challenges are born. To obtain the best results possible, the CT experimental simulation will be optimized using swarm intelligence techniques. In this talk we discuss a CT experimental simulator and an image quality analyzer, tools that will be used in CT optimization.

212 - Palladium silicide formation on n-Si (111) By Thermal Annealing

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.212) [For award: MSc]*

Primary author: *DANGA, Helga (Uninersity of Pretoria)*
Co-authors: *DIALE, Mmantsae (University of Pretoria); AURET, Danie (University of Pretoria); COELHO, Sergio (University of Pretoria)*

Palladium Schottky contacts were fabricated on epitaxially grown n-type Silicon (111) by resistive deposition. Current-voltage (I-V), capacitance- voltage (C-V) measurement techniques were used to characterise the as deposited and annealed Pd/n-Si Schottky contacts. These contacts were annealed at temperatures ranging from 200°C to 700°C, in steps of 100°C for ten minutes at each temperature. The ideality factor increased from 1.2 for as deposited to 1.6 after annealing at 700°C while the Schottky barrier height (SBH) decreased from 0.69 to 0.64 eV as the annealing temperature increased. In this study, silicides seem to start forming at 200°C where the ideality factor is lowers to a value of 1.1 and the SBH is at its highest value of 0.70eV. The Rutherford backscattering Spectroscopy (RBS) technique was used to verify temperatures at which Pd2Si was formed. The results obtained suggest that the Pd2Si silicide phase begins to form at 200°C and at 400°C it is completely formed.

216 - Charge and magnetic ordering dynamics under pressure in $LuFe_2O_4$

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.216) [For award: PhD]*

Primary author: *SIBANDA, Wisdom Nkosilathi (UJ)*
Co-authors: *CARLESCHI, Emanuela (University of Johannesburg); DIGUET, Gildas (UJ); MARTIN, Christine (ENSICAEN); HEARNE, GIOvanni (University of Johannesburg)*

Multiferroics offer the possibility to combine ferroelectric and magnetic ordering in materials, hence the realisation of multifunctional devices [1]. $LuFe_2O_4$ is one such compound. Initially thought to be the prototypical compound for charge-order (CO) based ferroelectricity, nowadays it is attracting interest because of its pronounced magneto-electronic coupling, as well as the spin/charge frustration anticipated in the triangular network of Fe atoms within the bilayers of the rhombohedral unit cell. Previous work has shown that the low pressure (LP) phase has a $T_N \approx 250$ K and a CO temperature of 330 K in the highly stoichiometric sample investigated here [2]. In this work pressure has been used as a thermodynamic variable to tune the magnetic-electronic properties of $LuFe_2O_4$. Generation of hydrostatic pressure was by means of a diamond anvil cell, and ^{57}Fe Mössbauer spectroscopy (MS) was used to probe magnetic-electronic phase transformations. Measurements were performed up to ~30 GPa at room temperature. We find evidence of an electron hopping component Fe^{2+}<->Fe^{3+} already present at ambient pressure on the time scale of the Mössbauer effect, with a hopping frequency of 1.4 MHz. At ~5 GPa the CO breaks down, and the hopping component completely dominates, with the hopping frequency increasing to ~10 MHz. The MS spectral line shape at 7 GPa shows new emerging features, supposed to be evidence of a new structural phase initiating at this pressure, consistently with previous x-ray diffraction studies [3]. Furthermore, at 10 GPa new magnetic hyperfine structure is observed in the high pressure (HP) phase at room temperature. This suggests a change of the LP spin frustrated state to that of a new magnetic-state in the HP phase 'with reduced frustration'. The MS spectral envelope of the HP phase suggests that two magnetic-electronic states co-exist, a new CO state is stabilised at HP and unusual spin states are also involved. This is consistent with the claims of previous x-ray and electron diffraction studies of this HP phase recovered to ambient conditions [4].[1] X. S. Xu et al., PRL 101, 227602 (2008).[2] S. Lafuerza et al., PRB 88, 201304 (2013).[3] A. D. Christianson et al., PRL 100, 107601 (2008).[4] J. Rouquette et al., PRL 105, 237203 (2010).

220 - Modelling Inhomogeneities in the EBL

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D1.220) [For award: MSc]*

Primary author: *KUDODA, Ayman (University of the Witwatersrand)*
Co-author: *FALTENBACHER, Andreas (University of the Witwatersrand)*

Extragalactic Background Light (EBL) is the diffused light accumulated from all the galaxies and stars. EBL is an important tool for studying the cosmic galaxy formation history from the decoupling era until present time. In this work we model the distribution and, in particular, the fluctuations of the EBL. The study is based on the semi analytical galaxy catalogue from the Millennium Simulation data base. As a test of our model we propose to investigate the correlation between steepening of the Gamma ray spectra and the fluctuations of the EBL.

221 - Studies of structural properties of Al and Y co-doped tin oxide

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.221)*

Primary author: *NTIMANE, Nduma James (University of Limpopo)*
Co-authors: *RAMMUTLA, Koena erasmus (University of Limpopo); MOSUANG, Thuto (University of Limpopo)*

Nanocrystalline Al/Y co-doped tin oxide powders were successfully synthesized using the sol-gel method. The samples were subjected to different temperatures ranging from 200 to 1000 degrees celsius. The effects of co-doping and temperature on the structural properties of Al/Y co-doped tin oxide nanoparticles were investigated. The characterization techniques used were X-ray powder diffraction (XRD) and Raman spectroscopy. The average particle sizes were found to be in the range between 2.5 – 8 nm in the temperature range studied while the strains were in the range between 2.76 – 0.53. Both the XRD and Raman spectroscopy confirm that at higher temperatures yttrium stannate is formed.

222 - Transverse Momentum and Tsallis Distribution]{Transverse Momentum Distributions in proton - proton Collisions at LHC Energies and Tsallis Thermodynamics

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.222)*

Primary author: *CLEYMANS, Jean (University of Cape Town)*

A detailed study of the transverse momentum distributions of charged particles produced in $p - p$ collisions at LHC energies is presented. This is done using a thermodynamically consistent form of the Tsallis distribution. All variables used are thermodynamical and in particular, the temperature, T, follows from the standard thermodynamic definition as being the derivative of the energy with respect to the (Tsallis) entropy. The momentum distribution of the final state particles can be described very well by the Tsallis distribution. The values of the parameters are determined from measurements by the ALICE, ATLAS and CMS collaborations and are discussed in detail. In particular, the Tsallis parameter, q, is found with consistent values for all the transverse momentum distributions despite large differences in kinematic regions and increases slightly with beam energy, reaching a value of 1.15 at 7 TeV. It is concluded that the hadronic system created in high-energy $p - p$ collisions at mid-rapidity behaves consistently with Tsallis thermodynamics.

226 - Chemiresistive Gas Sensing Properties of Vanadium Pentoxide nanoparticles

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.226) [For award: MSc]*

Primary author: *AKANDE, Amos (University of Limpopo)*
Co-authors: *MWAKIKUNGA, Bonex (CSIR); RAMMUTLA, Erasmus Koena (University of Limpopo)*

Nanoscale materials are very suitable for gas detection at molecular level due to their inherent small size, high conductance and large surface-to-volume ratio. Semiconductor metal oxides like SnO2, ZnO, WO3, V2O5 and TiO2 are widely investigated materials for gas sensors application because of their simplicity, easy to synthesis, cost effective and capability of detecting large number of toxic and volatile gases under different conditions. Vanadium pentoxide (V2O5) nanoparticles were prepared using microwave hydrothermal synthesis technique. The structure, symmetry and thermal property of the material was studied with X-ray diffraction, Raman spectroscopy and Differential scanning calorimetry, its morphology with Scanning electron microscopy and physical adsorption analysis with Brunauer-Emmiter-Teller technique. The material's gas sensing capabilities was tested for ammonia (reducing gas) and nitrogen dioxide (oxidizing gas) keeping operating temperature constant. It was observed that the sensor's resistance decreases when ammonia gas was injected to the measurement chamber but decrease in resistance was also recorded as opposed to increase when nitrogen dioxide gas was added.

227 - Beta-decay spectroscopy of neutron-rich nuclei

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.227) [For award: PhD]*

Primary author: *MAKHATHINI, Lucky (iThemba LABS/Stellenbosch University)*
Co-authors: *BARK, Rorbet (iThemba LABS); PAPKA, Paul (Stellenbosch University/iThemba LABS); ROHWER, Erich (Stellenbosch University)*

The nucleus is a complex quantum-mechanical entity governed by the strong, weak, and electromagnetic forces acting between the constituent nucleons, which can be finally bound into various finite nuclear systems. The aim of nuclear-structure research is to obtain experimental information that can be confronted with results from theoretical models in order to improve our understanding of the atomic nucleus. In this project we intent to develop a tape station to be used at Flerov Laboratory of Nuclear Reactions at Joint Institute for Nuclear Research, Russia and at iThemba Laboratory For Accelerator Based Science, South Africa. The primary goal is to study the β-decay of nuclei in the vicinity of the closed neutron shells at N=82 and N=126 at iThemba LABS and FLNR-JINR, respectively. At iThemba LABS, neutron-rich nuclei will be produced via fission reactions while at FLNR-JINR transfer reactions will be used. In these facilities, the neutron-rich reaction products will be separated using selective laser-ionization, accelerated to ~ 50 keV and transported to a measuring station (tape station) where γ-rays from excited states populated by β-decay will be observed. The tape station will be used to reduce the background from the decay chain to stability, by using a tape to transport the unwanted activity away from the detectors. These measurements will give information vital to understanding the nuclear shell model and shell structure in the neutron-rich regions, possibly answering questions like: are magic numbers still valid in very neutron-rich nuclei far from the line of stability? Recently, theoretical work suggest that they are not. The planned facilities at iThemba LABS and FLNR-JINR will be described.

228 - Winter and Spring aerosol characteristics over Johannesburg (South Africa) Using AERONET Data

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D2.228) [For award: PhD]*

Primary author: *ADESINA, Joseph (UKZN)*
Co-author: *SIVAKUMAR, Venkataraman (University of KwaZulu Natal)*

As effort is being made to fully understand the role aerosol plays in climate, attention is being given to its optical and microphysical properties. In this paper we present a study based on six months AERONET data over Johannesburg. The analysis was generally based on the seasonal variations of aerosol properties during the winter (June to August) and spring (September to November). Aerosol optical depth (AOD440) varied from 0.12±0.06 to 0.18±0.08 in winter and between 0.19±0.07 to 0.26±0.06 in spring, the increment which can be attributed to the biomass burning season. Using the Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model we were able to trace the origin of the air masses. The columnar water vapor (CWV) varied 0.48±0.17 to 0.85±0.38 cm in winter and 0.87±0.34 to 1.76±0.16 cm in spring while the Angstrom exponent (α440-870) varied from 1.23±0.33 to 1.46±0.33 in winter and 1.40±0.19 to 1.60±0.21 during spring. The aerosol volume size distribution which is of bimodal log-normal structure has its fine mode dominant at about 0.15μm radius and the coarse mode at about 4μm. The single scattering albedo (SSA) and the asymmetry parameter (ASY) generally decreased with wavelength.

233 - Improvement of luminescence properties by post annealing ZnO nanopowders prepared by chemical bath method

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.233) [For award: MSc]*

Primary author: *MOLEFE, Fokotsa Victor (University of the Free State)*
Co-author: *KOAO, Lehlohonolo Fortune (University of the Free State)*

ZnO nanopowders were prepared by chemical bath method and dried at room temperature, further more they were annealed in air at 300 oC and 600 oC for 2 hours to study the effect of temperature. XRD, SEM, UV-vis, and PL characterization techniques were employed to analyse the structure, morphology, optical and luminescence properties of ZnO nanopowder samples. The obtained crystal structure from XRD was hexagonal wurtzite with the mean lattice parameters a = b = 3.25 Å and c = 5.18 Å. The increase in annealing temperature resulted into the grain size increase where the estimated grain size increased from ~ 27 nm to ~ 35 nm. SEM morphology shows small clustered nanoflakes at room temperature, at high annealing temperature the nanoflakes becomes more pronounced as a result SEM results confirmed the nanometer grain size. UV – vis reflectance spectra shows a maximum 90 % reflection edge at ~250 nm, these reflection edge is red shifted to ~350 nm as the annealing temperature increases. The band gap energy of ZnO nanopowders determined using Kubelka Munk's equation was found to decrease from 3.2 eV to 2.8 eV with an increase in the annealing temperature. PL measurements reveal the broad deep level emission in the blue region; due to increase in the annealing temperature the luminescence intensity was more intensified.

237 - Resonance effects in coupled Josephson junctions with LCR-shunting

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.237) [For award: MSc]*

Primary author: *KULIKOV, Kirill (JINR)*
Co-authors: *SHUKRINOV, Yury (JINR); RAHMONOV, Ilhom (Joint Institute for Nuclear Research)*

One of the important problems on the way of using the intrinsic Josephson junctions in HTSC as terahertz lectromagnetic waves sources[1] is a synchronization of all junctions in a stack to increase a power of radiation. An intensive attempts to solve this problem are based on using LC-shunting which leads to such synchronization [2,3]. We examine the effect of LC shunting on the phase dynamics of Josephson junction. It has been shown that additional (rc) branches appear in the current–voltage characteristics of the junctions when the Josephson frequency is equal to the natural frequency of the formed resonance circuit (rc-frequency) [4]. The effect of the parameters of the system on its characteristics has been studied. The double resonance has been revealed in the system when the Josephson frequency is equal to the rc-frequency and double frequency of a longitudinal plasma wave appearing under the parametric resonance conditions. We study the effect of electromagnetic radiation on the parameters of the system [5]. The double resonance has been revealed in the system when the frequency of radiation is equal to the Josephson frequency and the rc-requency. Triplet resonance has been investigated in the system when the external frequency of microwave irradiation coincides with the rc-frequency, the Josephson frequency, frequency of a longitudinal plasma wave. 1. L. Ozyuzer et al, Science, 318, 1291, (2007).2. M. Tachiki, K. Ivanovic, K. Kadowaki and T. Koyama, Phys. Rev. B 83, 014508 (2011).3. T. Zhou, J. Mao, H. Cui, X. Zhao, L. Fang and S. Yan, Physica C 469, 785 (2009).4. Yu. M. Shukrinov, I. R. Rahmonov, K. Kulikov, Journal of Experimental and Theoretical Physics Letters, 96, 657 (2012).5. Yu. M. Shukrinov, P. Seidel, E. Ilichev, W. Nawrocki, M. Grajcar, P. A. Plecenik , I. R. Rahmonov, K. Kulikov. Journal of Physics: Conference Series, 393, 012020 (2012).

239 - Stable priors for Bayes Factors

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.239)*

Primary author: *DE KOCK, Michiel (University of Stellenbosch)*
Co-author: *EGGERS, Hans (University of Stellenbosch)*

Constructing reference priors for parameter spaces usually results in a proliferation of metaparameters. Bayes Factors, for example, require proper priors, and the usual class of ignorance priors then necessarily results in two metaparameters for every parameter, namely an upper and lower bound. With the goal of reducing the number ofmetaparameters, we replace ignorance priors by stable priors which are based on a stability property and consistent transformations between the parameters. We illustrate the procedure with an example from High-Energy Physics where we use Bayes Factors with stable priors to compare different parametrisations.

240 - New research opportunities with the K600 magnetic spectrometer

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.240)*

Primary author: *NEVELING, Retief (iThemba LABS)*
Co-authors: *SMIT, Frederick David (iThemba LABS); NEMULODI, Fhumulani (University of Stellenbosch); PAPKA, Paul (Stellenbosch University); SWARTZ, Jacobus (Stellenbosch University); ADSLEY, Philip (University of Stellenbosch)*

Recent modifications to the scattering chamber and focal plane detectors of the K600 magnetic spectrometer at iThemba LABS allows for exciting new research opportunities.Measurements at extreme forward angles, including zero degrees, became feasible circa 2009. However, the different beam-stop configurations did not allow for measurements between 2 and 5 degrees. Information about the angular distribution in this small angular range is quite important to positively identify different spin-parities. A new small-angle mode was designed and successfully tested in March 2014. This will allow one to distinguish between M1 and E1 states in inelastic proton scattering. Also, at these angles one can study the poorly known spin-dipole mode. Knowledge of the spin-dipole response in selected nuclei is crucial for description of the dynamics prior to core collapse in massive stars. It is well known that the addition of coincident particle and gamma detection to the K600 zero degree capability enhances the selectivity of such a facility. For this purpose funding from the NRF was secured to allow for the establishment of a coincident segmented ancillary detector system for the K600. A number of Double Sided Silicon Strip Detectors (DSSSD's) as well as NIM and VME electronics were acquired as part of this project. Furthermore a new scattering chamber, optimized for coincident particle and gamma detection, was recently manufactured. The first experiment to make use of the new hardware is scheduled for June 2014. The lower detection limit for charged particles in the K600 depends critically on the trigger scintillators in the focal plane. Presently low energy charged particles in transfer reactions studies at 0 degrees are stopped inside the first scintillator, which necessitates the creation of a trigger with only one scintillator. This results in a unusually high trigger rate due to the high rate of low energy charged particles and photons originating from the internal beam-stop. The use of two thin scintillators should however enable coincidence triggering. The expected reduction in signal-to-noise ratio will allow for experiments to be performed more efficiently at higher beam-currents. This is crucial in the study of weakly populated states.Preliminary data to illustrate the new capabilities will be presented.

241 - Surface Brillouin scattering studies on annealed ion-modified CVD diamond

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.241) [For award: PhD]*

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

Surface Brillouin scattering studies show a transition from a hard diamond-like damaged material to a softer material after annealing at 500 degrees Celsius and 800 degrees Celsius depending on the local damage density. CVD diamonds were implanted with carbon ions in single and multiple energy regimes to a maximum energy of 150 keV and doses of 1.5 x 1016 and 1.0 x 1016 ions/cm squared, respectively. Surface Brillouin scattering studies were then carried out to study the transformation of the damaged near surface region due to heat treatment at different annealing temperatures. Surface acoustic modes are used to study the evolution. Raman studies was also used to show the structural changes occurring due to the annealing effects on the sample surface.

242 - Cross-section measurements for neutron-induced reactions in Co and Au at neutron energy of 60 MeV

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.242)*

Primary author: MALEKA, Peane Peter *(iThemba LABS)*
Co-authors: *NCHODU, Rudolph Mahlomola (iThemba LABS); SMIT, Frederick David (iThemba LABS); BUFFLER, Andy (University of Cape Town); GEDULD, Dieter (University of Cape Town); DOMULA, Alexander (TU-Dresden/IKTP)*

The IRDFF library currently consists of more than 70 reactions that are important for reactor dosimetry, fusion and fission studies. Moreover, there are few existing experimental data at this energy range and most of them have large uncertainties (30-50%). Theoretical model calculations provide an additional source of cross-section data but more experimental data are still required for benchmarking calculations and for the adjustment of model parameters where necessary. New evaluations are proposed on the basis of new experimental data combined with data obtained from consistent theoretical model calculations. Evaluated libraries and the few existing experimental data mainly agree on the shape of the cross-section, but differ in absolute values.Neutron induced cross section measurements for the (n, 3-6n) reactions of various target materials using quasi mono-energetic neutron beams are being conducted at iThemba LABS to improve and extend the International Reactor Dosimetry Fusion File (IRDFF) library.For this contribution we will report on the cross section measurement for neutron induced reactions, 59Co(n,3n)57Co and 197Au(n,4n)194Au using quasi-monoenergetic neutron beam of 60 MeV.

244 - Chaotic Phenomena in Stack of Josephson Junctions

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.244) [For award: Hons]*

Primary author: MEDVEDEVA, Svetlana *(Moscow Institute of Physics and Technology, JINR)*
Co-author: *SHUKRINOV, Yury (JINR)*

Nowadays Josephson junctions (JJ) have important applications in quantum-mechanical circuits such as SQUIDs, superconducting qubits, and RSFQ digital electronics. The phase dynamics is one of the key moments in the studies of JJ. Chaos in the stack of JJ often has negative influence on work of devises based on Josephson effect, so it is important to avoid it. Consequently, it is necessary to know parameters upon which chaos in JJ occurs and how chaotic states are developed.In present research the phase dynamics of JJ with different values of dissipation parameter in the interval (0.1,0.6) for different values of the amplitude and frequency of the external electromagnetic radiation is investigated. We use the resistively and capacitively shunted junction model. To simulate IV-characteristics and the Poincare sections we solve the system of nonlinear differential equations using 4-th order Runge-Kutta method. We present results demonstrated the fragmentation of the Shapiro steps and their subharmonics. The influence of the coupling between JJ in the stack on the subharmonic structure is studied. Behavior between first and second harmonics is investigated. We study effect of coupling between junctions on current voltage characteristics at β=0.3, Ω=0.5 and A=0.8. We found nontrivial disappearance of Shapiro step subharmonics with increase in the coupling parameter. The influence of radiation and parameters of Josephson junctions in the stack on chaotic phenomena is discussed. These results may be used in design devices based on JJ.

245 - Metal oxides for photovoltaic devices

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.245) [For award: PhD]*

Primary author: MAABONG, Kelebogile *(University Of Pretoria)*
Co-author: *DIALE, Mmantsae (University Of Pretoria)*

Metal oxides are emerging as important materials for various applications such as memory capacitors, transistors, photovoltaic (PV) devices due to their attractive properties such as wide band gap, high permittivity, chemical stability and physical properties. Metal oxides provide superior electrical isolation properties, reducing interface recombination. In PV devices, metals oxides have potential as conducting electrodes, window layers, light absorbing layers or antireflection coatings. The quality of the interface layers within the device plays a very important role in regard to the performance of many devices. Deposition of suitable metal oxides (dielectric material) can enhance optical properties and interfacial properties of PV devices. While different metal oxides are under consideration for applications in PV devices, materials with high dielectric constant (high-k) are preferable. However, high-k materials present performance degrading issues such as high density of interfacial defects, low band gaps and smaller band offsets. A combination of high-k material and high band gap material appears as a promising solution. A lot of effort is required on the choice of materials and understanding of interface engineering schemes of multicomponent structures. This work is an effort towards the same and a review of recent advances on metal oxides for PV devices is presented.

246 - Correlation between entangled states as measured from accelerated world lines.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.246) [For award: PhD]*

Primary author: HARTMAN, Jonathan *(University of Johannesburg)*
Co-authors: *CONNELL, Simon (University of Johannesburg); PETRUCCIONE, Francesco (UKZN)*

In this work we calculate the correlation function of two entangled particles in accelerated frames. We find no no extra phase shifts when one of the entangled particles are accelerated uniformly from rest. However, by the equivalence principle of general relativity, constant acceleration can also have the same effect on a body as a gravitational field does without acceleration. So, we also compare the results to those of a paper which does find a phase change between entangled particles in a gravitational field. We consider the possibility that acceleration could result in a phase change if the particle has a non-zero initial velocity and the acceleration is such that it changes the direction of the particle motion.

248 - Pressure effects on the magnetic behavior of the local moment ferromagnet CeCuSi

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.248)*

Primary author: HEARNE, GIOvanni *(University of Johannesburg)*
Co-authors: *DIGUET, Gildas (University of Johannesburg); STRYDOM, Andre (University of Johannesburg); SONDEZI-MHLUNGU, Buyi (University of Johannesburg); KAMENEV, Konstantin (University of Edinburgh); BAUDELET, Francois (Synchrotron SOLEIL)*

Interest in Ce or U based ternary intermetallics has been ongoing for the last three decades, because they show a variety of exotic magnetic-electronic ground-states (e.g. heavy fermion behavior , non Fermi-liquid characteristics, etc). Most magnetic Ce*TX* compounds order antiferromagnetically (*T* is a transition-metal and *X* is a *p*-band element). One candidate, CeCuSi, is among a select number that exhibits ferromagnetic ordering at low temperatures; other candidates being CePd*X* (*X* = P, As, Sb). The ferromagnetic transition in this compound has been established from both specific heat data (λ-type anomaly manifested at T_C =15 K) and magnetization measurements in which an ordered moment of ~1 μ_B has been obtained. The hybridization (*J*) between the localized 4*f* and more extended *d* orbitals (Ce 5*d* and *T*3*d*), which influences intersite magnetic ordering of Ce moments via the RKKY indirect interaction mechanism involving the *d* conduction electrons, is readily tuned under pressure. Consequently new ground states can be stabilized at reduced inter-atomic spacing without the complexity of disorder from doping. Many well known antiferromagnetic Ce*TX* compounds have been the focus of attention in pressure studies in the last decade. There has been much less done, if any, in elucidating the pressure response of *ferromagnetic* analogs. We present the results of our pressure studies on the title compound. These studies have entailed : (i) SQUID magnetization measurements to ~10 GPa in a turn-buckle magnetic diamond anvil cell (TM-DAC) to monitor both T_C and magnetic susceptibility, (ii) x-ray absorption spectroscopy (XAS) at the Ce L_3-edge (~5.7 keV) to pressures of ~16 GPa. The latter necessitates use of “perforated” diamond anvils in a membrane-DAC for both a near edge spectroscopy (XANES) probe of Ce valence and x-ray absorption dichroism (XMCD) at 6 K to monitor shell-specific 5*d*-3*d* conduction electron spin polarization in the magnetically ordered state. We evidence increasing T_C values (from 15 K to 30 K), and yet collapse of the XMCD signal, with rising pressure up to 10 GPa; beyond which signatures of a valence change are manifest in the XANES profiles.

249 - Cost effective way of heating household size biogas digesters manufactured in South Africa

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.249) [For award: PhD]*

Primary author: NEKHUBVI, Vhutshilo *(University of Venda)*
Co-author: *TINARWO, David (University of Venda)*

Researchers around the globe deepened their most focus on the influence of temperature on the production of the biogas. It was found that amongst other parameters affecting the production of biogas, temperature was the most critical one since anaerobic digestion is a temperature sensitive process. Laboratory experiments showed that the process of heating the biogas digester to a temperature of about 40oC is crucial for mesophilic bacteria’s growth and activity in order to obtain optimum biogas production. To achieve the above temperature, heating techniques and methods are required since energy is required for this process. In this study an attempt has been made to find ways of supplying the necessary energy at minimum cost to heat the digester. Digesters in Limpopo province and in other parts of the country are installed underground and the energy required to heat them can only be associated with solar radiation falling to the specific locations where the systems are. Practical work showed that no single digester installed in Limpopo province is operating at temperatures above 27OC in all seasons and they are producing less gas than expected by the installer and operators. Other researches indicated that several methods for increasing the digester temperature have been proposed in the literature but these kinds of solutions increase the cost and complexity of the digesters and considered to be less appropriate for small farmers and villagers in low income countries. The main aim of this study was to develop a technique or method involving design and testing of a simple and cost effective heating apparatus suitable for supplying heat to the biogas digester systems.

250 - Sputter deposition and characterization of diamond like carbon thin films

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.250) [For award: MSc]*

Primary author: CHONCO, Nelisiwe Princess *(University of Zululand)*
Co-authors: *NDWANDWE, Muzi (University of Zululand); NYAWO, Thembinkosi (University of Zululand); THETHWAYO, Charles (University of Zululand)*

Deposition of diamond like carbon (DLC) thin films were prepared by a DC magnetron sputtering on glass and silicon substrates. The characterisation techniques used are: Scanning electron microscopy (SEM) for imaging and chemical composition on the surface of the thin film. Atomic force microscopy (AFM) for studying the surface roughness of thin and thick films in coatings and Raman spectroscopy basically characterized type of carbon presence in the samples and also to check the DLC spectrum with presence of D and G peaks where G correspond to graphite while D correspond to diamond. Raman spectroscopy shows the D peak which is approximately 1360 cm-1 and the G peak is approximately 1550 cm-1. Ratio is important factor in determining whether the DLC is more diamond like or graphitic.

251 - First Calculation of the full Space-Time Evolution of Jets

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.251) [For award: MSc]*

Primary author: MEIRING, Ben *(University of Cape Town)*
Co-author: *HOROWITZ, William (University of Cape Town)*

Particle physics has had remarkable success in describing collider data using the usual Feynman diagram techniques, but there is still little knowledge regarding what happens to particles during the time of interaction. We use the Schwinger-Keldysh finite-time formalism applied to an interacting scalar field theory to derive a perturbative expression for the energy momentum tensor associated with the production of an off-shell jet, in an effort to analytically probe the untouched regime of finite-time physics. Possible applications include perturbative calculations of dispersion relations for interacting non-linear theories, insight into the flow of momentum for off-shell particles, and the creation of a hybrid early-time pQCD/late-time AdS/CFT energy loss model to describe high-momentum observables in heavy-ion collisions.

258 - Searches for Z' boson decaying to two hadronic taus at a centre-of-mass energy of 8 TeV with the ATLAS detector.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.258) [For award: MSc]*

Primary author: HSU, Catherine *(University of the Witwatersrand)*

The sensitivity of the analysis of the Z' boson in the Sequential Standard Model decaying to two hadronic taus benefits from studies aiming at improving the signal efficiency and the ability to distinguish the signal against background processes that mimic the tau signature in the detector. Thus, the significance of each trigger and trigger combinations are investigated, as well as the performance of different techniques and ideas used to improve the tau identification using tracking. The data sample used were recorded by the ATLAS detector during the 2012 run of the Large Hadron Collider at a centre-of-mass energy of 8 TeV with an integrated luminosity of 19.5 inverse femtobarn. Since it is important in this analysis to be able to reconstruct a tau lepton from its hadronic decay products, a study of the light collection uniformity and response in the crack scintillation counters of the ATLAS hadronic tile calorimeter was performed, and preliminary results were obtained.

260 - Data Processing System for the Time-of-Flight Spectrometer of Heavy Ions in the wide range of Energies.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.260) [For award: PhD]*

Primary author: MALAZA, Vusi *(Stellenbosch University)*
Co-authors: *JACOBS, Noel Mkhululi (Stellenbosch University); PYATKOV, Yuri (Joint Institute for Nuclear Research); KAMANINI, Dmitry (Joint Institute for Nuclear Research); ZHUCHKO, Vladimir (Joint Institute for Nuclear Research)*

At the present moment it is well known that detecting fission fragments from a decay of heavy nuclei using silicon detectors comes with two experimental challenges, namely Pulse Height Defect and Plasma delay. The negative effect of the Pulse Height Defect (PHD) is observed when registering the energy of the fission fragment and the one of Plasma Delay (PD) is observed when registering time of the fission fragments using the silicon detectors. Finding a solution to these experimental challenges is critical to the investigation of the new decay of low excited heavy nuclei called “Collinear Cluster Tri-partition” (CCT)[1].A precise but rather complicated procedure that takes into account the above mentioned experimental challenges (PHD and PD) has been successfully developed. This procedure involves an iterative process where the correct masses of fission fragment is calculated taking into account both PHD and PD in the measurement of energy and Time Of Flight (TOF) respectively. This procedure is divided into 3 stages. The first stage is the first approximation where the energies of the fission fragment is calculated without taking into account the PHD and the PD. The second stage is the calculation of the PHD value using an empirical formula derived by Mulgin et al [2]. The last stage involves using a special equation suggested by Neidel and Henschel [3] to calculate the PD. In this way, the correct PD values are obtained and are then used to calculate the correct TOF for fission fragments. A special code to perform the abovementioned procedures was first designed in Fotran 95 programming language. At the moment a newly improved and modern code is currently being developed in C++ programming language. This modern code also includes a design of an easy to use graphical interface that runs the iteration used to find the parameters without compiling. In this paper we present both the description of this analysis procedure and a detailed explanation of this modern code.References1. Pyatkov Yu.V. et al.,Eur. Ph ys. J. A 48 (2010) p 942. Mulgin S. et al., NIM A 388 (1997) p 254-259.3. Neidel H, Henschel H., Nucl. Instr. Meth. 178 (1980) p137 - 148

262 - X-ray reflectometry and Surface Brillouin scattering studies of thin films of VC deposited on Si by RF magnetron sputtering

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.262) [For award: PhD]*

Primary author: JAKATA, Kudakwashe *(University of the Witwatersrand)*
Co-authors: *COMINS, Darrell (University of the Witwatersrand); MSIMANGA, Mandla (iThemba Labs(Gauteng)); WAMWANGI, Daniel (University of the Witwatersrand)*

VC has high hardness, a high melting point and chemical stability which makes it useful as a thin protective coating. Thin films have been deposited with varying layer thicknesses and RF powers on a (100) Si wafer using RF magnetron sputtering at working gas pressures of $4x10^{-3}$ mbar. The substrate was placed 50 mm from the target and initially plasma etched before the deposition of the vanadium carbide film. Varying the deposition time and RF power produces films of different thicknesses, stoichiometry and microstructures. X-ray reflectometry (XRR) was then used to determine the layer thicknesses, roughness and density of the deposited layers. The layer thickness and density are used as input parameters in calculations that are carried out after surface Brillouin scattering (SBS) experiments in order to determine the elastic stiffnesses of VC thin films. SBS is a non-destructive technique that uses a tandem Fabry-Perot interferometer to measure the frequency shift in laser light scattered from the sample due to the propagation of surface acoustic waves. The results presented show that the VC/Si system consists of an elastically harder layer (VC) on a softer substrate (Si) since the Sezawa modes characteristic of a soft on hard system were not observed. In order to observe the Sezawa modes together with the Rayleigh mode and thus allow the elastic constants to be determined using computational methods, the growth of the VC films on a substrate elastically harder the films such as SiC is in progress.

267 - Thermal-transport and electronic structure properties of $CePdIn_2$

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.267)*

Primary author: *SNYMAN, Jasper Snyman (University of Johannesburg)*
Co-authors: *CARLESCHI, Emanuela (University of Johannesburg); DOYLE, Bryan (University of Johannesburg); MAGNANO, elena (IOM-CNR, Laboratorio tasc, Italy); NAPPINI, Silvia (Laboratorio TASC, IOM-CNR); PIS, Igor (Laboratorio TASC, IOM-CNR); BONDINO, Federica (Laboratorio TASC, IOM-CNR); STRYDOM, Andre (University of Johannesburg)*

The presence of cooperative phenomena and electronic correlations in Ce-based systems leads to the formation of a variety of unusual ground states, such as new quantum states of matter, magnetic ordering, itinerant heavy fermion behaviour and unconventional superconductivity. The ground state properties of these systems are governed mainly by the antiferromagnetic exchange coupling of the Ce 4*f* magnetic moments with conduction band states. This gives rise to two competing mechanisms, i.e. the Kondo and the RKKY interactions.$CePdIn_2$ has been classified by the recent literature as a local moment ferromagnet with T_C = 10 K, a small Kondo temperature of about 5 K and metallic behaviour of the resistivity above T_C [1]. This suggests that the physical properties of the system can be understood in the framework of the RKKY interaction, where Ce 4*f* electrons are expected to have a localised nature. In this work we report on our recent experimental results on the bulk thermal-transport and electronic structure properties of $CePdIn_2$, which reveal subtleties not captured by such a classification. In particular, our specific heat results show model mean field ferromagnetic behaviour emerging below 10 K, implying that long-range magnetic correlations are important in establishing magnetic order. Furthermore, the Seebeck coefficient changes sign twice below 100 K, which can be readily explained within the framework of competing (exchange and correlation) energy scales particular to Ce-based intermetallics in which the Kondo interactions become prominent. Moreover, resonant photoemission and x-ray absorption measurements at the Ce M_{54} edges allow us to determine the valence of the Ce ions and to reveal a large *f-d* electron hybridization together with a significant intermediate valency.Combined, these results suggest that $CePdIn_2$ is a hereto-overlooked member of a small family of strongly correlated ferromagnetic Kondo lattices [2,3], whose properties are determined by a drastic modification in 1) the Ce-ion valence and 2) the 4*f* hybridization strength which affects the electron hopping between the ions.[1] L.M. Da Silva et al., Physica B 404, 3018 (2009)[2] C.D. Batista et al., PRL 88, 187203 (2002)[3] C.D. Batista et al., PRB 68, 214430 (2003)

270 - Thermally induced lensing determination from the coefficient of defocus aberration

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: C.270) [For award: PhD]*

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

The effects of lensing due to a temperature gradient in a laser crystal as a result of an end-pumped configuration in a solid-state laser resonator were investigated. It is well known that as the result of thermally induced lensing, the effective length of a laser cavity is altered, thus altering the properties of the selected mode at the output of the laser. Typically, the radius of curva ture of a lens may be described from the coefficient of the defocus aberration, which can be described from the set of orthogonal Zernike polynomials. The defocus coefficient of known lenses (physical and digital) was measured using a Shack-Hartmann wave-front sensor, as a calibration technique. With this we probe a Nd:YAG gain medium with a collimated Gaussian beam operating at 633 nm and the coefficient of the defocus aberration under active pumping at a variety of pump powers was measured. The position of measurement inside the crystal is varied relative to the end-pumped surface and the resulting focal lengths are compared to typical thermal lens measured data in active end-pumped solid-state lasers.

272 - Investigation of the migration behaviour of Strontium ion implanted in Silicon Carbide

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.272)*

Primary author: *THABETHE, Thabsile (University of Pretoria)*

The migration behaviour of strontium through single and poly crystalline SiC (6H-SiC and CVD-SiC) wafers was investigated using Rutherford backscattering spectroscopy (RBS), scanning electron microscopy (SEM) and Raman spectroscopy. A fluence of 1.153×10^16 cm^-2 of Sr ion was implanted into 6H-SiC wafer with an energy of 360 keV at room temperatures (RT = 23 °C). The change in average depth of the implantation Sr ion profile was determined by isochronal and isothermal annealing studies at temperatures up to 1400 °C. The strong influence of radiation damage on diffusion after room temperature implantations was observed in all cases during the initial annealing stages at 1000 °C. Recrystallization of the highly disordered crystal at this annealing temperature is taking place. Further diffusion took place as the annealing temperature was increased from 1000 to 1400 ºC. Annealing of the radiation damage and structural reconstruction was observed to be taking place at these annealing temperatures.

274 - Characterization of Temperature Dependence of the Electron Capture Cross Section of E-Center in Sb-Doped Germanium

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.274) [For award: PhD]*

Primary author: *OMOTOSO, Ezekiel (University of Pretoria)*
Co-authors: *MEYER, Walter (University of Pretoria); AURET, Danie (University of Pretoria); COELHO, Sergei (UP); NGOEPE, Phuti (University of Pretoria)*

The temperature dependent capture cross section of the E-center in Ge after intentionally irradiating the sample by alpha particle has been investigated. Ohmic contact and Schottcky diodes were deposited of n-type Sb-doped Ge by resistive evaporation. DLTS measurements were made by high resolution Laplace DLTS. From an Arrhenius plot, we found that the thermal emission of the E-center had activation energy of (0.370±0.001) eV and an apparent capture cross section of 2.22×■10■^(-15) cm^2. For a constant filling pulse width, the height of the DLTS peak due to the E-centre increased with increasing temperature. This is the evidence that the E-center has a temperature activated capture cross section. The capture barrier energy and true capture cross section of Ge E-center have been determined to be (0.052±0.003) eV and (2.25±0.05)×■10■^(-17) cm^2 respectively

279 - Monte Carlo simulation of secondary gamma production during proton therapy for dose verification purposes – Part II

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.279) [For award: PhD]*

Primary author: *JEYASUGITHTHAN, Jeyasingam (University of Cape Town)*
Co-author: *PETERSON, Stephen (University of Cape Town)*

The accelerated protons used in proton therapy are used to kill the cancer cells, but can damage normal tissue as well. Consequently, any uncertainty in the dose delivery during proton radiotherapy will strongly affect the success of overall treatment. In recent years, the detection of scattered (prompt) gammas produced within the patient from inelastic nuclear collisions of the treatment protons with nuclei found in the body has been proposed for online treatment verification. The aim of this work was to simulate these discrete prompt gammas using Geant4 (v9.6.02), a Monte Carlo radiation transport code. A primary component of the simulation was to get the physics modelled properly. Geant4 provides several models for low energy proton inelastic nuclear reactions: the binary cascade (BIC) model, the precompound (PRECO) model and the intra nuclear cascade (INCLXX) model. In order to increase the accuracy of our prompt gamma simulations, an appropriate sampling of the three models is required. The suitability of these models for discrete gamma emission from excited state of 16O, 12C and 14N nuclei was tested by comparing simulated inelastic gamma production cross section data against available experimental data in the energy range 0 to 200 MeV. Among these physics models, the precompound model (with the Fermi breakup activated) was found to be the most suitable for producing reasonable prompt gamma spectra. With the physics modelled appropriately, two Geant4 proton therapy models (pencil beam and passive scatter beam) were used to investigate the prompt gamma production from a water phantom. 200 MeV protons were simulated for both models and the prompt gamma energy spectrum was acquired using a LaBr3 detector actively shielded by a BGO detector. Time-of-flight (TOF) techniques were used to eliminate the scattered gammas from the beam line element and the secondary neutrons from the target. These Geant4 simulations are mimicking a set of measurements to be completed this year and a comparison between the measured and simulated results will follow.

282 - Reactive DC sputter deposition and charactersation of AlN thin films

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.282)*

Primary author: *NYAWO, Thembinkosi Goodman (University of Zululand)*
Co-authors: *NDWANDWE, Muzi (University of Zululand); THETHWAYO, Thulani (University of Zululand); CHONCO, Nelisiwe (University of Zululand); MASANGO, Thuba (University of Zululand)*

Thin films of Aluminium Nitride (AlN) have been deposited on Si wafers using RF reactive sputter deposition in a nitrogen ambient. AlN is a wide bandgap semiconductor suitable for deep ultraviolet optoelectronics. The films have been characterized using Atomic Force Microscopy (AFM), Rutherford Backscattering Spectrometry (RBS), Scanning Electron Microscopy (SEM) and the oxygen content has been profiled using resonant RBS. The films were found to be smooth and uniform and adhere well to the Si substrate.

284 - Comparison of the gasifier char-resin blends with gasifier soot-resin blends using different characterization techniques

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.284) [For award: MSc]*

Primary author: *MELAPI, Aviwe (Fort Hare Institute of Technology)*
Co-authors: *MAMPHWELI, Sampson (Fort Hare Institute of Technology); KATWIRE, David (University of Fort Hare); MEYER, Edson (Fort Hare Institute of Technology)*

Biomass gasification is a chemical process whereby organic material is thermally broken down inside a gasifier for the generation of syngas. The syngas produced is then used to drive the engine that drives the generator and generates electricity. This project investigated the chemical composition of the by-products of the gasification process with specific reference to their potential usage in other areas. The analysis of the blended materials was achieved using FTIR, SEM/EDX and Bomb calorimeter. FTIR confirmed the similar spectra in all char-resin blended ratios. For soot-resin, almost the same functional groups as observed in char-resin appeared except the broad peak shown around 3900 cm-1 which was due to OH of carboxylic acids. SEM/EDX showed attractively bonded products of char-resin and soot-resin with varying elemental quantities for both materials. In bomb calorimeter measurements, 70%Resin-30%Char gave highest calorific value, followed by 50%Resin-50%Soot with values of 35.23MJ/kg and 34.75MJ/kg consecutively. The final paper will present the obtained results.

286 - Investigation of the effect of iodine bombardment in glassy carbon.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.286) [For award: PhD]*

Primary author: *ODUTEMOWO, Opeyemi (University of Pretoria)*
Co-author: *MALHERBE, Johan (University of Pretoria)*

The diffusion behavior of iodine and the structural changes in glassy carbon due to iodine ion bombardment was investigated using Rutherford Backscattering spectroscopy and Raman spectroscopy respectively. The glassy carbon sample was implanted with iodine ions at 200 keV to a fluence of 2×10 16 ions/cm 2. This implantation was done at room temperature. Migration of iodine towards the surface of the glassy carbon was observed when the sample was heat treated in vacuum at 200 oC. The diffusion became further enhanced at increasing temperature. Loss of iodine was also recorded.The Raman spectra showed the sample became damaged after iodine ion implantation. Recovery of the glassy carbon sample was noticed with increasing annealing temperatures.

291 - The Stochastic Schroedinger Equations Approach to Open Quantum Systems

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.291) [For award: PhD]*

Primary author: *SEMINA, Juliia (University of KwaZulu-Natal)*
Co-authors: *SEMIN, Vitalii (University of KwaZulu-Natal); PETRUCCIONE, Francesco (UKZN); BARCHIELLI, Alberto (Politecnico di Milano)*

A first aim of the theory of open quantum systems is the description of the time evolution of a quantum system S (the open system) interacting with an external environment E. To describe the partial dynamics of such an open system one can use the master equation for the reduced density matrix ρ(t). Usually, the master equation is derived with the help of the Markov approximation. This approximation fails when the memory effects can not be ignored, i. e. for strong coupling, correlations, and entanglement in the initial S-E state and at low temperature. Several different approaches have been proposed to describe this non-Markovia dynamics.In both situations (Markovian and non-Markovian) a useful approach to describe concrete physical evolutions is provided by the theory of the stochastic Schroedinger equation (SSE). A SSE is a stochastic differential equation for a wave-function process ψ(t). In this situation, the residual effects of the system-bath interaction are reflected in stochastic terms. The link with the traditional master equation is given by the average property E[|ψ(t)><ψ(t)|] = ρ(t), where E denotes the average over the realizations of ψ(t). SSEs find wide application in quantum optics, i.e for the description of photo-detection or heterodyne/homodyne detection. These kind of equations can be simulated numerically with the help of the Monte-Carlo wave function method.In this work [1] we describe how to introduce memory effects in the stochastic Schroedinger equation via coloured noise. Specifically, the approach is illustrated by using the Ornstein-Uhlenbeck process as colored noise and simulations of the non-Markovian process are shown. Finally, an analytical approximation technique is tested with the help of the stochastic simulation of a dissipative qubit.[1] I. Semina, V. Semin, F. Petruccione, A. Barchielli , OSID, 21, 1440008 (2014).

293 - Electrical properties of $Cr_{100-x}Co_x$ alloy thin films on oriented MgO (100)

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.293)*

Primary author: *KADAM, M (University of Johannesburg)*
Co-authors: *PRINSLOO, ARE (University of Johannesburg); FULLERTON, EE (University of California, San Diego); SHEPPARD, CJ (University of Johannesburg)*

The magnetic phase diagrams of Cr with group-8 magnetic transition metals Co and Fe exhibits a triple point, where the incommensurate (I) spin density wave (SDW), commensurate (C) SDW and paramagnetic (P) phases converge [1]. Cr-Co alloys has shown considerable promise in practical applications because of its Invar-like properties [2], as well as the fact that Cr/Co multi-layered systems show enhancement of the SDW due to the exchange interaction between the Co moments and the SDW these alloys [3]. This can find application in recording and storage media. Comparison between Cr in bulk and thin film forms revealed dimensionality plays an important role in modifying the SDW structure [4] and this study extends these investigations to include Cr-Co. Epitaxial $Cr_{100-x}Co_x$ thin films of thickness (*t*) 200nm, with $0 < x < 8$, were prepared on MgO(100) substrates using DC magnetron co-sputtering techniques. The epitaxial nature of these monolayers was confirmed using XRD analyses. The resistivity (ρ) for these samples was determined in the temperature range $2K < T < 395K$ and the temperature associated with the minimum in the $d\rho/dT$ versus *T* curves were used to determine the Néel transition temperatures (T_N) for the individual samples. The T_N versus *x* plot for this sample series shows that T_N decreases up to 2at.% Co and then increases, reaching a maximum at approximately 6at.% Co. Hall coefficients (R_H) for the films with $x = 1$ and 4 were determined on cooling from 300K down to 2K, in a constant magnetic field of 5 T. Interestingly, the R_H versus *T* plots appears to reveal a spin-flip transition at about 100K for 1at.% Co thin film, while it is absent for 4at.% Co sample. The present results will shed light on the effect of dimensionality on the electrical properties of the Cr-Co alloys. [1] Fawcett E *et al*. 1994 *Rev. Mod. Phys.* **66** 25[2] K. Fukamichi *et al*. 1976 *Trans. Jpn. Inst. Metall.*. **17** 125 [3] Ge S *et al*. 1988 *J. Appl. Phys* **63** (8) 4297[4] Zabel H 1999 *J.Phys. Condens. Matter* **11**9303

294 - Effects of Catalyst/Ba mole fraction on the structure and luminescence properties of BaCO3:1% Eu3+,2% Dy3+ phosphors synthesized using sol-gel process.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.294) [For award: MSc]*

Primary author: *TEBELE, Angelina Seithati (University of the Free State)*

BaCO3:1% Eu3+,2% Dy3+ powders were synthesized by sol-gel process at a relatively low temperature ~ 80 0C. Metal nitrates were used as the source of metal ions and citric acid as a chelating agent. The Catalyst/Ba mole fraction in the solution were varied from 1.0 - 2.5 during synthesis. The annealed powder samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and photoluminescence (PL) spectroscopy. The XRD data revealed that the annealed samples consist of orthorhombic BaCO3 with BaO impurities. Morphology of the phosphor was influence by the Catalyst/Ba mole fraction. PL spectra indicated that there are emission peaks at different wavelength positions. The most intense peak is at 616 nm, which is attributed to the 5D0-7F2 transitions of Eu3+.Keywords: Luminescence; BaCO3:1% Eu2+,2% Dy3+; Catalyst/Ba; Sol-gel

295 - Measurement of Higgs production in association with high PT jets with the ATLAS detector

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.295)*

Primary author: *MELLADO, Bruce (University of the Witwatersrand)*

The first measuremet of the differential cross section of the Higgs boson, performed in the diphoton decay channel will be presented. The dataset used corresponds to 20.3 fb-1 of proton-proton collisions at the center of mass of 8 TeV, produced by the LHC and collected by the ATLAS detector in 2012. With its high signal selection efficiency the diphoton decay channel is well suited to probe the underlying kinematic properties of the signal production and decay. Measurements for several diphoton and jet distributions are made for isolated photons within the geometric acceptance of the detector and they are corrected for experimental acceptance and resolution. Results are compared to theoretical predictions at the particle level. Prospects for Run 2 will be discussed

297 - The status of the LHeC project and its impact on Higgs physics

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.297)*

Primary author: *MELLADO, Bruce (University of the Witwatersrand)*

The LHeC is envisioned to collider electrons and protons concurrently with proton-proton collisions at the LHC. The overall status of the project will be summarized. This comprises a reviw of the accelerator facility, the Energy Recovery Linac, and the detector design.The ATLAS and CMS collaborations at the Large Hadron Collider have observed a new particle consistent with a scalar boson and with a mass of about 125 GeV. The prospects of studying this newly discovered boson at the LHeC are reviewed. This includes ability to isolate the H to bb decay with a large signal-to-background ratio about S/B = 2 and the model independent exploration of the CP-properties of the HVV,V = W,Z couplings. The latter is a unique capability of ep collisions. The propescts of other decay channels will also be discussed. An enhanced instantaneous luminosity scenario of $L = 1034cm^{-2}s^{-1}$ is considered. In this scenario the LHeC becomes a Higgs factory.

298 - Nature of the four-quasiparticle negative-parity rotational bands in ^{194}Tl

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: B.298)*

Primary author: *SHIRINDA, OBED (iThemba LABS)*
Co-authors: *LAWRIE, Elena (iThemba LABS); MASITENG, Paulus (University of Johannesburg)*

Three negative-parity rotational bands have been identified in the ^{194}Tl [1-3] nucleus. All three bands are associated with a four-quasiparticle $\pi h_{9/2} \times \nu i_{13/2}^{-3}$ configuration at high spins. Two of these bands show exceptionally close near-degeneracy in the excitation energies, and furthermore a close similarity in their other properties, e.g. alignments, B(M1)/B(E2) ratios, etc. [1]. Based on these results the pair of four-quasiparticle negative-parity bands in ^{194}Tl was interpreted as perhaps the best chiral pair found to date [1]. The nature of the third $\pi h_{9/2} \times \nu i_{13/2}^{-3}$ band, however, remains unclear. It was suggested [2], that this band could correspond to axially symmetric nuclear shape. As an alternative, the three bands could form a multiplet of chiral partners built on the same nucleon configuration [2]. In this work we aim at studying further the nature of the three negative-parity bands. We used the experimental data on the lifetime measurements for these bands [3] and performed multi-particle-plus-triaxial rotor model (MPR) [4] calculations. These calculations were carried out for both triaxial ($\beta_2 = 0.15$, $\gamma = 40°$) and axially symmetric nuclear shape. The results will be presented and discussed.[1] P.L. Masiteng et al., Phys. Lett. B719, 83 (2013).[2] P.L. Masiteng et al., Submitted to Eur. Phys. J. A[3] P.L. Masiteng, PhD thesis, University of the Western Cape, (2013).[4] B.G. Carlsson and I. Ragnarsson, Phys. Rev. C74, 044310 (2006).

303 - The use of diffusion barriers to control first phase formation in solid state reactions

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.303) [For award: PhD]*

Primary author: *ABRASS, Hameda (University of Pretoria)*
Co-author: *THERON, Chris (University of Pretoria)*

Concentration controlled phase selection in solid state reaction has been proposed as a model to interpret first phase formation occurring at solid interfaces. This is done in the context of the effective heat of formation model. The results of solid state reactions between a thin film of Co and single crystalline Si substrates are presented. Various thicknesses of the same composition diffusion barrier (Fe90Zr10) were deposited on a Si substrate in a molecular beam epitaxial growth chamber. The formation of the various Co- silicides found at diffusion barrier interlayer's are interpreted in terms of the reduced flux of reactant atoms at the reaction interface. The reduced fluxes are due to the different thicknesses of the diffusion barriers. Samples were annealed for times ranging from 5 to 24 hrs at temperatures ranging from 350 - 800°C and the phase formation sequence was characterized by Rutherford backscattering spectrometry, scanning electron microscopy and X-ray diffraction.

305 - Digital spiral-phase bi-photon imaging

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: C.305) [For award: MSc]*

Primary author: *MHLANGA, Thandeka (CSIR and UKZN)*
Co-authors: *MCLAREN, Melanie (CSIR); HAMADOU IBRAHIM, Alpha (CSIR); FORBES, Andrew (CSIR)*

Quantum ghost imaging using entangled photon pairs has become an interesting field of investigation as it illustrates the quantum correlation between the photon pairs. In ghost imaging, an object is placed in the signal arm and a mobile (bucket) detector is placed in the idler arm, such that it scans through the transverse plane of the idler beam to give coincidence counting rate. The amplitude (shape) of the object is recovered from the measured coincidence count rate. We introduce a new technique using digital holograms to recover not only the amplitude, but also the phase of digital object. Down-converted photon pairs are entangled in the orbital angular momentum basis, which are typically measured using a spiral phase hologram. Thus encoding a spiral annular slit hologram into the idler arm, we can recover the amplitude of the object by varying the slit radially and simultaneously, recover the phase by varying the spiral component. We show that there is a good correlation between the encoded object and the reconstructed images, without the need of a 'bucket' detector as in the traditional ghost imaging which only recovers the amplitude.

306 - Investigation and evaluation of a custom Raman spectroscopy setup

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: C.306) [For award: MSc]*

Primary author: *PFUKWA, Cathrine (Stellenbosch University)*
Co-authors: *NEETHLING, Pieter (Stellenbosch University); SCHWOERER, Heinrich (Stellenbosch University); ROHWER, Erich (Stellenbosch University)*

Since the advent of the laser Raman spectroscopy has become an invaluable tool for the qualitative analysis of molecular compounds. Few other techniques can match the accuracy of Raman spectroscopy with regards to identifying a compound. Raman spectroscopy has the added advantage that it can often be used in situ and in aqueous environments. This has facilitated a tremendous amount of research in the field with numerous derivatives being developed, such as Surface Enhanced Raman Spectroscopy (SERS), Tip Enhanced Raman Spectroscopy (TERS) and Spatial Offset Raman Spectroscopy (SORS) to name but a few.In this work a custom Raman spectroscopy setup will be described. An old double monochromator has been re-commissioned and converted into a Raman spectrometer through the addition of a sensitive intensified CCD detector and an Ar-ion laser is used as an excitation source. Examples of measurements performed on the system will be shown to illustrate the resolution, accuracy and detection limit of the setup. Lastly, a brief comment will be made with regards to the future research planned with this setup and in the Raman spectroscopy laboratory.

307 - Superconductivity in LaRh2Sn2

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.307) [For award: PhD]*

Primary author: *STRYDOM, Andre (University of Johannesburg)*
Co-author: *BRITZ, Douglas (University of Johannesburg)*

LaRh2Sn2 crystallizes in the centrosymmetric primitive tetragonal crystal structureP4/mmm (number 123) [1] commonly referred to as the CaBe2Ge2-type which was confirmed onour synthesized samples by x-ray diffraction. The existence of this superconducting transitionwas published [2] and in this study we proceed with an extensive study into the properties of thissuperconducting ground state using physical property measurements. Electrical resistance andheat capacity measurements reveal a sharp and well defined superconducting transition TSC =0.70 ± 0.07 K. The low-temperature heat capacity measurements show LaRh2Sn2 to be a weaklycoupled [3] bulk BCS superconductor that has an s-wave singlet ground state with an isotropic energy gap 3.38 ± 0.06 meV. From the field dependenceof the electrical resistance the upper critical field was estimated to be 0.127 ± 0.003 T. Withthe calculated penetration depth and coherence length LaRh2Sn2 is a type-II superconductor which was confirmed with low temperature magnetization measurements.reference[1] M. Francois et al., J. Less-Common Met. 113, 231 (1985).[2] A. Strydom and D. Britz, J. Phys. Soc. Jpn. 81, SB018 (2012).[3] W. L. McMillan, Phys. Rev. 167, 331 (1968).

308 - Synthesis, characterization and magnetic ordering of the semiconducting intermetallic compound $FeGa_3$

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.308) [For award: MSc]*

Primary author: *AHMED, Mustafa (University of Johannesburg)*
Co-authors: *CARLESCHI, Emanuela (University of Johannesburg); HEARNE, GIOvanni (University of Johannesburg); SNYMAN, Jasper (University of Johannesburg); DOYLE, Bryan (University of Johannesburg)*

Intermetallic compounds which are formed by good conductive metals are usually metallic. However, $FeGa_3$ was found to be a semiconductor with a narrow gap measured to be between 0.2 and 0.46 eV [1,2,3]. This gap mainly arises from the hybridization between the Ga 4*p* and Fe 3*d* bands [4]. The band-gap has been established experimentally by various techniques [4,5], and its origin verified by density functional theory (DFT) calculations [2,5]. $FeGa_3$ crystallizes in the tetragonal space group $P4_2/mnm$(No. 136) [3]. The magnetism in this compound has not yet been observed, with various magnetization and specific heat measurements suggesting that it does not occur down to very low temperatures [4,6]. Recent work has also shown that the effect of the chemical doping on single crystal $FeGa_3$ creates a spin 1/2 local moment and drives the compound to become metallic [7]. Mössbauer spectroscopy (MES) has shown the absence of an internal magnetic field at the site of Fe confirming that no ordering above room temperature occurs [3]. $FeGa_3$ has recently been predicted to become metallic under pressure [1].We will report on the preliminary results for this project. In particular, we will show how $FeGa_3$ single crystals has been synthesized by the self flux method, and then characterized by means of x-ray diffraction, energy dispersive analysis and MES. Furthermore, our measurements of the magnetic state of $FeGa_3$ as a function of temperature using MES will provide insights not previously reported. Our planned measurements as a function of pressure to search for a proposed metal-insulator transition will also be discussed.[1] J.M. Osorio-Guillen et al., Phys. Rev. B, 86 (2012) 235202[2] Y. Amagai et al., J. Appl. Phys., 96 (2004) 5644[3] Y. Imai and A. Watanabe, Intermetallics, 14 (20 06) 722[4] N. Tsujii et al., J. Phys. Soc. Jpn., 77 (2008) 024705[5] U. Haussermann et al., J. Solid State Chem., 165 (2002) 94[6] Y. Hadano et al., J. Phys. Soc. Jpn., 78 (2009) 013702[7] E.M. Bittar et al., J. Phys. Conf. Ser., 200 (2010) 012014

309 - Overview of the Mineral-PET run of mine Diamond bearing rock sorter

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.309) [For award: PhD]*

Primary author: *TCHONANG POKAHA, Marius (University of Johannesburg)*
Co-authors: *COOK, Martin (University of Johannesburg); CONNELL, Simon (University of Johannesburg)*

Mineral-PET is a technology for the sorting of diamond bearing rock (kimberlite ore) based on a mineral analogue of the well-known medical Positron Emission Tomography (PET) imaging technique. The naturally occurring carbon in kimberlite needs to be activated via photonuclear transmutation before it can be imaged. For the R phase of the project, a technology demonstrator has been built. This is a planar PET array built around a conveyor belt using kimberlite phantoms. The phantoms consist of blocks of cement with the radioactive material (Na-22) uniformly distributed throughout it to simulate the homogenous background radiation from various non-diamond PET emitters. Diamonds are modeled in the phantom by the inclusion of a localized “hot-spot” of Na-22. This system has been used to benchmark computational simulations and to explore the physics issues for the specification of a pilot scale plant at a mine. The review will provide new results and updates on the performance and outlook for Mineral-PET.

312 - Analysis of photo-response of a back contact silicon solar cell under spot illumination

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.312) [For award: PhD]*

Primary author: *KWARIKUNDA, Nicholas (Nelson Mandela Metropolitan University)*
Co-authors: *VAN DYK, Ernest (NMMU); VORSTER, Frederik (NMMU); OKULLO, Willy (Makerere University)*

Photovoltaic (PV) devices characterisation involves extraction of performance and device parameters from current-voltage (I-V) characteristics obtained under specific conditions. However, under outdoor conditions, solar cells are exposed to varying conditions such as changing intensity and spectral content which affects the I-V characteristics and performance of the device. In this study, a back contact silicon solar cell was spot illuminated using 445nm and 785nm wavelength lasers with a spot size of ~ 200∝m. Current and voltage values at different laser power outputs ranging from 0 to 45mW were acquired while carrying out light beam induced current (LBIC) measurements from which I-V characteristics were obtained. A curve fitting algorithm based on the single diode model was applied to extract device and performance parameters. The results obtained were used to study the photo-response of the device when subjected to very narrow spectral range at different wavelengths and changing illumination intensity. This paper discusses the effect of changing spectral content and illumination intensity on the device and performance parameters of a spot illuminated back contact silicon solar cell.

313 - Lifetimes and transition probabilities in the positive parity states band in ^{194}Tl

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.313)*

Primary author: *MASITENG, P L (University of Johannesburg)*
Co-authors: *LAWRIE, E A (iThemba LABS); PASTERNAK, A A (Ioffe Physical-Technical Institute, Russia)*

The excited states in ^{194}Tl were populated in the ^{181}Ta (^{18}O,5n) reaction at the beam energies of 91 and 100 MeV delivered by the SSC at iThemba LABS. The emitted γ-rays were detected using the AFRODITE γ-ray array, which comprised 9 clovers and 6 LEPS. Lifetimes in the positive parity band near and above backbending region of ^{194}Tl were studied by DSAM and a total of five lifetimes were extracted. The reduced transition probabilities of magnetic dipole B(M1) and electric quadrupole B(E2) have been obtained from evaluated lifetimes. In this contribution the experimental details of the Doppler shift attenuation method, results of the lifetimes and the extracted transition probabilities will be presented.

318 - Norm conserving pseudopotentials for 1-D systems

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.318)*

Primary author: *SALAGARAM, Trisha (University of Pretoria)*
Co-authors: *ANDREW, Richard (University of Pretoria); CHETTY, Nithaya (University of Pretoria)*

We have devised norm-conserving pseudopotentials for several non-interacting 1-D quantum mechanical systems namely, the infinite square well, finite square well, simple harmonic oscillator and hydrogen atom. The purpose of this study is to develop simple computational exercises to teach undergraduate and graduate students particular theoretical and numerical aspects of the pseudopotential method which is an essential aspect of modern electronic structure software, and which many graduate students do not understand, in spite of them using these codes for their research. We compare logarithmic derivatives, as well as energies of appropriate excited states of the real and pseudo systems to determine the transferability of the calculated pseudopotentials. We obtain highly transferable pseudopotentials for the hydrogen atom, moderately transferable pseudopotentials for the infinite square well and poorly transferable pseudopotentials for the finite square well and simple harmonic oscillator.

322 - Effect of annealing temperature on structural and luminescence properties of Eu3+-doped Y2O3 red-emitting phosphor thin films by Pulse Laser Deposition method.

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.322) [For award: PhD]*

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)*

Ali AGa*, Dejene BFa and Swartb HC.a*Department of Physics, University of the Free State (Qwaqwa Campus), Private Bag X13, Phuthaditjhaba, 9866, South Africa.bDepartment of Physics, University of the Free State, P.O. Box 339, Bloemfontein, 9300, South Africa.* Corresponding author: Tel: +27 58 718 5265; Fax: +27 58 718 5444;E-mail: aliag@qwa.ufs.ac.zaKeywords: Pulsed-laser deposition, Thin film, Y2O3:Eu3+, Crystallinity, Phosphor.Abstract.Pulse Laser Deposition was used to deposit red-emitting Y2O3:Eu3+ thin films. X-ray diffraction (XRD) measurement confirmed the crystallinity of the films which improved with an increase in annealing temperature. Photoluminescence measurement indicates intense red emission around 626 nm due to 5D0→7F2 transition of Eu3+. Scanning Electron Microscopy (SEM) show agglomerates of non-crystalline particles with spherical shapes for as-deposited films. After annealing at high temperature, SEM also confirms that the crystallinity of the films improved. Atomic Force Microscopy (AFM) further confirmed the crystallinity of the films at higher annealing temperatures. UV measurement gave a band gap in the range of 4.6-4.8ev. In this paper, the structural and photoluminescence (PL) properties of temperature dependence characteristics of Y2O2S:Eu3+ thin film, successfully deposited by PLD method were reported.

336 - Irradiation-induced improvement in crystalline quality of epitaxially grown InGaN thin films: A preliminary study

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.336)*

Primary author: *MADHUKU, Morgan (iThemba Labs)*
Co-authors: *AHMAD, Ishaq (National Centre for Physics, Pakistan); SALEEM, Hamid (National Centre for Physics, Pakistan); HUSNAIN, Ghulam (National Centre for Physics, Pakistan)*

Group III-nitride semiconductors, aluminium nitride (AlN), gallium nitride (GaN), indium nitride (InN) and related alloys are obtained by combining group III elements (Ga, Al, In) with the group V element, N. The III-V nitrides are an unparalleled material system with many prominent features such as wide bandgap, high mechanical and thermal stability, large piezoelectric constants, and excellent electro-optical properties. The energy gap of ternary III-nitride alloys like indium gallium nitride (InGaN), aluminum gallium nitride (AlGaN), or indium aluminum nitride (InAlN), can be adjusted to conform to light emission in the whole visible spectrum and into the deep ultraviolet (UV) region. In principle, the bandgap energy of the alloys can be varied continuously from 0.7 eV (pure InN) to 6.2 eV (pure AlN). Therefore, III-nitride alloys are ideal building blocks for numerous optoelectronic devices for use in many applications such as UV photo-detectors, visible light emitting diodes (LEDs) and blue laser diodes (LDs).This work was carried out on the 5UDH-2 Pelletron Tandem Accelerator at Experimental Physics Department, National Centre for Physics (NCP), Islamabad, Pakistan. In this work, we focused on InGaN material for investigation of the effects of Phosphorus (P^+) irradiation on its structure, optical and electronic properties. Presently, there are a limited number of reports on InGaN:P in the literature. Therefore, it was necessary to investigate the effects of P^+ incorporation into InGaN thin films. Preliminary results from Rutherford backscattering spectrometry and channeling (RBS/C) indicate that the quality of the InGaN thin films is improved by ion irradiation. Irradiation with 0.7 MeV P^+ ions to 1 x 10^{14} ions/cm^2 at room temperature reduces the channeling minimum yield (X_{min}) from about 60% to about 30%, but X_{min} increases considerably above this dose. Detailed experimental investigations will be carried out to obtain more information on the observed irradiation-induced-improvement in crystalline quality of InGaN thin films.

337 - Combustion synthesis of Dy3+–doped YVO4 phosphor

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.337)*

Primary author: FOKA, Emily *(University of the Free State)*

Yttrium orthovanadate (YVO4) belongs to the space group 19D4h [1] and is an important optical material that has been given considerable attention due to its outstanding characteristics, such as excellent thermal, mechanical and optical properties. There are two basic approaches to generate white light from light emitting diodes (LEDs). One is by mixing light of different colours emitted by several chips called multichip LEDs and the other is to convert the light emitted from a blue or ultraviolet (UV) LED to a longer wavelength light using phosphors, which are called phosphor-converted (pc) – LEDs. In order to produce a phosphor that will produce white light for the LED applications Dy3+ –doped YVO4 phosphors were produced by a combustion method at 600oC. The structure and optical properties of the powders were investigated using X-ray diffraction (XRD), scanning electron microscopy , Fourier transform infrared spectroscopy and photoluminescence (PL). The XRD patterns showed the tetragonal phase which agreed very well with the standard JCPD file (17-0341). In the PL, the emission spectra exhibited a weak band at 663 nm for 4F9/2-6H11/2 and a peak at 283 nm for 4F9/2-6H13/2 and the 257 nm peak with a higher intensity for the 4F9/2-6H15/2 transition. The emission colour of the luminescence is close to white because of the yellow (4F9/2 → 6H13/2) and blue (4F9/2 → 6H15/2) emissions of Dy3+ and has the potential to be used as a phosphor for pc-LEDs.

342 - Conceptualizing Scale

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: E.342) [For award: Hons]*

Primary author: SCHWARTZ, Marty *(Unizul Science centre)*

The concept of scale is of paramount importance in an age where the advancement of science is taking place at the extremes of scale. It has been shown that students have great difficulty with regard to scale. Does this difficulty arise from a deficiency in the student's estimation ability? Estimation has been shown to be a key aspect in grasping the scale concept. A deficiency in the estimation ability of students may not necessarily be mathematical in terms of numeracy but may be due to weaknesses students have with being able to perceive spatial visualization.The ability to navigate oneself in the web of scales is vital in the understanding of the scale concept. To move from one scale to another without loss of comprehension requires facilitation. What is the nature of this facilitation? Is this facilitation in the form of dual representation, where understanding of one scale is obtained by recalling similarities of another? Or does this facilitation take on the form of expertise (skills) that one uses to decipher the unknown? A programme on scale will be conducted at the University of Zululand (Unizul) Science Centre where students will be taken from the galactic scale down to the nano. A study will be conducted where the competency of students with regard to the scale concept will be examined. What factors play what role in facilitating their competency in this area will also form part of the study.

343 - Multi-wavelength classification of unidentified AGN in the Fermi 2LAC catalogue

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D1.343) [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)*

The observation and modelling of Active Galactic Nuclei (AGN) provides useful insight on the evolution of active galaxies and the mechanisms present in super massive black holes and jets. We are commencing with a long term campaign to identify and study possible counterparts to the unidentified sources in the Fermi-LAT 2LAC catalogue, through optical photometric and spectroscopic observations. The optical data will be obtained with telescopes such as the Boyden 1.5-m, SAAO 1.9-m telescope and SALT. The results of this campaign can then be used for the multi-wavelength follow-up studies of selected AGN counterparts in order to construct a radio to gamma-ray Spectral Energy Distribution (SED). The selection criteria of the candidate sources are briefly discussed along with the preliminary results obtained from observations to date.

345 - Flexible Spectrum and the effects of Crosstalk on a 20 Gb/s Signal over a 12 km Optical Fibre

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.345) [For award: PhD]*

Primary author: BOIYO, Duncan *(Nelson Mandela Metropolitan University)*
Co-authors: *ROTICH KIPNOO, Enoch (Nelson Mandela Metropolitan University); GIBBON, Tim (Nelson Mandela Metropolitan University); LEITCH, Andreww (Nelson Mandela Metropolitan University)*

A flexible spectrum is an elastic grid whose frequencies are dynamically assigned to multiple channels in scalable and efficient high capacity systems. With varying traffic conditions, flexible spectrum networks employ technologies such as the Reconfigurable Optical Add/Drop Multiplexers (ROADMs) to remotely assign channels and avoid static wavelength assignments providing high density. In such networks, the difference in the channel spacing between these transmitting channels might however induce multichannel interferences such as crosstalk. In this work, we theoretically investigate and discuss the implications of crosstalk penalty in telecommunication systems. This is done by considering channels spacings 25 GHz, 31.25 GHz, 37.5 GHz and 50 GHz as the power of the interfering channel is varied from 0 dBm to 25 dBm. A penalty of 0.7 dB to 11 dB for channel spacings of 50 GHz to 25 GHz was obtained for a 12 km fibre transmission. The 11 dB penalty realized in 25 GHz is due to the detrimental crosstalk from the interfering channel resulting to power sharing. Therefore, the presence of crosstalk in the system degrades the quality of the signal by increasing the bit error rate (BER). The significance of the result is to identify the optimal transmission channel spacing that provides low penalty for a specific fibre link and the use of impairment-aware controls to improve the spectrum efficiency.

351 - Charge Density Waves Formation in 1T-$TiSe_2$ Based on Pump-Probe Femtosecond Electron Diffraction

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: C.351) [For award: MSc]*

Primary authors: *SCHWOERER, Heinrich (Stellenbosch University);* SULEIMAN, Aminat Oyiza *(Stellenbosch University)*
Co-authors: *HAUPT, Kerstin (Stellenbosch University); ERASMUS, Nicolas (Stellenbosch University)*

1T-$TiSe_2$ is an inorganic crystal that has been studied for almost four decades as systems with strong electron-electron and electron-phonon correlations. The main attraction to this family of compound is its potential to exhibit a ground state phenomenon known as charge density waves (CDWs) whose detailed physical origin has not been controversially undetermined.We shall be using an ultrafast femtosecond laser based on pump-probe technique, namely ultrafast electron diffraction, to investigate some of the noble features associated with this crystal. A pump laser pulse excites the crystal from its ground state and the probe pulse (ultrashort electron pulse) takes the snapshot of this evolution of the lattice generating an electron diffraction pattern of the crystal. Hence the dynamical structural behaviour can be observed in time with a subpicosecond temporal resolution. Temperature increase in the crystal due to pump laser shall be characterised.Time-resolved measurements targeting the behaviour of the associated features shall be investigated as well as characterised. The suppression of the charge density wave order, electron-phonon coupling time, and the CDW recovery processes shall be determined.

352 - Pulse shaping using a 2D spatial light modulator

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: C.352) [For award: Hons]*

Primary author: *SPANGENBERG, Dirk-Mathys (University of Stellenbosch)*
Co-authors: *NEETHLING, Pieter (University of Stellenbosch); ROHWER, Erich (University of Stellenbosch);* VILJOEN, Ruan *(Stellenbosch University)*

The 2D spatial light modulator (SLM) can alter only the phase of incident light. Despite this one can do phase and amplitude shaping utilizing the high resolution of these devices. The basic setup can be easily extended for multiple beams each of which can be individually temporally shaped allowing one to do arbitrary temporal pulse shaping and characterization.

353 - Composition analysis of Uranus and Neptune using visible-light New Horizons data

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D1.353) [For award: Hons]*

Primary authors: *THROOP, Henry (University of Pretoria);* KOLBE, Isobel *(University of Pretoria)*

NASA's New Horizons (NH) spacecraft was launched in 2006 for a July 2015 encounter with Pluto. Its path through the Solar System allows observation to be made of a variety of planets and asteroids during its nine-year cruise to Pluto, in particular Uranus and Neptune. The nature and composition of these gaseous planets will determine the angle at which light is reflected off them. NH's unique geometry allows us to study the reflected light from Uranus and Neptune at a range of phase angles (Sun-target-observer angle) which are not observable from Earth. We will report on NH's visible-light observations of Uranus and Neptune taken throughout cruise, and the implications this has for the composition and structure of cloud layers in these bodies' atmospheres.

355 - Non-linear power amplifiers for atomic physics applications

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: C.355) [For award: MSc]*

Primary author: BURD, Shaun *(CSIR)*
Co-authors: *UYS, Hermann (CSIR); DU TOIT, Pieter (University of Pretoria / iThemba LABS)*

RF amplifiers are essential components of atomic physics laboratories. They are used to drive electro- and acousto-optical modulators, to generate RF fields in Paul traps, and to manipulate the hyperfine states of trapped atoms. Typically, expensive commercial broad band linear amplifiers are used to amplify a signal from a signal generator. However, in most cases a high RF voltage is required only to drive a resonant load at a specific frequency. We show that high efficiency, narrow band, nonlinear RF amplifiers can easily be constructed to drive a resonant load. These amplifiers are low cost, and can be constructed by physics students from readily available parts. We present laser frequency stabilization systems, and an RF Paul trap driver based on our amplifiers, that demonstrate the applicability of nonlinear amplifiers in experimental atomic physics.

359 - Analysis of a Thermal Conductivity Measurement Technique Formulated as a Nonlinear Inverse Heat Conduction Problem

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.359)*

Primary author: RAMNATH, Vishal *(University of South Africa)*

Thermal analysis and solution of heat problems most often utilizes known thermal conductivity material data which is typically experimentally determined from heat flux measurements through the application of Fourier's law. The challenge posed by this approach is the need for known thermal conductivity reference materials which may be inhomogeneous and have large associated uncertainties in industrial physics applications. In this paper we investigate the feasibility of developing a thermal conductivity measurement system that utilizes known radiometric input sources and temperature output measurements by formulating the system as a nonlinear inverse heat conduction problem and solving utilizing recent techniques from geophysics and optimization.

363 - Numerical Investigation of Temperature Profiles in Gray Gas Mediums with Combined Radiation-Conduction Heat Transfer

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.363)*

Primary author: *RAMNATH, Vishal (University of South Africa)*

In this paper we numerically formulate and solve for the temperature profile in a gaseous planar layer modelled as a gray medium with coupled radiation-conduction heat transfer. The problem is specified in terms of the integral equation representation of the energy equation with a radiative source term which is first solved by finite differences. Results are then investigated for accuracy by comparing to a spherical harmonic based solution of differing orders. Extensions of the integral equation to include scattering effects in terms of the conduction-radiation Stark parameter are briefly discussed and contrasted to spherical harmonic and discrete ordinate approximations.

365 - Commensurate charge density wave formation in a novel organic molecular conductor (DCNQI) and tantalum diselenide (4Hb-TaSe2) crystals

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: C.365) [For award: PhD]*

Primary author: *OLAOYE, Olufemi Opeyemi (Stellenbosch University)*
Co-authors: *HUEWE, Florian (University of Würzburg, Germany); SCHWOERER, Heinrich (Stellenbosch University); VON FLOTOW, Andrea (Stellenbosch University); SMIT, Bart (Stellenbosch University); ERASMUS, Nicolas (Stellenbosch University)*

Electron diffraction simulation models are used to investigate structural dynamics in a novel organic molecular conductor (Cu [2, 5-CD3-DCNQI]2) crystals and tantalum diselenide (4Hb-TaSe2 cystals). DCNQI crystals undergo photo-induced Peierl's phase transition from a conducting (room temperature) to an insulating phase (Tc = 73 K). A phenomenal sudden drop, in orders of magnitude, in their electric conductivity has been attributed to a periodic lattice distortion and a modulation of electron density, paving way for charge density formation in these crystals. For the first time, the formation of characteristically commensurate charge density waves satellite reflections (qCDW = 0.3333 c*), dominantly driven by the Cu-atoms' charge ordering and the cooperative Jahn-Teller distortions on DCNQI molecules, was modelled and analysed. Tantalum diselenide (4Hb-TaSe2) crystals undergo phase transition from a metallic (T > 600 K) to an insulating (T < 600 K) phase. These crystals belong to the layered compounds of transitional metal dichalcogenides, which are famous for their gigantic magneto-resistance, rich phase diagram and polytypic nomenclature. In agreement with the existing experimental data, electron diffraction simulation shows that the phase transition (with Tc = 410 K) in these crystals invokes the formation of hexagram clusters of commensurate charge density wave (CDW) peaks, which surround each Bragg's peak of the high temperature phase. Moreover, these commensurate CDW peaks are rotated by 13.9■ relative to the lattice, with a wave vector given as qCDW = 0.277 a*. Two satellite reflection orders are also observed – a unique characteristic of intertwined crystals.

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

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.368) [For award: PhD]*

Primary author: *KOAO, Lehlohonolo (UFS)*
Co-authors: *DEJENE, Birhanu (UFS); SWART, Hendrik (University of the Free State)*

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.

369 - AutoCal: A Software Application for the Auto Calibration of Stellar Magnitudes

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D1.369)*

Primary authors: *WIUM, Daniël (University of the Free State); VAN SOELEN, Brian (University of the Free State)*

We present a software application that largely automates the process of auto calibrating stellar magnitudes, where auto calibration refers to the calculation of calibrated magnitudes for sources in crowded fields.AutoCal uses a pattern-matching algorithm that Edward Groth and Peter Stetson developed around 1985 to match stars on a FITS frame (using a list of frame coordinates and magnitudes as generated by IRAF) to entries of stars in a catalogue covering the same area of sky. A weighted least squares fitting is performed to calculate a linear function that best describes the relationship between the observed and catalogue magnitudes for these stars.The automation of the matching saves time and decreases the possibility of errors. Additionally, the automated matching can be performed on thousands of stars in a frame.We present an overview of the software application as well as results obtained for calibrated magnitudes for SXP6.85, a Be/X-ray Binary system in the Small Magellanic Cloud. The data was captured with the IRSF telescope located at the South African Astronomical Observatory during three observing runs spanning December 2007 to December 2010. The results are compared to previously published results and show a good agreement.

375 - Investigating the chromosphere above sunspot umbrae with an acoustic resonator

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D2.375)*

Primary author: *SNOW, Ben (Univesity of Northumbria at Newcastle Upon Tyne, UK)*
Co-author: *BOTHA, Gert (University of Northumbria at Newcastle Upon Tyne, UK)*

Above a sunspot umbra the chromosphere resonates with three-minute oscillations. These oscillations can be explained as an acoustic resonator with slow magnetosonic waves moving along magnetic field lines and are partially reflected at the solar photosphere and transition region. The temperature structure of the chromosphere is explored by perturbing the plasma with random noise. Spectra of the velocity fluctuations show that as the chromospheric depth increases, the gradient of the power in the spectra decreases. This relation is explored with white, pink and brown noise seeds as well as different temperature profile configurations. It was found that a clear signature in the obtained spectra can be used as a potential measure for the chromospheric depth above sunspots.

379 - Molecular dynamics studies of some carbon nanotubes chiral structures

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.379)*

Primary author: *MOSUANG, Thuto (University of Limpopo)*
Co-authors: *RAMMUTLA, Erasmus (Univerisity of Limpopo); SHAI, Moshibudi (University of Limpopo)*

Structural and equilibrium properties of armchair (cnt(12,12)) and two chiral (cnt(10,12) and cnt(12.10) carbon nanotubes are studied using classical molecular dynamics. The formulation uses the Tersoff potential under the NVT ensemble to study these properties. Structural properties are studied using the radial distribution and structure factor functions. The equilibrium properties are studied using the total energy against lattice parameter variation. Similarities and differences in cnt(12,12), cnt(10,12), and cnt(12,10) symmetries are discussed.

380 - Computational Modelling Studies of PtS surfaces

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.380)*

Primary author: *MASENYA, Mamogo (University of Limpopo)*
Co-author: *NGOEPE, Phuti (University of Limpopo)*

Precious metal sulphides such as PtS and PdS are major compounds occurring in the Pt and Pd ores, and play an important role as catalyst in the petroleum refining industry. In our previous work, the PtS and PdS minerals were investigated using density functional methods within planewave pseudopotential methods and predicted stability of PtS, $Pt_{12.5}Pd_{37.5}S_{50}$ and PdS phases. The current study is based on the surface properties of PtS and their interaction with oxygen and water molecules. It was found that the (101) surface displayed the lowest energy, hence is the most stable. Interestingly, the adsorption of oxygen show preferential to Pt atom, whereas with hydration of the surface gives a non-spontaneous reaction.

382 - Silicide formation in Pd-Si and Pd-SiC diffusion couples

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.382)*

Primary author: *NJOROGE, Eric (University of Pretoria)*
Co-authors: *THERON, Chris (University of Pretoria); DANGA, Helga (University of Pretoria); KABINI, Jeaneth Thokozile (Univerity of Pretoria); MALHERBE, Johan (University of Pretoria)*

The reactions between Pd thin films deposited by resistive evaporation on Si and 6H-SiC substrates have been investigated by Raman, Rutherford backscattering spectrometry (RBS) and glancing-incidence X-ray diffraction (GIXRD). The deposited films were subsequently annealed from 100 to 800°C. At room temperature, no silicides were detected to have formed in either couple. After annealing, a reaction zone was formed between Pd and the two substrates. Pd starts to react with Si at 200°C while at 400°C with SiC. The initial phase to form in Pd-Si couples was Pd2Si and in Pd-SiC samples were Pd4Si and Pd9Si2. These initial phases formed were theoretically predicted by the binary and ternary effective heat of formation (EHF) models and the experimental results corroborate this.

384 - Coupling coefficients and excitonic transitions in $CuGaSe_2$

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.384)*

Primary author: *MACHATINE, Augusto (University of Pretoria)*
Co-author: *DIALE, Mmantsae (University of Pretoria)*

The chalcopyrite structure contains semiconductor compounds and alloys that crystalize in a space group D_{2d}^{12}. These compounds are used in the fabrication of solar cells. The excitonic radiative transitions in chalcopyrite $CuGaSe_2$/ are investigated using group theoretical methods in the absence and presence of spin-orbit interaction. We have calculated the coupling coefficients for optical direct transitions at high symmetry points Γ, X, N and P in the Brillouin zone of chalcopyrite structure. The inclusion of spin-orbit interactions results in modification of selection rules for radiative processes. The obtained dielectric functions,tensors, absorption coefficients and refractive index are determined by the exciton symmetry Γ6xΓ6, Γ6xΓ7 and Γ7xΓ7 Kronecker products. The critical point analysis throughout the Brillouin zone at point Γ, X, N, and P are discussed in the absence and presence of spin-orbit interaction in the study of reflectivity peaks. The theoretical results are used in the interpretation of reflectivity and photoluminescence spectra in chalcopyrite group and coupling coefficients also useful in the construction of effective Hamiltonains from which estimates of optical transition energies can be made.

386 - Characterization of cerium doped yttrium gadolinium aluminate garnet (Y-Gd)3 Al5O12:Ce3+ phosphor thin films fabricated by pulsed laser deposition

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.386) [For award: PhD]*

Primary author: WAKO, Ali *(University of the Free State)*
Co-authors: *DEJENE, Francis (University of the Free State); HENDRICK, Swart (University of the Free State)*

Thin films of cerium doped yttrium gadolinium aluminate garnet (Y-Gd)3Al5O12:Ce3+ (YGAG:Ce) were deposited on Si(100) substrates by a pulsed laser deposition (PLD) technique using a 266 nm NdYAG pulsed laser under varying deposition conditions, namely; substrate temperature, substrate – target distance, number of laser pulses and the working atmosphere during the film deposition process. Luminescent films have significant technological applications in high resolution display devices such as electroluminescent devices, cathode-ray tubes (CRTs), television screens, fluorescent lamps, plasma display panels and field emission displays (FED's). The effect of substrate temperature, number of laser pulses, working atmosphere and annealing temperatures on the structure and morphology properties of the (YGAG:Ce) thin film phosphor were analysed. Photoluminescence (PL) data were collected in air at room temperature using a 325 nm He-Cd Laser. The films with well-defined grains (rougher surfaces) showed higher PL intensity compared to films with poorly-defined grains (smooth surfaces) as confirmed from the atomic force microscopy data [1]. A slight shift in the wavelength of the PL spectra was observed from the thin films when compared to the PL spectra of the phosphor in powder form which is probably due to a change in the crystal field. The PL intensity increased with an increase in the substrate temperature [2]. References(1) Nsimama P. D. PhD thesis, University of the Free State 2010.(2) J.J. Dolo, H.C. Swart, E. Coetsee .J.J. Terblans, O.M. Ntwaeaborwa, B.F. Dejene, Hyperfine Interact 2010 197,129 –134.

389 - Quantum Theory: Reality, Contextuality and Locality

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.389)*

Primary author: JONES, Glyn *(UNISA)*
Co-authors: *DE BEER, Richard (UNISA); FOUCHÉ, Willem (UNISA); HEIDEMA, Johannes (UNISA)*

Despite the successes of quantum theory in the last 90 years, and the advances in its application in the atomic and subatomic domains in the last 20, there remains a remarkable diversity of opinion when it comes to the interpretation of a number of the foundational aspects of the theory. This diversity adds to the intriguing nature of the subject, but complicates the task of lecturers who teach quantum mechanics at under- and postgraduate levels, as well as those scientists who remain uneasy about their grasp of the subject throughout their careers.This talk will address some aspects of the conceptual problems to do with the hidden-variable theories and John Bell's papers on the subject.

391 - Comparing the results of two different CCD image reduction packages

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: D1.391) [For award: MSc]*

Primary author: *KGOADI, Refilwe (University of Johannesburg)*
Co-author: ENGELBRECHT, Chris *(University of Johannesburg)*

One on the most critical procedures in observational studies of stellar physics is photometric data reduction. In this study, two software packages will be compared using a large volume of raw CCD data obtained from the 1.0m telescope based at the Sutherland site of the South African Astronomical Observatory (SAAO). IRAF runs on the Linux operating system, and is an open-source software package that is commonly used for data reduction. AIP4WIN, on the other hand, is designed for the Windows operating system and can only be obtained by purchasing the textbook authored by Richard Berry and James Burnell. These packages will be compared on the basis of their operational parameters, and - more importantly - on the basis of the results that they produce from the same dataset.

394 - Temperature dependence of coercivity and magnetization of Sr1/3Mn1/3Co1/3Fe2O4 nanoparticle ferrites

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.394) [For award: PhD]*

Primary author: OSMAN, Nadir *(University of KwaZulu-Natal)*
Co-author: *MOYO, Thomas (University of Kwazulu-Natal)*

Single phase Sr1/3Mn1/3Co1/3Fe2O4 nano-particle ferrite was obtained by glycol thermal technique. The phase formation was confirmed by x-ray diffraction. The particle size distribution and the quality of the nanoparticles were observed by transmission electron microscopy. Scanning electron microscope was used to monitor the particle shapes and surface morphology. Magnetic properties as a function of the measuring temperature were investigated using mini cryogen free VTI system in the temperature range of 4 K to 300 K in an external magnetic field of up to 5 T. The magnetic investigations revealed significant increase in the coercivity from 0.02 T to 1.12 T 300 K and 4 K, respectively. The temperature dependence of the coercive are fields are discussed in terms of Kneller's law and the magnetization in terms of Bloch's law.

399 - Synthesis and characterization of CdO-Carbon nanostructures hybrid for LPG sensing

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.399) [For award: MSc]*

Primary author: SEFAGE, Amanda *(University of Zululand)*
Co-authors: *NDWANDWE, Muzi (University of Zululand); MBUYISA, Puleng (University of Zululand); DHONGE, D (CSIR); THETHWAYO, Charles (University of Zululand); NYAWO, Thembinkosi (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), Rutherford backscattering spectrometry (RBS) etc. 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. For comparison a thin film of Fe was deposited to act as the catalyst for the carbon nanostructures growth.The different structures grown using the two different catalysts were exposed to LPG and Nitrogen gases while monitoring the change in the sensors electrical resistances. The electrical responses of the sensors to LPG gas were investigated at different operating temperatures and different gas concentrations.

401 - Optical, ESR and surface state XPS investigation in 0D ZnO nanostructures doped with rare earth ions

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.401) [For award: MSc]*

Primary author: KABONGO, Guy Leba *(UNISA)*
Co-authors: *MHLONGO, Gugu (CSIR); MOTHUDI, Bakang Moses (University of South Africa); HILLIE, Thembela (CSIR); SWART, Hendrik (University of the Free State); DHLAMINI, Mokhotjwa Simon (University of South Africa)*

We report on the (micro)-structural, optical, morphological, surface state and magnetic characteristics of un-doped and rare earth (RE) doped zinc oxide (ZnO) 0-dimension (0D) semiconductor nanostructures, which were successfully synthesized via a facile sol-gel process. The optical investigation of as-synthesized samples as revealed by optical absorption spectroscopy showed a blue shift of the absorption band-edge as compared to the bulk material, which could be an effective indication of quantum confinement effect. From the transmission electron microscopy (TEM) results, it was observed a morphological change as the dopant concentration was increased probably due to the Ostwald ripening effect; furthermore, the highly crystalline nature of the synthesized 0D nanostructures was confirmed. Finally, defects state in the semiconductor nanostructures was studied using photoluminescence (PL) spectroscopy, x-ray photoelectron spectroscopy (XPS) and Electron Spin resonance (ESR).

406 - Temperature-dependent barrier characteristics of Pd/ZnO Schottky barrier diodes

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.406) [For award: MSc]*

Primary author: MAYIMELE, Meehleketo Advice *(University of Pretoria)*
Co-authors: *DIALE, Mmantsae (University of Pretoria); AURET, Danie (University of Pretoria); MTANGI, Wilbert (University of Pretoria)*

The current-voltage (I-V) characteristics of Pd/ZnO Schottky barrier diodes were measured in the 30-370K temperature range and have been interpreted based on the assumption of a Gaussian distribution of the barrier heights due to the barrier inhomogeneities that prevail at the interface. It shows that the occurrence of a Gaussian distribution of the barrier height is responsible for the decrease of the apparent barrier height , increase of the ideality factor n and non-linearity in the activation energy plot at low temperature. The inhomogeneities are considered to have a Gaussian distribution mean barrier height of = 0.985 eV and a standard deviation of =0.022 V at zero bias. Furthermore, the mean barrier height and the Richardson constant values were obtained as 0.883 and 0.541 A K-2cm-2 , respectively by means of the modified Richardson plot. Hence, it has been concluded that the temperature dependence of the I-V characteristics of the Schottky barrier on Pd/ZnO can be successfully explained based on thermionic emission mechanism with a Gaussian distribution of the barrier heights.

407 - Microwave synthesis of graphene nickel aluminum layered double hydroxide (LDH)

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.407) [For award: MSc]*

Primary author: TAGHIZADEH, Fatemeh *(University of Pretoria)*
Co-authors: *BARZEGAR, Farshad (University of Pretoria); MOMODU, Damilola (University of Pretoria); BELLO, Abdulhakeem (University of Pretoria); DANGBEGNON, Kadiou (University of Pretoria); MANYALA, Ncholu (University of Pretoria)*

Layered double hydroxide (LDH) with petal-like platelets structure has been produced via microwave irradiation reaction within 1-3 hours by hydrolysis of urea with homogeneous solution of Nickel nitrate and Aluminum nitrate. The feed ratio of the Ni and Al, microwave reaction power and time has been optimized. Pure crystalline Layered double hydroxide (LDH) structure was obtained for feed ratio of 2.0 and reaction power of 100 W with growth time of 1 hour. The structure obtained shows uniform and homogeneous size distribution with high crystallinity. The sample was functionalized with graphene foam and the samples were characterized by x-ray diffraction (XRD), scanning electron microscope (SEM) and Raman spectroscope. The obtained LDH/graphene composite materials were tested as electrode for electrochemical capacitors and it demonstrate good capacitance behavior as potential candidate for energy storage applications.

409 - A review on Effect of Ion Implantation on Hexagonal Boron Nitride

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.409) [For award: PhD]*

Primary author: *ARADI, Emily (University of the Witwatersrand)*
Co-authors: *NAIDOO, Shunmugam Ramsamy (University of the Witwatersrand); DERRY, Trevor (University of the Witwatersrand); WAMWANGI, Daniel (University of the Witwatersrand); BILLING, David (University of the Witwatersrand); JULIES, Basil (University of the Western Cape)*

The extreme properties of cubic BN (c-BN), similar to or even superior to diamond, have led to a great deal of research on techniques for its synthesis. The study herein focuses on the synthesis of c-BN from the hexagonal phase (h-BN) by radiation effect using the ion implantation process. The effect of varying implantation parameters including the ion mass, the ion fluence (1×10^{14} - 1×10^{15} ions/cm^2), the implantation energy (30 - 150 keV) and implantation temperature, with respect to the end-products are investigated. The presence of the c-BN phase is inferred using glancing incidence XRD (GIXRD) at glancing angles $0.01 \leqslant \omega \leqslant 5^{o}$ and Scanning Transmission Electron Microscopy (STEM). The GIXRD pattern after implantation exhibited c-BN and r-BN. These diffraction peaks were determined to be dependent on the incident glancing angle's penetration depth for the X-rays, which corresponded to the penetration depth of the different ions in h-BN from simulations. Transmission Electron Microscopy showed high density regions in h-BN after implantation with HRTEM lattice fringes with lattice parameter of the c-BN in the implanted region.

410 - Magnetic and thermodynamic properties of Ce23Ru7Mg4 compound

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.410)*

Primary author: *DEBNATH, Jyotish Chandra (University of Johannesburg)*
Co-authors: *STRYDOM, A.M (University of Johannesburg); PÖTTGEN, R (Universität Münster)*

Complex metal alloys have been shown to offer new possibilities in developing high efficiency thermoelectric material [1]. Among the correlated electron class of magnetic systems, the enhanced thermoelectric power characteristic of Kondo metals offers a distinct advantage in gaining thermoelectric efficiency. Here we present exploratory results of a study on the novel compound Ce23Ru7Mg4 which has 68 atoms per unit cell and therefore qualifies as a complex metal alloy.The magnetic susceptibility and heat capacity for Ce23Ru7Mg4 compound have been studied above room temperature to low temperature range and in the applied magnetic field up to 7 T. This compound crystallizes with the hexagonal non-centrosymmetric Pr23Ir7Mg4-type structure, with space group P63mc [2]. The structure is built up from complex three dimensional networks of edge and corner-sharing RE6Ru trigonal prisms. The magnetic susceptibility and specific heat both exhibit a distinct anomaly at ~2 K which most probably suggests a paramagnetic to antiferromagnetic phase transition. The magnetic susceptibility revealed a magnetic moment μeff = 2.235 μB/Ce which is close to the value for cerium in pure Ce metal (μeff = 2.54 μB), indicating a presence of well localized magnetic moments carried by the stable Ce3+ ions. The magnitude of the electronic specific heat coefficient γ = 127 mJ/Ce-mol K2 suggests correlated electron behavior in this compound.[1] S. Paschen, C. Godart and Y. Grin in Complex metallic alloys: fundamentals and applications, Jean-Marie Dubois; Esther Belin-Ferre■ (eds.), Weinheim: Wiley-VCH Verlag, 2011. [2] S. Linsinger, M. Eul, W. Hermes, R-D. Hoffmann and R. Pöttgen, Z. Naturforsch 64b (2009) 1345.

411 - Effect of diamond grain size on magnetic properties of cobalt phase in PCD

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.411) [For award: MSc]*

Primary author: *NGWEKHULU, Tsholofelo Themba (University of the Witwatersrand)*
Co-authors: *SIGALAS, Iakovos (University of the Witwatersrand); NAIDOO, Mervin (University of the Witwatersrand)*

Polycrystalline diamond (PCD) table comprises diamond grains, which are non-magnetic, a metal phase (cobalt-base), which is the only ferromagnetic component in the material and WC which is non-magnetic and which moves into PCD during cobalt infiltration. Experiments were conducted to determine the magnetic saturation and coercive field strength of PCD and relate them to image analysis results. Three variants of diamond powders were selected for this study. These had average particle diameters of 4.5μm, 12.5μm, and 25.3μm respectively. WC-Co substrates readily available and sintered at ElementSix (PTY) Ltd containing 13 wt. % Co were used to sinter the PCD table onto the WC-Co. These substrates were sintered at 1400°C and a pressure of 40mbar to form a dense body. The PCD tables were separated from the substrate, prepared for analysis and characterized for magnetic saturation, coercivity and microstructure, including image analysis. The magnetic values were correlated with analytical image analysis results. Clear correlations between metal phase content and magnetic saturation and cobalt mean free path and coercivity exists. It was found that magnetic saturation measurements are independent of the shape and size of the specimen. As the particle size of a non-magnetic material increases, the number of magnetic domains of the metallic phase increases, and therefore the coercive force decreases. It is found that the diamond starting particle size has large influence on the metallic phase microstructure and magnetic properties. Furthermore, the more fine grain diamond particles have higher sintered density over coarser diamond particles indicating a higher volume fraction of metallic cobalt. This is confirmed by the high values of magnetic saturation measurements for fine grain diamond over coarse grain one.

412 - First-principles study of Fe-doped MgO

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.412)*

Primary author: *MOLEPO, Mahlaga (University of Pretoria)*
Co-author: *LOMBARDI, Enrico (UNISA)*

We present a theoretical investigation on the structural, thermodynamic and magnetic properties of substitutional iron impurity in rocksalt magnesium oxide, (MgO: Fe_{Mg}) as a candidate dilute magnetic semiconductor for spintronic applications. *Ab initio* pseudopotential density functional calculations were performed for Fe in MgO at various charge and spin states in order to determine the most stable configurations. The generalized gradient approximation with the on-site Hubbard potential correction was used. We find that the double positively charged (Fe^{+2}) with high spin (S=2) state and O_h symmetry center is the most energetically favorable, while the low spin (S=1) state with D_{4h} symmetry center is 0.63 eV higher in energy. The thermodynamic transition levels within the wide MgO bandgap are estimated for the various charge states. Furthermore, we show that Fe introduces spin polarized 3*d* levels within the bandgap, with magnetic moments and stabilization energies depending on its charge state.

414 - Digital Laser for On-Demand Mode Pulses

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: C.414) [For award: PhD]*

Primary author: *NGCOBO, Sandile (CSIR)*
Co-author: *FORBES, Andrew (CSIR)*

In this paper we demonstrate experimentally for the first time a potentially new method of using a digital laser to implement laser pulsing of desired mode shapes with varying intensities. This method shows complete control over the pulse shape, repetition and duration of the pulses is possible by simply controlling the type of holographic grey-scale image that is displayed on the SLM and its display duration to control the Q-switch status of the laser. We show that we can digitally control the output of the laser to be either a series of discrete modulated pulses or cw mode pulses of desired shape with desired repetition in real time on a standard solid-state laser resonator.

415 - Probing student perspectives in a first year astronomy course at the University of Cape Town

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: E.415)*

Primary author: *RAJPAUL, Vinesh (University of Cape Town)*
Co-authors: *ALLIE, Saalih (UCT); BLYTH, Sarah (University of Cape Town)*

We report on research carried out to improve teaching and student engagement in the introductory astronomycourse at the University of Cape Town. We describe the development of an instrument, the IntroductoryAstronomy Questionnaire (IAQ), which we administered as pre- and post-tests to students enrolled in the course.The instrument comprised a small number of questions which probed three areas of interest: student motivationand expectations, astronomy content, and worldview. Amongst our findings were that learning gains weremade in several conceptual areas, and that students appeared to develop a more nuanced view of the nature ofastronomy. There was some evidence that the course had a positive impact on students' worldviews, particularlytheir attitudes towards science.

423 - Fully programmable SoC based Ethernet to PCI Express Bridge for an ARM Based High Data Throughput Cluster for the sROD of the Tile Calorimeter of the ATLAS detector

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.423)*

Primary author: *SPOOR, Matthew (University of the Witwatersrand)*

Big Science projects such as the ATLAS experiment at the Large Hadron Collider at CERN require huge amounts of data to be transferred and processed. General purpose cluster computers are not suitable for the data throughput that is required, instead customised computer systems need to be designed and implemented. This project aims to design and build an Ethernet to PCI Express (PCIe) bridge/ packet manager for such a computer system. This board will be created using a Zynq fully programmable System on Chip (Soc) that uses both an FPGA and an ARM processor on a single chip. For initial prototyping a Zedboard Development kit will be used.This board will be in direct communication with a small cluster of ARM processors nodes through a PCIe backplane. Its roll will be to take in data through high speed Ethernet, modify it for PCIe transport and send it to an available ARM node. Once data is processed by a node it can be send back to the Zynq board for Ethernet transport. This project will be part of the electronics upgrade of the Tile Calorimeter. Later designs will have the entire ARM cluster and bridge on a single mezza nine card that can be attached to the Super Read Out Driver (sROD) of the Tile Calorimeter. It will assist with the processing and formatting of the massive amounts of data being received from the detector.

427 - A Monte Carlo Simulation of a Noisy Quantum Channel with Memory

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.427) [For award: PhD]*

Primary author: *AKHALWAYA, Ismail (University of Johannesburg)*
Co-authors: *PETRUCCIONE, Francesco (UKZN); MOODLEY, Mervlyn (University of KwaZulu-Natal)*

The classical capacity of quantum channels is well understood for channels with uncorrelated noise. For the case of correlated noise, however, there are still open questions. We calculate the classical capacity of a forgetful channel constructed by Markov switching between two depolarizing channels. Techniques have previously been applied to approximate the output entropy of this channel and thus its capacity. In this paper, we use a Metropolis-Hastings Monte Carlo approach to numerically calculate the entropy. The algorithm is implemented in parallel and its performance is studied and optimized. The effects of memory on the capacity is explored and previous results are confirmed to higher precision.

428 - Influence of solvent casting and weight ratios on the morphology and optical properties of inorganic-organic hybrid structures

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.428)*

Primary author: *MULLER, Theo (University of the Western Cape)*
Co-authors: *RAMASHIA, Albert Thinavhuyo (University of the Western Cape); MOTAUNG, David (CSIR); CUMMINGS, Franscious (University of the Western Cape); MALGAS, Gerald (University of the Western Cape); ARENDSE, Christopher (University of the Western Cape)*

Organic photovoltaic (OPV) solar cells have been spotlighted as harnessing clean energies because of their advantages of simple processing, low cost, semi-transparency, high-mechanical flexibility, and light weight. The potential applications of OPV solar cells using heterojunction (BHJ) structures have driven extensive and successful efforts to enhance their power conversion efficiency (PCE). It has been demonstrated that nanoscale morphology in the active layer of poly (3-hexylthiophene) (P3HT) and (6,6)-phenyl C61 butyric acid methyl ester (PCBM) is essential for improved transport of charge carriers in the OPV cell and for enhancing its efficiency. Several experimental methods have been proposed to control this morphology in order to improve the current power conversion efficiency. To offset low efficiencies, inorganic semiconductors have been incorporated into the BHJ structures due to their high carrier mobilities. Among inorganic semiconductors, Zinc oxide (ZnO) is one of the most promising inorganic semiconductor materials because it is inexpensive and ZnO-nanorod arrays offer an excellent controllable transport path with high electron mobility. In this contribution the effect of solvent to control the degree of mixing of the polymer, fullerene and ZnO nanoparticles components into a hybrid inorganic-organic structure, is investigated in detail. Evolution of the domain size, structure and optical properties of the blends induced by ZnO:P3HT:PCBM spin-coated from different weight ratios in order to improve the charge transport pathways is studied, using X-ray diffraction, UV-vis, photoluminescence and spectroscopic ellipsometry.

429 - Towards a crystal undulator

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: B.429)*

Primary author: *CONNELL, Simon (University of Johannesburg)*
Co-authors: *HAERTWIG, Juergen (ESRF, University of Johannesburg); MAVUNDA, Dazmen (NECSA and UJ); THRAN THI, Thu Nhi (ESRF)*

SH Connell, Jürgen Härtwig, Dazmen Mavunda, Thu Nhi Thran ThiThe CUTE FP7 project proposes to produce ultimately a MeV range gamma ray laser by the FEL principal in a crystal undulator. The GeV range electron beam would need to be captured in a high index crystallographic channel of a crystal superlattice, in such a way that the varying electrostatic crystalline field would resemble a Tesla range periodically varying magnetic field with a few micron pitch, when viewed in the reference frame of the undulating electron or positron. We have investigated a prototype diamond superlattice using x-ray diffraction topography. The undulator fabrication principle involved CVD growth of diamond on a diamond substrate while varying the concentration of boron in the gas phase during growth. This should lead to the periodic variation of the lattice dilatation by the varying concentration of the single substitutional boron impurity atom. The validation via x-ray diffraction topography proved non-trivial but was eventually promising.

435 - Characterisation of Aluminium/Yttrium Double-doped Tin Oxide Nanoparticles using XRD Patterns.

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.435) [For award: Hons]*

Primary author: *DANGAISO, Tichawona (University of Venda)*
Co-author: *KIRUI, Joseph (University of Venda)*

In this report, prepared SnO2 nanoparticles were characterized using XRD patterns. A PW1830 system X-ray diffractometer with anode of Co (wavelength of 1.7889Å of Co Kα) and also that of Cu (wavelength of 1.5405Å of Cu Kα) was used to characterize the samples. Four samples of aluminium/yttrium double-doped tin oxide were previously synthesized at different temperatures (200 oC, 400 oC, 600 oC, 800 oC and 1000 oC). The powder samples were loaded into glass sample holders taking care not to have them in preferred orientations. X-ray diffraction patterns were recorded over 2θ angular ranges of 50 – 80o for Co anode and 4.3050 – 67.2190o for Cu anode with a step size of 0.025o. The crystallinity was shown to improve with an increase in temperature. Results also revealed that double doping significantly reduced the grain growth of SnO2. The lattice parameters (the d-spacing) were calculated using a computer program. The shape of the XRD patterns showed the tetragonal structure of SnO2 nanoparticles with the help of theoretical deductions.

436 - Absorption degradation of Poly crystalline silicon solar cell due to hot spot formation

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: F.436) [For award: MSc]*

Primary author: *OSAYEMWENRE, Gilbert (Fort Hare Institute of Technology)*
Co-authors: *MEYER, Edson (Fort Hare Institute of Technology); MAMPHWELI, Sampson (Fort Hare Institute of Technology)*

This paper focuses on the degradation of solar cell absorbance due to localized heat. A decrease in optical absorbance represents a huge problem because of long-term solar cell degradation, decrease in absorption coefficient and a reduction in solar cell conversion efficiency. This decreases the photo-generating current hence reduces the effective efficiency of the solar device. This research investigates the reduction in Poly-Si cell absorption and correlates this with hot spot formation. Infrared Thermography was used for mapping of the cell temperature profile, while IR flying meter software was used to identify the hot spot centre. Fourier Transformation Infrared Spectroscopy (FTIR) was used for absorption characterization. The study was undertaken through indoor hot spot assessment method by subjecting the device to a reverse biased condition. This method was chosen so as to test the cell susceptibility to hot spot formation. The results show a direct correlation between localized heat and absorption degradation, the final paper will present the detailed results.

437 - Adaptation of roof ventilators as micro-power generation units in homes

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: F.437) [For award: PhD]*

Primary author: *MANYEREDZI, Terrence (University of Fort Hare)*
Co-author: *MAKAKA, Golden (University of Fort Hare)*

Ventilation is one of the aspects that determine quality of the indoor environment. Traditionally residential construction greatly relied on air infiltration through the building envelope. More ventilation than necessary is normally expensive in terms of energy. The incorporation of energy efficiency measures can drastically reduce energy consumption without compromising thermal performance of the building. In most cases the use of natural ventilation is not adequate so the need of mechanical ventilation. The incorporation of a power generation roof ventilator (PGRV) is a promising solution in meeting the energy needs and maintaining a thermally comfortable indoor environment. Literature shows that researchers do appreciate that power can be generated from a roof ventilator at negligible performance degradation in terms of ventilation. However, the researches fall short of detailing whether performance degradation is uniform for all modes of operation or it is a variable in itself thereby calling for intensive studies on characterising performance degradation of the roof ventilator. A voltage generator added to the rotating ventilator is an additional load to the rotating component that reduces its rotational capabilities. That reduction in rotational capability therefore translates to reduced ventilation efficiency since both power output and ventilation depend on the size of the centrifugal force on the ventilator. The paper gives a critical review of the work done to date by different researchers on power generator roof ventilators and identifies areas of research that need more attention.

438 - A circular current's bi-Cartesian magnetic dipolar model and the bias in deriving fields from own potentials

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: G.438)*

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. Our bi-Cartesian dipolar model of a circular current shows that magnetic fields at any field point are derivable from associated Cartesian components of the magnetic vector potential. Then clarifying the bias in deriving fields from own potentials becomes fairly easy. This is done in parallel with that a simple axial electric dipole. It also shows that the traditional an hoc definition of a circular current's magnetic dipolar moment is based on functionally limited component magnetic vector potentials, and is icorrect by a factor of 2.

439 - A DLTS investigation of the annealing behaviour of the E-centre in alpha-particle irradiated Ge.

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.439) [For award: PhD]*

Primary author: *NGOEPE, Phuti (University of Pretoria)*
Co-authors: *MEYER, Walter (University of Pretoria); AURET, Danie (University of Pretoria); OMOTOSO, Ezekiel (University of Pretoria); COELHO, Sergei (UP); DIALE, Mmantsae (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.

441 - Multi-dimensional Quantum Walks using classical light

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: G.441)*

Primary author: *KONRAD, Thomas (UKZN)*

The physics of single photons and classical states of light are similar in many respects and therefore certain effects that are considered quantum can in fact also be observed with classical light. I discuss some examples such as "interactio-free measurements" as well as quantum walks. Noting that even multi-dimensional quantum walks can be realized, the question to what extent quantum computation can be simulated with classical light can be addressed.

445 - X-Ray characterization of Fe and Cu doped CdO nanoparticles by ball mill method

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.445)*

Primary author: *MAKGOBELA, Rasitilo (Universsity of Limpopo)*
Co-author: *RAMMUTLA, Koena (University of Limpopo)*

The doped and undoped cadmium oxide (CdO) nanoparticles were successfully synthesized using high energy ball mill method. Different percentages (5, 10 and 15) of Fe (respectively Cu) metals were added to the CdO compound, and the resulting compound was ball milled using steel balls and vials. The particle size, size distribution and microstructural evolution were characterized using of X-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The particle sizes of the powders were found to be of nanometer size and were changing with doping concentration. SEM micrographs show that the powders are compact and dense. Ultraviolet visible (UV-Vis) and Photoluminescence (PL) studies are underway.

446 - Computational study of (110) β-TiO_2O surface

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.446) [For award: PhD]*

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

The principle simulation is of great importance when it comes to thorough understanding of surface structure and properties of metal oxides. Adsorption of some molecules such as H_2O, CO and O_2O has been of great interest in the surface study field on metals and metal oxides. We present the results of a density functional theory (DFT) investigation of the surfaces of rutile titanium dioxide, β-TiO_2O. Redox properties of (110) surface of rutile TiO_2 are being investigated by calculating the relative surface free energy of different compositions as a function of oxygen chemical potential. Oxidation of the surface gives the most stable energy which is also exothermic which implies that the process occurs spontaneously. Reduced surfaces are relatively unstable; they give positive energies (endothermic) which suggests that energy is needed for the process to occur.

447 - Computational Phase Stability Study of Pt Alloys and Nanoparticles

Poster1 - Tuesday 08 July 2014 17:10 *(Poster Board: A.447)*

Primary author: *TIBANE, Malebo (University of South Africa)*

The phase stability of PtCr alloy was studied by using the plane- wave pseudopotential methods. We report the structural, electronic and dynamic stability of five different phases of PtCr alloys. The elastic constants and moduli were investigated to determine the strength of the systems. The results predict the stable structures we recommend to be used for high temperature applications in aggressive environments. Our findings form the basis of stability study of Pt nanoparticles.

448 - The behaviour of damage in sapphire and MgO implanted with silver ions

Poster2 - Wednesday 09 July 2014 17:10 *(Poster Board: A.448)*

Primary author: *KOZAKIEWICZ, Anna (University of the Witwatersrand)*

The study was performed with the crystals of MgO and α-Al2O3 and implantedwith 150 keV silver ions. The depth and distribution of the implanted ions were analyzed by Rutherford Backscattering Spectrometry and Transmission Electron Microscopy.The degree of damage and the morphology of ion implantation generated nanostructures within crystalline matrices is strongly dependant on the crystal orientation. The cross section Transmission Electron Microscopy analysis shows that the damaged by ion implantation area, which extends from the surface into the sample bulk consists of regions of distinct morphology. The closest to the surface zone is silver nanoparticles (NP) rich. The nanoparticles show crystalline structure in both materials. This region, despite very high concentration of silver NPs, preserved itscrystallinity, better in MgO than in sapphire, implanted under the same conditions. The NPs show broad size distribution, with ranges from about 1 nm to 15 nm. The similar phenomenon was observed in sapphire powder samples.The NPs there were spilled to carbon supportive film, with much larger average sizes thin in the substrate. The zones beyond silver ions range,show considerable damage of different character with preserved crystal structure and low concentration of silver ions. The depth profile is consistent with SRIM calculations in sapphire, but differs in MgO.

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