South African Institute of Physics

UNIVERSITY OF ZULULAND

The 58th Annual Conference of the South African Institute of Physics (SAIP)

8-12 July 2013

RICHARDS BAY CAMPUS, UNIVERSITY OF ZULULAND

www.unizulu.ac.za · www.saip.org.za

RESTRUCTURED FOR RELEVANCE

PROMOTING LASER SCIENCE IN SOUTH AFRICA

Introducing research opportunities at the CSIR National Laser Centre

Rental pool programme

The CSIR National Laser Centre (NLC) through funding by the Department of Science and Technology (DST) makes available cutting-edge laser equipment to researchers in laser-related fields including laser-based manufacturing. The grant also covers scientific and technical support. For further information on the grant, please contact the NLC through the contact details given below.

African Laser Centre (ALC)

Research funds are available through the ALC to support laser-based research collaborations between South African-based researchers and African* researchers. Visit the ALC website at www.africanlasercentre.org or contact the NLC for additional information.

** African – Defined as researchers based outside South Africa on the African continent.*

NLC collaborations

We carry out research in collaboration with higher education institutions, other science councils and industry in the following broad laser-related fields:

- Laser-based manufacturing
- Laser physics and technology
- Biophotonics
- Mathematical optics
- Applied photonics
- Advanced photonic materials

For more information, visit the CSIR website at www.csir.co.za and follow the NLC link.

Student opportunities

Vacation work

- Graduate students in science and engineering may apply for summer vacation work at the NLC.

Internship

- A year-long internship programme may be applied for by graduates in order to gain experience and mentoring in laser-related science, engineering and manufacturing.

Studentship

- Studentships may be applied for by Master's and doctoral students who carry out their research work on NLC projects at the NLC research facilities while registered at a local university.

The CSIR NLC is a highly specialised CSIR facility focusing on the development of lasers and laser application technology through research, development and innovation.

Contact details:
Tel: 012 841 3511
Fax: 012 841 3152
E-mail: nlcinfo@csir.co.za
CSIR National Laser Centre
PO Box 395 Pretoria, 0001 South Africa

CSIR
our future through science

TABLE OF CONTENTS

OPENING CEREMONY

RICHARDS BAY CAMPUS
8 July 2013

17:45	Arrival of all delegates.
18:20	Performance by UNIZULU Music Group
18:30	Welcome to UNIZULU message by VC, Prof. Fikile Mazibuko.
18:40	Welcome to Mhlatuze by Mayor, Honourable Councillor, Mr E. Mbatha.
18:50	Message by SAIP President, Prof. Simon Connell.
18:00	Opening of SAIP2013 by KZN-MEC-Education / Minister B. Nzimande.
19:10	Music
19:20	Launch of the National Report on Physics Undergraduate Training in South Africa.
20:00	Launch of the Book “History of Physics” in South Africa.
20:20	Drinks, dinner

SILVER JUBILEE BANQUET

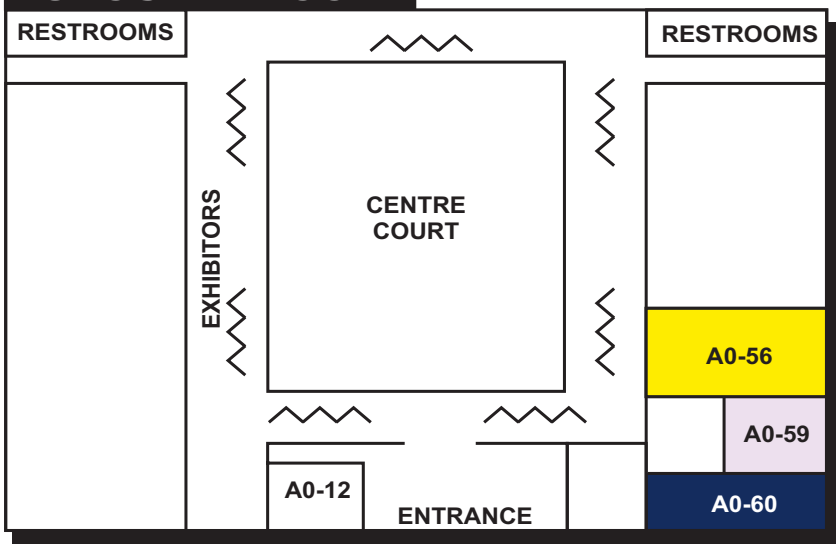
BHEKUZULU HALL (MAIN CAMPUS)
12 July 2013

17:00	**Arrival** Light Drinks & Arrival sherry
17:30	**Welcome remarks** (MC or SAIP2013 Chair)
17:35	**Remarks by Umkhanyakude District Mayor** Honourable Councillor, Mr Vilane
18:00	**Starter is served**
18:20	**Remarks by SAIP President** Prof Simon Connell
18:25	**Awarding of Student Prizes** Prof Simon Connell & Specialist Group Chairs
19:00	**Dinner is served**
18:45	**Reading of Citation & Award for Silver Jubilee Medal Winner** Prof Simon Connell
19:55	**Remarks by Silver Jubilee Medallist**
20:00	**Hand Over to Incoming President** Prof Simon Connell & Dr Igle Gledhill
20:10	**Vote of Thanks by SAIP2013 Chair**
20:15	**Dessert & Entertainment**

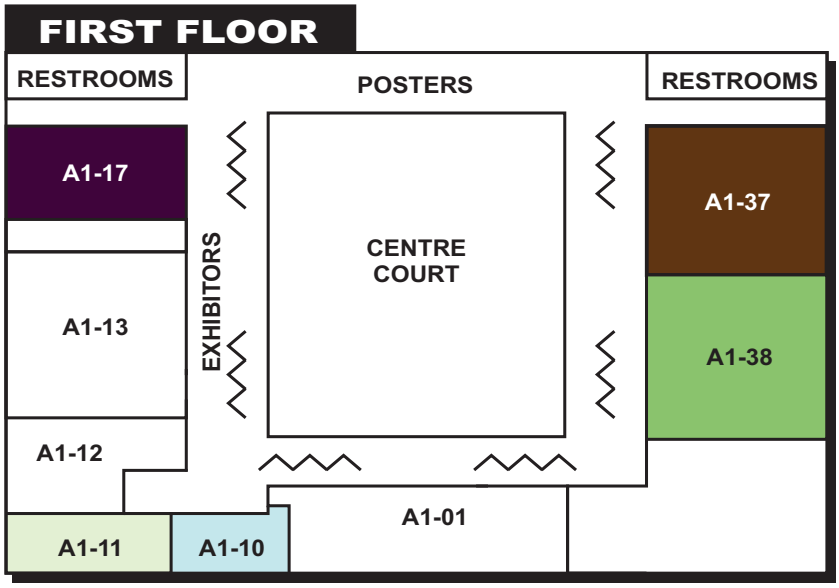
MAPS & VENUE LIST

LAYOUT OF CAMPUS LECTURE HALLS

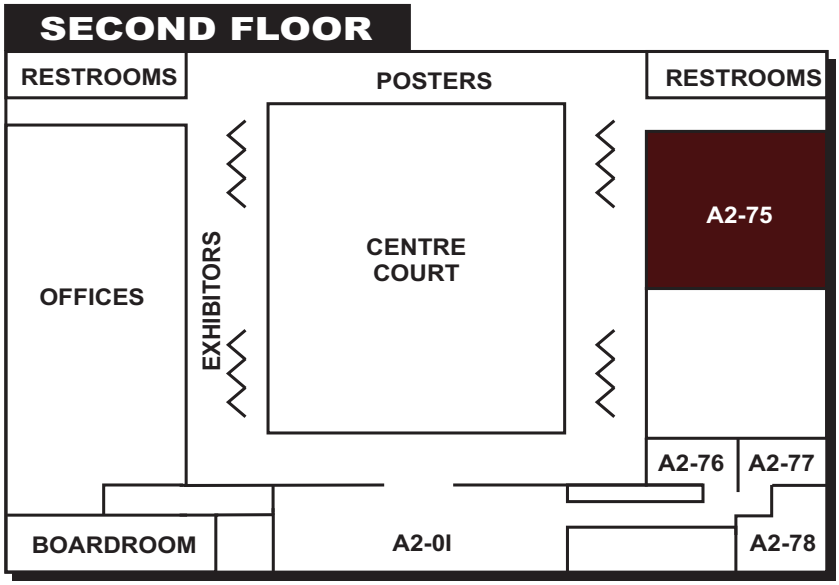
GROUND FLOOR



FIRST FLOOR



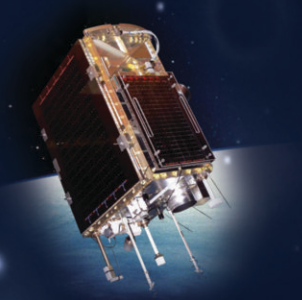
SECOND FLOOR



VENUE LIST

Division for Condensed Matter Physics and Materials (DCMPM1)	**A2-75**
Division for Condensed Matter Physics and Materials (DCMPM2)	**A0-60**
Nuclear, Particle and Radiation Physics (NPRP)	**A1-38**
Photonics	**A1-11**
Astrophysics	**A0-56**
Space Science	**A1-17**
Physics Education	**A0-59**
Applied Physics Forum	**A1-37**
Theoretical & Computational Physics	**A1-10**
Plenaries	**Centre Court**

sansa
SOUTH AFRICAN NATIONAL
SPACE AGENCY



A giant leap into space science and technology – a new era in service of humanity

SANSA's **mandate** is to provide for the promotion and use of space and cooperation in space-related activities, foster research in space science, advance scientific engineering through human capital and support the creation of an environment conducive to industrial development in space technologies within the framework of national government policy.

Our **vision** is to be a leading contributor to advancing society through space science and technology.

Our **mission** is to:

- Implement South Africa's National Space Strategy.
- Integrate and manage South Africa's space activities:
  - industrial development in space science and technology
  - space research and infrastructure
  - outreach, skills development and capacity building
  - international cooperation in space-related activities.

SANSA Earth Observation

Improved livelihoods through space

- World-class Earth Observation Centre.
- Key remote sensing technologies and services.
- Satellite imagery and geo-information for:
  - natural disasters
  - public safety and security
  - health-related issues
  - infrastructure and utilities
  - environmental conservation and effective land use.

SANSA Space Science

Creating knowledge and developing skills

- Space science research.
- Magnetic-related services and products for the defence, aerospace, navigation and communications industries.
- Space weather: measure, interpret, forecast and predict.
- Industrial development of space technology.
- Knowledge and skills in space science, technology and engineering.
- Awareness in space science and technology.

SANSA Space Operations

Letting satellites work for us

- Operate ground station and 10 full-motion antennae 24/7.
- Launch and lifecycle support of more than 20 satellites annually.
- Satellite signal tracking and receipt.
- Orbit transfers, testing and mission control.
- Ground infrastructure for international clients.
- Navigation signal accuracy and reliability.

SANSA Space Engineering

Advancing our future through space technology

- Satellite assembly, integration and testing facility and upgrades.
- Satellite system and sub-system development.
- Advanced manufacturing technology initiatives.
- Knowledge and skills in space systems for South Africa's space technology base.
- Local and international partnerships.

South African National Space Agency (SANSA)
Enterprise Building, Mark Shuttleworth Street, Innovation Hub, Pretoria
Tel: +27 12 844 0500 • Fax: +27 12 844 0396 • PO Box 484, Silverton 0127, Gauteng, South Africa
Email: information@sansa.org.za • www.sansa.org.za

GUIDELINES FOR SPEAKERS & 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

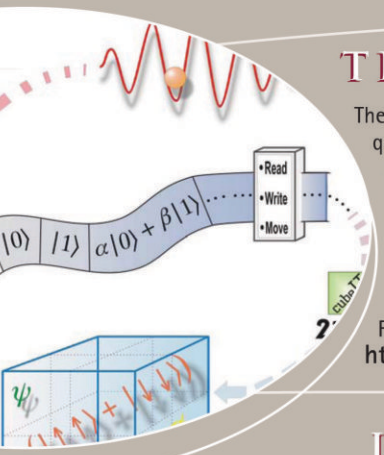
- Posters should be displayed on the allocated board for the duration of the conference
- Board assignments will be according to contribution number
- If you present more than one poster, we'll try to place then on adjacent boards
- You must be available at your poster during the assigned poster session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

CHAIRS

- Please keep to the scheduled times
- Make it a point that you re-check the date, time and venue of your session
- Please be on time, at least 5 minutes before your session starts.
- Consult with the session assistant in the venue (whether presentations are on computer and how the microphone system works)
- Identify the speakers before your session starts.
- No alterations are to be made to the programme. Talks may not be moved earlier due to a speaker not turning up.
- Welcome delegates and speakers at the beginning of your session
- Make the following announcements:
  - All cellphones are to be switched off
  - The title and name of the speaker
  - Whether it is a group presentation
  - Whether the speaker competes for an MSc or PhD prize
- Thank all the speakers at the end of the session
- Allow questions according to time. Stay within the timeslots.
- Report shortcomings to the session assistant
- Report to the front desk if the speaker was absent

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

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

To join us and for bursary information contact: [e] physoffice@sun.ac.za

[t] (021) 8083391 or [f] (021) 8083385

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY

jou kennisvennoot • your knowledge partner

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
Poster should be put up on the poster boards on the ground, 1st and 2nd floor of the main building for the duration of the conference. It is important that presenters avail themselves during their allocated session for discussions. Posters should be removed by Friday after lunch.

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 marquee just outside the main building.

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 in room A1-13.

TRANSPORT
A schedule for the shuttle service to King Shaka International Airport and Richards Bay Airport will be available at the registration desk. Shuttle usage will be for your own account.

SAIP2013 T-Shirts
Ordered shirts will be issued during registration. Additional T-Shirts 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 or contact the Richards Bay Campus centralized security number: 035 902 6970

ORGANIZING COMMITTEE

UNIVERSITY OF ZULULAND
Muzi Ndwandwe (Chairperson)
Thulani Jili (Co-Chairperson)
Betty Kibirige
Bouke Spoelstra
Sifiso Ntshangase
Thembinkosi Nyawo
Sphephelo Khanyile
Nana Thabezhe
Futhi Nzuza
Tsepiso Buthelezi
Normah Zondo
Bhekani Dlamini
Percy Sefage

SOUTH AFRICAN INSTITUTE OF PHYSICS
Brian Masara (Executive Officer)
Linette White (Secretary)
Roelf Botha (Indico system, Programme Book)

LIST OF ADVERTISERS, EXHIBITORS & SPONSORS

ADVERTISERS
Labotec (Pty) Ltd
CSIR National Laser Centre & Rental Pool
Nelson Mandela Metropolitan University
South African Council for Natural Scientific Professions
South African National Space Agency (SANSA) Space Science
University of Pretoria
University of South Africa (UNISA)
University of Stellenbosch, Physics Department
University of Stellenbosch, National Institute for Theoretical Physics (NITheP)
University of Zululand
Wirsam Scientific & Precision Equipment (Pty) Ltd

EXHIBITORS
Centre for High Performance Computing (CHPC)
South African Institute of Physics
Square Kilometre Array (SKA)
Carl Zeiss (Zeiss Optronics)

PAMPHLET
Wiley and Sons

PRIZES
National Metrology Institute of South Africa
Wirsam Scientific & Precision Equipment (Pty) Ltd

SPONSORSHIP
Venue - University of Zululand

MESSAGE FROM THE SAIP PRESIDENT

Once again, we all look forward to the most important event in the calendar of the South African Institute of Physics – our Annual Conference! It is my pleasure to welcome you all. The University of Zululand will host us, in the beautiful environs of their campus, for the first time. Three meetings precede the conference. These are; the Winter School on the Applications of Synchrotron Radiation, the Winter School on High Energy Physics and the Biophysics Workshop. The conference itself is an opportunity for scholarly presentation, discussion, building networks and planning for the future, both within the Divisions and Forums as well as within the broader community.

With respect to the domain of the first Winter School, it is a pleasure to record that South Africa signed an agreement with the ESRF on the 21st May 2013 to become a Scientific Associate of this facility. The programme's flagship is the ESRF, but it is broader than this, and includes funding for access to other synchrotrons as well as a capacity building budget. This agreement is the latest addition to the suite of programmes whereby South African scientists can access large scale international infrastructure, joining the programs related to CERN, JINR and the astronomy facilities, including our own SKA programme.

A major milestone at this conference will be the release of the report resulting from the project on the Review of Physics Training. This has been our most important project over the past several years, and it is particularly significant and valued that the SAIP partnered with the Council on Higher Education (CHE) to conduct the review and develop the report. There will be several opportunities to reflect on the report and develop the plans for the implementation of the Recommendations. We have every anticipation we will see the same enormous benefits to the health of the discipline as we saw arise from the preceding project on Shaping the Future of Physics. Another highlight I want to draw your attention to is the release of the Council commissioned book on “Physics in South Africa”.

Next I mention that at the Annual General Meeting we will vote on changes to our Constitution related to the final step in our registration as a Professional Body. Once again, this will open the door to the professionalisation and further growth of the Institute, leading to an enhanced ability to promote the health of our discipline.

A special welcome also to the invited guests, listed in the next pages. An additional special welcome to the students; we trust the Conference will be a significant event in your career, now and in the future. We are all deeply indebted to the Local Organizing Committee chaired by Prof Muzi Ndwandwe, which has compiled an excellent programme and to Mr Brian Masara, Executive Officer of the SAIP Executive Office and his team, for their significant role in managing and developing the many projects of Council. Finally many thanks to you all, who are participating, we wish you a very rewarding and valuable experience.

Simon Connell
President, South African Institute of Physics

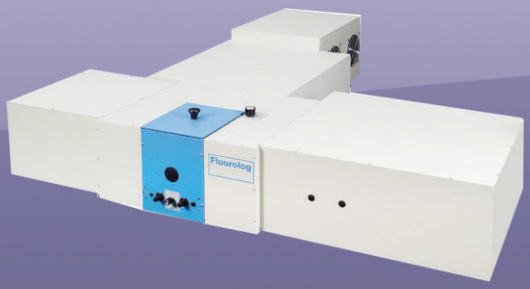
wirsam

SCIENTIFIC & PRECISION EQUIPMENT (PTY) LTD.

SERVICE TO THE LABORATORY
45 Years
1968 - 2013

HORIBA Scientific

RAMAN



Spectrofluorometer

Rigaku

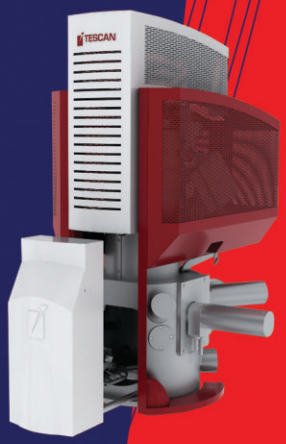
XRD & XRF

Newport

Experience | Solutions

TESCAN SEM

MIRA Field Emission Scanning Electron Microscopes



JOHANNESBURG
T: +27 (0) 11 482 1060
F: +27 (0) 11 726 6094
E: wirsamjb@wirsam.com

CAPE TOWN
T: +27 (0) 21 386 9020
F: +27 (0) 21 386 9012
E: wirsamct@wirsam.com

DURBAN
T: +27 (0) 31 709 0199
F: +27 (0) 31 709 0193
E: wirsamdb@wirsam.com

PORT ELIZABETH
T: +27 (0) 41 365 2060
F: +27 (0) 41 365 2143
E: wirsampe@wirsam.com

VAAL TRIANGLE
T: +27 (0) 16 931 1731
F: +27 (0) 16 981 9028
E: wirsamvt@wirsam.com

MESSAGE FROM THE VC - UNIVERSITY OF ZULULAND

Welcome to the University of Zululand (UNIZULU). It is indeed an honour and privilege to host the 58th South African Institute of Physics (SAIP) Conference. This conference creates the opportunity to engage with experts, academics, researchers within the field of Science, Engineering and Technology (SET). As a leading comprehensive institution of higher education, UNIZULU believes in fostering debate, discussion, critical thinking, interactive quality education and above all academic excellence. For UNIZULU this is a space to establish national, international and inter-continental partnerships to further research, innovations, develop new and novel systems and models relating to and within the field of physics and related disciplines.

South Africa's population, unemployment rate, poverty and crime is on the rise, in addition we are faced with the skills shortage in many sectors, such as the spread of HIV & AIDS, climate change and food security. These problems are not unique to SA, many countries globally are facing these challenges and others relating to economic and political instability. As educators, scientists and researchers it is vital that we encourage SET interest among learners to ensure a better, brighter future.

Over the last 20 years, SA has made great strides in securing its democracy, stabilising the economy and addressing social and economic issues. However, as members of the public, private, government and corporate sector we have a responsibility to ensure we participate in efforts to foster technology transfer, facilitate investigations into new areas of interest, design and produce new tools, equipment, systems, policy and protocol for the betterment of mankind. Education in the context of the above is the apex of the national development in South Africa.

SA is expanding its areas of SET interest; however a greater focus is required to position them within the wider political, social and economic spaces. It is important that those involved in scientific, social and economic research tap into technology, innovation research and development funding to facilitate the expansion of existing centres of excellence and development new SET institutions and research and development agencies within novel fields. In addition, we need to broaden our existing knowledge of areas like nanotechnology, astronomy, Indigenous Knowledge Systems and biotechnology. In such areas growth is focused on Sciences [SET] and Business Management, a shift in the shape of the offerings in the Humanities and consolidation in the Education Faculty as part of academic renewal. Refocusing on relevant and strategic goals in the areas of Languages, Psychology, Developmental Studies, Rural Development, etc.

As a rapidly emerging hegemony in Africa, SA has the influence and support to contribute to the global economy through intercontinental and international partnerships in conjunction with world class scientists, researchers and leading institutions. We have the capacity and the competence and it is imperative for the growth of our country and the continent that we have systems in place to monitor, evaluate and control the efficient use of our natural resources, that we spearhead policy development and implement regulations. We need to encourage public participation in SET community based projects, drive competition through excellence in SET research and production.

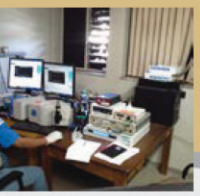
UNIZULU's trajectory is focused on creating an enabling environment to ensure we produce leaders across fields and productive citizens who will contribute to new developments in Africa and the world. The 2013 SAIP conference is one of the critical sources of encouragement for UNIZULU. We are focused on developing new platforms for exchange of ideas and discussion and we believe that together we can strengthen Africa's response to global change through research and technology. We trust that you find this conference beneficial and we look forward to your support in the future.

WELCOME TO UNIZULU...SIYANAMUKELA!!

Professor Fikile NM Mazibuko
Vice-Chancellor

Physics@UNISA

The Department of Physics at the University of South Africa (UNISA) offers Undergraduate studies (from 1st to 3rd year) and Postgraduate studies (from Honours to PhD). The research activities in the Department fall into the following focus areas:



- **Computational Physics**
  - ✓ Development of Computational Physics Methods
- **Condensed Matter Physics (Experiment)**
  - ✓ Semiconductor Physics: Fabrication & characterization of semiconductor diodes
  - ✓ Nanotechnology Physics: Synthesis & characterization of up- and down-conversion nano-phosphors
- **Condensed Matter Physics (Theory)**
  - ✓ Modeling of electrical properties semiconductor alloys, spintronics, etc
  - ✓ Properties of hard metals
- **Nuclear Physics (Theory)**
  - ✓ Dynamics of bound and scattering states of few-particle systems
  - ✓ Studies of multi-nucleon transfer reactions in low-energy collisions for heavy ions
  - ✓ Studies of dynamics of nuclear reactions involving exotic nuclei
  - ✓ Properties of Bose-Einstein Condensates
- **Inverse Scattering Theory**
  - ✓Marchenko inverse scattering theory (applications in seismic modeling, etc)

For further information go to http://www.unisa.ac.za/ or contact the department via:
Email: physics@unisa.ac.za or Tel: +27(0)12-429 8027

MESSAGE FROM THE DEAN, UNIZULU

It is a great honour for the University of Zululand(UNIZULU) to host the 2013 Conference of the South African Institute of Physics. This Conference promises to be exciting with an interactive approach to cutting edge technology and leading research. As a comprehensive University in South Africa, UNIZULU is focused on providing a platform for the exchange of information, establishment of academic and corporate partnerships, discourse regarding the latest scientific developments and promoting positive global impact through novel innovations.

Papers presented at the conference will cover wide areas including nanotechnology, nuclear and applied physics, photonics, biosciences, space science, applied, theoretical, computational, particle and radiation physics.

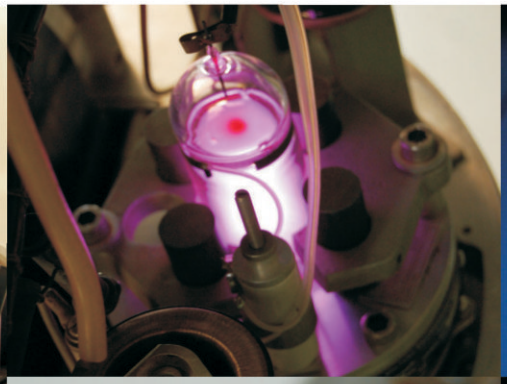
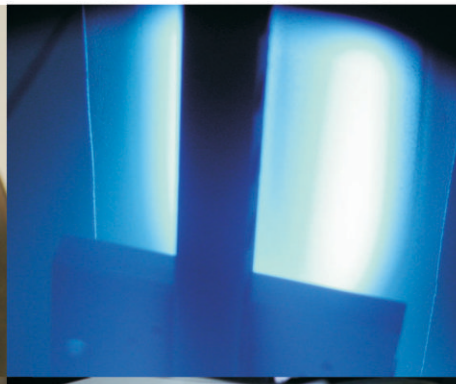
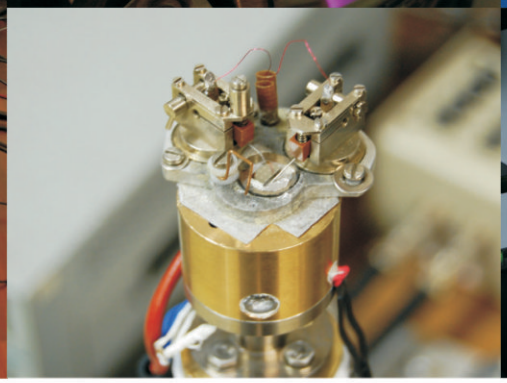
Globally, there exists a great demand for the expertise of scientists and researchers. These individuals have made great strides in the development of new technology, systems, equipment and products. However, in the 21st century we are faced with the deterioration of our natural resources, the ever pervading threat of biological and nuclear warfare and climate change amongst many others. As scientists and particularly physicists, it is expected that you will make major contributions to the advancement of society and in the realms of industry, health and the economy.

In a developing third world country, it is critical that measures be taken to encourage public interest in the vast sub-fields of science. The contributions made by physicists such as Marie Curie, Albert Einstein, Isaac Newton, Stephen Hawking's and others have not only made ground breaking research and discoveries in the study of physics but the progress of man and the environment. Their work has inspired us and opened new areas of interest and greater questions within the world of physics.
In relation to physics, all things within the universe are interconnected and evolving. Mind, matter and space are interconnected and the study of which can be considered as an evolutionary form of education. It is relative to our progress, and in relation to our present times it is fundamental to our existence, survival and future development. Education is the most important factor in the evolution of both the individual and society. Together, let us work on making new discoveries, creating new knowledge and develop ground breaking research that is at the cutting edge of technology.

SAIP 2013 is a medium for us to engage, critically discuss research and new innovations.I urge you to take this opportunity to forge new partnerships to strengthen your research capacity as physicists, engage the interest of learners to ensure an increase in the number of students registering for Science, Engineering and Technology qualifications and establish new networks. The fate of our future generations is best described in the words of Aristotle, “All who have meditated on the art of governing mankind have been convinced that the fate of empires depends on the education of youth."
May you have a most enjoyable and rewarding conference.

Professor R Ori
Dean: Faculty of Science & Agriculture University of Zululand

University of Pretoria
Department of Physics


We offer postgraduate opportunities in the following research focus areas

Materials

- Nuclear applications
- Under irradiation
- Solar cells
- Opto-electronics
- Carbon-based
- Nano-magnetism

Theoretical Physics

- Mathematical physics
- High energy theory
- Quantum resonances theory
- Quantum information theory
- Computational solid state physics
- Symmetries and group theory

Astronomy

Biophysics

Physics Education

Enquiries about postgraduate studies

Head: Department of Physics
University of Pretoria
Private Bag X20, Hatfield, 0028

Email: Chris.Theron@up.ac.za
Tel: +27 12 420 2455
Fax: +27 12 362 5288
Web: **http://www.up.ac.za/physics**

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Natural and Agricultural Sciences

MESSAGE FROM THE HOD - DEPT OF PHYSICS, UNIZULU

The Department of Physics of the University of Zululand welcomes you to the 58th Annual South African Institute of Physics Conference, SAIP2013. The Department opened its doors to students for the first time in 1963. The first Head of Department was Prof. F.K. Peters. The University at the time was still a part of UNISA. Both Department and University has grown to what it is today, offering degrees at both undergraduate and postgraduate levels.

It is our hope that during this Conference you will have many fruitful discussions and meet other scientists both in your sub-field of Physics as well as in other sub-fields. We plan to have posters on display for the duration of the conference. You are therefore welcome to view these any time you please. Should you require a room for any ad hoc meeting or discussion do not hesitate to contact us.

Since SAIP2013 is held at our new Richards Bay Campus, we decided to have the closing function (Banquet) at Bhekuzulu Hall, located within our main Campus at KwaDlangezwa about 25 km from Richards Bay. This will enable you to see the main Campus. Should you want to see the Department of Physics, then let us know. The University of Zululand Science Centre is a project of the Department of Physics aimed at developing an interest in Physics (Science & Mathematics in general) to the community of Zululand. It is located in Richards Bay. You may visit it if you wish.

During this conference, you may visit Hluhluwe Game Reserve or Smangaliso Wetland Park, a World Heritage . It is hoped this will give you a much needed breather and relaxing atmosphere during the Conference.

Prof. Muzi Ndwandwe
Head: Physics, UNIZULU

PLENARY SPEAKERS

Andrea Goldoni
Elettra - Sincrotrone Trieste

Andrea Goldoni (1967) holds a Physics Degree from the University of Modena (1992) and a Ph.D. in Physics from the University of Trieste (1996). After a period as exchange researcher at the Stanford University (USA) in the group of Z.-X. Shen, from June 1997 he became a beamline scientist of the Elettra Synchrotron facility (Trieste). From 2006 to the end of 2011 he was the Head of the "Surface Science Division" and the coordinator of the "Beamline Group". Actually he is the Head of the "micro- & nano-carbon laboratory" (http://www.elettra.trieste.it/lightsources/labs-and-services/labs-mnc/lmnc-home.html).
He was the Coordinator of several research projects on carbon-based molecules (fullerenes, nanotubes and porphyrins) and of a project for a new beamline for high-resolution angle-resolved photoemission experiments (BaD ElPh) funded by the Italian Ministry for University & Research (MIUR) and by a regional project for the preparation of nanostructured chemical nanosensor. Actually he is involved in two European projects (ERG, 2011-2014 and EuNetAir, 2012-2015) and one Italian project (NANOSOLAR, 2012-2016) funded by MIUR. He (co)authored > 195 refereed scientific papers in the area of condensed matter physics, surface science and nanoscience
(the list is available at http://www.elettra.trieste.it/People/AndreaGoldoni).

Investigation of porphyrins on metal surfaces with synchrotron radiation: conformation, magnetic and electronic properties
Tuesday 09 July 09:00

Self-assembled organic monolayers on metal substrates are currently considered as templates for the ordered organization of "isolated" metallic atoms as well as for spintronics applications. The fine control on the self-assembling and on the magnetic anisotropy represent key issues in the development of these molecule-metal interfaces. For magnetic interfaces, there is a strong urge to develop magnetic molecular materials by designing new combinations of interactions between magnetic centres in organic materials and substrates based spins. Recent developments in the field of surface magnetism and the possible applications of some paramagnetic 3d metallo-porphyrins as switchable elements in molecular spintronic devices, have generated much interest into the structural and magnetic properties of these molecules. Here we show how synchrotron radiation based techniques are extremely important to understand in detail the adsorption geometry, the magnetic and electronic structure of porphyrin systems on metals and the possible changes of these molecules during the adsorption and the interaction with the substrate. Combining synchrotron measurements with scanning tunnelig microscopy and DFT calculations allow to obtain a complete picture of several behaviours observed in these systems.

Cinzia Cepek
Institute of Materials –
National Research Council
IOM-CNR
Trieste - Italy

Cinzia Cepek graduated in Physic at the University of Trieste, Italy in 1995 (thesis titled: 'Interaction and Charge Transfer between C60 Molecules and Metals: Transition Metals and Lanthanum'). She received her Ph.D degree in Solid State Physic at the Mathematisch-naturwissenschaftlichen Fakultät der Universität Zürich, Switzerland in 2000 (supervisor: Prof. J. Osterwalder, thesis entitled: 'C60 Interaction with Metals and Semiconductors').

Dr. Cinzia Cepek has more than 15-years experience in thin films growth and surface science. Since 2001 she is scientist of CNR-IOM, and since 2006 she is the scientific responsible of the Analytical Division of the CNR-IOM institute (Trieste). The mainly studied systems in the last years include fullerenes, carbon nanotubes, MgB2 and SiC thin films, and nano-structured films produced by supersonic cluster beam source. During the last years she focused her research activity on the study of the growth mechanisms of carbon-based materials and their hybrids, obtained via catalytic CVD in UHV conditions. A sizeable part of the work is performed via access to international synchrotron radiation facilities.

Dr. Cinzia Cepek has more than 85 peer-reviewed articles in high impact factor international journals and various conference proceedings. She locally coordinated and has been involved in several national and international research projects, funded by the Italian Government and private industries.

Synchrotron radiation characterizations of carbon-based nanostructures
Tuesday 09 July 12:10

The basis of X-ray photoemission spectroscopy (XPS) will be briefly addressed and, as practical examples, we will show many applications on carbon-based materials obtained using synchrotron radiation in real-time. The carbon nanostructures (CNs) were grown via catalytic chemical vapour deposition and were investigated using complementary spectroscopic and microscopy techniques, also in situ and during the synthesis process. In addition to XPS, the CNs were investigated using scanning microscopies, high resolution transmission electron microscopy, and low energy electron diffraction. Flux, energy and lateral resolution available using synchrotron radiation are extremely high. These unique characteristics enable the identification of some of the key growth mechanisms and help to identify the best catalyst condition to control the growth process and the final CNs.

Magnano Elena
Institute of Materials –
National Research Council
IOM-CNR
Trieste - Italy

Elena Magnano has got the degree in Physics from the University of Genoa (IT) in 1995 and the Phd from the ETHZ (CH) in 2003. Between 1998-2002 she worked as visiting scientist at International and National Laboratories (Forschungzentrum in Jülich (Germany), at the Laboratorio di fisica delle superfici, Modena e Reggio Emilia (Italy) and at the Laboratorio di fisica delle superfici, Genova (Italy)), and as a user on approved proposals in many International Synchrotron Radiation facilities (European Synchrotron Radiation Facility (ESRF), Grenoble (France), Laboratoire pour l'Utilisation du Rayonnement électromagnétique (LURE), Orsay (France), Light Source (NSLS), Brookhaven National Laboratory, Brookhaven (USA, Soleil synchrotron radiation facility, Paris (France), Berliner Gesellschaft für Elektronenspeicherring-Synchrotronstrahlung mbH (BESSY I), Berlin (Germany). Since 2002 she is a researcher with CNR-IOM in Trieste. In 2004 she started working as operative beamline scientist at the BACH beamline at Elettra synchrotron radiation facility in Trieste (Italy). The scientific activity has been mainly devoted to the study of electronic and magnetic properties of thin films prepared in situ and nanostructured materials (organic molecules and metal-organic hybrid interfaces, ferromagnetic alloys based on manganese, oxides of transition metals) and materials complex (fullerenes, carbon nanotubes, superconductors, oxides, inter-metallic compounds, metal alloys) studied in UHV using synchrotron radiation based techniques. She is co-oauthor of 67 papers on refereed international journals.

Magnetic and electronic properties of surfaces by advanced soft x-ray synchrotron radiation techniques
Tuesday 09 July 16:40

The use of synchrotron radiation is very powerful for the electronic and magnetic characterization of solid surfaces, exploiting its main properties as high brilliance, high flux, high stability, energy and polarization tunability, and pulse structure. The last features are of paramount importance to investigate the electronic magnetic properties of oxides, oxides thin films and buried interfaces. In the first part of my talk I will introduce the audience to absorption spectroscopy based on synchrotron radiation polarized light. The layout of a beamline dedicated to dichroism investigation (the BACH beamline at Elettra – Italy) will be described and some specific experiments performed on thin films oxide interfaces, providing important information about strain, orbital occupation and magnetic anisotropy, will be discussed. In the second part, I will introduce a new apparatus suitable for laser-pump and synchrotron radiation-probe time-resolved measurements in the sub-ns range. The system operates by exploiting the multi-bunch filling mode of the Elettra synchrotron storage ring to probe optically excited states with a continuous array of x-ray pulses. Preliminary data will be presented.

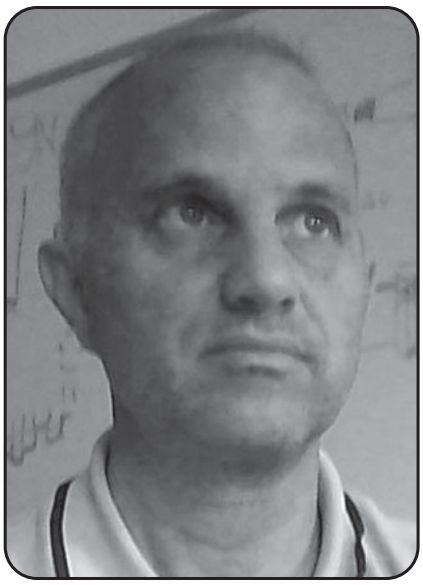
Barbara Montanari
STFC Rutherford Appleton
Laboratory
United Kingdom

Barbara Montanari (born 1969) is a senior research scientist and a group leader at STFC Rutherford Appleton Laboratory, a government-owned research establishment in England, UK, where she has held a permanent position since 2004. Her main area of research is the theory, modelling, and simulation of organic magnetic materials and carbon polymorphs (including fullerenes, nanotubes, and graphene) at the quantum level. In addition, she hold a role as a scientific liaison officer between the National Laboratories, with the objective of increasing science impact through increased inter-disciplinary collaboration. She is also very active in the area of gender issues in science and public outreach. Before joining STFC, she had two postdoctoral experiences. At Imperial College, London (2001-2004), she developed software as part of the software package CASTEP for computing first principles vibrational spectra and studied the vibrational properties of TiO2. At Queen's university, Belfast (1999-2000), she developed a tight binding model for alumina. She obtained her PhD in physics (full marks) from Forschungszentrum Jülich (Germany) where between 1996 and 1998 she worked on modelling organic polymers. She obtained her undergraduate degree in physics in from Modena university (Italy) in 1995, having carried out a year-long research projects at SISSA, Trieste (Italy).

Gender Gap in Science and Leadership
Wednesday 10 July 11:50

In the first part of this presentation I will talk about my personal career experience, highlighting the challenges and opportunities that I, like most women in physics, encounter. In addition to my journey in science, I will talk about my personal development as a leader.The second part of the seminar will focus on what are, in my opinion, the main factors that keep the gender gap in science and leadership subbornly open. These include the meritocracy myth, emphasis on independence over inter-dependance, cult of prestige, competition and shame culture, authoritative leadership, quantity over quality, and the neglect of the EQ. For all these issues, I will offer solutions that both men aqnd women can implement in their own life. I will also present my survival guide to covert and overt gender bias and practical advice for managing career breaks and achieving a balance between work and family life.

PLENARY SPEAKERS



Marco Lazzarino

Institute of Materials –
National Research Council
IOM-CNR
Trieste - Italy

Marco Lazzarino got the degree in Physics from the University of Genoa (IT) and the Phd from the University of Groningen (NL). From 1992 to 1998 he worked on the electronic properties of semiconductor devices, including heterostructures, Schottky barriers, hybrid superconductor-semiconductor and 2D electron gas with INFM in Trieste and with SNS in Pisa, Italy. Since 1999 he is a scientist with CNR-IOM in Trieste where initially worked in the field of scanning probe microscopy, nano-lithography and low temperature SNOM.

In 2003 a visiting period at Princeton University (NJ) triggered a new interest in the application of probe microscopy to life science and the development of micro and nanoelectromechanical systems for the detection and manipulation of biological molecules. Nano-mechanobiology is still his current scientific activity.

He is also scientific coordinator of a the Nano-Bio-Analysis Laboratory of the Center for BioMedicine (CBM S.c.r.l. - Trieste) dedicated to the application of scanning probe microscopy to biology.

He is co-author of 85 papers on international journals.

Nanomechanical sensing for biology and medicine
Wednesday 10 July 16:40

Biological sensing in the mechanical domain provides unique opportunities to measure forces, displacements and mass changes from cellular and subcellular processes. Nanomechanical systems are naturally well matched in size with molecular interactions, and, because of their potential single-molecule sensitivity, they represent the ideal candidates for investigate biological processes at the single molecule and at the single cell levels.

During my talk I will treat two important applications of mechanobiology giving a special enphasys to the experimental aspects. In the first part I will introduce atomic force microscopy and force spectroscopy with recent examples of single molecules and single cell force spectroscopy experiments. In the second part I will review the micro- and nano-mechanical approach to molecular biosensing, and finally discuss the recent advances obtained in our laboratory.

Ted Williams

South African Astronomical Observatory (SAAO)

Rutgers University

University of Cape Town

Theodore (Ted) Williams holds a physics BS degree (1971) from Purdue University (USA) and astronomy PhD (1975) from the California Institute of Technology (USA). He worked on detector technology development for space telescopes at the Princeton University Observatory (1975-79, USA). He took a position on the faculty of the Department of Physics and Astronomy at Rutgers University (1979-present, USA), where he pursued observational studies of the kinematics and dynamics of galaxies, and developed instrumentation for imaging spectroscopy. He served as the Director of the Graduate Program in Physics and Astronomy at Rutgers and Associate Chair of the Department there. He led Rutgers' participation in the Southern African Large Telescope (SALT), contributed to all aspects of the project's development, and served on the SALT Board of Directors from 1998-2012 (chair 2006-2012). He became the Director of the South African Astronomical Observatory in January 2013.

Dark Matter - the Unseen Universe
Thursday 11 July 08:00

Astronomers now widely accept the view that most of the mass of the universe exists in the form of an unknown substance, which we call dark matter. We know more about what dark matter isn't than what it is. I'll review the observational evidence that builds a compelling case for dark matter, discuss some of the current astronomical programs to explore its nature, and ask if there are possible alternative explanations. Just as the search for the "aether" at the beginning of the 20th century revealed fundamental flaws in our understanding of physics and led to a new view of space and time, dark matter indicates that our current standard model cannot be a complete explanation of matter, and possibly hints at a new revolution in our understanding of the physical nature of the universe.

Sahal Yacoob
University of KwaZulu-Natal

Sahal Yacoob completed his undergraduate and MSc degrees at the university of Cape Town between 1996 and 2002. He received his PhD (2010) at Northwestern University for his work on the measurement of the mass of the W boson at the Tevatron proton-antiproton collider at Fermilab as part of the D0 collaboration. Since then he has been part of the ATLAS collaboration at CERN studying collisions from the Large Hadron Collider. Initially based at CERN as a post-doc for the University of the Witwatersrand (2010) he is now starting a research group as a lecturer at the University of Kwazulu-Natal (2012). Dr. Yacoob has put considerable effort into making it possible to contribute to ATLAS from South Africa, working to incorporate local computing resources into the ATLAS infrastructure as well as doing a number of outreach events with high school students from surrounding areas.

Beyond the Standard
Thursday 11 July 09:00

The lecture will discuss extensions to the standard model of particle physics which gives an incomplete description of the interactions between the basic building blocks of matter but has yet to fail an experimental test. Once the standard model has been introduced, the audience will share in the excitement of the Large Hadron Collider at CERN, learning about selected results from the past year (since the Higgs boson discovery), and plans for the future when the machine restarts at a new energy. With South Africa now official part of the ATLAS and ALICE experiments the talk will also explore the uniqueness of working on an experiment with thousands of collaborators spread across the world, and why that is awesome.

Thomas Feurer
STFC Rutherford Appleton Laboratory
United Kingdom

Thomas Feurer started his career in Physics at the University of Würzburg, Germany, in 1984 and received the “Diplom” in Physics in 1990. The following 6 months he spent as a visiting scholar at the Rice University, USA, working on optically induced percolative phase transitions. In 1994 he earned his Ph.D. degree at the University of Würzburg and moved to the University of Jena as a postdoc. For the next 6 years his research interests were ultrafast linear and nonlinear optics, femtosecond spectroscopy and coherent control of quantum systems, high-power short-pulse laser-matter interaction at relativistic intensities, generation of femtosecond hard x-rays, and femtosecond time-resolved x-ray diffraction. He received the “Habilitation” beginning of 2001 and moved to the Massachusetts Institute of Technology, USA. There, his research interests were high-frequency acoustic spectroscopy, ultrafast optics and pulse-shaping, nonlinear spectroscopy of liquids and solids, coherent control of collective excitations in solids, generation of phase-matched high harmonics, EUV nonlinear femtosecond spectroscopy. In 2002 he was appointed Research Associate. In 2004 he became full professor at the University of Bern, Switzerland, and his current research interests are in fiber lasers, in ultrafast optics and spectroscopy, in quantum optics, and in linear and nonlinear THz science. He has published more than 100 journal papers and holds several patents. In 1997, he received the Carl Zeiss Research Award, in 1999 the Werner-von-Siemens Medal, and in 2001 he was awarded with a Max-Kade Fellowship. Thomas Feurer is a member of the Optical Society of America (OSA) and the American Physical Society (APS).

Shaping frequency entangled photon pairs
Thursday 11 July 10:00

Entanglement is one of the most intriguing features of quantum theory and is a fundamental resource for quantum information processing. It was experimentally revealed by the observation of correlations with no classical origins. Through Bell inequalities, the non-locality of nature was tested by numerous experiments using entangled two-dimensional states (qubits). Both, fundamental tests of quantum theory and applications would benefit greatly from entanglement in higher dimensions. Entangling d-dimensional states denoted as qudits allows to formulate generalized Bell inequalities, which are more resistant to noise than their two-dimensional predecessors. In loophole free Bell experiments the detection efficiency threshold can be lowered. Finally, both the effective bit rate of quantum key distribution and the robustness to errors can be increased. These examples, among others, stimulated research towards different schemes to generate and manipulate photonic qudits in high dimensions. One of the most promising schemes is entanglement in transverse modes. Here, we demonstrate an alternative approach which has the potential to reach even higher dimensions. Specifically, we demonstrate the creation, characterization, and manipulation of frequency entangled qudits by shaping the energy spectrum of entangled photons, a technique that has its origin in ultrafast optics. We show different shaping schemes and applications thereof. We verify the generation of maximally entangled qudit states up to d=4 through tomographic quantum state reconstruction. Subsequently, we measure Bell parameters for entangled qubits and qutrits as a function of their degree of entanglement.

PLENARY SPEAKERS

Jacob Bortnik

Department of Atmospheric and Oceanic Sciences
University of California, LA

Center for Solar Terrestrial Research, Department of Physics
New Jersey Institute of Technology
Newark

Jacob Bortnik (*1974) holds Bachelors (1996) and Masters (1998) degrees from the University of the Witwatersrand in Johannesburg, South Africa, and a PhD (2004) from Stanford University where he worked on the precipitation of relativistic electrons from the Earth's radiation belts due to lightning-generated plasma waves. After doing a postdoc in the Department of Atmospheric and Oceanic Sciences at the University of California, Dr. Bortnik remained in the same department as a research scientist. In 2008, Dr. Bortnik was the lead author of a Nature article, which described the theoretical solution to a 40-year old problem in space physics, concerning the origin of a mysterious wave called plasmaspheric hiss. This story was listed as one of the top 100 stories of 2008 in Discover magazine. In 2009, he was the lead author of a Science article that reported on the first satellite observation that conclusively confirmed this theoretical model. In 2010, Dr. Bortnik led a team of scientists in discovering the origin of the pulsating aurora, another famous space physics problem, whose solution was published in Science in the same year. Dr. Bortnik currently leads several international research efforts including the new program of the Scientific Committee on Solar-Terrestrial Physics.

Recent progress in understanding very low frequency waves, high energy particles, and the coupled inner magnetospheric environment.
Friday 12 July 08:00

In the 50 years since the discovery of the Earth's high-energy radiation belts, much progress has been made in understanding the characteristics and dynamics of this highly variable population of particles. The need to understand and particularly forecast relativistic electron fluxes, is made more urgent by the large (and ever increasing) number of satellites that are embedded in this hazardous region of space, representing various functions such as global positioning, weather monitoring, communications, military surveillance, and many others. In this talk, I will briefly survey the history of radiation belt research to the present time, discuss some of the natural (very low frequency) plasma waves that appear to play key roles in controlling the dynamics of the radiation belts, and illustrate how these waves fit into the broader picture of the coupled inner magnetospheric environment. Particular attention will be paid to results from the recently launched Van Allen Probes, that are recording in unprecedented detail the radiation environment as the sun awakens from its long and deep solar minimum.

Caslav Brukner

Faculty of Physics,
University of Vienna, Austria

Institute of Quantum Optics and Quantum Information, Austrian Academy of Sciences

Caslav Brukner (*1967) is associate Professor at the University of Vienna, Austria. He received his M.S. degree in Physics from the University of Vienna (1995) and earned a Doctor of Technical Sciences from the Vienna University of Technology (1999). He has held positions at the Imperial College London (Marie Curie Fellow, 2004), the Institute for Quantum Optics and Quantum Information, Austrian Academy of Sciences, Tsinghua University in Beijing (Chair Professor, 2005-2008) and University of Belgrade, Serbia (Visiting Professor since 2008). His primary research interests are foundations of quantum physics and quantum information theory. He contributed to information-theoretical reconstruction of quantum mechanics, derivation of the general Bell inequality, also known as “Werner-Wolf-Zukowski-Brukner” inequality, and more recently, to formulation of quantum mechanics on indefinite causal structures.

Quantum Interference of “Clocks”
Friday 12 July 11:50

Experimental tests of general relativity performed so far involve systems that can be effectively described by classical physics. On the other hand, observed gravity effects on quantum systems do not go beyond the Newtonian limit of the theory. In light of the conceptual differences between general relativity and quantum mechanics, as well as those of finding a unified theoretical framework for the two theories, it is of particular interest to look for feasible experiments that can only be explained if both theories apply.

We propose testing general relativistic time dilation with a single “clock” in a superposition of two paths in space-time, along which time flows at different rates. We show that the interference visibility in such an experiment will decrease to the extent to which the path information becomes available from reading out the time from the “clock”. This effect would provide the first test of the genuine general relativistic notion of time in quantum mechanics. We consider implementation of the “clock” in evolving internal degrees of freedom of a massive particle and, alternatively, in the external degree of a photon and analyze the feasibility of the experiment. More details can be found:

M. Zych, F. Costa, I. Pikovski, T. C. Ralph and Č. Brukner, General relativistic effects in quantum interference of photons, Class. Quantum Grav. 29 224010 (2012). M. Zych, F. Costa, I. Pikovski, Č. Brukner, Quantum interferometric visibility as a witness of general relativistic proper time, Nature Communication 2:505 doi: 10.1038/ncomms1498 (2011)

Iakovos Sigalas

Ceramics Focus Area
DST/NRF Centre of Excellence in Strong Materials, Wits

Iakovos Sigalas obtained his PhD in experimental solid-state physics and a Diploma in Advanced Studies in Science from the University of Manchester, U.K. He also has a BSc Physics (Honours) from Athens University, Greece. His research Interests include Hard ceramic materials for cutting tool and wear part applications, Energy Ceramics and Titanium alloy studies. His employment started as a lecturer at Greek Universities. Subsequently he worked at the CSIR (1980) and later Element Six Pty Ltd as Research Manager (1991). He is presently employed by Element Six and is Professor in Ceramic Science at Wits. He has 77 publications in international refereed journals, 29 Patents and authored over 60 technical reports. He has also contributed to two books.

Hard and Ultrahard Materials Research at the University of the Witwatersrand

Friday 12 July 13:50

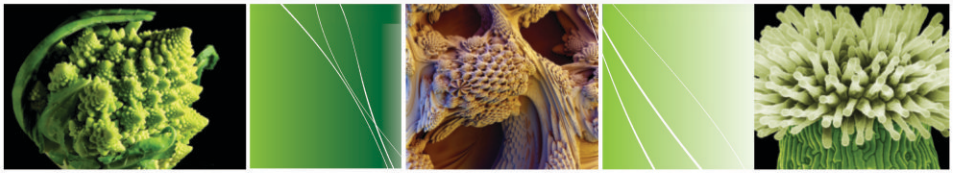
There is a continuous demand for improved efficiency of engines, plants and production processes. For this reason, ceramics have gained an ever increasing importance as engineering materials. In the group of advanced materials, carbon in the form of diamond, carbides, nitrides and borides have reached an outstanding position due to their excellent hardness, chemical and mechanical properties, particularly at high temperatures.
There is extensive work in the development of new hard materials, aimed at competing with diamond, not just in hardness, but in cost-effectiveness in general.

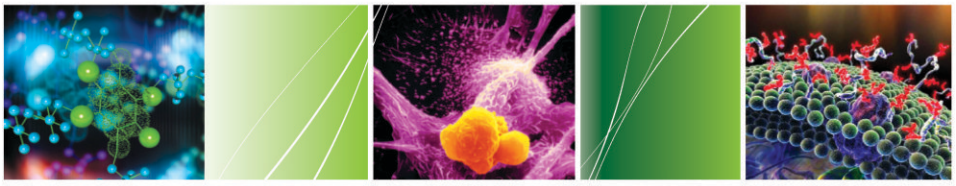
This paper covers some of the cutting edge work done at present in this area and then focuses on the work done in our laboratories. This covers work on polycrystalline diamond, cubic boron nitride, boron suboxide and other hard oxides and nitrides. A great deal of this activity was focused on the development of hard and ultrahard materials at low pressures (<70 MPa), as opposed to the traditionally ultrahigh pressures used in the synthesis and sintering of such materials.

The materials made using this approach are evaluated with regard to their industrial applicability in manufacturing and occasionally oil and gas drilling processes.

SACNASP

South African Council for Natural Scientific Professions





Suite B 313
Geoscience Buildings
280 Pretoria Rd
Silverton | PRETORIA

Private Bag X540
Silverton 0127
Tel:+ 27 (12) 841 1075
Fax: +27 (12) 841 1057
sarnap@geoscience.org.za

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

Join us on Facebook

SAIP DIVISIONS & MEETINGS

DIVISION	CHAIR	E-MAIL	MEETING
Division for Condensed Matter Physics and Materials	Prof. Japie Engelbrecht	dcmpm@saip.org.za	Wednesday 10 July - 14:30
Nuclear, Particle and Radiation Physics	Dr. Simon Mullins	nuclear@saip.org.za	Friday 12 July - 11:10
Photonics	Prof. Erich Rohwer	photonics@saip.org.za	Tuesday 09 July - 14:30
Astrophysics and Space Science	Dr Ilani Loubscher	astrophysics@saip.org.za	Wednesday 10 July - 09:00
Physics Education	Dr Sam Ramaila	education@saip.org.za	Wednesday 10 July - 14:30
Applied Physics Forum	Dr Freddie Vorster	applied@saip.org.za	Wednesday 10 July - 10:30
Theoretical and Computational Physics	Prof. F G Scholtz	theoretical@saip.org.za	Wednesday 10 July - 09:20

MEETING LIST

MEETING	TIMESLOT	VENUE
SAIP Council meeting: Current members	Monday 8 July 09:30 – 17:00	Boardroom
CSIR NLC Laser Rental Pool User Group	Monday 8 July09:30 – 17:00	
SAIP Council Meeting: New members	Tuesday 9 July 18:40 – 20:40	Boardroom
WiPiSA Lunch	Wednesday 10 July 12:50 – 13:50	
SAIP Students Meeting	Wednesday 10 July	
SAIP Council Meeting with HODs	Wednesday 10 July 18:40 – 20:40	Boardroom
SAIP Council Meeting with Division Chairs	Thursday 11 July 18:00 – 20:00	Boardroom
SAIP Annual General Meeting	Friday 12 July 14:50 – 16:20	A2 - 75

NON SPECIALISTS LECTURES

TRACK	PRESENTER	CONTRB.	TITLE	TIME
DCMPM	Prof. Johannes Neethling	30	Status of Aberration-corrected Transmission Electron Microscopy in South Africa	Friday 12 July - 10:30
Photonics	Dr. Tjaart Krüger	63	Laser spectroscopy of natural light harvesting: unravel, regulate and control	Wednesday 10 July - 16:00
Astrophysics	Prof. Catherine Cress	151	Radio Astronomy at the Centre for High Performance Computing	Wednesday 10 July - 10:30
Space Science	Prof. Ludwig Combrinck	52	Progress with the development of the Lunar Laser Ranger for South Africa	Wednesday 10 July - 11:10
Education	Dr. Raymond Sparrow	569	Skills development and training	Wednesday 10 July - 13:50
Applied	Dr. Igle Gledhill	511	Numerical Modelling of Pavement Materials	Wednesday 10 July - 09:20
Theoretical	Prof. Thomas Konrad	274	Classical optics in the language of quantum mechanics	Friday 12 July - 11:10

APPLICATIONS OF SYNCHROTRON RADIATION : 8 July 2013, Venue A1-10

8:00-9:00	**Registration & Tea**
9:00-9:15	**Welcome & Opening** Prof. Simon Connell - **Venue: A2-75**
9:15-9:20	**Announcement**
9:30-10:45	**Highlights of Synchrotron Science at Elettra** Dr. Andrea Goldoni (Elettra, Italy)
10:45-11:15	**Tea Break**
11:15-12:30	**Magnetic and electronic properties of surfaces by advanced soft x-ray synchrotron radiation techniques** Dr Elena Magnano(IOM-CNR)
12:30-13:00	**General discussion**
13:00-14:00	**Lunch**
14:00-15:15	**Microscopy and nano-lithography with synchrotron radiation.** Dr Marco Lazzarino (IOM-CNR)
15:15-15:35	**Tea Break**
15:35-16:50	**Understanding the growth mechanisms and fine structure of nanostructured carbon grown via CVD using synchrotron radiation** Dr Cinzia Cepek (IOM-CNR)
16:50-17:10	**Opportunities to access International Synchrotrons** Tshepo Ntsoane, (NECSA)

HIGH ENERGY PHYSICS 8 July 2013, Venue A0-59

8:00-9:00	**Registration & Tea**
9:00-9:15	**Welcome & Opening** Prof. Simon Connell - **Venue: A2-75**
9:15-9:20	**Announcement**
9:30-10:00	**Presentation of the National SA-CERN Programme** Prof. J. Cleymans (UCT, iThemba LABS)
10:00-10:45	**Introduction to the Quark-Gluon Plasma** Dr. A. Muronga (UJ)
10:45-11:15	**Tea Break**
11:15-12:30	**Description of the ATLAS detector and the discovery of the Higgs Boson** Dr B. Mellado (WITS)
12:30-13:00	**Description of the ALICE Detector** Dr F. Bossu (iThemba LABS)
13:00-14:00	**Lunch**
14:00-15:15	**Introduction to Modern Topics in High Energy Physics.** Dr W. Horowitz (UCT)
15:15-15:35	**Tea Break**
15:35-16:50	**A virtual tour of the ATLAS Detector** Dr S. Yacoob (UKZN)
16:30-16:50	**Introduction to the UJ Physics Programme at the ATLAS Detector** Dr Elizabeth Castaneda-Miranda (UJ)

BIOPHYSICS WORKSHOP 8 July 2013, Venue A0-56

9:00-9:30	**Introductory Lecture** Raymond Sparrow (CSIR)
9:30-10:10	**Femtosecond Spectroscopy** Tjaart Krüger (University of Pretoria)
10:10-10:50	**Quantum Biology** Francesco Petruccione (UKZN)
10:50-11:10	**Tea**
11:10-11:50	**New tools for correlative light and electron microscopy** Diane van Rossum (Till Photonics, Germany)
11:50-12:30	**Optical manipulation** Patience Mthunzi (CSIR)
12:30-14:00	**Lunch**
14:00-14:40	**Bio-imaging** Ben Loos (Central Analytical Facility)
14:40-15:20	**Modelling of Biological Processes** Kristian Müller-Nedebock (Stellenbosch University)
15:20-15:40	**Tea**
15:40-16:20	**Single-Molecule Spectroscopy: Beyond the Ensemble Average** Tjaart Krüger (University of Pretoria)
16:20-17:00	**Electron Microscopy** Trevor Sewell (UCT)

TUESDAY 9 JULY 2013

7:30 - 8:45	REGISTRATION & TEA			
8:45 - 9:00	WELCOME SESSION (Centre Court)			
9:00 - 10:00	**PLENARY : GOLDONI, Andrea** Investigation of porphyrins on metal surfaces with synchrotron radiation: conformation, magnetic and electronic properties			
10:00 - 10:30	TEA BREAK			
TRACK	**A1:** Div. for Condensed Matter Physics and Materials (A2-75)	**A2:** Div. for Condensed Matter Physics and Materials (A0-60)	**B:** Nuclear, Particle and Radiation Physics (A1-38)	**C:** Photonics (A1-11)
Theme Chair	Msc for Award Francis Dejene	PhD for Award Ted Kroon	Bound to be Clustered in atomic nuclei - LP Masiteng	Beam shaping Pieter Neethling
10:30 - 10:50	Low-Energy Electronic Structure and Fermi Surface of the itinerant metamagnet $Sr_3Ru_2O_7$ — 50 Ms. SOHANFO NGANKEU, Arlette (UJ) MSc	Magnetic Phase Diagram of $Cr_{100-x}Os_x$alloys — 24 Mr. FERNANDO, Pius Rodney PhD	Characterization of the 2+ excitation of Hoyle state in 12C — 224 Mr. NEMULODI, Fhumulani (SU) PhD	Creating and decomposing vector Bessel beams — 16 Dr. DUDLEY, Angela (CSIR)
10:50 - 11:10	Investigation of Diffusion for the ion implanted Xenon in 6H-SiC — 25 Ms. THABETHE, Thabsile (UP) MSc	Characterization of Transition metal nitrides thin films deposited using RF Magnetron Sputtering — 66 Mr. KURIA, Jonah (Wits) PhD	Aspects of the structure of heavy carbon isotopes — 7 Prof. KARATAGLIDIS, Steven (UJ)	A coaxial superposition of coherent Gaussian beams — 79 Mr. NAIDOO, Darryl (CSIR) PhD
11:10 - 11:30	Modification of glassy Carbon under Strontium ion implantation — 55 Ms. ODUTEMOWO, Opeyemi (UP) MSc	Electronic and mechanical properties of the actinide mononitride and dinitride — 23 Mr. OBODO, Kingsley (UP) PhD	Search for the 5 alpha cluster state in 20Ne — 231 Mr. SWARTZ, Jacobus (SU) PhD	Bessel-Gaussian entanglement — 143 Ms. MCLAREN, Melanie (CSIR) PhD
11:30 - 11:50	Luminescent properties of pulse laser deposition (PLD) thin films of SrGa2S4:Ce3+ coated with metallic TaSi2 — 77 Ms. MOLEME, Pulane Msc	Synthesis and characterization metal chalcogenide nanocrystals used as active layers in solar cells — 18 Mr. KALENGA, Pierre Mubiayi (Wits) PhD	Cluster Model Analysis of Th isotopes — 69 Mr. DU TOIT, Erasmus (SU) Msc	Efficient sorting of Bessel beams — 254 Ms. MHLANGA, Thandeka (CSIR) Msc
11:50 - 12:10	Relative stability of graphene and carbon nanotube structures — 133 Ms. SHAI, MOSHIBUDI (UL) MSc	The calculated vacancy formation energies of Al, Ni, Cu, Pd, Ag, and Pt — 118 Ms. VAN DER WALT, Cornelia (UFS) PhD	Status of the study of multi-body decays of heavy nuclei using the modified Light Ions Spectrometer — 80 Mr. MALAZA, Vusi (SU) PhD	Beam shaping with a laser amplifier — 217 Dr. LITVIN, Igor (CSIR)
12:10 - 13:10	**PLENARY : Dr. CEPEK, Cinzia** Synchrotron radiation characterizations of carbon-based nanostructures			
13:10 - 14:10	LUNCH			
Theme Chair	Msc for Award Cinzia Cepek	PhD for Award Japie Engelbrecht	Insights into Nuclear Structure & Re-actions from AFRODITE- Castaneda	Cold atoms Erich Rohwer
14:10 - 14:30		Magnetic properties of the $(Cr_{100-x}Al_x)_{99}V_1$ alloy system — 153 Mr. MUCHONO, Blessed (UJ) PhD	Investigation of the radiative strength function in ^{74}Ge — 98 Dr. NEGI, Dinesh (iTHEMBA LABS)	Cold Atoms at UKZN — 32 Dr. MORRISSEY, Michael (UKZN)
14:30 - 14:50	Synthesis of NIS nanostructures by microwave-assisted hydrothermal technique — 168 Ms. LINGANISO, Ella (CSIR) MSc	AES and TOF-SIMS measurements of In segregation in a polycrystalline Cu crystal — 121 Mr. MADITO, Moshawe (UFS) PhD	Reaction mechanisms studied using the iThemba LABS recoil detector — 67 Dr. NTSHANGASE, Sifiso Senzo (UZ)	DIVISION MEETING — 589
14:50 - 15:10	The effects of substrate temperature on the structure, morphology and photoluminescence properties of pulsed laser deposited Y3 (Al,Ga)5O12:Ce3+ nano thin films — 148 Mr. DLAMINI, Sipho (UFS) MSc		Search for chirality in 193Tl — 265 Mr. NDAYISHIMYE, Joram (SU) PhD	
15:10 - 15:40	TEA BREAK			
Theme Chair	- Max Chirwa	- Mokhotjwa Simon Dhlamini	Tracking progress with a TIGRESS detector - Zipho Ngcobo	Ultra fast spectroscopy Christine Steenkamp
15:40 - 16:00	Computational modelling studies of structural, electronic and mechanical properties of palladium sulphide — 443 Ms. MASENYA, Mamogo (UL)	Hydrogen Functionalized Graphene for possible Spintronics Applications — 8 Prof. RAY, Sekhar Chandra (Wits)	Developing gamma-ray tracking with a segmented Ge detector — 292 Dr. LAWRIE, Elena (iThemba LABS)	Ultrafast photodynamics of charge transfer reactions in Indoline-sensitized ZnO solar cells — 104 Mr. ROHWER, Egmont (SU) PhD
16:00 - 16:20	Computer Simulation Study of Manganese Dioxide Nanotubes — 474 Mr. TSHWANE, David (UL)		Simulating the position sensitivity of the iThemba LABS segmented clover detector — 176 Mr. NONCOLELA, Sive (UWC) PhD	Observation of structural dynamics of 1T-TiSe2 using femtosecond electron diffraction — 127 Ms. SULEIMAN, Aminat Oyiza (SU) Msc
16:20 - 16:40	Spectral selectivity of doped Zinc and Aluminium oxide thin films prepared by spray pyrolysis for Solar Energy applications — 444 Mr. SIMPEMBA, Prospery C. (Copperbelt Univ)	Synthesis of zinc oxide based nanophosphors by solution-combustion method — 49 Dr. KUMAR, Vinod (UFS) PhD	Depletion voltage measurements of the iThemba LABS segmented clover detector — 300 Mr. EASTON, Jayson (iThemba LABS and UWC) PhD	Adaptive quantum coherent control of a multilevel molecular system in the time-frequency domain — 259 Dr. BOTHA, Lourens (CSIR NLC)
16:40 - 17:40	**PLENARY : Dr. MAGNANO, Elena** Magnetic and electronic properties of surfaces by advanced soft x-ray synchrotron radiation techniques			
17:40 - 18:40	POSTER SESSION: Division for Condensed Matter Physics and Materials (First Floor)			

REGISTRATION & TEA

WELCOME SESSION (Centre Court)

PLENARY : GOLDONI, Andrea
Investigation of porphyrins on metal surfaces with synchrotron radiation: conformation, magnetic and electronic properties

TEA BREAK

D1: Astrophysics (A0-56)	**D2:** Space Science (A1-17)	**E:** Physics Education (A0-59)	**F:** Applied Physics (A1-37)	**G:** Theoretical and Computational Physics (A1-10)
- Derck Smits	- Ettienne Koen	- Mark Herbert	Biophysics Tjaart Krüger	- Kristian Müller-Nedebock
SALT Observations of Herschel Discovered Gravitationally Lensed Galaxies 539 Prof. LEEUW, Lerothodi (UNISA)			Quantum coherence and transport processes in photosynthesis 453 Ms. MARAIS, Adriana (UKZN) PhD	The March 2015 total solar eclipse and its potential for testing the General Theory of Relativity 90 Prof. COMBRINCK, Ludwig (HartRAO)
Fuelling the star formation in brightest cluster galaxies 48 Dr. LOUBSER, Ilani (UNW)	Noise sensitivity of a VHF broadband interferometer 21 Mr. WEN, Chih-Fong (UKZN) Msc	The barometer of scientific endeavour: A comparative analysis 73 Dr. RAMAILA, Sam (UJ)		Preliminary site survey for a laser interferometer gravitational-wave observatory (LIGO) for South Africa 551 Prof. COMBRINCK, Ludwig (HartRAO)
Exploring Star Formation in Dwarf Galaxies at z~1 with the Hubble Space Telescope 109 Ms. RAMRAJ, Riona (UCT SAAO) Msc	Particle flux forecast using space wind parameters in a multivariate auto-regressive model with Kalman filtering 36 Ms. HILLEBRAND, Charlotte (UKZN) Hon	The Virtual Observatory - A New Era for Astronomy Education 128 Dr. BARWAY, Sudhanshu (SAAO)	Femtosecond spectroscopy of the carotenoids in the main light-harvesting complex of plants 216 Mr. BOTHA, Joshua (CSIR NLC)	Investigation of Phase Transitions in Tungsten Trioxide 269 Mr. GOVENDER, Malcolm (CSIR) PhD
	Detecting Lightning Distribution Changes using Satellite Imagery 35 Ms. BOOYSENS, Aimee (SANSA) Hon	Postgraduate student driven outreach in physics at Stellenbosch University 82 Mr. RIGBY, Charles (SU)	The role of catalytic residues in amidases as revealed by mutagenesis and X-ray crystallography 119 Prof. SEWELL, Trevor (UCT)	
The Sutherland site seeing conditions and the prospect of an AO system for SALT 355 Ms. CATALA, laure (UCT SAAO) PhD	Monitoring land-cover changes using satellite imagery 40 Mr. GOOSEN, Wayne (SANSA) Hon	Is there a gap between the high school curriculum and first year university experience? 513 Ms. SONDEZI, Buyi (UJ)	Laser Penetration through different skin phototypes 160 Dr. KARSTEN, Aletta (CSIR)	

PLENARY : Dr. CEPEK, Cinzia
Synchrotron radiation characterizations of carbon-based nanostructures

LUNCH

- Christo Venter	- Nkanyiso Mbatha	- Mdumiseni Nxumalo	Biophysics Raymond Sparrow	-
Galaxy peculiar velocities in the Zone of Avoidance 278 Mr. SAID, Khaled (UCT) Msc	Prediction of foF2 from GPS TEC over AFRICA 283 Mr. SSESSANGA, Nicholas (SANSA) PhD		The mechanism of the amidases: Mutating the glutamate adjacent to the catalytic triad inactivates the enzyme 573 Prof. SEWELL, Bryan Trevor (UCT)	
Development of an Improved Mode Identification Formula For Pulsating Stars 61 Mr. MEKONNEN MENGISTIE, Getachew (NWU) PhD		Using Astronomy to enhance Physics teaching at undergraduate level 433 Ms. CATALA, laure (SAAO-UCT)	Modelling interacting filaments in motility assays 448 Prof. MüLLER-NEDEBOCK, Kristian (SU)	
	Tomographic imaging of the ionospheric structure and disturbances in the region of the East-Central Africa region 434 MUTALE, Mubela (Univ Zambia) Hon	Overview of the Extended Curriculum Programme Physics at the University of the Western Cape 197 Dr. HERBERT, Mark (UWC)	A matched quadruplet of terbium radionuclides for nuclear imaging and radionuclide therapy 220 Dr. STEYN, Deon (iTEMBA LABS)	

TEA BREAK

- Lerothodi Leeuw	- Brady Wen	- Douglas Clerk	Materials Mmantsae Diale	-
The Virtual Atomic and Molecular Data Centre (VAMDC) 9 Prof. SMITS, Derck (UNISA)	Progress towards a GIC prediction framework 123 Dr. LOTZ, Stefan (SANSA)	If 1+1=3, then E=1/2mc! 214 Dr. CARLESCHI, Emanuela (UJ)	Solid state reaction of ruthenium with silicon carbide, and the implications for its use as a schottky contact for high temp. operating schottky diodes 33 Mr. MUNTHALI, Kinnock Vundawaka (UP) PhD	
Elemental abundance determinations in photoionized nebulae 164 Ms. PROZESKY, Andri (UNISA) PhD	Extraction of surface impedance from magnetotelluric data 218 Mr. KHANYILE, Sfundo (SANSA) Msc	University students performance in different types of exam questions informs on their problem solving skills as well as studying ability 554 Dr. ALBERS, Claudia (WITS)	The variation of dose rate dependence parameters of synthetic diamond detectors with electron energy 111 Mr. ADE, Nicholas (Wits) PhD	
Spectroscopic Observations of Eclipsing Contact Binary Stars 76 Ms. SKELTON, Patricia (UNISA) PhD	Estimation of Arrival Time, Duration, and Intensity of Major Storms Caused by Earth Directed Halo Coronal Mass Ejections Using the WSA-Enlil Cone Model 65 Mr. ALAMIREW, Netsanet (UCT, SANSA) Msc	The IAU Office of Astronomy Development 358 Dr. MAUDUIT, Jean-Christophe (IAU)	A Novel Mode of Current Switching Dependent on Activated Charge Transport 572 Mr. WALTON, Stanley (UCT) PhD	

PLENARY : Dr. MAGNANO, Elena
Magnetic and electronic properties of surfaces by advanced soft x-ray synchrotron radiation techniques

POSTER SESSION: Division for Condensed Matter Physics and Materials (First Floor)

WEDNESDAY 10 JULY 2013

7:30 - 8:00	**REGISTRATION & TEA**			
8:00 - 9:00	**PLENARY :**			
TRACK	**A1:** Div. for Condensed Matter Physics and Materials (A2-75)	**A2:** Div. for Condensed Matter Physics and Materials (A0-60)	**B:** Nuclear, Particle and Radiation Physics (A1-38)	**C:** Photonics (A1-11)
Theme Chair	MSc for Award Vijay Kumar	PhD for Award Johan Malherbe	Quirks of Quarkonia but nothing tops ZZ decay channels- Bruce Mellado	Bio photonics Erich Rohwer
09:00 - 09:20	248 Advanced Power Sources for Electronic Devices and Electric Vehicles Mr. MASEDI, Cliffton (UL) Msc	202 The effect of chemical pressure on the ferromagnetic (FM) ordering of Ce*TX* compounds Ms. SONDEZI, Buyi (UJ) PhD	529 Phenomenological interpolation of quarkonia cross sections Dr. BOSSU, Francesco (iThemba LABS)	166 Low Intensity Laser Irradiation (LILI) in combination with Growth Factors in a Co-culture System supports the Differentiation of Mesenchymal Stem Cells Mr. MVULA, Bernard PhD
09:20 - 09:40	198 High temperature conductance fluctuations and Tomonaga - Luttinger liquid behaviour of aligned metallic SWCNT ropes Ms. NCUBE, Siphephile Msc	268 Structural and Magnetic Properties of MgxSrxMnxCo1-3xFe2O4 Nanoparticle ferrites Mr. OSMAN, Nadir (UKZN) PhD	155 Research progress in the H-> ZZ$^{(*)}$ -> $t^+ t^- l^+ l^-$ decay channel Mr. HAMITY, Guillermo (WITS)	135 The Impact of Low Intensity Laser Irradiation on Lung Cancer Stem Cell Viability and Proliferation Ms. CROUS, Anna Magdalena Msc
09:40 - 10:00		267 Synthesis, characterization and gas sensing applications of Tungsten Trioxide Mr. GOVENDER, Malcolm (CSIR) PhD	172 Leptons from J/y and heavy-flavour hadron decays in pp and Pb-Pb collisions studied with ALICE at the LHC Dr. FöRTSCH, Siegfried (iThemba LABS)	547 Graphene substrates for increased embryonic stem cell optical transfection efficiency Dr. MTHUNZI, Patience (CSIR - NLC)
10:00 - 10:30	**TEA BREAK**			
Theme Chair	Msc for Award Vinod Kumar	PhD for Award Erasmus Koena Rammutla	Holding up the world with ATLAS Simon Connell	Laser development Lourens Botha
10:30 - 10:50	508 Analysis of controlled structural disorder in few layer graphite and graphene Ms. SANDERS, Kirsty (Wits) MSc	279 New Techniques for Determining Dopant Concentrations In Nitrogen Doped Carbon Nanospheres Mr. MARSICANO, Vincent (Wits) PhD	195 Identifying Exclusive Proton-Proton Interactions in the ATLAS Experiment Mr. SCHENCK, Ferdinand (UCT) Msc	193 A CW and Actively Q-switched Thulium-doped Fibre Laser Mr. COETZEE, Riaan Stuart (SU) Msc
10:50 - 11:10	517 Electronic Transport Properties of Silicon-germanium Nanowires Mr. ASLAN, Tahir (Wits) Msc	458 Spin-lattice relaxation in Fe implanted ZnO Mr. MASENDA, Hilary (Wits) PhD	512 Using the Higgs as a portal to the "hidden sector" Dr. CASTANEDA, Elizabeth (UJ)	479 A 2-crystal high-power CW and Q-switched Nd:YLF laser at 1314nm Mr. BOTHA, Roelf (HartRAO)
11:10 - 11:30	515 Magnetic Properties of CoFe2O4/CoFe2 nanocomposites reduced by activated charcoal in argon atmosphere Mr. EZEKIEL, Itegbeyogene (UKZN) Msc	297 The effect of EWG and EDG on the HOMO and LUMO levels of Alq3 Ms. DUVENHAGE, Mart-Mari (UFS) PhD	134 Search of invisible anomalous Higgs boson decays with the ATLAS detector at the LHC MOLEFI, Itumeleng	468 5 Watt Zinc Germanium Phosphide Optical Parametric Oscillator Mr. JACOBS, Cobus (CSIR)
11:30 - 11:50	263 Mott's Variable Range Hopping Model: an Easy Method for Identification of Phase Transition Mr. AKANDE, Amos (CSIR, UL) Msc	477 White Cathodoluminescence $Zn_{0.3}Mg_{0.7}Al_2O_4$:Tb^{3+};Eu^{3+} Mr. SHAAT, Samy (UFS) PhD	234 Applications of JIMLWK Evolution to Exclusive J/y Production in the ATLAS Detector Ms. RAMNATH, Andrecia (UCT) Msc	470 Acousto vs. Electro Optic Modulators in Short pulse, high peak power Q-switched lasers Mr. MAWEZA, Loyiso (CSIR) PhD
11:50 - 12:50	**PLENARY: Prof. MONTANARI, Barbara** **Gender Gap in Science and Leadership**			
12:50 - 13:50	**LUNCH**			
Theme Chair	Msc for Award Japie Engelbrecht	PhD for Award Hendrik Swart	Giants amongst Resonances : the Ultimate Collectiivity- S Karataglidis	Spectroscopy Pieter Neethling
13:50 - 14:10		527 Back surface influence on Brillouin scattering in ion-implanted chemical vapor deposited diamond Mr. MOTOCHI, Isaac (Wits) PhD	255 A survey of the fine structure phenomenon of the Isovector Giant Dipole Resonance in nuclei across the periodic table at a forward scattering angle Prof. CARTER, J (Wits)	83 An improved Nd:YAG laser pumped setup for vacuum ultra violet spectroscopy of carbon monoxide molecules Mr. RIGBY, Charles (SU) PhD
14:10 - 14:30	37 The Electrical Transport Properties of Bulk Nitrogen Doped Carbon Microspheres Mr. WRIGHT, William (Wits) Msc	169 High frequency Luttinger liquid excitations and ballistic transport in aligned CNTs range at room temperature Mr. CHIMOWA, George (Wits) PhD	251 Fine structure of the Isoscalar Giant Quadrupole Resonance using proton inelastic scattering at 200 MeV in spherical to highly deformed neodymium isotopes Dr. USMAN, I. T (Wits)	122 Simultaneous measurement of EFISH in transmission and in reflection from the Si/SiO2 interface of a thin Si membrane Mr. NDEBEKA, Wilfrid (SU) PhD
14:30 - 14:50	DIVISION MEETING	588	249 Influence of the proton core on the fine structure of the Isovector Giant Dipole Resonance as a function of nuclear deformation across the neody-mium & samarium isotope chains Ms. DONALDSON, Lindsay (Wits) PhD	131 The effect of SLM dependent dispersion on spatial beam shaping Mr. SPANGENBERG, Dirk-Mathys (SU) PhD
14:50 - 15:10			230 Quasi-free nucleon knockout contribution in 40Ca(p,p') inclusive scattering at 200 MeV Dr. USMAN, Iyabo (Wits)	446 Material characterization using Terahertz time-domain spectroscopy Mr. SMITH, Shane Msc
15:10 - 15:40	**TEA BREAK**			

REGISTRATION & TEA

PLENARY :

D1: Astrophysics (A0-56)	D2: Space Science (A1-17)	E: Physics Education (A0-59)	F: Applied Physics (A1-37)	G: Theoretical and Computational Physics (A1-10)
- Ilani Loubser	-	- Paul Molefe	Modelling Ernest van Dyk	- Frederik Scholtz
584 DIVISION MEETING		215 First year astronomy students interpretation of the term "radiation" — Ms. TAKANE, Mpeli (UCT) Msc	14 Lightning Activity Predictions for Single Buoy Moorings — Dr. COLLIER, Andrew (SANSA)	184 Three-body Bound state calculations — Mr. MUKERU, Bahati (UNISA) PhD
		74 A scientifically efficient approach for uniform evaluation of Physics practicals using software embedded and improvisation-based system at Doornfontein Campus of the University of Johannesburg — Dr. RAMAILA, Sam (UJ)	511 NON-SPECIALIST: Numerical Modelling of Pavement Materials	583 DIVISION MEETING
		244 What is problem-solving? — Dr. NAIDOO, Deena (Wits)	Dr. GLEDHILL, Irvy (Igle) (CSIR)	

TEA BREAK

- Ilani Loubser	- Shimul Maharaj	- Deena Naidoo	- Frederick Vorster	- Thomas Konrad
151 NON-SPECIALIST: Radio Astronomy at the Centre for High Performance Computing — Prof. CRESS, Catherine (CHPC, UWC)	47 Study of the time variation of geomagnetic field over Southern Africa applying harmonic splines technique on CHAMP satellite data — Mr. NAHAYO, Emmanuel (SANSA)	72 Competency in units and measurement: Does it provide a good indicator of the performance of students in university first year Physics? — Dr. REDDY, Leelakrishna (UJ)	586 DIVISION MEETING	451 Modelling the stability of a semiflexible network tethered to a membrane — Prof. MüLLER-NEDEBOCK, Kristian (SU)
		253 Active Learning 101 — Mr. CLERK, Douglas (Wits)		6 Concavity of energy surfaces — Prof. KARATAGLIDIS, Steven (UJ)
116 Line, LINER, linest - from micro-AGN to ultra-luminous LINERS. One and the same? — Prof. WINKLER, Hartmut (UJ)	52 NON-SPECIALIST: Progress with the development of the Lunar Laser Ranger for South Africa	288 Correlation between the social background of a selected group of grade 10 learners and their views on the nature of science — Mr. BALOYI, Vonani (UP) PhD	301 South African night sky brightness during high aerosol epochs — Prof. WINKLER, Hartmut (UJ)	75 Heavy Baryons with Strangeness — Mr. BLANCKENBERG, Jaco (SU) PhD
209 Dust in the Radio Galaxy and Merger Remnant NGC 1316 (Fornax A) — Mr. ASABERE, Bernard Duah (UJ) Msc	Prof. COMBRINCK, Ludwig (HartRAO)	170 Exploring Science Shows that Bridge the Gap between Indigenous Knowledge (IK) and Modern Science: The Lightning (Electricity) Show — Mr. NXUMALO, Mdumiseni (UZ)		505 Finite-size key in QKD protocols for Renyi entropies — Mr. MAFU, Mhlambululi (Centre for Quantum Technology) PhD

PLENARY: Prof. MONTANARI, Barbara
Gender Gap in Science and Leadership

LUNCH

- Theodore Williams	- Jacob Bortnik	- Sam Ramaila	Telecommunication Phil Ferrer	- Francesco Petruccione
240 Advanced simulation techniques for the design of next generation radio interferometers — Mr. ATEMKENG TEUFACK, Marcellin (RU) PhD	43 Improvements in accuracy of a real-time orbital propagator by modelling perturbation forces acting on a LEO CubeSat — Mr. TSHILANDE, Thinawanga (SANSA) Mte	569 NON-SPECIALIST: Skills development and training	86 Advancement of quantum ommunication through entanglement — Ms. ISMAIL, Yaseera (UKZN) PhD	365 The Emergence of Gravitational Spaces — Mr. MOOLMAN, Simon (Wits) Msc
242 New minimization techniques, solvers and calibration algorithms — Mr. GAZOYA, Emmanuel (RU) PhD	429 Correlation between SQUID data and ionospheric and/or seismic events — Mr. MATLADI, Thabang (SANSA) Men	Dr. SPARROW, Raymond Walter	171 Chromatic dispersion compensation for VCSEL transmission for applications such as Square Kilometre Array South Africa — Mr. ROTICH KIPNOO, Enoch (NMMU) PhD	186 Simulating Black-Hole Radiation — Mr. CARLSON, Warren (Wits) PhD
236 Measuring and correcting primary beam instability in radio interferometry — Mr. MAKHATHINI, Spheshile (RU) PhD	150 Characterization of TRINNI events — Mr. GARAPO, Kevin (UKZN) PhD	582 DIVISION MEETING	311 Implementation and security analysis of fiber-based B92 QKD protocol — Mr. SENEKANE, Makhamisa (UKZN) PhD	188 Black-Hole Pulsar Binaries: Simulations on the Grid — Mr. CARLSON, Warren (Wits) PhD
235 Analysis of Self-Calibration Artefacts — Ms. NUNHOKEE, Chuneeta Devi (RU) Msc	200 Acoustic resonators above sunspot umbrae — Dr. BOTHA, G.J.J. (Northumbria University)		320 FPGA-based emulation of qudit quantum Fourier transform circuit — Mr. SENEKANE, Makhamisa (UKZN) PhD	568 Nuclear Matter Equation of State and the Neutron Stars — Prof. MURONGA, Azwinndini (UJ)

TEA BREAK

WEDNESDAY 10 JULY 2013

TRACK	A1: Div. for Condensed Matter Physics and Materials (A2-75)	A2: Div. for Condensed Matter Physics and Materials (A0-60)	B: Nuclear, Particle and Radiation Physics (A1-38)	C: Photonics (A1-11)
Theme Chair	- Mandla Msimanga	- Hafiz Abdallah	Banking on Monte Carlo methods Iyabo Usman	Digital laser Lourens Botha
15:40 - 16:00	Ab initio simulation study of spinel $LiMn_2O_4$ and nickel doped $LiMn_2O_4$ 476 Mr. MALATJI, Kemeridge Tumelo (UL)		Cytogenetic analysis of Co-60 y-radiation-induced chromosome damage and simulations using the Geant4 Monte Carlo toolkit 46 Mr. FOURIE, Hein (SU) Msc	The digital laser 276 Mr. NGCOBO, Sandile (CSIR) PhD
16:00 - 16:20	Computer simulation studies of SPINEL $LiTi_2O_4$ 481 Ms. LEDWABA, Raesibe Sylvia (UL)	Degradation of organic solar cells with solution processed ZnO 129 Ms. MBULE, Pontsho Sylvia (UFS)	Monte Carlo simulation of Neutron Transport in Nuclear Reactors 257 Ms. MUDAU, Rotondwa (UJ) Msc	NON-SPECIALIST: Laser spectroscopy of natural light harvesting: unravel, regulate and control 63
16:20 - 16:40	Phase stability and martensitic transformation of TiPt shape memory alloys 480 Mr. MASHAMAITE, Mordecai (UL)	Energy loss and energy loss straggling of (MeV) heavy ions through thin film materials by Time of Flight spectrometry 99 Dr. MSIMANGA, Mandla (iThemba LABS)	Validation of a passive beam Monte Carlo model for measuring prompt gamma rays during proton adiotherapy 232 Mr. JEYASUGITHTHAN, Jeyasingam (UCT) PhD	Dr. KRüGER, Tjaart (UP)
16:40 - 17:40	**PLENARY : Dr. LAZZARINO, Marco** **Nanomechanical sensing for biology and medicine**			
17:40 - 18:40	**POSTER SESSION: NPRP, Photonics, Astro & Space, Education, Applied and Theoretical (Second Floor)**			

WEDNESDAY 10 JULY 2013

D1: Astrophysics (A0-56)	**D2:** Space Science (A1-17)	**E:** Physics Education (A0-59)	**F:** Applied Physics (A1-37)	**G:** Theoretical and Computational Physics (A1-10)
- Andreas Faltenbacher	- Andrew Collier	- Sam Ramaila	Radiation Physics Trevor Derry	- Azwinndini Muronga
	Electrostatic wave Instabilities driven by counter-streaming electron beams in space plasmas 58 Mr. MBULI, Lifa (SANSA, UKZN) Msc	National Report on Review of undergraduate physics education in public higher education institutions 590	Analysis of the spatial and spectral neutron distribution of various conceptual core designs with the aim of optimising the SAFARI-1 research reactor 387 Mr. OLAUWALEYE, Olakunle (UJ) Msc	Quantum Teleportation of photonic multi-level systems 524 Prof. KONRAD, Thomas (UKZN)
Shedding light on the invisible Radio signals from Dark Matter 296 Ms. ORFORD, Nicola (Wits) Msc	Nonlinear ion-acoustic and electron-acoustic waves in multi-ion space plasmas 92 Dr. MAHARAJ, Shimul Kumar (SANSA)		Ion Beam Modification of the Structure and Properties of Hexagonal Boron Nitride 541 Ms. ARADI, Emily (Wits) PhD	Nitrogen-Vacancy colour centre in diamond characterization using QUANTUM ESPRESSO 509 Mr. ZULU, Bheki (UKZN) PhD
Polarized Compton scattering in cosmic structures 441 Mr. EMRITTE, Mohammad Shehzad (Wits) Msc	Simulations of ion acoustic waves in Saturn's magnetosphere 28 Mr. KOEN, Etienne (SANSA) PhD		Elemental analysis of Kimberlite and associated Country Rock 516 Mr. TCHONANG POKAHA, Marius (UJ) PhD	Quantum Measurements Along Accelerated World-Lines 463 Mr. HARTMAN, Jonathan (UJ) PhD

PLENARY : Dr. LAZZARINO, Marco
Nanomechanical sensing for biology and medicine

POSTER SESSION: NPRP, Photonics, Astro & Space, Education, Applied and Theoretical (Second Floor)

THURSDAY 11 JULY 2013

07:30 - 08:00	**REGISTRATION & TEA**
08:00 - 09:00	**PLENARY : Prof. WILLIAMS, Theodore** **Dark Matter - the Unseen Universe**
09:00 - 10:00	**PLENARY : Dr. YACOOB, Sahal** **Beyond the Standard**
10:00 - 11:00	**PLENARY : Prof. FEURER, Thomas** **Shaping frequency entangled photon pairs**
11:00 - 18:00	**EXCURSION**

FRIDAY 12 JULY 2013

7:30 - 8:00	**REGISTRATION & TEA**			
8:00 - 9:00	**PLENARY : Dr. BORTNIK, Jacob** **Recent progress in understanding very low frequency waves, high energy particles, and the coupled inner magnetospheric environment**			
TRACK	**A1:** Div. for Condensed Matter Physics and Materials (A2-75)	**A2:** Div. for Condensed Matter Physics and Materials (A0-60)	**B:** Nuclear, Particle and Radiation Physics (A1-38)	**C:** Photonics (A1-11)
Theme Chair	- Joseph Asante	- Sekhar Chandra Ray	Applied Radio-activity : Neutron-Activated and Natural- Vusi Malaza	Fibres optics Pieter Neethling
09:00 - 09:20	Computational study of anatase TiO_2 nanotube as an anode material for lithium ion batteries 491 Mr. GANDAMIPFA, Mulatedzi (UL)	Carbon in Modern Nuclear Reactors 555 Prof. MALHERBE, Johan (UP)	Emissions of Trace Elements from Motor Vehicles Monitored by Active Biomonitoring: a tunnel study in the Western Cape, South Africa using ICP-MS and neutron activation 203 Ms. NDLOVU, Ntombizikhona Beaulah (SU) PhD	Is long distance free-space quantum communication with the OAM state of light feasible? 219 Ms. MCLAREN, Melanie (CSIR) PhD
09:20 - 09:40	DFT+U study of Li adsorption on (110) ß-MnO_2 surface 483 Ms. MAENETJA, Khomotso (UL)		Determination of U-235 in the context of interference with Ra-226 for the study of the disequilibrium in the U-238 decay series 520 Mr. KHUMALO, Thokozani (UJ) Msc	Fibre Bragg grating Sensor For Real Time Fence Monitoring 205 Ms. MUKARUGINA, Stephanie (UJ) Msc
09:40 - 10:00	Electronic and Optical properties of Si_3Al(P, As) 564 Dr. AZEMTSA DONFACK, Hermann (UNISA)	Synthesis and characterization of novel semiconductor nanocrystals for third generation solar cells 431 Dr. MOLOTO, Nosipho (Wits)	To study the mobility of the naturally radioactive materials (NORMs) in the sediments as a function of changing environmental conditions 503 Mr. SHONGWE, Nkosinathi Sipho (UJ) Msc	Hot-Spot Detection and Location over an Optical Fibre 438 Mr. KABOKO, Jean-Jacques Monga (UJ) PhD
10:00 - 10:30	**TEA BREAK**			
Theme Chair	- Moise Bertin	- Johan Malherbe	Fast Neutron fluence and damage Simon Connell	Advances in Laser & optics Erich Rohwer
10:30 - 10:50	NON-SPECIALIST: Status of Aberration-corrected Transmission Electron Microscopy in South Africa 30		Comparison of neutron fluence spectra measured with NE213 proton recoil spectrometer and NE230 deuteron recoil spectrometer 256 Mr. MASONDO, Vusumuzi Msc	Improvement of calibration accuracy in fibre optic wavelength for DWDM applications 427 Dr. ADRIAAN, van Brakel (NMISA) ?
10:50 - 11:10	Prof. NEETHLING, Johannes (NMMU)		Study of fast neutron irradiation induced damage on Graphite and Zircaloy-4 175 Mr. MAHAFA, Tshepo (UJ) Msc	A Theoretical Model and Simulation of Low-Reflectivity Active Linear Cavity for temperature and vibration sensing 504 Mr. DELLA TAMIN, Michelin (UJ) Mr. OKAFOR, Emmanuel E. (UJ) Msc
11:10 - 11:30	Characterization and Optimization of P3HT and PCBM blends for Photo-absorbance 530 Mr. KALONGA, Given (Zambia Bureau of Standards)	Benefits of the circular current's duo Cartesian magnetic dipolar model 560 Dr. CHIRWA, Max (WSU)	DIVISION MEETING 594	Stability of a laser cavity with non-parabolic phase transformation elements 137 Dr. LITVIN, Igor (CSIR NLC) ?
11:30 - 11:50	Computational Modelling Study of nickel-rich pentlandite {111} surface 486 Mr. MKHONTO, Peace Prince (UL)	Ab initio calculations on the structural, electronic and optical properties of the hazardous silver nitrides 557 Mr. SULEIMAN, MOHAMMED S. H. (Wits)		Thermal aberrations in optical materials 162 Mrs. BURGER, Liesl (CSIR NLC) PhD
11:50 - 12:50	**PLENARY : Prof. BRUKNER, Caslav** **Quantum Interference of "Clocks"**			
12:50 - 13:50	**LUNCH**			
13:50 - 14:50	**PLENARY : Prof. SIGALAS, Iakovos** **Hard and Ultrahard Materials Research at the University of the Witwatersrand**			
14:50 - 16:20	**GENERAL MEETING**			
17:00 - 23:00	**BANQUET**			

REGISTRATION & TEA

PLENARY : Dr. BORTNIK, Jacob
Recent progress in understanding very low frequency waves, high energy particles, and the coupled inner magnetospheric environment

D1: Astrophysics (A0-56)	**D2:** Space Science (A1-17)	**E:** Physics Education (A0-59)	**F:** Applied Physics (A1-37)	**G:** Theoretical and Computational Physics (A1-10)
- Catherine Cress	-	- Leelakrishna Reddy	Renewable Energy Frederik Vorster	- Frederik Scholtz
Effects of tides on the occurrence of pulsations in components of binary star systems 507 Mr. PREDIERI, Massimo (Wits) Msc		Physics foundation program: Implications for second year mainstream physics module 514 Mr. MOLEFE, Paul (UJ)	On the characterisation of photovoltaic solar cells by means of device parameter extraction algorithms 229 Mr. BEZUIDENHOUT, Lucian (NMMU) Msc	Quantum teleportation, quantum scissor and quantum transcription 260 Dr. GOYAL, Sandeep (UKZN)
Investigation of characteristic signals of a black-hole pulsar binary system on the grid 149 Mr. CARLSON, Bevan (Wits)		The challenges of tutor training for high school learners 567 Prof. MURONGA, Azwinndini (UJ)	Comparison of indoor and outdoor current-voltage characterisation of photovoltaic modules 284 Ms. CROZIER, Jacqui (NMMU) PhD	Scalable implementation scheme for quantum walks using classical light 258 Dr. GOYAL, Sandeep (UKZN)
How circumstellar discs in Be stars influence mass accretion in Be/X-ray binary systems 78 Mr. MONAGENG, Itumeleng (UCT, SAAO) Msc		Conceptual Coherence By Contrast 179 Mr. SCHWARTZ, MJ (UZ)	Effect of spectral changes on I-V parameters of triple junction solar cells 266 Mr. KWARIKUNDA, Nicholas (NMMU) PhD	

TEA BREAK

- Hartmut Winkler	-		Renewable Energy Sampson Mamphweli	- Steven Karataglidis
CTA: The next-generation giant for ground-based Gamma-ray Astronomy 91 Mr. DAVIDS, Isak Delberth (NWU) PhD			Modeling and real time simulation of instantaneous performance of residential air source heat pump water heater 10 Mr. TANGWE, Stephen Loh (UFH) Msc	
Modelling the light curves of Fermi LAT millisecond pulsars 102 Dr. VENTER, Christo (NWU)			Effect of air dynamics in the concentrator and behind the rotor on power output of a Concentrator Augmented Wind Turbine (CAWT) 440 Ms. SHONHIWA, Chipo (UFH) PhD	A review of generalized and unsharp measurements 262 Ms. BASSA, Humairah (UKZN, CSIR NLC) PhD
Modelling the gamma-ray and radio light curves of the double pulsar system 245 Mr. SEYFFERT, Albertus (NWU) Msc			Development of a Large Area Light Beam Induced Current scanner 478 Dr. VORSTER, Frederik (NMMU)	NON-SPECIALIST: Classical optics in the language of quantum mechanics 274
Implementation of an offset-dipole magnetic field in a geometric pulsar emission code 213 Ms. BREED, Monica (NWU)				Prof. KONRAD, Thomas (UKZN)

PLENARY: Prof. BRUKNER, Caslav
Quantum Interference of "Clocks"

LUNCH

PLENARY : Prof. SIGALAS, Iakovos
Hard and Ultrahard Materials Research at the University of the Witwatersrand

GENERAL MEETING

BANQUET

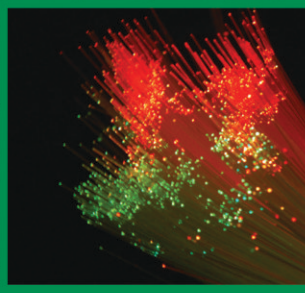
Nelson Mandela Metropolitan University

for tomorrow

Department of

Physics

Faculty of Science



RENEWABLE ENERGY

Sustainable Energy for the Future

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

The following Applied Physics skills are also acquired:

- LabView programming
- Data acquisition system design
- Computer- equipment interfacing
- Data acquisition an analysis
- Curve fitting and parameter extraction

Future student projects include:

- Advanced Light Beam Induced Current (LBIC) characterisation
- PV device performance parameter extraction
- Concentrator PV technology development
- Solar Resource assessment

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

OPTICAL FIBRE TELECOMMUNICATION RESEARCH

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

NMMU has one of the best equipped Optical Fibre Research laboratories in Africa.

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

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

The Optical Fibre Research Unit is part of the Telkom-sponsored Centre of Excellence.

Scholarship opportunities are available for good, motivated students.

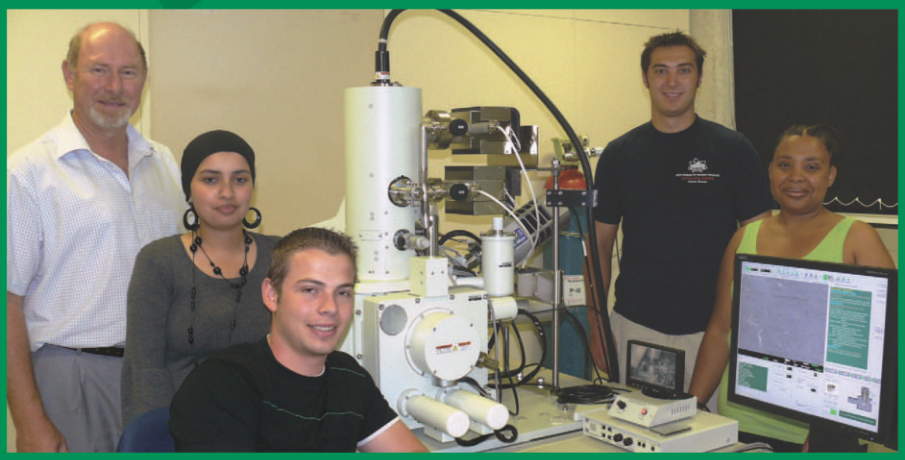
CONTACT
Prof Tim Gibbon
Tim.Gibbon@nmmu.ac.za

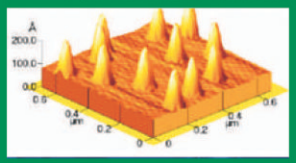
Nelson Mandela Metropolitan University

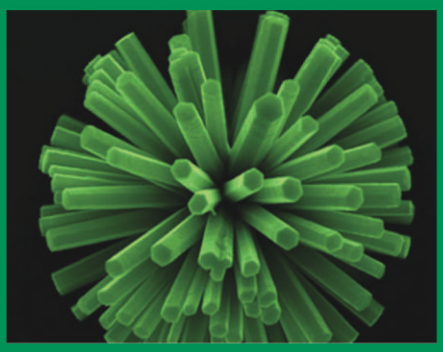
for tomorrow

Faculty of Science

Department of Physics







NANOPHYSICS RESEARCH AND CAREER OPPORTUNITIES

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

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

NMMU'S TRACK RECORD IN NANOPHYSICS AND ELECTRON MICROSCOPY

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

NANOPHOTONICS

Nano-sized materials for opto-electronic devices

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

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

WE CURRENTLY DEVELOP:

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

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

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

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

POSTER SESSION 1

C#	Presenter(s)	Award	Title
2	Dr. TLALI, Spirit & Mr. MORUTI, Kao & Mr. MOLEKO, Nkuebe	N/A	Study of Nanomaterials under High Pressure
5	Mr. SEBITLA, LESOLLE	N/A	Room Temperature and High Temperature Ion Implantation of Cadmium (Cd) in Glassy Carbon: Diffusion behaviour and Raman Analysis
15	Dr. DUDLEY, Angela	N/A	Encoding mutually unbiased bases in orbital angular momentum for quantum key distribution
17	Mr. OUMA, Cecil	PhD	On the metastability of the C center in Silicon: An ab initio study
26	Mr. JILI, Thulani	N/A	Theoretical Study of Positron States in Barium Flouride using Independent Particle Model and Generalized Gradient Approximation
42	Prof. ENGELBRECHT, Japie	N/A	Assessment of Neutron-Irradiated 3C-SiC
44	Mr. MOTLOUNG, Setumo Victor	PhD	Effects of Cr3+ions concentration in Cr-doped ZnAl2O4 nanocrystals synthesized using sol-gel process
54	Mr. NOTO, Luyanda Lunga	PhD	Effects of different TiO2 phases on the luminescence of CaTiO3:Pr3+
56	Mr. MADIBA, itani given	N/A	Competitive Growth Texture of Pulse Laser Deposited VO2 Nanostructures on Glass Substrate
57	Mr. YAGOUB, MYA	PhD	Luminescent properties of Pr3+doped SrF2 at different synthesis
64	Ms. THABEZHE, Nokwethemba Fortunate	MSc	Thermodynamic stability of VO2 in contact with thin metal films
71	Mrs. MOHMMED JAFER BAKEET, Rasha	PhD	Luminescent properties of Y2O3:Bi3+
81	Mr. NAIDOO, Darryl	PhD	Azimuthal beam superpositions with intra-cavity rings
87	Mr. YOUSIF, A.	PhD	Effect of different annealing times on the structure of Y3(Al,Ga)5O12:Tb thin film grown by PLD
88	Ms. TSHABALALA, Modiehi Amelia	PhD	Synthesis and Characterization of white light emitting Sr2SiO4:Tb3+,Eu3+phosphor
89	Dr. KUMAR, Vijay	PhD	Raman Spectral Analysis of Organometallic Composite Film Synthesized by Electrochemical Route
94	Ms. MOKOENA, Puseletso	MSc	Luminescent properties of Ca5(PO4)3OH:Gd3+, Pr3+phosphor powder
95	Mr. NYAWO, Thembinkosi & Mr. THETHWAYO, Charles Thulani	MSc	Synthesis and characterization of magnetron sputter deposited Ge-nanowires
97	Mr. NYAWO, Thembinkosi & Prof. NDWANDWE, Muzi	N/A	Growth and characterization of carbon nanotubes on ZrN thin film surfaces
100	Mrs. JACOBS, Susan	N/A	Magnetic properties of Cr/Cr99.65Ru0.35 hetero-structures
105	Mr. ONDZIBOU, Ninon Gildas	N/A	Structural and electronic properties of transition metal chalcogenides (MoS2 , Mo2 S4 , and Mo6 S8)
108	Mr. DONGHO NGUIMDO, Guy Moise	N/A	Structural and electronic properties of chalcopyrite AIAgX2 and AICuX2(X= S, Se, Te)
110	Mr. DLAMINI, Sanele	N/A	Experimental Setup in Cold Atom Experiment
112	Ms. FOKA, Kewele Emily	PhD	YVO4:Eu3+thin films prepared by PLD
113	Dr. DOLO, JAPPIE	N/A	Effect of zinc acetateconcentrations on the structure, morphology and optical properties of ZnOnanoflakes synthesized by chemical bath deposition method
132	Mr. OLAOYE, Olufemi(Opeyemi)	PhD	Analysis of electron diffraction patterns in DCNQI salts
140	Mr. UNUIGBE, David	PhD	Production and characterisation of silicon nanoparticles for printed electronics
144	Ms. MCLAREN, Melanie	PhD	Quantum entanglement with a Hermite-Gaussian pump
154	Mr. KOAO, Lehlohonolo	PhD	Effect of synthesis temperature on the structure, morphology and optical properties of PbS nanoparticles prepared by chemical bath deposition method
163	Ms. DLAMINI, Wendy & Bonakele	N/A	XRD, Mössbauer and magnetic properties of MgxCo1-xFe2O4 nanoferrites
174	Dr. GONFA, Girma Goro	N/A	Synthesis and characterization of ZnO nanoparticles
175	Mr. CRONJE, Shaun	PhD	Evaporation models for segregation
180	Mr. NKOSI, Steven	PhD	Control of Magnetism near Metal to Insulator Transitions of VO2
182	Mr. FERNANDO, P R	PhD	Characterization of epitaxial Cr thin films
187	Ms. SIMO, Aline	PhD	Electrospun polyehylene oxide nanocomposite fibers reinforced withVO2 nanoparticles: Fabrication and optical analysis
189	Dr. MBATHA, Nkanyiso	N/A	Development of Durban LIDAR system for aerosol and temperature measurements in the neutral atmosphere
191	Mrs. JACOBS, Bincy Susan	PhD	Influence of magnetic field on the transition temperature of the (Cr84Re16)89.6V10.4 alloy
211	Mr. TABAZA, Wael	PhD	Blue luminescence from Bi doped MgAl2O4 prepared by the combustion method
212	Mr. ABBASS, Abd Ellateef	PhD	Effect of Ag nanoparticles on the luminescence of Tb doped sol-gel silica
221	Ms. RATSIBI, Edzani	MSc	Dependance of central spot sixe, propagation distance, and number of rings of a Bessel beam on the axicon's apex angle
223	Prof. DEJENE, Francis	N/A	Luminescent properties of Dy3+, Eu3+, Tb3+and Sm3+doped barium borate phosphors synthesized by solution combustion process
226	Prof. DEJENE, Francis	N/A	Energy transfer and photoluminescence properties of Ce3+and/or Tb3+-doped PbS nanorods
233	Dr. MOLOI, Sabata	N/A	Static electrical characteristics of silicon diodes at different temperatures: For radiation-hard detectors
241	Mr. ABDULSALAM, Mahmud	PhD	A Theoretical Investigation of the Structural, Electronic and Phase
246	Mr. MPSHE, Kagiso	MSc	Spin-dependent electronic properties of random layered semiconductor systems
250	Mr. KOEN, Wayne	PhD	Efficient Ho:YLF laser pumped by a Tm:fiber laser
261	Ms. MHLANGA, Thandeka	MSc	Modal decomposition of Bessel-Gaussian beams
272	Mr. NGCOBO, Sandile	PhD	Tuneable Gaussian to Flat-top resonator by amplitude beam shaping
273	Mr. BASHIR, Aiman	PhD	Electrical and magnetic properties of NdAuGe compound
282	Ms. MAHLANGU, Rosinah	N/A	The elastic properties and the phonon dispersions of TiPtCo shape memory alloy using the supercell approach
286	Mr. SITHOLE, THOKOZANE MOSES	MSc	Synthesis and Characterization of CaBxOy:Eu3+nano-phosphors prepared using Solution - Combustion Method
287	Ms. SHIMAPONDA, Mulundumina	MSc	Mathematical model for interferometric noise in a Raman distributed fiber sensor
289	Ms. SONDEZI, Buyi	N/A	The determination of critical behavior of ferromagnetic CeCuGe using magnetocaloric effect

POSTER SESSION 1

C#	Presenter(s)	Award	Title
290	Dr. MOSUANG, Thuto	N/A	Molecular dynamics simulations of Ti and Y impurities in tin-dioxide (SnO2)
293	Mr. UNGULA, Jatani	Hons.	Effect of annealing on undoped and Ce, Dy, Eu, Ni-doped ZnO properties synthesized by sol-gel method using zinc acetate and sodium hydroxide in aqueous ethanol solution
298	Dr. ASANTE, Joseph	N/A	Sn and Sb segregation in single and polycrystalline Cu
303	Ms. MASINA, Bathusile	PhD	Plasma dynamics and species emission study of vanadium (IV) oxide (VO2) in oxygen background
322	Dr. ABDALLAH, Hafiz M I	N/A	Synthesis, structural and magnetic properties of MnxNi1-xFe2O4 nanoferrites
326	Dr. ABDALLAH, Hafiz M I	N/A	Synthesis and magnetic characterizations of MnxFe3-xO4 nanoferrites
346	Ms. DANGA, Helga	MSc	Thermal stability studies on Palladium Schottky contacts on n- Si (111) and the defects introduced during fabrication and annealing processes
349	Mr. NUBI, Olatunbosun Nubi	N/A	Effects of Combinational Doping on the Phase Transformation of Nano Titanium Dioxide
357	Dr. ASANTE, Joseph	PhD	Microstructural Characterization of Sub-micron Copper Powder Consolidated by Spark plasma sintering for Heat Sink
439	Mr. NAMBALA, Fred Joe	PhD	Comparative analysis of fabricated Titanium Schottky doides on silicon and gold doped silicon
445	Dr. NEETHLING, Pieter	N/A	Raman spectroscopy of biological and chemical samples
450	Mr. SMITH, Shane	MSc	A reflection setup for Terahertz time-domain spectroscopy
452	Mr. MPOYO, Justice Sompo	MSc	Modelling and simulation of a Distributed Feedback Erbium Ytterbium doped fiber laser
462	Mr. SIMFUKWE, Joseph	MSc	Design and evaluation of a low-cost photovoltaic system with semi-diffuse structured Aluminium reflectors
464	Mr. MBIOMBI, Wilfred	N/A	Surface Brillouin scattering characterization of Diamond-like carbon thin films on silicon substrate
466	Mr. WAKO, ALI	PhD	Thermoluminescence study of beta -irradiated SrAl2O4:Eu2+,Dy3+ phosphors
475	Mr. MMAKGABO, Manaka	N/A	Photoluminescence properties of rare-earths and manganese doped strontium aluminate phosphors prepared by combustion method
482	Ms. MPHAHLELE, Mallasaitiwa	N/A	computer modelling studies of pressure dependance on cobalt pentlandite mineral
484	Ms. CHUMA, Moyahabo Hellen	N/A	SSC-DFTB parameterization of Pd and TiO2 systems
506	Dr. MEHLAPE, Mofuti	N/A	Computational studies of the bulk cobalt pentlandite (Co9S8): Validation of the potential model
510	Mr. LETHOLE, NDANDULENI LESLEY	PhD	Thermodynamic, structural, electronic and mechanical stability study of olivine LiMPO4 (M : Mn, Fe, Co)
525	Mr. MBELA, Kalengay	PhD	Magnetic properties of Sn0.2Cr1.8-xFexO4 nanooxides
528	Mr. THABETHE, Bongani	MSc	Synthesis and characterization of tin oxide nanostructures for gas sensing applications
538	Dr. CHIRWA, Max	N/A	A circular current's duo Cartesian magnetic dipolar model and limitations on fields as spatial derivatives of potentials
543	Dr. MOYO, Thomas	N/A	Synthesis and magnetic properties of Mg1-xZnxFe2O4 nanoferrites
544	Dr. TIBANE, Malebo	N/A	First-Principles Study of Thermodynamic and Dynamic Stability of Ru-Cr Alloys
545	Prof. RAMMUTLA, Erasmus Koena	N/A	Structural studies of Y and Zr doped nano-crystalline tin oxide using EXAFS and Raman Scattering techniques
548	Ms. BOITUMELO, Mokae	Hons.	Optical delivery of anti-HIV-1drugs into CD+cells through a diffraction limited femtosecond laser beam spot
552	Ms. AIRO, Mildred	MSc	One step synthesis and characterization of Indium Monoselenide nanoparticles for photovoltaic application
556	Mr. JILI, Thulani	N/A	Annihilation of Positrons with High Momentum states in Lithium Flouride using Local Density Approximation and Generalized Gradient Approximation
558	Mr. KABONGO, Guy Leba	MSc	Sol-gel synthesis and characterization of terbium ion doped zinc oxide nanoparticles
559	Prof. DHLAMINI, Mokhotjwa Simon	N/A	Synthesis and characterization of luminescence properties of CaAl2O4:Eu2+,Tm3+ phosphors powder
561	Dr. MACHATINE, Augusto & Mr. NIYONGABO, Prime	N/A	Magnetic Symmetry for Hexagonal Manganite RMO3
570	Mr. PARADZAH, Alexander	MSc	Electrical characterization of 5.4 MeV alpha-particle irradiated 4H-SiC with low doping density
571	Dr. MTANGI, Wilbert	N/A	Effect of the alpha particle charge state and energy on irradiation induced deep level defects in ZnO
575	Ms. TEBELE, Angelina Seithati	Hons.	Luminescence properties of blue-red emitting SrAlxOy:1percent Eu2+,x percent Cr3+ phosphors prepared using sol-gel method

POSTER SESSION 2

C#	Presenter(s)	Award	Title
0	Dr. DE VILLIERS, Jean	N/A	Inversion of Geomagnetic Fields to Derive Ionospheric Currents that Drive Geomagnetically Induced Currents
3	Mr. LATIF, Mouftahou	PhD	Angular distributionofthelsovectorgiantdipoleresonance(IVGDR) in neutron-rich calcium isotopes with proton inelastic scattering reaction at 200 MeV
11	Mr. TANGWE, Stephen	MSc	Analytical evaluation of energy losses of an air source heat pump water heater
20	Ms. KHUMALO, Nontobeko	MSc	Study of octupole vibrations in nearly spherical nuclei
22	Mrs. MATANDIROTYA, Electdom	PhD	Methods for measuring and Modeling geomagnetically induced currents (GICs) on power lines
27	Mrs. NEMAIR, Mahassin. A. A	PhD	Simulation of Electron Dynamics in the Earth's Magnetosphere
29	Mr. KOEN, Etienne	PhD	Simulations of oblique electrostatic wave propagation
31	Ms. PHORI, Abigail	MSc	Experimental Characterisatics of small oil Thermal Energy Storage (TES) tank for domestic applications
34	Dr. COLLIER, Andrew	N/A	Investigating Dunedin Whistlers using Volcanic Lightning
38	Mrs. MATAMBA, Tshimangadzo Merline	MSc	Ionospheric response during geomagnetic storm events in 2004
39	Dr. MBATHA, Nkanyiso	PhD	Evidence for SuperDARN polar mesosphere summer echoes (PMSE) at SANAE IV, Antarctica: first observation
59	Mr. BROADLEY, Simon	PhD	New crystal structure of MSHB from Mycobacterium tuberculosis shows insight into the catalytic mechanism
68	Dr. JACOBS, Mkhululi	N/A	A comparative analysis of first year physics student expectations at the University of the Western Cape and Military Academy
70	Prof. CLEYMANS, Jean	N/A	Systematic Properties of the Tsallis Distribution: Energy Dependence of Parameters in High-Energy p-p Collisions
84	Mr. MARIOLA, Marco	PhD	Open-source electronics for quantum key distribution

POSTER SESSION 2

C#	Presenter(s)	Award	Title
101	Ms. PILLAY, Sharmini	PhD	Hybrid Two-way QKD in Free Space
103	Ms. SINGH, Ann	N/A	The importance of damage tests
126	Mr. MUKUMBA, Patrick	PhD	Performance monitoring of a Field-Batch Biogas Digester fed with agricultural wastes at different mixing ratios
136	Ms. NWOKOLO, Nwabunwanne	MSc	Investigating the impact of equivalence ratio and temperature of input airon the conversion efficiency of a down draft biomass gasifier
139	Mr. ABEDIGAMBA OYIRWOTH, Patrick	PhD	Studies of the amplitude ratios in the atmosphere of the sun
141	Mr. ERO, Felix	PhD	Thermodynamic Characteristics of a Large Scale Downdraft Gasifier in a Scalar Energy Field
142	Mr. WASSIN, Shukree	MSc	Pulse Delay Chromatic Dispersion Measurements in Single Mode Fibre
145	Mr. REED, Robert	PhD	High Voltage Board for the Mobile Test Bench for the ATLAS Detector
146	Mr. REED, Robert	PhD	Higgs to Four Lepton
147	Mr. KOUROUMA, Hamed	PhD	A 40 Gbps Wavelength Division Multiplexing (WDM) Optical Network for Data Transmission for MeerKAT
158	Mr. SHIKWAMBANA, Lerato	PhD	Aerosol measurements at the National Laser Centre, Pretoria and at the University of KwaZulu Natal, Durban using the CSIR mobile LIDAR system
159	Ms. MHLANGA, sibaliso & GUMBO, mervyn	N/A	The Quark Gluon plasma
161	Mr. MTUMELA, Zolile	N/A	A multiple instrument investigation of the nature of geomagnetic pulsations
173	Mr. FELEKE AYANE, Getinet	MSc	Multicolour Photometric Study Of Pulsation on Pre-Main Sequence Star V351Ori (HD 38238)
177	Mr. SENOSI, KGOTLAESELE JOHNSON	MSc	Investigation of W^{+\-} bosons production with different Parton Distribution Functions in proton-proton collisions
178	Mr. CHABATA, Tichakunda Valentine	PhD	Digital signal processing algorithm for signal analysis and performance monitoring in an optical communication link
181	Mr. MASUKUME, Peace-Maker	N/A	Assessment of wind energy potential in the Amatole District in the Eastern Cape Province of South Africa
183	Mr. SEHONE, Alfred Mogotsi	MSc	Radiometric Survey at A Heavy Mineral Mining Company On The West Coast Of South Africa
185	Mr. SEHONE, Alfred Mogotsi	MSc	Radiometric Characterisation Of Bricks For Use In A Planned Calibration Facility For In-Situ Gamma-Ray Detectors
190	Mr. TUCKER, Bevan	MSc	Black-Hole Pulsar Binaries: Timing and Fluxes
192	Dr. MBATHA, Nkanyiso	N/A	TIMED/SABER Observations of mesospheric inversion layers over Southern Africa
196	Mr. NJOROGE, Eric	PhD	AFM and SEM studies Zr thin films on SiC
199	Dr. SHIRINDA, O.	N/A	Measuring the performance of the iThemba LABS Segmented Clover Detector
201	Dr. BOTHA, G.J.J.	N/A	The robustness of magnetic flux tubes surrounded by magnetoconvection
204	Ms. NDLOVU, Ntombizikhona Beaulah	PhD	Comparison of two Software Packages for High Resolution Gamma Spectrometry Used for Neutron Activation Analysis of Biomonitors
206	Mr. LEKWENE, Papi	MSc	Modelling the atmosphere of A-Stars using the ATLAS9 program with OPAL EOS
207	Mr. GUMBO, Mervyn & Ms. SIBALISO, Mhlanga	N/A	Quark Gluon Plasma (QGP)
222	Dr. MASITENG, Paulus	N/A	194Tl as the first example revealing chiral symmetry breaking in the pair of four-quasiparticle bands
227	Dr. MATTHEWS, Alan	N/A	A solar-thermal cooker using oil for heat transfer
228	Dr. MATTHEWS, Alan	N/A	A solar-thermal cooker using high-pressure steam for heat transfer
243	Dr. FERRER, phil	N/A	Orbital simulations for a satellite with a corona ionization thruster
252	Mr. SAKILDIEN, Muneer	N/A	Temporal variation of line radiation from the GTS-ECRIS at iThemba labs
270	Mr. SCHULTZ, Ross	PhD	Spectral shaping and subcell modeling of the current density of a HCPV device as a function of operational conditions
271	Mr. IMMANUEL, Mulaudzi	MSc	Preliminary results of a Monte Carlo study of neutron beam production at iThemba LABS
275	Mr. MASIKE, Titus	MSc	LED Board for the mobile test bench
280	Mr. NTAMEHLO, Luvo	N/A	A Search for Pulsations in the Infrared region of Herbig Ae star V589 Mon
281	Mr. MAKHUBELA, Mathews	MSc	Preliminary results of a Monte Carlo study to determine neutron fleunce using activation
285	Dr. RAHMAN, Nurur	N/A	Recent Results on Spatially Resolved Molecular Gas Star Formation Law from CARMA Survey Towards Infrared-bright Nearby Galaxies (STING)
295	Dr. BUCHER, T.D.	N/A	Challenges in the simulations of the iThemba LABS segmented clover detector
299	Mr. MATSHAWULE, Siyambonga	MSc	Probing the Cosmological Model With Meerkat and the SKA
309	Prof. DERRY, Trevor	N/A	New iThemba-LABS and Wits University Ion Implantation Facility
318	Mr. MAIBANE, Kutullo	MSc	Validation of the calculated efficiency parameters for the gamma-ray detector using 152Eu standard sources
435	Ms. NJINGANA, Primrose Nosicelo	MSc	Outdoor perfomance parameters, temperature effect and irradiance measurements in Photovoltaic home system
449	Dr. WAMWANGI, Daniel	N/A	Induced Stress studies of RF Magnetron Sputtered FeCr thin films by surface Brillouin scattering and GIXRD
459	Mr. JOHNSON, Matthew	MSc	Modelling Stellar Convection
461	Mr. MAFU, Mhlambululi	PhD	Tsallis entropy and quantum uncertainty in information measurement
471	Mr. MABIZELA, Polycarp	MSc	Kinetic analysis of the various biomass / coal blends for co-gasification purpose
485	Dr. RAHMAN, Nurur & Prof. WINKLER, Hartmut	N/A	SDSS J12002-0204: Unusual IZw 1object or a nearby BAL Seyfert?
502	Mr. AHOUA, Sylvain Malan	PhD	Evaluation of the NeQuick model in Southern mid-latitudes using South African co-located GPS and Ionosonde stations data
518	Mr. MAHLASE, Conrad	N/A	CFD simulation of the CSL
521	Prof. COLAFRANCESCO, Sergio	N/A	Shining Light through walls using dark matter - Axion-photon mixing in astrophysics
522	Mr. KEELEY, LLOYD	MSc	stereoseismology of Beta Cepheid Stars using multicolor photometry: Mode Identi cation
526	Ms. GAQA, Sibongiseni	MSc	The properties and suitability of various biomass/coal blends for co-gasification in a downdraft biomass gasifier
535	Dr. BEZUIDENHOUT, Jacques	N/A	Measuring low concentrations of naturally occurring uranium by analyzing the gamma ray decays of 234Pa
536	Dr. BEZUIDENHOUT, Jacques	N/A	A study of the relationship between the activity concentrations of naturally occurring uranium and radium in various locations in the South Africa
540	Prof. MELLADO, Bruce	N/A	The discovery of a Higgs boson at the LHC and future prospects
542	Mr. ZAMBOU, Serges	PhD	AC/DC performance of a fully printed current switching silicon basedtransistor
546	Mr. ASARE, JOSEPH	PhD	Redesign of the High Voltage Controller Card in Mobidick4
549	Mr. THETHWAYO, Charles Thulani	MSc	Synthesis and characterisation of carbon nanostructures, for hydrogen storage and gas sensing application
550	Ms. BVUMBI, Suzan Phumudzo	PhD	Life time measurements in the transitional nucleus 150Sm
562	Dr. CHIRWA, Max	N/A	Analysis of similarities and differences between a circular current's and a simple electric dipole's Cartesian torques
563	Mr. NGCOBO, Zipho	PhD	The development of a converter target for the production of radioactive beams at iThemba LABS
565	WHITEHEAD, Andile	N/A	Analysis of the Tsallis distribution and it's applicability to high energy physics
577	Mr. AMAR, Gilad	N/A	Anomalous Higgs Couplings

Book of Abstracts

0 - Inversion of Geomagnetic Fields to Derive Ionospheric Currents that Drive Geomagnetically Induced Currents.

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: DE VILLIERS, Jean *(South African National Space Agency)*
Co-authors: *CILLIERS, Pierre (South African National Space Agency)*

This research focusses on the inversion of geomagnetic field measurement to obtain source currents in the ionosphere. The ionospheric currents during a geomagnetic storm induce geo-electric fields, which in turn create geomagnetically induced currents (GICs) in power lines. These GICs may cause damage to grounded power transformers. The ultimate aim is to develop a system for predicting the ionospheric source currents from solar event data and use the link between the source currents and GICs to provide advance warning to power utilities. Line currents running East-West along given latitude are postulated to exist at a certain height above the Earth's surface. This physical arrangement expresses the fields on the ground in terms of the magnetic north and down component, and the electric east component. Ionospheric currents are modelled by inverting Fourier integrals of elementary geomagnetic fields using the Levenberg-Marquardt technique. The output parameters of the model are the current strength, period, height and latitude of the ionospheric current system. A conductivity structure with five layers from Quebec, Canada, based on the Layered-Earth model, is used to obtain the complex skin depth at a given angular frequency. The paper will present inversion results based on the Quebec structure and simulated geomagnetic fields. Model parameters can be obtained to within 2% of published values. This technique has applications for modelling the currents of electrojets at the equator and auroral regions, as well as currents in the magnetosphere.

2 - Study of Nanomaterials under High Pressure

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *SINGH, Madan (National University of Lesotho, Roma, Lesotho)*
Co-authors: TLALI, Spirit *(National University of Lesotho, Lesotho)*; MORUTI, Kao *(National University of Lesotho)*; MOLEKO, Nkuebe *(National University of Lesotho)*

A simple Theory is proposed to predict the effect of pressure to study the volume expansion of nanomaterials. Different possible forms of equation of state are discussed with their correlations. Only two input parameters, namely, the bulk modulus and its first pressure derivative are required for calculations. We have considered a wide variety of nanomaterials, such as, metals [Ni (20 nm), α-Fe (nanotubes), Cu (80nm) and Ag (55nm)], semiconductors [Ge (49 nm), Si, CdSe (rock-salt phase), MgO (20nm) and ZnO], carbon nanotube (CNT), ZnSe(Zinc Blende 80nm) and Znse(Rocksalt Phase 80nm) to analyze the effects of pressure on them. The results have been compared with the available experimental data as well as with those obtained through other theoretical approaches. A good agreement between theory and experiment demostrates the validity of present approach.

3 - Angular distribution of the Isovector giant dipole resonance (IVGDR) in neutron-rich calcium isotopes with proton inelastic scattering reaction at 200 MeV

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: LATIF, Mouftahou *(Wits)*
Co-authors: *USMAN, Iyabo (Wits); FEARICK, Roger (UCT); ELIAS, Sideras-Hadad (Wits); PAPKA, Paul (SU); JINGO, Maxwell (Wits); KUREBA, Oscar (Wits); DONALDSON, Lindsay (Wits); FUJITA, Hirohiko (Research Centre for Nuclear Physics, Osaka University); FUJITA, Yoshitaka (Department of Physics, Osaka University); PIETRALLA, Norbert (Institute fur Kernphysik, TU Darmstadt); KRUGMANN, Andreas (Institute fur Kernphysik, TU Darmstadt); CARTER, John (Wits); TAMII, Atsushi (Research Centre for Nuclear Physics, Osaka University); COOPER, Gordon (Wits); BUTHELEZI, Zinhle (iThemba LABS); NEVELING, Retief (iThemba LABS); SMIT, Fredrick (iThemba LABS); FORTSCH, Siegie (iThemba LABS); VON NEUMAN-COSEL, Peter (Institute fur Kernphysik, TU Darmstadt); RICHTER, Achim (Institute fur Kernphysik, TU Darmstadt)*

High energy-resolution proton inelastic scattering experiments have been extensively explored during the last decade at iThemba LABS, Somerset West, South Africa. This is with a view to understanding the structure of giant resonances in nuclei across the periodic table. Fine structure of the Isovector Giant Dipole Resonance (IVGDR) in isotopes of calcium (42, 44, 48Ca) has been proposed to be investigated using (p, p') reaction at 200 MeV. Distorted Wave Born Approximation (DWBA) calculations have been used to determine angular distributions of the prominent E1 states up to the region of the IVGDR. The experimental investigation will be carried out with the recently developed Zero-degree Facility of the K600 Magnetic spectrometer of iThemba LABS.

5 - Room Temperature and High Temperature Ion Implantation of Cadmium (Cd) in Glassy Carbon: Diffusion behaviour and Raman Analysis.

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: SEBITLA, LESOLLE *(PhD student)*
Co-authors: *THERON, Chris C. (Supervisor); HLATSHWAYO, Thulani (Co-Supervisor); MALHERBE, Johann B. (Co-Supervisor)*

In the context of radioactive waste disposal related to the back end of the nuclear fuel cycle, we studied the diffusion of cadmium ions implanted in glassy carbon. Glassy carbon is a material considered as a possible migration barrier for radioactive elements in the nuclear waste storage process due to its high thermal stability and chemical inertness even in extreme environments. Glassy carbon samples were implanted with 360 keV Cd ions to a fluence of 2 x 10^16 cm-2 at room temperature and at 430 oC. The samples were isochronal vacuum annealed in the temperature range 350 o C to 700 oC. Rutherford backscattering spectroscopy (RBS) was used to investigate the diffusion of the implanted cadmium implanted at various temperatures. Broadening of the cadmium profile (i.e. measurable diffusion) was observed at temperatures beyond 400 oC. Microstructural information of the substrates was obtained from Raman spectroscopy. Implantation at room temperature and at 430 oC produced different changes in the Raman carbon D and G peaks suggesting that the radiation caused damage to the microstructure of glassy carbon. Some recovery (but not complete) followed the different annealing temperatures and annealing times.

6 - Concavity of energy surfaces

Theoretical - Wednesday 10 July 2013 10:50

Primary authors: KARATAGLIDIS, Steven *(University of Johannesburg)*
Co-authors: *GIRAUD, Bertrand (CEA/Saclay)*

The property of concavity in calculations of energy surfaces is developed and discussed, in reference to strict energy minimization when collective coordinates are constrained. Such collective coordinates are actually subject to quantum fluctuations and these prevent, via tunnel effects, the probing of maxima and saddle points. A solution to the problem is developed. It allows to bypass the concavity syndrome and recover maxima and saddle points.

7 - Aspects of the structure of heavy carbon isotopes

NPRP - Tuesday 09 July 2013 10:50

Primary authors: KARATAGLIDIS, Steven *(University of Johannesburg)*
Co-authors: *AMOS, K. (University of Melbourne/University of Johannesburg); SVENNE, J. (University of Manitoba); CANTON, L. (INFN/University of Padova); FRASER, P. R. (INFN/University of Padova); VAN DER KNIJFF, D. (University of Melbourne)*

A multi-channel algebraic scattering (MCAS) method has been used to obtain spectra of a number of light-mass nuclei, which are treated as a two-cluster system, in these cases a nucleon plus nucleus. The MCAS method gives both sub-threshold and resonance states of the nuclei in question. To date, collective models have been used to specify the interactions between the nucleon and low-lying states of the nucleus that form the compound. For the case of the carbon isotopes, these studies have been complemented by sufficiently complex and complete shell-model calculations. Comparisons with the shell model results provide new insights into the validity of those from MCAS.

8 - Hydrogen Functionalized Graphene for possible Spintronics Applications

DCMPM2 - Tuesday 09 July 2013 15:40

Authors: RAY, Sekhar Chandra *(School of Physics, University of the Witwatersrand)*

Few Layered of Graphene (FLG), were synthesized using Plasma enhanced Chemical Vapor (PECVD) deposition process and subsequently functionalized with hydrogen in hydrogen-plasma-atmosphere at different temperature starting from room temperature to 200oC to convert them into Graphone (attachment of hydrogen in one layer of graphene). Both the graphene (functionalized and non-functionalized) were characterized with X-ray absorption near edge structure spectroscopy (XANES), Raman, X-ray photoemission spectroscopy (XPS) etc. and found that the electronic structural properties of graphene were changed on hydrogenation. Surprisingly, it was also seen that the magnetic properties is enhanced drastically on hydrogenation of graphene (graphone). Hydrogen content were estimated from XANES spectra and found that the magnetization is changes with hydrogen content present in the graphone. Results suggested that this graphene/graphone is very useful for the spintronics applications.

9 - The Virtual Atomic and Molecular Data Centre (VAMDC)

Astro - Tuesday 09 July 2013 15:40

Authors: SMITS, Derck *(University of SA)*

Atomic and molecular data are used in many diverse areas of scientific research and industrial development. Each area has developed its own specialized data repositories and protocols for accessing these data. Often, users from one area are not aware of results produced by other groups, which can lead to duplication of effort in generating data.The Virtual Atomic and Molecular Data Centre (VAMDC) is a European Union Framework 7 funded programme that has built a common electronic infrastructure for the exchange and distribution of a range of diverse atomic and molecular databases using a standard protocol via a single portal. Therefore, the effort expended by users in searching for and retrieving data is minimized.VAMDC includes access to the Vienna Atomic Line Database (VALD-3),Cologne Database for Molecular Spectroscopy (CDMS), the UMIST databse for astrochemistry, CHIANTI, and BASECOL. Data provided includes central wavelengths, energy levels, statistical weights, transition probabilities, electron and proton collision rates and line broadening parameters. Because a number of different databases are interrogated by VAMDC, the reliability and accuracy of data can be assessed.The presentation will illustrate how to use the VAMDC tools to extract atomic and molecular data from the various databases.

10 - Modeling and real time simulation of instantaneous performance of residential air source heat pump water heater.

Applied - Friday 12 July 2013 10:30

Primary authors: TANGWE, Stephen Loh *(Fort Hare Institute of Technology, University of Fort Hare)*
Co-authors: *MEYER, Edson (Fort Hare Institute of Technology; University of Fort Hare); MICHAEL, Simon (Fort Hare Institute of Technology; University of Fort Hare)*

Air source heat pump on like water and geothermal source heat pumps are widely used in sanitary hot water production by virtue of the relative ease of harvesting low grade aero-thermal energy and less complexity in operating and maintaining the heat pump unit. The optimization of power and coefficient of performance of the system require a detail and crucial investigation of compressor, condenser, evaporator, expansion valve and thermo physical properties of the refrigerant to ensure components are under steady state condition for their optimal performance when system is in operational heating mode. It is worth mentioning that this approach for optimizing system is challenging and time consuming. Hence this paper appraises identifying primary and secondary predictors of the system performance and these variables were employed to develop a multiple linear regression model of the power and COP. Since our goal was to develop a robust model, an optimization of the input variables was performed using constrained linear least square solver in matlab optimization tool. Furthermore, a data acquisition system was designed and built to measure ambient temperature, relative humidity, condenser, evaporator, inlet cold water and outlet hot water temperatures of the ASHP. In addition, electrical power of ASHP and its water flow rate were also measured while system was in heating up cycle. The results showed that COP depends primarily on volume of water heated, temperature of cold water and hot water from the ASPH while the influence of ambient temperature and relative humidity were secondary. The predictors were ranked by weight importance using a function reliefF in matlab statistical tool. We , concluded by designing a simulation using the mathematical model which can be used by manufacturers of residential ASHP and energy saving company to determine performance and energy savings.

11 - Analytical evaluation of energy losses of an air source heat pump water heater

Poster2 - Wednesday 10 July 2013 17:40

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

Air source heat pump water heater is a renewable and energy efficient device used for sanitary hot water production. The system comprises of two major blocks namely storage tank and heat pump connected by pipes . These blocks can either be compact as in the integrated model or split as in the retro-fit model. ASHP water heater efficiency is primarily governed by its coefficient of performance usually more than 200 % and also depends on the circumstances and climatic conditions under which the system is operating. In this paper, the analysis of energy losses was performed using SIRAC residential split type heat pump of 1.2 kW input power and 240 V single phase as per manufacturer's specification to retrofit a 200 litres high pressure kwikhot storage tank without hot water being drawn off for the entire monitoring period. Likewise to experimentally determine the losses a data acquisition system was designed and built to measure ambient temperature, relative humidity, outlet hot water temperature of the storage tank, in let cold water and outlet hot water temperatures of the ASHP. Two flow meters were also installed on the inlet cold water pipe of ASHP and on the outlet hot water pipe of storage tank. In addition, electrical power of ASHP was also measured. The results showed that heat gain to compensate stand by losses could range from 1.8 kWh to 2.1 kWh with the corresponding electrical energy used ranging from 0.55 kWh to 0.66 kWh. The stand by losses depend primarily on volume of water heated , ambient temperature and relative humidity while influence of the temperature difference between the hot water and cold water from respective pipes of ASHP is secondary. Finally, we also determined the energy consumed by the micro controller of ASHP to be approximately 0.10 kWh.

14 - Lightning Activity Predictions for Single Buoy Moorings

Applied - Wednesday 10 July 2013 09:00

Authors: COLLIER, Andrew *(SANSA Space Science)*

Offshore Single Buoy Moorings (SBMs) serve as points for tankers to load and offload gases or liquids. They cater for ships of any size and remove the need to enter port. This is especially important for very large vessels. SBMs located in areas of intense lightning activity are vulnerable to disruptions caused by thunderstorms. Furthermore, some of the fluids transferred via SBMs are either hazardous or flammable. A direct lighting strike while a ship is tethered to a SBM would therefore have catastrophic consequences. We present an ensemble machine learning model which uses real time global lightning data to predict lightning activity in the vicinity of SBMs. These predictions will be used to schedule SBM transfers and to provide advanced warning of dangerous conditions.

15 - Encoding mutually unbiased bases in orbital angular momentum for quantum key distribution

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: DUDLEY, Angela *(CSIR National Laser Centre)*
Co-authors: *MAFU, Mhlambululi (UKZN); GOYAL, Sandeep (UKZN); GIOVANNINI, Daniele (Department of Physics and Astronomy, SUPA, University of Glasgow); MCLAREN, Melanie (CSIR National Laser Centre); KONRAD, Thomas (UKZN); PADGETT, Miles (Department of Physics and Astronomy, SUPA, University of Glasgow); PETRUCCIONE, Francesco (UKZN); LüTKENHAUS, Norbert (Institute for Quantum Computing & Department for Physics and Astronomy, University of Waterloo); FORBES, Andrew (CSIR National Laser Centre)*

We encode mutually unbiased bases (MUBs) using the higher-dimensional orbital angular momentum (OAM) degree of freedom associated with optical fields. We illustrate how these states are encoded with the use of a spatial light modulator (SLM). We demonstrate how (d+1)-mutually unbiased measurements can be made in both a classical prepare and measure scheme and on a pair of entangled photons. In the entanglement-based scheme we perform mutual unbiased measurements for dimensions ranging from d = 2 to 5. The calculation of the average error rate, mutual information and secret key rate show an increase in information capacity as well as higher generation rates as the dimension increases.

16 - Creating and decomposing vector Bessel beams

Photonics - Tuesday 09 July 2013 10:30

Primary authors: DUDLEY, Angela *(CSIR National Laser Centre)*
Co-authors: *LI, Yanming (Department of Electrical and Computer Engineering, North Carolina State University, Rayleigh, North Carolina 27695, USA); MHLANGA, Thandeka (CSIR National Laser Centre); ESCUTI, Michael (Department of Electrical and Computer Engineering, North Carolina State University, Rayleigh, North Carolina 27695, USA); FORBES, Andrew (CSIR National Laser Centre)*

We show how to generate non-diffracting vector Bessel beams by implementing a spatial light modulator (SLM) and a q-plate, which is an azimuthally-varying birefringent plate. The SLM first creates the scalar Bessel beams which are then converted into vector Bessel beams by the use of the q-plate. We demonstrate how the orbital angular momentum (OAM) of these generated beams can be measured by performing a modal decomposition on each of the beam's polarization components. This is achieved by separating the polarization components through a circular polarization beam-splitter before performing the modal decomposition. We study both single charged Bessel beams as well as superpositions and the results are in good agreement with theory.

17 - On the metastability of the C center in Silicon: An ab initio study

Poster1 - Tuesday 09 July 2013 17:40

Authors: OUMA, Cecil *(Student)*

The electronic properties of the C center defect in silicon (Si) have been investigated by ab initio density functional theory (DFT). The C center is a boron- vacancy (B-V) pair in Si. We present the properties of four (4) configurations of the C center. We report defect levels for isolated BSi and VSi at Ev+0.07 eV and Ev+0.21 eV respectively for the 0/-1 thermodynamic transition, and Ev+0.08 eV and Ev+0.06 eV for two configurations of the C center compared to experimentally reported levels at Ev+0.5 eV and Ev+0.36 eV. The other two configurations of the C center did not have levels for the 0/-1 transition. We report configurationally charge-induced metastability of the C center in the four different configurations occurring in the negative charge states of the defect.

18 - Synthesis and characterization metal chalcogenide nanocrystals used as active layers in solar cells

DCMPM2 - Tuesday 09 July 2013 11:30

Authors: KALENGA, Pierre Mubiayi *(University of Witwatersrand)*

Metal chalcogenide nanomaterials have been the most intensively studied because of their quantum confinement and photoconductivity. Their properties are exploited for various applications including photovoltaic cells, catalytic activity and biological sensors. This project aims to synthesize copper selenide, quantum dots (QDs) using "one pot" colloidal and microwave assisted methods for applications in photovoltaics. Those two routes of synthesis will be used to prepare copper indium selenide and copper indium gallium selenide nanoparticles based on the yield and properties of copper selenide nanocrystals. The nanocrystals are analyzed by X-ray diffraction (XRD) and their solutions in chloroform are analyzed by UV-Visible spectroscopy (UV-Vis), Fluorescence spectroscopy (PL), and Transmission electron microscopy (TEM). Electrical properties are investigated via current and voltage measurement. A large blue shift of synthesized materials is observed indicating that the nanoparticles are relatively small. TEM images show small size particles with defined shapes and XRD spectra show that the particles are crystalline in specific phases.

20 - Study of octupole vibrations in nearly spherical nuclei.

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: KHUMALO, Nontobeko *(Masters Student)*
Co-authors: *NTSHANGASE, Sifiso (University of Zululand); ORCE, Nico (University of the Western Cape)*

Recent studies of double octupole states in 146Gd have resulted in the need of deep studies to bedone on two-phonon octupole excitation in 146Gd. Octupole vibrations come closer to the idealharmonic oscillator as a result of the larger number of particles participating in the motion andthe weaker mixing of negative-parity states at low excitation energies. Octupole vibrations are, however, much more complex than the other modes of vibrations, such as dipole and quadrupole, and little is known about them. This vibrational mode is a result of a vibrating nucleus thatundergoes pear-shaped distortion, with "stem end" and the "blossom end" exchanging places periodically. In this project we study the octupole vibrations in the even-even nearly-spherical nucleus 146Gd82. A state with J=6+ at 3485 keV has already been suggested in 146Gd, and together with the finding, for the first time, of a 6+ $\rightarrow$ 3- $\rightarrow$ 0+ cascade of E3 γ-ray transitions, this has been interpret as the two-phonon octupole excitation. So the aim of the project is to investigate this 6+ state and other missing members of the octupole quartet in order to accurately characterize two-phonon octupole vibrations in nearly-spherical nuclei.

21 - Noise sensitivity of a VHF broadband interferometer

Space Science - Tuesday 09 July 2013 10:50

Primary authors: WEN, Chih-Fong *(University of Kwa-Zulu Natal)*
Co-authors: *COLLIER, Andrew (University of Kwa-Zulu Natal)*

A VHF interferometer can be used to measure the three-dimensional source of radiation emitted by lightning discharges. This is achieved by analysing the phase delay between the signals recorded at each of the three antennas.Using a numerical model of an interferometer coded in R we simulated a simple interferometer, including the source, antennas and a data processing unit. First, a monochromatic and isotropic point source was simulated in order to validate the structure of the model. The model was then expanded to include multiple monochromatic signals and finally a truly broadband signal. Using the model we were able to simulate the effects of noise on the resolving power of the interferometer and determine under what conditions the observations become unreliable

22 - Methods for measuring and Modeling geomagnetically induced currents (GICs) on power lines

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MATANDIROTYA, Electdom *(SANSA: Space Science, Cape Peninsula University of Technology)*
Co-authors: *CILLIERS, P. J. (SANSA: Space Science, Cape Peninsula University of Technology); VAN ZYL, R.R. (Cape Peninsula University of Technology)*

The implementation of two proposed techniques for measuring and modelling geomagnetically induced currents (GICs) in power lines are discussed in this paper. GICs are currents in grounded conductors driven by an electric field produced by time varying magnetic fields linked to magnetospheric-ionospheric currents during magnetic storms. These currents can cause overheating and permanent damage to high voltage transformers in power systems. Measurements of GICs are done on the neutral to ground connections of transformers in some substations. There is a need to know the magnitude and direction of the GICs flowing on the power lines connected to the transformers. Direct measurements of GICs on the lines are not feasible due to the low frequencies of these currents which make current measurements using current transformers (CTs) impractical. Two methods are proposed to study the characteristics of GICs in power lines. The differential magnetic measurement (DMM) technique is an indirect method to calculate the GICs flowing in the power line. With the DMM method, low frequency GIC current in the power line is estimated from the difference between magnetic recordings made directly underneath the power line and at some distance away, where the geomagnetic field is still approximately the same as under the power line. An analysis of the spectrum of GICs, of the DMM technique, and preliminary results are presented. Finite element (FE) modelling with COMSOL- Multiphysics is implemented so that the nature of the return currents flowing on the power lines and the Earth's surface can be analysed. In order to develop the FE model, historical geomagnetic data recorded at SANSA in Hermanus and realistic Earth conductivity values derived from the literature are used as the modelling inputs to the FE model.Preliminary results of current density distributions obtained by means of FE modelling are alsopresented.

23 - Electronic and mechanical properties of the actinide mononitride and dinitride

DCMPM2 - Tuesday 09 July 2013 11:10

Primary authors: OBODO, Kingsley *(University of Pretoria, South Africa)*
Co-authors: *CHETTY, Nithaya (University of Pretoria, South Africa)*

We present a detailed comparative study of the electronic and mechanical properties of the actinide mononitrides and actinide dinitrides within the frame work of the Perdew-Burke-Ernzerhof generalized gradient approxima- tion (GGA [PBE]) and GGA + U implementations of density functional theory with the inclusion of spin-orbit coupling. The dependence of selected observables of these materials on the effective U-parameter has been investigated in detail. The examined properties include the lattice constants, bulk modulus, effect of charge density distribution, hybridization of the 5f orbital and energy of formation for actinide nitride compounds. The Hubbard U parameter is included to give a proper description of the 5f electrons, and subsequently accurately determine the structural and electronic properties of the compounds. The mononitride and dinitride of all the actinide nitrides investigated using GGA (PBE) and GGA [PBE] + U approach is metallic except UN2 which is an insulator. Also UN, NpN, PuN, NpN2 and PuN2 are magnetic systems with an orbital dependent magnetic moments oriented in the z-axis.

24 - Magnetic Phase Diagram of $Cr_{100-x}Os_x$ alloys

DCMPM2 - Tuesday 09 July 2013 10:30

Primary authors: FERNANDO, Pius Rodney *(PhD Student)*
Co-authors: *PRINSLOO, A R E (University of Johannesburg); SHEPPARD, C J (University of Johannesburg)*

The magnetic phase diagram of $Cr_{100-x}Os_x$ exhibits a triple point at T_l = 315 K and x_l = 0.14,where the incommensurate (I) spin-density-wave (SDW),commensurate (C) SDW and paramagnetic (P) phases coexist. Previous studies [1,2] focused on measurements around the triple point and concentrations up to x = 2. However, the magnetic phase diagrams [1] of other Cr alloys with group-8 diluents, such as those of Cr-Re and Cr-Ru, show interesting features for $x >> x_l$.This is indicative of the possible merits of an investigation into the magnetic phase diagram of Cr-Os,specifically at high diluent concentrations. For this purpose, a polycrystalline $Cr_{100-x}Os_x$ alloy series with $2 < x < 22$ was prepared. Sample buttons were arc-melted from high quality starting materials and characterized using scanning electron microscopy, electron microprobe analysis and X-ray diffraction. Analyses show that the alloys are homogenous in composition and single-phase for Os diluent concentration up to x = 22. Electrical resistivity (ρ) measurements as function of temperature (T),in the temperature range of 2 K < T < 1100 K, was used to obtain the magnetic transition temperatures of the various alloys. The onset of antiferromagnetism causes large anomalies in the ρ versus T curves, associated with the Néel transition temperatures (T_N)[1]. These results were used to determine the magnetic phase diagram of the $Cr_{100-x}Os_x$ alloy system for $x > 2$. Present results show that T_N increases up to 575 K at x = 4, and then decreases for $x > 4$. This behaviour is similar to that observed for other Cr alloys with group-8 impurities [1].Interestingly, results reveal that the antiferromagnetism in the $Cr_{100-x}Os_x$ alloy system is fully suppressed at x = 13. The present results are interpreted and explained in terms of the theory of Fedders and Martin [3]. [1] Fawcett E, Alberts HL, Galkin VY, Noakes DR and Yakhmi JV 1994 Rev. Mod. Phys. 66 25.[2] Butylenko AK and Nevadcha VV 1982 Sov. Phys. Tech. Phys. 27(1) 102.[3] Fedders PA and Martin PC 1966 Phys. Rev. 143 245.

25 - Investigation of Diffusion for the ion implanted Xenon in 6H-SiC

DCMPM1 - Tuesday 09 July 2013 10:50

Authors: THABETHE, Thabsile *(University of pretoria (Tuks))*

AbstractThe diffusion behaviour of implanted xenon in 6H-SiC has been investigated using Rutherford backscattering spectroscopy (RBS) and channelling techniques. Xenon (Xe+) ions with energy of 360 KeV were implanted in SiC with a fluence of 1 × 1016 cm-2 at room temperature (23oC) and 600°C. 5h isochronal annealing was performed at temperatures ranging from 1000 to 1500°C in steps of 100oC. Channelling revealed that the sample (6H-SiC) at room temperature created an amorphous layer, 600°C it did not cause amorphisation, the crystal structure was preserved. Annealing the sample from 1000oC to 1500oC for caused some annealing of the radiation damage with defects still remaining. While at 600oC the damage pick disappears completely at 1500oC but the virgin spectrum is not achieved. This happened because of dechanneling due to extended defects like dislocations. RBS on the annealed samples 600oC showed that no diffusion of the Xe occurred on the implanted samples when they were annealed with temperatures from 1000oC to 1400oC. A slight shift of the xenon peak position towards the surface after annealing at 1400°C was observed for 600oC implantation. After annealing with 1500oC, a shift toward the surface accompanied by diffusion was observed to be taking place for both 600oC implantation. In the room temperature implanted samples there was evidence of diffusion of the xenon which only started after annealing at 1200°C. The diffusion was accompanied by a loss of xenon from the SiC surface. The shift towards the surface is due to thermal etching of the SiC at 1400 and 1500°C and it might also be due to the migration of xenon corresponded to a gas migration model.

26 - Theoretical Study of Positron States in Barium Flouride using Independent Particle Model and Generalized Gradient Approximation

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: JILI, Thulani *(University of Zululand)*
Co-authors: *SIDERAS-HADDAD, Elias (University of the Witwatersrand); WAMWANGI, Daniel (University of the Witwatersrand)*

High momentum components of positron-electron annihilation radiation are in general related to the annihilations of core electrons with positrons. A theoretical approach is conducted to study the contributions of low to high momentum components of electron-positron momentum density in ionic barium flouride. Annihilation rates are calculated within the Independent Particle Model (IPM) and Generalized Gradient Approximation (GGA). Defect and defect-free zones annihilation rates are also considered.

27 - Simulation of Electron Dynamics in the Earth's Magnetosphere

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: NEMAIR, Mahassin. A. A *(University of KawZulu-Natal)*
Co-authors: *COLLIER, Andrew B. (SANSA Space Science, Hermanus, South Africa)*

The dynamics of electrons with energies from hundreds of keV to tens of MeV were simulated in a dipole magnetic field. A uniform convection electric field was superimposed. Energetic electrons can be injected into the inner magnetosphere around midnight at the onset of the substorm expansion phase. These electrons proceed to drift eastward towards dawn. Energy dispersion is expected because of their different drift velocities. The model was used to simulate the evolution of the energy, radial distance (L shell) and pitch angle distribution function with local time. The results of the simulations are compared to experimental observations from geosynchronous satellites.

28 - Simulations of ion acoustic waves in Saturn's magnetosphere

Space Science - Wednesday 10 July 2013 16:20

Primary authors: KOEN, Etienne *(SANSA Space Science)*
Co-authors: *COLLIER, Andrew (SANSA Space Science); MAHARAJ, Shimul (SANSA Space Science); MBULI, Lifa (SANSA Space Science)*

Existence domains and characteristics of ion acoustic waves are studied in atwo-temperature electron, adiabatic ions and low density ion plasma with the electron components being kappa-distributed. Such an environment has been found in Saturn's magnetosphere. Using a Particle-in-Cell (PIC) simulation, the evolution of the spatial electric field is tracked during the entire simulation, after which a dispersion diagram is constructed to study the dispersion characteristics of the ion acoustic mode.

29 - Simulations of oblique electrostatic wave propagation

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: KOEN, Etienne *(SANSA Space Science)*
Co-authors: *COLLIER, Andrew (SANSA Space Science); MAHARAJ, Shimul (SANSA Space Science); MBULI, Lifa (SANSA Space Science)*

The electron-acoustic instability in a magnetised plasma having three electroncomponents, one of which is a field-aligned beam of intermediate temperature, isinvestigated using a Particle-in-Cell simulation. When the magnetic field strength is such that the plasma frequency of the cool electrons is less than the electron gyrofrequency, the only instability in the electron-acoustic frequency range is the strongly magnetized electron-acoustic instability. Its growth rate and real frequency exhibit a decrease with propagation angle and it grows at small to intermediate wave numbers.

30 - NON-SPECIALIST: Status of Aberration-corrected Transmission Electron Microscopy in South Africa

DCMPM1 - Friday 12 July 2013 10:30

Primary authors: NEETHLING, Johannes *(Director, Centre for HRTEM, Nelson Mandela Metropolitan University)*
Co-authors: *OLIVIER, Jaco (Centre for HRTEM, NMMU); O'CONNELL, Jacques (Centre for HRTEM, NMMU)*

The development of spherical aberration-corrected electron microscopes in the 1990s has enabled sub-ångström resolution studies of nanomaterials in scanning transmission electron microscopy and transmission electron microscopy modes. Aberration-corrected electron microscopy allows the high-precision mapping of atom positions and the atomic-scale imaging of the chemical composition and nature of bonds between atoms. Since the characterisation of nanostructures down to the atomic scale is essential for the understanding of some of its physical properties, the availability of aberration-corrected electron microscopy is important for the development of nanotechnology. Interesting high resolution electron microscopy results from the Centre for High Resolution Transmission Electron Microscopy in Port Elizabeth, which was launched in October 2011, will be presented and discussed.

31 - Experimental Characterisatics of small oil Thermal Energy Storage (TES) tank for domestic applications

Poster2 - Wednesday 10 July 2013 17:40

Authors: PHORI, Abigail *(North West University)*

A small thermal energy storage (TES) tank is designed to test the thermal performance of oil for domestic heat storage applications. Charging experiments to store thermal energy are done using an oil circulating coil in contact with a hot plate. Discharging experiments to extract the energy stored are performed using an oil heat exchanger immersed in a water bath. The temperature distribution along the height of the storage as a function of flow rate is monitored for the charging and discharging experiments. The energy and exergy stored are evaluated for each experimental test. Results of the experimental tests indicate various degrees of thermal stratification along the height of the storage tank. Lower flow-rates are suggested to maintain a reasonable degree of thermal stratification during charging. For discharging, high flow-rates enable a faster rate of energy extraction at the expenses of a loss in thermal stratification. Water boiling for simple domestic cooking applications is also found to be possible using the experimental setup.Keywords: Charging and discharging; oil storage tank; thermal stratification; energy and exergy stored; water boiling; flow rate

32 - Cold Atoms at UKZN

Photonics - Tuesday 09 July 2013 14:10

Primary authors: MORRISSEY, Michael *(University of KwaZulu NAtal)*
Co-authors: *PETRUCCIONE, Francesco (UKZN); SEMONYO, Malehohonolo (UKZN); DLAMINI, Sanele (UKZN)*

Since the concept was first introduced in 1975, laser cooling of atoms has become a very important tool in many fields of physics research. Using the combination of on-resonant laser cooling (to provide a velocity dependant force) and magnetic trapping (to provide a position dependant force) the magneto-optical trap (MOT) allows the routine production of an atomic samples with a large number of atoms (1010 atoms) at an extremely low temperature (< 100 μK). This allows researcher to trap, manipulate and probe cold atoms with relative ease and has lead to many significant contributions to our understanding of atomic and molecular physics, as well as precision metrology.At UKZN we have one of the very few cold atom setups in the African continent. The focus of this presented will the experimental setup of the existing cold atom experiment in UKZN. This will entail the vacuum, laser, and magnetic field systems used to create the magneto-optical trap. Also presented will by some analysis of the cold atom setup, such as temperature, size, atomic density, as well as the dynamic properties of the system.

33 - Solid state reaction of ruthenium with silicon carbide, and the implications for its use as a schottky contact for high temperature operating schottky diodes.

Applied - Tuesday 09 July 2013 15:40

Primary authors: MUNTHALI, Kinnock Vundawaka *(University of Pretoria and Polytechnic of Namibia)*
Co-authors: *THERON, Chris (University of Pretoria); AURET, Danie (University of Pretoria)*

A thin film of ruthenium was deposited on n-type 4H-SiC by electron beam deposition technique so as to study the interface behaviour of the ruthenium schottky contact with silicon carbide at various annealing temperatures. Ruthenium Schottky diode dots were also fabricated by using electron beam deposition of ruthenium on n-type 4H-SiC which had nickel deposited on it by resistive evaporation technique as back ohmic contact . The Ru-4H-SiC Schottky barrier diodes (SBDs) and Ru-4H-SiC films were both annealed isochronally in a vacuum furnace at temperatures ranging from 500 -1000 oC. After each annealing temperature, full IV and CV characterisation was performed on SBDs, and the Ru-4H-SiC thin films were analysed as well by Rutherford Backscattering spectrometry (RBS). Raman analysis of Ru-4H-SiC thin film which was annealed at 1000 oC was also done. RBS analysis showed evidence of ruthenium oxide formation and the diffusion of ruthenium into silicon carbide starting from annealing temperature of 700 oC going upwards. Raman analysis of the sample that was annealed in a vacuum at 1000 oC also showed clear peaks of ruthenium oxide, D and G carbon peaks which indicate the formation of graphite. Despite the occurrence of the chemical reactions and diffusion of ruthenium into SiC, the SBDs showed very good linear CV characteristics and excellent forward IV characteristics up to final annealing temperature of 1000oC.This is the first time in the World where a diode shows normal operation after annealing at a high temperature of 1000 oC. The SBDs had a small series resistance of below 20 Ω.The SBHs from IV characteristics were nearly equal to(but less than) 1eV and the ones obtained from CV characteristics were slightly higher than 1eV but less than 2 eV. The ideality factor for the most part was closer to 1 and showed very little variations at various annealing temperatures.

34 - Investigating Dunedin Whistlers using Volcanic Lightning

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *ANTEL, Claire (SANSA Space Science)*
Co-authors: COLLIER, Andrew *(SANSA Space Science, UKZN)*

Whistlers recorded at Dunedin, New Zealand, are anomalous: rather than being caused by lightning close to the magnetic conjugate point, they appear to be statistically linked to lightning on the west coast of Central America, several thousand km away. This conclusion, however, is the result of a global correlation analysis, which is complicated by the fact that there is a lot of lightning close to the proposed source region. This makes the chance of spurious coincidences between lightning and whistlers quite likely.Our aim was to find a direct link between individual whistlers and their causative lightning strokes. We focused our attention to sites of rare lightning activity: the electrified plumes of high-latitude volcanoes. By limiting our search to these locations, we succeeded in identifying individual lightning discharges which could be linked directly to whistlers at Dunedin. Two volcanoes on the Aleutian Islands, Mount Redoubt and Mount Okmok, were found to have had a prominent effect on Dunedin's whistler count. These are the first observations of whistlers linked to volcanic lightning.

35 - Detecting Lightning Distribution Changes using Satellite Imagery

Space Science - Tuesday 09 July 2013 11:30

Primary authors: BOOYSENS, Aimee *(SANSA Space Science)*
Co-authors: *COLLIER, Andrew B (SANSA Space Science); VIRIRI, Serestina (University of Kwa-Zulu Natal)*

The distribution of lightning across the Earth's surface varies both with location and time. Seasonal changes in lightning activity recorded in Low Earth Orbit (LEO) satellite data have been studied by various authors, who used classical time series analysis techniques. We present an alternative analysis based on automated pattern recognition, which identifies the changing state of lightning distributions using computer vision techniques. Due to the large quantity of data available, machine learning algorithms were the most efficient way of achieving our goals. This model not only has significant application in the analysis of historical lightning data but also in the forecasting of future lightning distributions.

36 - Particle flux forecast using space wind parameters in a multivariate auto-regressive model with Kalman filtering

Space Science - Tuesday 09 July 2013 11:10

Primary authors: HILLEBRAND, Charlotte *(University of KwaZulu-Natal)*
Co-authors: *COLLIER, Andrew B. (University of KwaZulu-Natal)*

Particles from the solar wind penetrate into the Earth's radiation belts where they can have a detrimental effect on the operation and lifetimes of satellites as well as influencing terrestrial communications and power lines. Forecasting conditions in the solar wind is thus an important problem. Previously this has been approached with various techniques including Kalman filtering and neural networks. We combine a Kalman filter with a multivariate autoregressive model based on pertinent features of the solar wind. In line with the findings of Sakaguchi et al (2013) this is expected to provide superior forecasting of solar wind conditions.

37 - The Electrical Transport Properties of Bulk Nitrogen Doped Carbon Microspheres

DCMPM1 - Wednesday 10 July 2013 14:10

Primary authors: WRIGHT, William *(University of the Witwatersrand)*
Co-authors: *MARSICANO, Vincent (University of the Witwatersrand); KEARTLAND, Jonathan (University of the Witwatersrand)*

The electrical transport properties of Nitrogen doped Carbon microspheres are experimentally investigated using a number of well-established techniques. Four samples of bulk nitrogen doped carbon microspheres were synthesised using a horizontal chemical vapour deposition reaction. The samples, with varying levels of Nitrogen dopant, are then characterised using EPR (electron paramagnetic resonance) and Raman spectroscopy to confirm the amorphous carbon structure and dopant level so that accurate comparisons between the properties of samples can be made. Raman data gives characteristic spectra of disordered carbon and the Ratios of the I_D and I_G peaks are calculated. EPR measurements allowed for comparisons between the number of paramagnetic centres in each sample to be compared. This offers a non-destructive technique to determine relative dopant levels and, if a standard is known, absolute dopant levels. Results of temperature dependent four probe resistance measurements on the four samples are presented. Attempts to explain these results using a fluctuation assisted tunnelling model and variable range hopping are explored. The apparent occurrence of a metal insulator transition in some samples is shown and attempts to explain this effect by dopant desorption is presented. The results of a series of variable temperature, high and low bias regime IV Characteristics experiments are presented. Attempts to explain the results of these experiments using a fluctuation assisted tunnelling and thermal activation model explored. The initial results of a series of field dependent and angle dependent magneto resistance experiments are presented and ideas for further experiments to shed light on the transport properties of the samples are given.

38 - Ionospheric response during geomagnetic storm events in 2004

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MATAMBA, Tshimangadzo Merline *(SANSA Space Science)*
Co-authors: *MCKINNELL, Lee-Anne (South African National space Agency (SANSA) Space Science, Hermanus, South Africa); HABARULEMA, John Bosco (South African National space Agency (SANSA) Space Science, Hermanus, South Africa)*

The ionosphere is the region of the ionised plasma extending from about 50 to 1200 km above the Earth's surface. It consists of free electrons and ions produced during interaction of extreme ultraviolet radiation (EUV) with upper atmosphere neutral gas. It is destabilised by solar activities such as coronal mass ejections (CME) and solar flares. In this study, the response of the critical frequency of the F2 layer (foF2) during geomagnetic storms in 2004 was investigated using ionosonde data obtained from South African Ionosondes network. Geomagnetic storm periods were identified based on the disturbance storm time index (Dst) which is a measure of the Earth's magnetic field disturbances. During the analysed period, negative ionospheric storm effects (decrease in electron density) were frequently observed.

39 - Evidence for SuperDARN polar mesosphere summer echoes (PMSE) at SANAE IV, Antarctica: first observation

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *OGUNJOBI, Olakunle (School of Chemistry and Physics, University of KwaZulu-Natal, South Africa)*
Co-authors: *SIVAKUMAR, Venkataraman (School of Chemistry and Physics, University of KwaZulu-Natal, South Africa); STEPHENSON, Judy (School of Chemistry and Physics, University of KwaZulu-Natal, South Africa);* MBATHA, Nkanyiso *(SANSA-Space Science)*

Recently, it has been known that during polar summer time, both charged ice particles and atmospheric turbulence play a major roles in the creation of the electron number density that can result to strong radar echoes in polar mesopause regions. These echoes are known as polar mesosphere summer echoes (PMSE). Understanding causative mechanism of such thermal structure between Antarctic and Arctic mesopause altitude is still ongoing and is partly due to few observations from Antarctica. In this study, we use the near-range measurements of the Super Dual Auroral Radar Network (SuperDARN) from South Africa National Antarctic Expedition (SANAE) IV (71.7 °S 2.9 °W) data. We have manually visualised the radar data for the summer time period from 2010/2011 to 2011/2012 to observe the PMSE occurrence over SANAE radar station. The present automated SuperDARN-PMSE extractor algorithm uses: backscatter power greater than 6 dB, Doppler velocity and spectral width below 50 m/s respectively. This automated algorithm has proved successful in removing meteor trails and E region backscatter echoes but with Field-aligned irregularities (FAI) contamination. SANAE IV riometer provides opportunity for an indirect proxy for anisotropic perturbations of plasma density associated with magnetic fields at mesopause altitudes. This unique opportunity allows isolation of FAI from SuperDARN-PMSE occurrence rate. For the first time, we present initial occurrence rate of SuperDARN-PMSE from SANAE and its conjugate vicinity during the two consecutive Antarctic and Arctic summers. Preliminary result indicates that with the availability of absorption data from riometer, a simple coincidence algorithm (SCA) may be a useful technique to isolate FAI contamination.

40 - Monitoring land-cover changes using satellite imagery

Space Science - Tuesday 09 July 2013 11:50

Primary authors: GOOSEN, Wayne *(SANSA Space Science)*
Co-authors: *COLLIER, Andrew (SANSA Space Science); VIRIRI, Serestina (University of Kwazulu Natal)*

Several regions around the World are currently undergoing rapid, wide-ranging changes in land cover due to human activities and natural events. These changes can have significant effects on regional and even global climate change. In this paper the focus is on urbanization in South Africa. Two major factors drive urbanisation: population expansion and the wider range of employment opportunities in urban areas. We employ a post-classification approach to detect land cover changes on a specific area from a time series of satellite images. Variance in spatial resolution and radiometric resolution between images was taken into account using radiometric normalization and geometric registration. We then used a maximum likelihood classifier to distinguish between the different land use classes. We are able to quantify the proportions of each land use class for every image and monitor the change over time. This information highlights the physical growth rate of a specific urban area caused by urbanization and it will allow environmental experts to diagnose the effects of these changes.

42 - Assessment of Neutron-Irradiated 3C-SiC

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: ENGELBRECHT, Japie *(NMMU)*
Co-authors: *DEYZEL, G (NMMU); MINNAAR, EG (NMMU); GOOSEN, WE (NMMU); VAN ROOYEN, IJ (Idaho State Labs, Idaho, USA)*

SiC is used as a containment layer in the triple-coated isotropic (TRISO) layers for the new generation of nuclear reactors. Consequently, the material is subjected to high fluences of nuclear fission particles and to high temperatures during the operation of such a nuclear reactor. The effects of irradiation on SiC have already been the subject of various investigations. This study reports on the analysis of 3C-SiC wafers irradiated at various fluences and an irradiation temperature of 800°C. A Bruker 80 V FTIR/Raman spectrometer, fitted with a Pike 10Spec specular reflection unit was employed to obtain infrared reflectance spectra from the samples, and 32 scans were taken at a resolution of 8 cm^{-1}. The surface roughness of the various samples was measured using a CSM Instruments Nano-indenter, fitted with an atomic force microscope (AFM). Reflectance spectra were used to extract the dielectric parameters of the samples, utilizing curve-fitting procedures. Variations in the reflectance and dielectric parameters of the irradiated samples were observed. The variations were found to be related to the fluence. In addition, variations could be linked to the surface roughness of the particular irradiated specimens. Results will be presented and discussed.

43 - Improvements in accuracy of a real-time orbital propagator by modelling perturbation forces acting on a LEO CubeSat

Space Science - Wednesday 10 July 2013 13:50

Primary authors: TSHILANDE, Thinawanga *(SANSA Space Science)*
Co-authors: *OPPERMAN, Ben (SANSA Space Science); VAN ZYL, Robert (Cape Peninsula University of Technology)*

A precise orbit propagator was developed for implementing on a cubesat's on board computer for real-time orbit position and velocity determination and prediction. Knowledge of the accurate orbital position and velocity of a Low Earth Orbit(LEO) Cubesat orbit is required for various applications such as antenna and imager pointing. Satellite motion is governed by a number of forces other than Earth's gravity alone. The inclusion of pertubation forces such as Earth's aspheric gravity, third body attraction (e.g. Moon and Sun), atmospheric drag and solar radiation pressure, is subsequently required to improve the accuracy of an orbital propagator. Precise orbit propagation is achieved by numerically integrating a set of coupled second order differential equations derived from modelling the satellite's acceleration vector due to all forces acting it. In this study the Runge-Kutta-Fehlberg numerical integration method of the order 7(8) (RKF78), resulting from imbedding RK7 into RK8 was selected for precision integration. This integrator was selected for its stability, high accuracy and computational efficiency. For precision quantification a one-day section of Satellite Laser Ranging -derived precision orbit of the SUNSAT satellite was used as reference. Results, at three-hour intervals, on the improvement in accuracy are demonstrated by the sequential adding of perturbation forces to the initial two-body solution.

44 - Effects of Cr3+ ions concentration in Cr-doped ZnAl2O4 nanocrystals synthesized using sol-gel process

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: MOTLOUNG, Setumo Victor *(University of the Free State)*
Co-authors: *NTWAEABORWA, Martin (University of the Free State); DEJENE, F.B. (University of the Free State); SWART, H.C. (University of the Free State)*

A report on the sol-gel preparation of nanosized ZnAl2O4:Cr3+ at a relatively low temperature (~80 °C). The mol% of Cr3+ was varied in the precursor during the synthesis. The gel, dried and annealed powder samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), Fourier transform infrared analysis (FTIR) and photoluminescence (PL) spectroscopy. The XRD data revealed that the dried and annealed samples consist of the mixture of ZnO, Al3O2 and cubic phases of ZnAl2O4. The estimated crystalline size for the cubic spine phase was found to be 28 nm in diameter. The surface morphology of the phosphors was influenced by the mol% of the Cr3+ in the precursor. FTIR spectra showed that the number of bands decreases when the samples are heat-treated at higher temperatures. PL spectra indicated that both undoped and Cr-doped ZnAl2O4 powders exhibit green PL emission when the powders are sintered at 700 oC in air. It indicates that the green emissions come from either the host or Cr3+ ions. However, it is noted that the green emission peaks were at different positions, 515 nm and 530 nm, for undoped and Cr-doped phosphors, respectively.

46 - Cytogenetic analysis of Co-60 γ-radiation-induced chromosome damage and simulations using the Geant4 Monte Carlo toolkit

NPRP - Wednesday 10 July 2013 15:40

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

The study investigates the determination and quantization of radiation damage on a cellular level and the replication of this energy deposition using the Geant4 Monte Carlo toolkit, developed for particle transportation simulations at CERN. The detection of micronuclei in binucleated cells was used to analyse the effects of the radiation. Results from micronucleus assays of rat brain endothelial and Chinese hamster ovary cells that have been irradiated with gamma rays, produced by a Co-60 teletherapy unit at iThemba LABS, are presented. Linear-quadratic dose response curves were determined for both cell lines and compared to those of other ionizing radiations. Additionally discussed are the simulated results of the Co-60 setup, irradiation and other relevant features offered by the Geant4 toolkit. Finally, prospective microdosimetric studies and simulations of damage caused by DNA-incorporated I-123 will be mentioned.

47 - Study of the time variation of geomagnetic field over southern Africa applying harmonic splines technique on CHAMP satellite data

Space Science - Wednesday 10 July 2013 10:30

Primary authors: NAHAYO, Emmanuel *(SANSA Space Science)*
Co-authors: *KOTZE, Pieter B. (SANSA Space Science); MCCREADIE, Heather (University of KwaZulu-Natal)*

The monitoring of the Earth's magnetic field requires a continuous recording of geomagnetic data. In the southern Africa, the ground recording stations are limited and the use of satellite data is needed for the studies where high spatial and temporal resolution data is required. The study of the fast time variation of geomagnetic field in the southern Africa region was conducted applying the harmonic splines technique on CHAMP satellite data that has been recorded between 2001 and 2005. The derived model, the Southern Africa Regional Model (SARM), was validated using the ground based data and the global model IGRF-11. The results of this study suggest that the southern Africa regional model can be improved combining the satellite data and ground data.

48 - Fuelling the star formation in brightest cluster galaxies

Astro - Tuesday 09 July 2013 10:50

Authors: LOUBSER, Ilani *(North-West University)*

I will report on an ongoing investigation aimed at constraining the formation and evolution of brightestcluster galaxies (BCGs) and the connection with the evolution of the host clusters. We use 2D and 3D spectroscopy to investigate the origin of the gas fuelling the recent star formation detected insome BCGs by measuring their emission lines. This enables us to derive fundamental gas properties such aselectron density and gas temperature, which in turn, enables us to derive accurate abundances. Our small,carefully selected, sample consists of star forming BCGs with detected H-alpha filaments, and have existing datafrom the X-ray regime available, but lacks the detailed optical emission-line data that will probe the dominantionization processes, excitation sources, morphology and kinematics of the hot gas. This, combined with theother multiwavelength data, will form a complete view of the different phases (hot and cold gas and young stars)and how they interact in the processes of star formation and feedback detected in central galaxies in cooling flowclusters, as well as the influence of the host cluster.

49 - Synthesis of zinc oxide based nanophosphors by solution-combustion method

DCMPM2 - Tuesday 09 July 2013 16:20

Primary authors: KUMAR, Vinod *(Department of Physics, University of the Free State, Bloemfontein, ZA-9300)*
Co-authors: *SWART, H. (Department of Physics, University of the Free State, Bloemfontein, ZA9300, South Africa); NTWAEABORWA, O. (Department of Physics, University of the Free State, Bloemfontein, ZA9300, South Africa)*

Zinc oxide (ZnO) is a wide direct band gap semiconductor (3.37 eV) with a large exciton binding energy (60 meV), and it is a promising future material for applications in the field of light emitting materilas1,2. The photoluminescence (PL) spectra show UV near band edge emission around 380 nm and defect related deep level emission (DLE), which depends upon the synthesis methods and growth conditions. The visible emission in ZnO is observed due to presence of DLE bands3,4. It is important to understand the origin of these emissions for the development of highly efficient optoelectronic devices. In this paper, ZnO nano-phosphors (NPr) were synthesized by a solution-combustion method using zinc nitrate and zinc acetate as precursors and urea as a fuel. Terbium nitrate pentahydrate and europium nitrate pentahydrate were used as a dopant source for terbium (Tb) and europium (Eu) to enhance the luminescence property of ZnO based NPr. Hexagonal wurtzite structures of ZnO were confirmed by the X-rays diffraction spectra. A broad band orange-red emission from 500 to 850 nm was obtained from the ZnO NPr prepared with the nitrate precursor which may be attributed to oxygen related defects. Terbium doped ZnO (ZnO:Tb) NPr has shown green emission, while europium doped ZnO (ZnO:Eu) NPr enhanced the red emission in ZnO NPr at lower doping concentrations. The intensity of the luminescence (DLE) decreased at higher concentration of Tb and Eu, due to the formation of Tb4+ and Eu4+.Keywords: DLE, XPS, ZnO, NPr and Red emissionReferences[1].Ozgur U.; Alivov Y.L.; Liu C.; Teke A., Reshchikov M.A.; Dogan S., Avrutin V.; Cho S.J. and Morkoc H.J. J. Appl. Phys. 2005, 98, 041301.[2].Kumar Vinod; Swart H.C.; Ntwaeaborwa O.M., Kroon R.E.; Terblans J.J.; Shaat S.K.K.; Yousif A., M.M. Duvenhage, Materials Letters (/10.1016/j.matlet.2013.03.073)[3].Gong Y.; Andelman T.; Neumark G.; O'Brien S.; Kuskovsky I. Nanoscale Res. Lett. 2007, 2, 297.[4].Djurisic, A.B.; Leung Y.H.: Tam K.H.; Hsu Y.F.; Ding L.; Ge W.K.; Zhong Y.C.; Wong K.S.; Chan W.K.; Tam H.L., Cheah K.W.; Kwok W.M.; Phillips D. Nanotechnology

50 - Low-Energy Electronic Structure and Fermi Surface of the itinerant metamagnet $Sr_3Ru_2O_7$

DCMPM1 - Tuesday 09 July 2013 10:30

Primary authors: SOHANFO NGANKEU, Arlette *(Department of Physics University of Johannesburg)*
Co-authors: *CARLESCHI, Emanuela (Department of Physics, University of Johannesburg); DOYLE, Bryan P (Department of Physics, University of Johannesburg); FITTIPALDI, Rosalba (University of Salerno); CUOCO, Mario (University of Salerno); VECCHIONE, Antonio (University of Salerno); ZABOLOTNYY, Volodymyr (IFW Dresden); VOBORNIK, Ivana (TASC Trieste); UNNIKRISHNAN, Manju (TASC Trieste); BORISENKO, Sergey (IFW Dresden)*

Sr3Ru2O7 is the second member of the Ruddlesdden-Popper series of strongly correlated oxides Srn+1RunO3n+1, where n defines the number of consecutive planes of the ruthenium oxygen (RuO6) octahedra layers in the unit cell. This compound has recently attracted the attention of the scientific community because of its unusual low-temperature physical properties such as metamagnetism and quantum criticality [1] with evidence of nematic fluid behaviour [2,3]. The early work of Binz et al. based on mean field theory showed that the metamagnetic behaviour observed in Sr3Ru2O7 [4] can be understood as a result of the presence of van Hove singularities (vHs) (i.e. sharp peaks observed in the density of states (DOS)) in the proximity of the Fermi energy and associated to Fermi surface (FS) sheets of different symmetry [5]. Therefore, the complete determination of the symmetry and the location of these singularities on the FS are of fundamental importance for the understanding of the quantum critical behaviour of Sr3Ru2O7. In this study we present our recent results on the low-energy electronic structure of Sr3Ru2O7, including details on the FS sheets. This investigation was performed via synchrotron-based angle resolved photoemission spectroscopy performed at 1K. Together with the reconstruction of the FS, our results show that - in addition to the flat band close to the X point that reveals a complex DOS with vHs near to the Fermi level (as suggested by Tamai and co-workers [6]) - there is another flat band associated to a FS sheet of a different symmetry around the Γ point that also reveals a complex DOS with vHs near the Fermi level. Moreover, evidence of vHs around the X point has been suggested in the FS of Sr3Ru2O7, with the presence of high intensity around this point. Finally, the presence of strong electron-phonon correlations was confirmed by the presence of kinks in band dispersions, which are the evidence of a sensitive coupling between the structural and magnetic properties in Sr3Ru2O7. [1] S. A. Grigera et al., Science 294, 329 (2001).[2] R. A. Borzi et al., Science 315, 214 (2007).[3] J. F. Mercure et al., Phys. Rev. Lett. 103, 176401 (2009).[4] B. Binz and M. Sigrist, Europhys. Lett. 65, 816 (2004).[5] C. Honerkamp, Phys. Rev. B 72, 115103 (2005).[6] A. Tamai et al., Phys. Rev. Lett. 101, 026407 (2008).

52 - NON-SPECIALIST: Progress with the development of the Lunar Laser Ranger for South Africa

Space Science - Wednesday 10 July 2013 11:10

Authors: COMBRINCK, Ludwig *(HartRAO)*

The development of a Lunar Laser Ranger based on a 1 m Cassegrain telescope is progressing well. This overview reports on the progress and sketches the way forward. Construction of a suitable housing for the telescope and a transportable control centre has been completed. Pointing and steering of the telescope is a critical issue and an overview is given of the software being developed as well as of the hardware requirements of the azimuth and elevation drive. A suitable laser system is being developed and the specifications as well as expected return signal levels are described. Data processing will be done using specially developed software which will allow highly accurate lunar ephemeris calculation in an orbital integrator which makes provision for the dynamics of the planets, the Moon and a number of asteroids. Possible scientific applications and participation in future interplanetary laser transponder based missions are described.

54 - Effects of different TiO_2 phases on the luminescence of $CaTiO_3:Pr^{3+}$

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: NOTO, Luyanda Lunga *(University of Free State (Student))*
Co-authors: *PITALE, Shreyas (University of Free State); NTWAEABORWA, Odireleng (University of Free State); TERBLANS, J. (University of Free State); SWART, Hendrik (University of Free State)*

The intentervalence charge transfer mechanism is known to be the reason behind the single red emission of Pr^{3+} doped $CaTiO_3$ at room temperature. This comes about as a result of complete depopulation of the 3P0 level carriers by populating the 1D2 state. However, the intensity of the single red emission peak from the 1D2 → 3H4 transition is highly dependent on energy transfer from the host to the luminescent centers of Pr3+[1,2]. The final compound can have different quantities of defects such as line defects, point defects, and vacancies. These are a result of slight changes in the preparation procedures such as heating rate, cooling rate, and chemical reaction rate. Different chemical reaction rates may also be introduced by different reagent phases. All these parameters may influence the properties of the final compound, which may in tum affect energy transfer from the host to the luminescent centers of Pr^{3+} because of many non-radiative centers that may be introduced in the material [3,4]. Luminescent dynamics including phosphorescence, absorption and phosphorescence decay measurements of $CaTiO_3:Pr^{3+}$ phosphor are reported. X-ray diffraction spectra indicated that $CaTiO_3:Pr^{3+}$ phosphor material was successfully prepared at 1200 ^{0}C using the solid state reaction method. A single red emission peak from the 1D2 → 3H4 transition of Pr^{3+} was observed upon probing the materials with photons using a photoluminescence spectrometer. The cathodoluminescence stability measurements were carried out for the sample prepared with rutile and anatase TiO_2, and the sample prepared using rutile TiO_2 shows better chemical stability. References(1) Noto, L. L.; Pitale, S. S.; Terblans, J. J.; Ntwaeaborwa O.M.; Swart, H.C. Physica B 2012, 407, 1517(2) Diallo, P. T.; Jeanlouis, K.; Boutinaud, P.; Mahiou, R.; Cousseins J. C. J. Alloys and Compd. 2001, 218, 323(3) Tang, W.; Chen, D. Mat. Res. Bull. 2009, 44, 836(4) Zhang, X.; Zhang, J.; Chen, X.; Lu, S.; Wong, X. J. J. Lumin. 2007, 122, 958

55 - Modification of glassy Carbon under Strontium ion implantation

DCMPM1 - Tuesday 09 July 2013 11:10

Primary authors: ODUTEMOWO, opeyemi *(university of pretoria)*
Co-authors: *MALHERBE, Johan (University of pretoria); LANGA, Dolly (University of pretoria)*

Diffusion, structural and surface changes of glassy carbon (Sigradur® G) due to implantation with 200keV strontium ions at room temperature are reported. The samples were implanted to a fluence of 2 ×1016 ions/cm2 at room temperature. The implanted samples were vacuum annealed at temperatures ranging from 200oC-900oC. The influence of ion implantation and annealing on surface topography was examined by the scanning electron microscopy (SEM), while Raman spectroscopy was used to monitor the corresponding structural changes induced in the glassy carbon. The depth profiles of the implanted strontium before and after annealing were determined using Rutherford backscattering (RBS).Compared to SRIM predictions the implanted strontium profiles was broader. After annealing, diffusion of the strontium atoms took place with a significant amount of the strontium atoms migrating to the surface of the glassy carbon. Evaporation of the strontium atoms was noticed as the melting point of strontium (769oC) was approached.The Raman spectrum showed that only some of the damage due to implantation was annealed out. Annealing at 20000C for 5 hours resulted in a Raman spectrum very similar to that of virgin glassy carbon indicating that the damage due to the ion implantation was annealed out. SEM showed large differences in the surface topography of the polished glassy carbon surfaces and those of as-implanted samples. Annealing did not significantly change the surface microstructure of the implanted samples.

56 - Competitive Growth Texture of Pulse Laser Deposited VO2 Nanostructures on Glass Substrate

Poster1 - Tuesday 09 July 2013 17:40

Authors: MADIBA, itani given *(iThemba labs)*

Vanadium dioxide is a strongly correlated transition metal oxide with a first-order insulator-to-metal transition (IMT) at 67 ° C and its potential applications ranging from femtosecond optical switching to thermal-management coatings. The IMT exhibits large changes in resistivity and near-IR transmission accompanied by a nearly simultaneous structural change from low-temperature monoclinic form with band-gap of about 0.7 eV to a high temperature, tetragonal rutile phase. The phase transition is generally agreed to arise from a combination of Mott and Peierls mechanisms. High-quality thin films are crucial for technologies that capitalize on the IMT. It is well known that film microstructure film/substrate interface and localized strain of VO2 can affect the hysteresis characteristics of the phase transition. VO2 synthesis is also complicated by the narrow temperature-pressure window in phase space, due to multiple valence states of vanadium. The report is based on the crystal structure and morphology of VO2 nanostructures synthesized by pulsed-laser deposition on soda lime glass. The VO2 nanostructures exhibit sharp a-axis diffraction peaks, characteristic of the VO2 monoclinic phase, which implies that highly a-axis textured VO2 was formed. A detailed description of the growth mechanisms and the substrate/film interaction is given, and the characteristics of the electronic transition and hysteresis characteristics of the phase transition are described by the morphology and grain boundary structure. The sharpness of the transition and the hysteresis upon heating and cooling are found to be a strong function of crystal structure and microstructure (grain size, and shape).

57 - Luminescent properties of Pr^{3+}doped SrF_2 at different synthesis

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: YAGOUB, MYA *(University of the Free State)*
Co-authors: *SWART, HC (University of the Free State)*

Lanthanide-based luminescent materials have been extensively investigated due to their contribution to a different range of applications [1, 2]. These fluoride based luminescent materials are prominent amongst other candidates because they have lesser energy losses due to non-radiative relaxation processes [1]. Recently, the trivalent praseodymium (Pr^{3+}) is found to be a promising ion in the lanthanide-based luminescent materials for enhancing the solar cell efficiency [3]. In addition, the emission intensity of Pr^{3+} was found to be strongly dependant on the synthesizing procedures [2]. Nano-structure fluoride of SrF_2:Pr^{3+} was prepared by both the hydrothermal and combustion methods. X-ray diffraction patterns indicate that the samples were completely crystalized with pure face-centered cubic (space group: Fm3m). Both SrF_2:Pr^{3+} samples exhibit green-red emission centered at 488 nm under excitation wavelength 439 nm at room temperature. The dependence of the Pr^{3+} emission and excitation on the sintering temperature were also investigated and the phosphorescence lifetimes for both synthetic techniques are reported.**References**[1] Bryan M. van der Ende, L. Aarts and A. Meijerink. Adv. Mater. **21**, 3073, (2009). [2] T. Murakami and S. Tanabe. J. Cerm. Soc. J **115** [10], 605, (2007). [3] Bryan M. van der Ende, L. Aarts and A. Meijerink. Phys. Chem. Chem. Phys. **11**, 11081, (2009).

58 - Electrostatic wave Instabilities driven by counter-streaming electron beams in space plasmas

Space Science - Wednesday 10 July 2013 15:40

Primary authors: MBULI, Lifa *(South African National Space Agency (SANSA) Space Science, P.O Box 32, Hermanus 7200, South Africa / Department of Physics, University of the Western Cape, Robert Sobukwe Road, Bellville 7535, South Africa)*
Co-authors: *MAHARAJ, Shimul (South African National Space Agency (SANSA) Space Science, P.O Box 32, Hermanus 7200, South Africa); BHARUTHRAM, Ramesh (University of the Western Cape, Office of the Deputy Vice-Chancellor (Academic), Robert Sobukwe Road, Bellville 7535, South Africa)*

Broadband electrostatic noise(BEN) observed in satellite data is found to be associated with field-aligned electron or ion beams in different regions of the magnetosphere such as the plasma sheet boundary layer(PSBL), bow shock and auroral kilometric radiation(AKR) regions. We consider a four-component plasma composed of drifting (parallel to ambient magnetic field) warm electrons and drifting (anti-parallel to ambient magnetic field) cool electrons and background hot electrons and ions in an attempt to further understand the excitation mechanisms for BEN. Using kinetic theory, electrostatic instabilities such as ion-acoustic, electron-acoustic and counter-streaming beam-resonant instabilities are found to be supported. The dependence of the instability growth rates and real frequencies on various plasma parameters such as cool electron beam speed, number density, temperature and temperature anisotropy, as well as the magnetic field strength are examined. It is found that cool electron beam number density and speed determines which instability can be excited. Using plasma parameters which are closely aligned with the measurements made by the Cluster satellites in the PSBL regions we find that the electron-acoustic and ion-acoustic instabilities could account for the generation of BEN in this region.

59 - New crystal structure of MSHB from Mycobacterium tuberculosis shows insight into the catalytic mechanism

Poster2 - Wednesday 10 July 2013 17:40

Authors: BROADLEY, Simon *(Electron Microscope Unit)*

The enzymes of the pathway leading to the synthesis of mycothiol (MSH) and those enzymes involved in its recycling are potential drug targets, since mycothiol, that is used by Actinomycetes for defense against electrophilic toxins and oxidative stress, is not found in humans. The structure of MshB was first described by Maynes et al. (PDB code 1q74). The pentacoordinate zinc(II) in the active site was found to be liganded to His13, Asp16, His147 and two water molecules. A mechanism was proposed in which the tetrahedral transition state, formed during amide hydrolysis, would be stabilized by the positively charged Zn2+ and the imidazolium side chain of His144. The structure of MshB was determined almost simultaneously by McCarthy et al. (PDB code 1q7t), who crystallized the enzyme in the presence of β-octylglucoside (BOG), which was found to occupy a location near the catalytic zinc. Hydrogen bonding to the glucopyranoside ring of BOG was interpreted as being analogous to that occurring with the natural substrate. In particular, three conserved residues, Arg68, Asp95 and His144 were hydrogen bonded via their sidechains to the 3-OH, 4-OH and 6-OH hydroxyl groups of BOG respectively. Huang and Hernick have recently explored the kinetics of MshB and suggested that Tyr142, a residue that was not previously implicated in the mechanism, plays a major role in the catalysis. They modelled the predicted position of Tyr142 based on their observations.This work, in which acetate (one of the normal reaction products) is visualized in the active site, provides necessary structural evidence for the proposal that Tyr142 is indeed located in the predicted position. This structure also rules out the possibility of His144 acting as a component of the oxyanion hole. Furthermore, the geometry we observe in the active site strongly suggests that the protonated form of Asp15 fulfils the role of general acid as originally suggested by Maynes et al. and rules out the proposal of Huang and Hemick that the general acid is His144. Furthermore, the structure reported here enables a detailed analysis of the binding of the natural substrate via hydrogen bonding to Arg68, Asp95 and His144, and identifies a change in the conformation of the side chain of Asp95 that stabilizes the substrate binding loop in the absence of substrate.

61 - Development of an Improved Mode Identification Formula For Pulsating Stars

Astro - Tuesday 09 July 2013 14:30

Primary authors: MEKONNEN MENGISTIE, Getachew *(North West University, Mafikeng Campus)*
Co-authors: *RODNEY MEDUPE, Thebe (North West University, Mafikeng Campus)*

Medupe et al. (2009) developed a new formula for photometric mode identification by considering the shapes of eigen functions in A stars. We calculated opacity tables using ATLAS9 model atmosphere computer program and use this to fit the new formula to delta Scuti stars.In this talk, I am going to explain and review modeidentification methods for pulsating stars and present the new improved photometric mode identification formula and our results.

63 - NON-SPECIALIST: Laser spectroscopy of natural light harvesting: unravel, regulate and control

Photonics - Wednesday 10 July 2013 16:00

Authors: KRüGER, Tjaart *(University of Pretoria)*

Laser spectroscopy is a powerful tool to investigate fundamental physical processes in biological systems by providing an unprecedented wealth of information. This presentation will demonstrate how different time-resolved spectroscopy techniques have been combined over the past two decades to give a complete description of natural light harvesting on the molecular level. Insights into the remarkable efficiency and regulation of these processes can be obtained by using techniques ranging from ultrafast (femtosecond) spectroscopy to single-molecule spectroscopy. The principle of coherently controlling the underlying quantum dynamics in these systems will be introduced, a goal that will contribute significantly to the advancement of the next generation of solar cells.

64 - Thermodynamic stability of VO2 in contact with thin metal films

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: THABEZHE, Nokwethemba Fortunate *(University of Zululand)*
Co-authors: *NDWANDWE, Muzi (University of Zululand); KIBIRIGE, Betty (University of Zululand); NKOSI, Steven (University of Zululand)*

Solid-state compound phase formation has been investigated between thin metal films (Co, Hf, Ni, Pd and Pt) and VO2 substrates using Rutherford backscattering spectrometry and X- ray diffraction techniques. The thin-film couples were annealed for time periods ranging from 45 min to 1 h between 400 oC and 900 oC. It was found that Hf reacts with VO2 whereas Co, Ni, Pd and Pt do not. Heats of reaction were calculated for all possible combinations of vanadium alloy and metal-oxide reaction products. Comparisons with experimental results obtained show in all cases that metal-VO2 reactions only take place where its calculated heats of reaction were negative. This study shows that the results obtained correlate well with the electronegativity of the metal, which offers a convenient empirical method of predicting whether a metal will react with VO2 or not. Only metals with a Miedema electronegativity parameter less than 4.9 Volts reacted with VO2.

65 - Estimation of Arrival Time, Duration, and Intensity of Major Storms Caused by Earth Directed Halo Coronal Mass Ejections Using the WSA-Enlil Cone Model

Space Science - Tuesday 09 July 2013 16:20

Primary authors: ALAMIREW, NETSANET *(UNIVERSITY OF CAPE TOWN, SOUTH AFRICA SPACE AGENCY)*
Co-authors: *GAUNT, TREVOR (UCT); CILLIERS, Pierre (SANSA, Space Science)*

The objective of this study is to apply the recently developed Wang-Sheeley- Arge(WSA)-Enlil Cone model for using observations of coronal mass ejections (CMEs) on the sun to compute estimates of the arrival time, intensity, location and duration of impact of the solar wind at Earth. These information together with measured GIC data from the ESKOM network can be used as inputs to develop a neural network model to estimate geomagnetically induced currents in the South Africa power network resulting from CMEs.A number of models have been developed to study the behavior of sun, solar wind, transient events, and the resulting storms when they are directed towards the Earth. The Wang- Sheeley-Arge Enlil(WSA-Enlil) Cone model is the current state of the art model which is a 3-D Magnetohydrodynamic (MHD) model used to simulate the solar wind from the Solar Corona out to the heliosphere. In this paper the arrival time duration, and intensity of a selected number of solar storms associated with CMEs are studied. We considered storms resulting from Halo CMEs with Dst less than -200 nT. The data for Halo CMEs is collected from observations of the Large Angle Spectroscopic Coronagraph(LASCO) on board Solar and Heliosphere Observatory(SOHO) satellite(http://cdaw.gsfc.nasa.gov/CME_list/). From the detected Halo CMEs we considered only those which are geoeffective. To associate the CMEs with the observed storms, we used the Advanced Composition Explorer (ACE) satellite data.Once we have chosen the dates of the storms, the simulation is done for each period and the nature of the individual storms is studied. The simulation output is then compared with satellite observations of the arrival times, duration, and intensity of solar storms.

66 - Characterization of Transition metal nitrides thin films deposited using RF Magnetron Sputtering

DCMPM2 - Tuesday 09 July 2013 10:50

Primary authors: KURIA, Jonah *(DST/NRF Centre of Excellence in Strong Materials, School of Physics, University of the Witwatersrand)*
Co-authors: *WAMWANGI, Daniel (DST/NRF Centre of Excellence in Strong Materials, School of Physics, University of the Witwatersrand); COMINS, J Darrell (DST/NRF Centre of Excellence in Strong Materials, School of Physics, University of the Witwatersrand)*

Thin hard films of transition metal nitrides have been successfully explored and used in the past due to their properties such as high hardness, biocompatibility, wear and corrosion resistance, and thermal stability. Substrate bias can be used to control and improve the thin film properties such as adhesion, intrinsic stresses, and hardness. In this work, NbN and ZrN thin films have been deposited on etched (100) Si substrates at sputter power ranging from 75W to 300W using RF magnetron sputtering at varying substrate bias. The effect of sputter power and substrate bias on the microstructure and subsequently on the elastic constants of the thin films is investigated. The microstructure of the thin films has been determined using a combination of x-ray diffraction (XRD) and transmission electron microscopy (TEM) and correlated to the deposition conditions. X-ray reflectivity (XRR) measurements have been used to study the surface and interface roughness, surface density gradients and layer density, and layer thickness of some select films. For surface Brillouin measurements the surface topography of these films has been examined by scanning electron microscopy (SEM) and atomic force microscopy (AFM). A time of flight spectrometer for heavy ion detection (HI-ERD) thin film analysis has been used to measure the films' thickness and stoichiometry for the various deposition conditions. For the surface Brillouin measurements, a backscattering geometry was used for measuring the laser light inelastically scattered by surface acoustic waves (SAWs) through the surface ripple mechanism. The spectra were excited using the 514.5 nm line of an argon-ion laser operated in a single axial mode. The scattered light was analysed by means of a Sandercock (3 + 3) pass tandem Fabry-Perot interferometer. Theoretical modelling based on the surface Green's functions has been used to predict and compare surface Brillouin spectra with the experimental spectra for select thin films.

67 - Reaction mechanisms studied using the iThemba LABS recoil detector

NPRP - Tuesday 09 July 2013 14:30

Authors: NTSHANGASE, Sifiso Senzo *(University of Zululand)*; NTSHANGASE, Sifiso *(University of Zululand)*

The iThemba LABS recoil detector has been used to study exotic asymmetric shapes in Po and U isotopes. In these studies other reaction products which were not expected to be observed according to PACE (Projected Angular Momentum Coupled Evaporation) calculation were strongly populated. These products are as a result of other reaction mechanisms other than complete fusion reaction. The presentation will discuss the unexpectedly observed nuclei and the proposed reaction mechanisms leading to their creation.

68 - A comparative analysis of first year physics student expectations at the University of the Western Cape and Military Academy

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: JACOBS, Mkhululi *(Stellenbosch University)*
Co-authors: *HERBERT, Mark (University of the Western Cape); MALAZA, Vusi (Stellenbosch University); SEHONE, Alfred (Stellenbosch University)*

Abstract The Maryland Physics Expectations Test (MPEX) is a psychometric scale that employs questionnaires and used to study the attitudes, beliefs, and expectations of students towards learning physics [1]. The survey has been validated through application to a number of institutions in the United States and around the world. In this survey student responses are categorised as either favourable or unfavourable as determined by the standard responses given by an expert control group [1]. In this paper a comparison of student expectations through this survey was conducted on the first year algebra class students at both the Military Academy's department for Military Physics and University of the Western Cape Physics department. The survey was administered in conjunction with the Force Concept Inventory in both groups before the commencement of the semester and towards the end of the semester. This paper will present preliminary findings of the survey.References[1] C.J. Omasits and D.J Wagner. 2006. Investigating the Validity of the MPEX Survey. AIP Conference Proceeding, Vol. 818 Issue 1, p145-148.

69 - Cluster Model Analysis of Th isotopes

NPRP - Tuesday 09 July 2013 11:30

Authors: DU TOIT, Erasmus *(Stellenbosch University)*

A simple prescription for selecting the cluster and core in a binary cluster model prescription of a nucleus is presented. The main aim of using this method is to determine and calculate results concerning the occurrence of exotic clustering in actinide nuclei. A previously published prescription of the core-cluster interaction is then used along with a local potential model to calculate the energy levels, $B(E_2;2^+ \rightarrow 02^+)$ and decay widths.

70 - Systematic Properties of the Tsallis Distribution: Energy Dependence of Parameters in High-Energy p-p Collisions

Poster2 - Wednesday 10 July 2013 17:40

Authors: CLEYMANS, Jean *(University of Cape Town)*

Changes in the transverse momentum distributions with beam energyare studied using the Tsallis distribution as a parameterization.The dependence of the Tsallis parameters q, T and the volume are determined as a function of beam energy.The Tsallis parameter q shows a weak but clear increase with beam energywith the highest value being approximately 1.15.The Tsallis temperature and volume are consistent with being independentof beam energy within experimental uncertainties.

71 - Luminescent properties of Y2O3:Bi3+

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: MOHMMED JAFER BAKEET, Rasha *(University of the Free State)*
Co-authors: *YOUSIF, A. (University of the Free State); SWART, H C (University of the Free State)*

The luminescent properties of Y2-xO3:Bix=0.002 were investigated and the fluorescence spectra show that the luminescence is stimulated by the emission from two types of centres. These two types of centres were associated with the substitution of the Bi3+ ion for the Y3+ ion in two different sites in the crystal lattice of Y2O3 (with point symmetries C2 and S6 1,2,3,4). The emission of Bi3+ in the S6 site causes blue luminescence with maxima at 360 nm and 407 nm and in the C2 site it gives green luminescence with the maximum at 495 nm. Both these emissions is related to the 3P1–1S0 transition1,3,4,5 in Bi3+. X-ray photoelectron spectroscopy (XPS) indicate that the O2-,Y3+ and Bi3+ ions occupy more than one coordination environment. This proves the two different sites in the Y2-xO3:Bix=0.002 structure. The diffuse reflectance was measured for Y2O3 and Y2O3:Bi and there was no change in the band gap when 0.2 % mol of Bi is doped in the Y2O3 host.References(1)L.G. Jacobsohn, M.W. Blair, S.C. Tornga, L.O. Brown, B.L. Bennett, R.E. Muenchausen, Applied physics. 2008, 104,124303. (2)F. Real, B. Ordejon, V. Vallet, J. Flament, J. Schamps, Chemical physics. 2009, 131,194501.(3)O. M. Bordun. Applied spectroscopy. 2002, 69,1.(4)G. Ju, Y. Hu, L. Chen, X. Wang, Z. Mu, H. Wu, F. Kang. Electrochemical society. 2011, 158,294.(5)X. Y. Huang, X. H. Ji, Q. Y. Zhang. The American ceramic society. 2011, 94, 833.

72 - Competency in units and measurement: Does it provide a good indicator of the performance of students in university first year Physics?

Education - Wednesday 10 July 2013 10:30

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

Units and measurements form an integral part of the Physics discipline. Competency in the conversion and manipulation of both fundamental and derived units is a key requirement to achieve success in both theoretical and practical components of Physics courses. In light of this imperative, an investigation into the performance of students in the handling of units in application-type questions and graphs as well as measurements in general, becomes relevant when considering the challenges facing the fit-for-purpose Physics modules in the Engineering and Health Sciences faculties across the universities in South Africa. The results from this study point to the existence of a reliable correlation between the quality of the students entering the university, their competency with respect to units and measurements and their performance in theoretical and practical components of Physics courses.

73 - The barometer of scientific endeavour: A comparative analysis

Education - Tuesday 09 July 2013 10:50

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

The quality of scientific output of a country is to a large degree intrinsically linked to global competitiveness. Concerted efforts have been made by scientists in various countries across the globe in a bid to elevate both the quality and quantity of scientific output in the face of pervasive resource constraints. Within the nexus of these concerted efforts, this article provides a comparative analysis of scientific output in terms of research publications and the number of Nobel Laureates in selected countries. Commensurate with developments in this regard, a concomitant reflection on some of the key underlying factors associated with the achievement level of scientific progress and development in various selected countries has been contemplated in accordance with the core thrust outlined. These factors have largely been considered as critical parameters that underpin the level of scientific progress and development in these selected countries.

74 - A scientifically efficient approach for uniform evaluation of Physics practicals using software embedded and improvisation-based system at Doornfontein Campus of the University of Johannesburg

Education - Wednesday 10 July 2013 09:20

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

Physics practical work at universities is traditionally evaluated on the basis of a laboratory report of the activities characterising a particular experiment. This form of evaluation generally puts a learner under considerable pressure in view of the required language proficiency as an additional aspect considered during the evaluation of the report for which penalties might be incurred. Hence, this article outlines how a Physics practical could be evaluated using software-assisted evaluation system based on a report which does not require language proficiency. The experimental report in this regard specifically encapsulates activities whose nature is described in terms of figures, graphs and drawings. The underlying theoretical knowledge associated with the experiment is provided as part of a detailed user-friendly experimental procedure.

75 - Heavy Baryons with Strangeness

Theoretical - Wednesday 10 July 2013 11:10

Authors: BLANCKENBERG, Jaco *(Stellenbosch University)*

We are interested in the soliton description of baryons with a single heavy quark (charm or bottom). In this approach such baryons emerge as bound composites of a soliton of meson fields built from light quarks (up, down, strange) and a meson field that contains a heavy quark. The soliton must then be quantized as a diquark because the fermionic character arises from binding the heavy meson field. We are particularly interested in heavy baryons that have non-zero strangeness; in the quark model that corresponds to, say, up-strange-bottom (usb). Thus the flavor symmetry breaking among the light quarks must be fully incorporated when constructing diquark states. In the soliton model that symmetry breaking is parameterized by differences between the masses and decay constants of kaons and pions. Here we present computations of the diquark eigen-energies and eigen-functions that incorporate all orders of the light flavor symmetry breaking. We also compare these results to a leading order treatment of flavor symmetry breaking. The heavy meson couples according to the heavy spin-flavor symmetry to the chiral field that carries the soliton. In the background of the soliton the heavy meson field develop bound states. We compute the associated binding energies. These are the seocond major ingredient for our prediction of the usb-mass.

76 - Spectroscopic Observations of Eclipsing Contact Binary Stars

Astro - Tuesday 09 July 2013 16:20

Authors: SKELTON, Patricia *(UNISA)*

W Ursae Majoris-type variable stars are eclipsing contact (EC) binary stars. The component stars of an EC binary range in spectral type from mid-A to late-K and each is assumed to be a main-sequence star. The All Sky Automated Survey (ASAS) has discovered over 5300 EC stars. Most of these stars have not been classified previously as variables and therefore their physical properties, such as their mass ratio q and temperatures T_1 and T_2 of the components, have yet to be determined. Spectroscopic data can be used to determine the temperatures and spectroscopic mass ratios of these ASAS EC stars. For a selection of EC stars from the ASAS database, spectroscopic data were obtained using the SpCCD spectrograph on the 1.9m telescope at the South African Astronomical Observatory in Sutherland. The results of the observations are presented.

77 - Luminescent properties of pulse laser deposition (PLD) thin films of SrGa2S4:Ce3+ coated with metallic TaSi2

DCMPM1 - Tuesday 09 July 2013 11:30

Primary authors: MOLEME, Pulane *(200922)*
Co-authors: *SWART, Hendrik (University of the Free State); TERBLANS, Koos (University of the Free State); NTWAEABORWA, Martin (University of the Free State)*

Cerium (Ce3+) doped SrGa2S4 is known to show bright blue luminescence. Under prolonged electron exposure electron stimulated surface chemical reactions (ESSCR) occur on the surface. Resulting in a high degradation rate of the luminescence intensity and desorbed gases which have a detrimental effect to the emitter tips of the field emission display (FED). Hence the use of thin luminescent films was considered. However, the sulfide thin films are still only exhibiting 40 - 75 % luminance brightness of the raw powder materials due to grain structure, stoichiometry and substrate roughness effects [1]. Several coating techniques have been developed by coating with conductive oxides such as MgO, SiO2, and SnO2 in trying to overcome the problem of degassing from the sulphide films [2]. In this study the films prepared from SrGa2S4:Ce3+ powder by pulsed laser deposition (PLD) technique were coated with metallic TaSi2. This material metallic features and unique properties such as high electrical conductivity and good chemical stability make it suitable material for use in application in field emission–emitter devices. Moreover, it is compatible to silicon substrate thus satisfying the requirements for the generation of nano-electronics [3]. In the present work, the effect of the substrate temperature on the structure, morphology and luminescent properties of the SrGa2S4:Ce3+ thin films coated with TaSi2 are presented. The X-ray diffraction (XRD) pattern showed broad peaks with the preferential growth along the (0 6 2) orientation. The highest PL intensity was demonstrated when 450ºC substrate temperature was used. The colour purity of the SrGa2S4:Ce3+ powder was not entirely affected by the coating layer. References[1] http://faculty.virginia.edu/Nanoscale Laser Processing/research_interests.htm[2] S-Il Oh, H-S Lee, K-B Kim and J-G Kang, Bull. Korean Chem. Soc. 31(12) (2010) 3723[3] Y-L Chueh, M-T Ko, L-J Chou, L-J Chen, C-S Wu and C- D Chen, Nano Lett. 6 (8) (2006) 1637-1644

78 - How circumstellar discs in Be stars influence mass accretion in Be/X-ray binary systems

Astro - Friday 12 July 2013 09:40

Authors: MONAGENG, itumeleng *(South African Astronomical Observatory / University of Cape Town)*

Be/X-ray binary systems are a subclass of high mass X-ray binary stars. These systems are composed of a non-supergiant B-type star whose spectra has (or had at some time) shown Balmer emission lines, and a neutron star which accretes material from the circumstellar disc around the Be star. Optical spectroscopy is used to study the behaviour of the circumstellar disc around the Be star and how it affects the mass accretion process onto the neutron star, leading to X-ray outbursts. Results from spectroscopic monitoring of systems in the Southern Hemisphere (obtained with SALT) and those in the Northern Hemisphere (obtained with the Liverpool telescope) will be presented. This, together with X-ray data, will be discussed to demonstrate how the varying properties (e.g size and density) of the circumstellar disc influence the different types of X-ray outbursts. The analysis of the data is carried out in the framework of the viscous decretion disc model, which predicts that circumstellar discs are truncated by resonant torques as a result of the neutron star orbiting around the Be star.

79 - A coaxial superposition of coherent Gaussian beams

Photonics - Tuesday 09 July 2013 10:50

Primary authors: NAIDOO, Darryl *(Council for Scientific and Industrial Research)*
Co-authors: *GODIN, Thomas (Institut FEMTO-ST); FROMAGER, Michael (Centre de Recherche sur les Ions, les Matériaux et la Photonique); AIT-AMEUR, Kamel (Centre de Recherche sur les Ions, les Matériaux et la Photonique); FORBES, Andrew (Council for Scientific and Industrial Research)*

We explore an interferometric beam shaping technique that considers the coaxial superposition of two Gaussian beams. This technique is traditionally implemented in a Mach-Zehnder interferometer; however, to avoid phase shift drift due to vibrations and thermal effects we employ amplitude and phase modulation with an SLM to achieve the beam shaping. We consider two Gaussian beams of equal but opposite curvature that possess the same phase and width incident on a focusing lens. At the plane of the lens we obtain a multi-ringed beam with a central intensity maximum which develops into a multi-ringed beam with a central null at the focal plane of the lens. The interesting feature of this beam is that is possesses two focal spots on either side of the plane of the focal position of the lens. We investigate the possibility of longitudinal optical trapping at the two focal spots with an obstruction positioned at the focal plane of the lens.

80 - Status of the study of multi-body decays of heavy nuclei using the modified Light Ions Spectrometer.

NPRP - Tuesday 09 July 2013 11:50

Primary authors: MALAZA, Vusi *(Military Academy, Stellenbosch University)*
Co-authors: *JACOBS, Noel (Military Academy, Stellenbosch University)*

In our previous experiments [1], [2] multiple manifestations of a new ternary decay of low excited nuclei called "Collinear Cluster Tri-partition" (CCT) were identified. This was due to features of the process observed. Recently a specific CCT mode was observed based on the double magic 132Sn cluster [3]. This unusual decay channel was revealed under the framework of the “missing mass" method, where only two fission fragments were actually detected with the third one missing. Unfortunately the data from our previous experiments suffered from plasma delay and pulse height defect (PHD). The PHD was solved with the use of a special procedure as was presented in our previous work reference [4].A new LIS setup as described in reference [4] was designed to solve the challenge of plasma delay but results from this setup suffered from background noise and poor mass resolution. To improve on this we have modified the LIS setup by increasing the flight between the spectrometer arms from 84mm to 170mm. This increase in the flight path has improved the mass resolution from 6 amu to 3 amu. The modified LIS setup also enables us to separate scattered or background events from real fission fragments events. In this paper aspects of the modified LIS setup are discussed and preliminary results are presented. The results show a clear separation between background noise and real events. References1. Pyatkov Yu.V. et al., Romanian Reports in Physics 59 (2007) p 3882. Kamanin D.V. et al., Int. Journal of Modern Physics E 17 (2008) p 22503. Pyatkov Yu.V. et al.,Eur. Phys. J. A 45 (2010) p 294. Malaza V.D. et al. Proc SAIP conf 2012, Pretoria, South Africa 9-13 Ju 2012

81 - Azimuthal beam superpositions with intra-cavity rings

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: NAIDOO, Darryl *(Council for Scientific and Industrial Research)*
Co-authors: *NGCOBO, Sandile (Council for Scientific and Industrial Research); GODIN, Thomas (Institut FEMTO-ST); FROMAGER, Michael (Centre de Recherche sur les Ions, les Matériaux et la Photonique); AIT-AMEUR, Kamel (Centre de Recherche sur les Ions, les Matériaux et la Photonique); FORBES, Andrew (Council for Scientific and Industrial Research)*

We demonstrate the intra-cavity generation of a coherent superposition of Laguerre-Gaussian modes of zero radial order but opposite azimuthal order. The superposition is achieved through a set of amplitude rings in a diode-pumped solid-state resonator. By adjusting the number of rings and their thicknesses we can produce modes up to azimuthal order 12. To infer the purity of these modes we perform a full azimuthal modal decomposition by an inner product executed on a phase-only spatial light modulator. We also investigate if there is a phase difference between the Laguerre-Gaussian modes to identify if the phase difference is spatially or temporally dependent. A hallmark of a phase difference is the rotation of the field as the beam propagates into the far field or a rotation of the field at a fixed position over time.

82 - Postgraduate student driven outreach in physics at Stellenbosch University

Education - Tuesday 09 July 2013 11:30

Authors: RIGBY, Charles *(Laser Research Institute, Stellenbosch University)*

Since its inception, the Stellenbosch laser student chapter (SLSC) has been active in promoting science through educational outreach to local communities in the form of interactive presentations on popular physics topics. The SLSC was founded in 2008 at Stellenbosch University (SU) and joined the Optical Society of America (OSA) in the same year. The chapter became affiliated with SPIE in 2010. Membership and participation is volunteer based.Chapter activities are primarily funded by two organisations SPIE and OSA. Grants are available in varying amounts for various categories of activities including social, professional development, hosting of travelling lecturers, travel grants to attend international workshops and outreach activities.The flagship event of the SLSC is the annual week long outreach road trip. This road trip endeavours to reach communities otherwise unreachable in a single day trip. There is a strong focus on reaching previously disadvantaged communities. Since 2011 the road trip has been department wide in that students from nuclear and theoretical physics branches are encouraged to participate.We present an overview of activities to date and encourage other institutions to consider similar student chapters.

83 - An improved Nd:YAG laser pumped setup for vacuum ultra violet spectroscopy of carbon monoxide molecules

Photonics - Wednesday 10 July 2013 13:50

Primary authors: RIGBY, Charles *(Laser Research Institute, Stellenbosch University)*
Co-authors: *STEENKAMP, Christine (Laser Research Institute, Stellenbosch University); ROHWER, Erich (Laser Research Institute, Stellenbosch University)*

Vacuum ultra violet (VUV) spectroscopy of carbon monoxide (CO) is an ongoing project at the Laser Research Institute (LRI) [1, 2, 3]. The main objective is detection of forbidden singlet-triplet transitions of CO for which experimentally measured wavelengths are not available. Tunable VUV light is generated via four-wave mixing of two dye laser beams in a magnesium vapour medium. The VUV light is used to selectively excite single rovibronic transitions of the CO molecules in the cooled sample (supersonic jet) while scanning the VUV wavelength and recording a laser induced fluorescence (LIF) excitation spectrum.Recently new laser equipment, including a Nd:YAG pump laser and a modern dye laser, has been acquired, providing narrower bandwidth, shorter pulse duration and higher pulse energies. Due to higher energies, prism based beam steering was needed which in turn raised polarisation concerns which are discussed. An intra-cavity etalon is used in an attempt to further narrow the laser bandwidth. LIF spectra recently produced are analysed and discussed. We compare the current system and improvements thereof to experiments done previously at the LRI. With the new equipment there is a possibility that spectral lines that were undetectable by the previous system may be detected.[1] Steinmann, C., Rohwer, E., & Stafast, H. 2003, ApJ, 590, L123[2] Du Plessis, A., Rohwer, E., & Steenkamp, C. 2007, J. Mol. Spectrosc., 243, 124[3] Dickenson, G., Nortje, A., Rohwer, E., Steenkamp, C. & Du Plessis, A. 2010, ApJL, 714, L268

84 - Open-source electronics for quantum key distribution

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MARIOLA, Marco *(University of kwazulu-natal)*
Co-authors: *MIRZA, Abdul (UKZN); PETRUCCIONE, Francesco (UKZN)*

Quantum Key Distribution (QKD) requires an optical link between the transmitter, called Alice, and the receiver, called Bob. QKD is a method to share a secure key between Alice and Bob using the quantum states of the single photon, each state represents a bit of the key. In free-space systems we consider the polarization as quantum state. The detectors of the receiver must be aligned with the transmitter. To align the system the laser beacon is used. Due to the turbulence effect, the laser beacon undergoes wondering, scintillation and the expansion of the spot [1]. The change of the polarization of the single photon and the laser beacon in free space can be neglected. However in mobile systems such as an aircraft, satellite or boat, the relative orientation of the polarization between the source and detector may vary due to the motion of the vehicle. It is necessary to build the appropriate detectors and actuators able to resolve the relative motion and orientation of the system. Initially the problem can be resolved using the classical analogical circuits and we compare the solution using an open source programmable logic unit. The open source electronics provides a powerful method to design a quantum key distribution system at low cost. We use open source electronic platforms together with open source software such as Scilab and python that use openCV package for tracking the laser beacon spot using the camera. [1] R. L. Fante, Proc. IEEE, vol.63, Electromagnetic Beam Propagation in Turbulent Media, 1669-1692, (1975).

86 - Advancement of quantum communication through entanglement

Applied - Wednesday 10 July 2013 13:50

Primary authors: ISMAIL, Yaseera *(UKZN)*
Co-authors: *MIRZA, Abdul (UKZN); PETRUCCIONE, Francesco (UKZN); FORBES, Andrew (CSIR-National Laser Centre)*

Quantum communication exploits some of the fundamental features of the quantum world, namely, the superposition principle and the Heisenberg uncertainty relation. The most advanced quantum information related technology at present is Quantum Key Distribution (QKD) which is a process that involves transmitting a secret key between two individuals. The most vital characteristic of such a method is that the secrecy of the generated key is guaranteed by the laws of nature. QKD systems, although capable of producing provably secure keys, must in itself be trusted. Entanglement provides this additional layer of security. To obtain entanglement, photons must undergo a second-order nonlinear process which is referred to as Spontaneous Parametric Down Conversion. Here, we will outline an optical system used to generate entanglement. Upon obtaining an entangled photon pair, a fibre coupled single photon detector in conjunction with polarising filters was used to detect, analyse and verify their non-classical polarisation correlation. The aim was to characterise the aforementioned system.A test for entanglement of photon pairs involves a measurement of correlation curves in two non-orthogonal bases namely the rectilinear and the diagonal bases. This was measured to a visibility of 91% for both bases. Entanglement was also verified by means of proving the violation of the CHSH (Clauser, Horne, Shirmony and Holt) inequality which states that in local realistic theories the absolute value of a particular combination of correlations between two particles is bounded by 2. Within the system mentioned the violation was measured to be 2.71 ± 0.03 which verifies entanglement. The purity of the states generated was also measured by performing a state tomography and hence constructing of the two-photon density matrix to determine the fidelity of the system. Furthermore, we touch-on exploiting QKD together with entanglement to shape a quantum network.

87 - Effect of different annealing times on the structure of Y3(Al,Ga)5O12:Tb thin film grown by PLD

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: YOUSIF, A. *(University of the Free State)*
Co-authors: *NTWAEABORWA, O.M. (University of the Free State)*

Y3(Al,Ga)5O12:Tb thin films were grown on Si (100) substrates using the pulsed laser deposition technique in an O2 working atmosphere. The influence of different annealing time on the optical, morphology and the structure was investigated. Atomic force microscopy showed an increase in grain size with an increase in annealing time. The photoluminecent emission spectrum presented similar characteristics for all different annealing times, and the emissions are described by the well-known 5D4–7FJ (J=6, 5, 4, 3…) transitions of the Tb3+ ion. The main PL emission peak was due to the 5D4→7F5 transition of Tb3+ and was measured at a wavelength of 544 nm with minor peaks at 489 nm (5D4→7F6), 561 nm (5D4→7F4) and 625 nm (5D4→7F3)1,2. New excitation band located at 200 nm was observed from all the annealed films which pointed to a change in the chemical environment, owing to the fact that, the 5d level depends strongly on the nature of the host due to a greater radial extension of the 5d orbital. Shift in the peak position to lower diffraction angles was also observed in the X-ray diffraction results compared to the pattern of the Y3(Al,Ga)5O12:Tb powder and other thin films1,2.References(1) A. Yousif, H.C. Swart, O.M. Ntwaeaborwa, Appl. Surf. Sci., 2012 (258) 6495.(2) A. Yousif, H.C. Swart, O.M. Ntwaeaborwa, E. Coetsee, Appl. Surf. Sci., 2013 (270) 331.

88 - Synthesis and Characterization of white light emitting $Sr_2SiO_4:Tb^{3+},Eu^{3+}$ phosphor

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: TSHABALALA, Modiehi Amelia *(University of the Free State)*
Co-authors: *NTWAEABORWA, Odirileng Martin (University of the Free State); SWART, Hendrik (University of the Free State)*

In recent years, the study on white light phosphors suitable for ultraviolet (UV) excitation has been attracting more attention for use in white light emitting diodes (LEDs). In white light LEDs, white light can be generated by combination of light of three primary colors (red, green and blue) emitted from different LED chips[1] or combination of blue LED with yellow-emitting phosphor materials[2,3]. It is important to find a phosphor that can be excited under near-ultra-violet and the blue region[3]. In recent studies it has been established that white light can be generated by doping one or more activator(s) in one matrix. For example, in this study white photoluminescence was generated when Sr_2SiO_4 co-doped with Tb^{3+} and Eu^{3+} was excited at 227 nm using a monochromatized xenon lamp. The calculated Commission Internationale de l'Eclairage (CIE) chromatic coordinates of the generated white light were (x=0.340, y=0.375), which are very close to those of standard white colour (x=0.333, y=0.333). The X-ray diffraction spectra indicated that the $Sr_2SiO_4:Tb^{3+},Eu^{3+}$ phosphor material was successfully prepared at 1000 $^{\circ}$C using the solid state method. Scanning electron microscopy images showed agglomeration of particles with irregular shapes. The decay characteristics showed that the phosphor consists of a single exponential decay curve.References(1) Yanmin, Q.; Xinbo, Z.; Xiao, Y.; Yan, C.; Hai, G.; Journal Rare Earths 2009, 27(2), 323(2) J.K. Park, M.A. Lim, C.H. Kim, H.D. Park Applied Physics Letters 2003, 82(5), 683(3) Yao, S.; Chen, D.; Central European Journal of Physics 2007, 5(4), 558

89 - Raman Spectral Analysis of Organometallic Composite Film Synthesized by Electrochemical Route

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: KUMAR, Vijay *(Department of Physics, University of the Free State, P.O. Box 339, Bloemfontein 9300, The Free State, South Africa)*
Co-authors: *ALI, Yasir (Department of Physics, Sant Longowal Institute of Engineering and Technology, Longowal District Sangrur-148106, Punjab, India); KUMAR, Vinod (Department of Physics, University of the Free State, P.O. Box 339, Bloemfontein 9300, The Free State, South Africa); SONKAWADE, R G (School of Physical Sciences, BBA University (A Central University), Lucknow-226025, India); DHALIWAL, A S (Department of Physics, Sant Longowal Institute of Engineering and Technology, Longowal District Sangrur-148106, Punjab, India); SWART, H C (Department of Physics, University of the Free State, P.O. Box 339, Bloemfontein 9300, The Free State, South Africa)*

We present the fabrication and characterization of Au-polyaniline (Au-PANI) composite film using electrochemical synthesis.1 The PANI film is prepared by the chronopotentiometery technique on a platinum substrate. The as deposited PANI film was modified with Au particles using cyclic voltammetery. X-ray diffraction (XRD), Fourier transform infrared (FTIR), Raman spectroscopy and Scanning electron microscopy (SEM) techniques were used to establish the structural-morphological properties of the Au–PANI composite. XRD spectra revealed (100) and (200) planes in the composite.2 FTIR spectra displayed the main vibrational bands; including the characteristic peaks.3-4 SEM image of PANI shows rough and porous morphology, whereas Au-PANI composite exhibit mesh type structure with uniform dispersion of the Au-particles. It is observed that the Au-PANI composite showed enhanced Raman characteristics (due to SERS effect of Au particles) in comparison to the pure PANI film. The analysis revealed that the Au-PANI composite can be used for highly sensitive and selective chemical and biological sensing applications.References(1) Ali, Y., Kumar, V., Sonkawade, R. G., Dhaliwal, A. S., Vacuum, 2013, 90, 59.(2) Xu, Q., Leng, J., Li, H. B., Lu, G. J., Wang, Y., Hu, X. Y., React. Funct. Polym. 2010, 70, 663. (3) Anand, P.B., Hasna, K., Anilkumar, K. M., Jayalekshmia, S., Polym. Int. 2012, 61, 1733. (4) Kinyanjui, J. M., Hanks, J., Hatchett, D. W., Smith, A., Josowicz, M., J. of the Elec.l Soc. 2004, 151, D113

90 - The March 2015 total solar eclipse and its potential for testing the General Theory of Relativity

Theoretical - Tuesday 09 July 2013 10:30

Authors: COMBRINCK, Ludwig *(HartRAO)*

The famous 1919 total solar eclipse expeditions organized by Arthur Eddington and Frank Dyson that first demonstrated the bending of starlight predicted by Einstein's general theory of relativity has long been surpassed by modern applications of the theory, in particular as applied to gravitational lensing. Is there however, still scope to test the general theory of relativity using a total solar eclipse? In this contribution a comparison is made between previous tests and the possibility of using the forthcoming 2015 total solar eclipse to measure the star light deflection. An evaluation is made of the suitability of modern imaging methods versus photographic plates. An observation and hardware strategy is outlined for such a test from Ny-Ålesund, which is situated at 78° 55´ N, 11° 56´ E on the west coast of Spitsbergen, Svalbard.

91 - CTA: The next-generation giant for ground-based Gamma-ray Astronomy

Astro - Friday 12 July 2013 10:30

Authors: DAVIDS, Isak Delberth *(North-West University, Potchefstroom Campus)*

The envisaged Cherenkov Telescope Array (CTA) project is a global initiative to build the next-generation ground-based very high-energy (VHE) gamma-ray telescope facility. It will serve as an open observatory to a wide astrophysics community, providing a deeper insight into the non-thermal high-energy universe. CTA is designed to achieve full-sky coverage, with one array in the northern and another one in the southern hemisphere. Through deployment of about 50 to 100 telescopes (in at least three sizes at the southern and at least two sizes at the northern site), CTA will have improved sensitivity by about an order of magnitude relative to present instruments, spanning about four decades of energy, from a few tens of GeV to above 100 TeV. The observatory will also feature enhanced angular and energy resolutions over current imaging air Cherenkov telescopes (IACTs). An international CTA collaboration of more than 1000 members from across the world has already completed a design study and started an EU-funded preparatory phase which is intended to lead to production readiness of CTA in 2014 with a 5-year construction period starting in 2015. In this presentation we introduce the CTA and provide an overview of the project and its scientific goals.

92 - Nonlinear ion-acoustic and electron-acoustic waves in multi-ion space plasmas

Space Science - Wednesday 10 July 2013 16:00

Primary authors: MAHARAJ, Shimul Kumar *(South African National Space Agency (SANSA) Space Science, P O Box 32, Hermanus 7200)*
Co-authors: *BHARUTHRAM, Ramesh (University of the Western Cape, Robert Sobukwe Road, Bellville 7535); SINGH, Satya Vir (Indian Institute of Geomagnetism, New Panvel (West), Navi Mumbai 410218); LAKHINA, Gurbax Singh (Indian Institute of Geomagnetism, New Panvel (West), Navi Mumbia 410218)*

Large amplitude ion-acoustic and electron-acoustic solitons will be investigated for a four-component plasma model composed of cool and hot electrons and cool and hot ions. The effect of retaining inertial effects for all species (treating all species as adiabatic) as opposed to neglecting the inertia of the hot components (assuming Boltzmann distributions for the hot species) will be explored. Considering very broad regions in parameter space, the focus of the study will be to investigate why upper Mach number limitations arise for ion-acoustic and electron-acoustic solitons.

94 - Luminescent properties of $Ca_5(PO_4)_3OH:Gd^{3+}$, Pr^{3+} phosphor powder

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: MOKOENA, Puseletso *(UFS)*
Co-authors: *SWART, Hendrik (UFS); NAGPURE, Indragit (UFS); NTWAEABORWA, Odirileng (UFS)*

Hydroxylapatite $Ca_5(PO_4)_3OH$ is a well-known bioceramic material for medical application. It is biocompatible meaning that it has the ability to form chemical bonds with living tissues. Recently, it has, however, been used as host for rare or alkaline earth ions to prepared light emitting materials or phosphors. Phosphate based inorganic compounds doped with rare earth ions form an important family of phosphors for solid state lighting applications [1]. Calcium phosphate powders have been synthesized by co-precipitation method. In this study, we prepared (using co-precipitation method) and investigated the structure, morphology, photoluminescent and thermoluminescent properties of $Ca_5(PO_4)_3OH$ co-doped with gadolinium (Gd^{3+}) and praseodymium (Pr^{3+}). The X-ray diffraction (XRD) patterns show a single hexagonal phase of $Ca_5(PO_4)_3OH$ consistent with standard JCPDS data file No 73-0293. The XRD peaks were sharp and intense suggesting that the phosphor was highly crystalline. The scanning electron microscopic images show that the powders consist of an agglomeration of spherical particles. The $Ca_5(PO_4)_3OH:Gd^{3+}$, Pr^{3+} phosphor exhibit a narrow emission peak at 313 nm due to the $^6P_{7/2}\rightarrow{}^8S_{7/2}$ transition of the Gd^{3+} ion, and the emission was sensitized by Pr^{3+} co-doping. The TL glow shows the single glow peak at 346 K. The single peak suggests that there is only one type of electron trap in the forbidden band of the material, and the trap may be due to the defects such as vacancies or impurities in the material. The luminescent properties of the $Ca_5(PO_4)_3OH:Gd^{3+}$, Pr^{3+} phosphor are evaluated for application of the phosphor in solid-state lighting.References[1] K N Shinde, S J Dhoble, Advanced Material letters, 2010, 1(3), 254-258

95 - Synthesis and characterization of magnetron sputter deposited Ge-nanowires.

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: NYAWO, Thembinkosi *(University of Zululand)*; THETHWAYO, Charles Thulani *(University of Zululand)*
Co-authors: *CHONCO, Nelisiwe (University of Zululand); SEFAGE, Percy (University of Zululand); NDWANDWE, Muzi (University of Zululand)*

Ge nanowires were synthesized on Si<100> substrates using Ag as a catalyst. The catalyst seeds were sputter deposited on the Si substrate at 2 exp-2 Torr and thereafter Ge was deposited. The catalytic effect of Ag to form nanowires of Ge was tested by looking at the samples using both SEM and AFM. Rutherford Backscattering Spectrometry (RBS) was also used to characterize the samples.

97 - Growth and characterization of carbon nanotubes on ZrN thin film surfaces

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: NYAWO, Thembinkosi *(University of Zululand)*; NDWANDWE, Muzi *(University of Zululand)*
Co-authors: *BUTHELEZI, Tsepiso (University of Zululand); NKOSI, Mlungisi (iThemba Labs)*

In this study catalyst Fe nanoparticles of different sizes have been sputter deposited on Al2O3, ZrN thin film surfaces at different values of pressure so as to vary their sizes. Carbon nanotubes(CNTs) have then been grown on ZrN by Chemical Vapour Deposition(CVD) using acetylene as a source of carbon. The growth of CNTs on ZrN has been compared to their growth on Al2O3. It has been found that it is easier to grow CNTs on Al2O3 than on ZrN under the same conditions. Methods of promoting CNTs grown on ZrN have been investigated. The resulting nanostructures have been characterized by Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM) and Rutherford Backscattering Spectrometry (RBS). Such structures may find potential use in field emission displays and gas sensors.

98 - Investigation of the radiative strength function in ^{74}Ge

NPRP - Tuesday 09 July 2013 14:10

Primary authors: NEGI, DINESH *(iThemba LABS)*
Co-authors: *WIEDEKING, M. (iThemba LABS); GUTTORMSEN, M. (University of Oslo); JONES, P.L. (iThemba LABS); KHESWA, B.V. (iThemba LABS); KHUMALO, N. (UWC); LARSEN, A.C. (University of Oslo, Oslo, Norway); LAWRIE, E.L. (iThemba LABS); LAWRIE, J.J. (iThemba LABS); MAJOLA, S.N.T. (UCT); MASITENG, L.P. (UJ); NCHODU, M.R. (iThemba LABS); BARK, R.A. (iThemba LABS); NDAYISHIMYE, J. (SU); NEWMAN, R.T. (SU); NONCOLELA, S.P. (UWC); ORCE, J.N. (UWC); PAPKA, P. (SU); RENSTROM, T. (University of Oslo); ROUX, D.G. (RU); SCHNEIDER, D.H.G. (Lawrence Livermore National Laboratory); SHIRINDA, O. (iThemba LABS); SIEM, S. (University of Oslo); BERNSTIEN, L.A. (Lawrence Livermore National Laboratory); SINGO-BUCHER, T.D. (iThemba LABS); SITHOLE, P.S. (UWC); STANKIEWICZ, M.A. (UCT); UWITZONE, P.C. (RU); BLEUEL, D.L. (Lawrence Livermore National Laboratory); BVUMBI, S. (UJ); DINOKO, T.S. (UWC); ERASMUS, N. (UWC); EASTON, J.L. (UWC); GORGEN, A. (University of Oslo)*

The Radiative Strength Function (RSF) represents the ability of nuclear matter to absorb and emit photons. It is one of the input parameters, along with the nuclear level density, for the calculations of nuclear cross sections and reaction rates relevant to astrophysical processes which are invoked to explain the origin of elements heavier than iron [1]. In this work we investigate the dependence of the RSF on the spin and parity of the final state and on the different reactions to excite quasi-continuum states, which are found in the region of high-level density below the particle threshold. This provides not only information about the validity of the Brink hypothesis [2] but will also help to better understand reactions in astrophysical environments. In this effect, an international collaborative effort is made to study the gamma decay of the quasi-continuum states of 74Ge using different reactions at different experimental facilities in the USA, Europe and South Africa. In this talk I will give an overview of the collaborative experiments and will report on the preliminary results from the 74Ge(4He,4He')74Ge reaction. The experiment was performed at iThemba LABS, with the AFRODITE gamma detector array in conjunction with two particle-telescopes consisting of two silicon detectors each of dimensions 5cm X 5cm. The telescopes were placed at an angle of ±45 degrees with respect to the beam axis. The method [3] of extracting the RSF consists of detecting correlated particle-gamma-gamma events. By selecting particles of specific energy the entrance excitation energy into the system is determined. A gate on gamma transitions from the discrete states selects the coincidence primary transitions feeding this state. The condition of having the sum of energies of the primary and the discrete gamma-rays equal to the excitation energy then provides unambiguous primary gamma-ray spectra from which the RSF is determined. * This work is based on research supported by the National Research Foundation of South Africa and on work performed under the auspices of the U.S. Department of Energy Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344[1] A.C. Larsen and S. Goriely, Phys. Rev. C 82,014318 (2010).[2] D.M. Brink, PhD Thesis, Oxford University (1955). [3] M.Wiedeking et. al., Phys. Rev. Lett. 108, 162503 (2012).

99 - Energy loss and energy loss straggling of (MeV) heavy ions through thin film materials by Time of Flight spectrometry

DCMPM2 - Wednesday 10 July 2013 16:20

Primary authors: MSIMANGA, Mandla *(iThemba LABS Gauteng)*
Co-authors: *PINEDA-VARGAS, Carlos (iThemba LABS); COMRIE, Craig (University of Cape Town)*

The accuracy of heavy ion beam analytical techniques such as Heavy Ion-Elastic Recoil Detection Analysis (HI-ERDA) depends on, among other factors, the accuracy of basic ion beam data such as stopping force and energy loss straggling, used as input in ion beam analysis codes. We present work done towards adding to the global database of experimental heavy ion stopping force and straggling data in compound materials of technological importance. Targets were in the form of free standing thin foils mounted on frames. The foils were characterised through RBS and AFM measurements to ascertain film thickness, stoichiometry and roughness. Energy loss and straggling measurements of Z > 3 ions were done in a transmission mode using the Heavy Ion ERD Time of Flight spectrometer at the iThemba LABS 6MV tandem accelerator. The stopping force and energy loss straggling of 12C, 28Si and 63Cu ions through Si3N4 and SiO2 foil targets were measured over the 0.1-0.8 MeV/u energy range, and these are compared to predictions from semi-empirical codes as well as to literature data, where available.

100 - Magnetic properties of Cr/$Cr_{99.65}Ru_{0.35}$ hetero-structures

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *PRINSLOO, Aletta (Department of Physics, University of Johannesburg); SHEPPARD, Charles (Department of Physics, University of Johannesburg)*
Co-authors: *VENTER, Andrew (Research and Development Division, Necsa Limited); FULLERTON, Eric (CMRR, University of California); RULE, Kirrily (ANSTO, Australia);* JACOBS, Susan *(UJ)*

Substantial focus has been placed on the investigation of magnetic properties in thin films and hetero-structures of Cr and Cr alloys, which have revealed fascinating properties not observed in bulk material [1]. These properties include the mediating role of Cr thin films in exchange coupled superlattices and in giant magnetoresistive (GMR) materials [2]. In order to broaden this knowledge, a previous contribution reported on dimensionality effects in epitaxial and polycrystalline Cr100-xRux alloy monolayer thin films, as well as on epitaxial Cr/Cr99.65Ru0.35 hetero-structures [3]. Conclusions from this study were based on resistivity as function of temperature measurements [3]. However, in order to fully understand the behaviour of the spin-density-wave (SDW) of Cr in these hetero-structure configurations, exploratory neutron diffraction studies were done on the Cr/Cr99.65Ru0.35 hetero-structures, following the same approach as for the Cr/Cr-Mn superlattices [1]. Epitaxial Cr/Cr99.65Ru0.35 hetero-structures were prepared by co-sputtering Cr99.65Ru0.35 layers from elemental sources onto MgO(100) substrates. Within the Cr/Cr99.65Ru0.35 structures the layer thickness of the Cr99.65Ru0.35 was held constant at 10 nm, while the Cr layer thickness was fixed at 10 and 50 nm, respectively. Samples were prepared to a total thickness of 700 nm. The concentrations and thicknesses of the films and hetero-structures were confirmed using Rutherford Back Scattering techniques. The neutron diffraction studies were performed on the Taipan triple-axis spectrometer at ANSTO (Australia). By utilizing the triple-axis instrument in elastic mode a very low background contribution in the detector could be attained, thus providing a sensitive probe for the small magnetic moments present in the thin Cr/Cr-Ru hetero-structures. The temperature dependence of the neutron results indicates the existence of the paramagnetic phase, as well as commensurate and incommensurate SDW phases in these samples. These results confirm key characteristics of the magnetic ordering and warrant further more comprehensive studies.REFERENCES[1] E.E. Fullerton, et al., Phys. Rev. Lett. 91 (2003) 237201[2] H.J. Zabel, J. Phys.: Condens. Matter 11 (1999) 9303[3] A.R.E. Prinsloo, et al., J. Magn. Magn. Mat. 322 (2010) 1126

101 - Hybrid Two-way QKD in Free Space

Poster2 - Wednesday 10 July 2013 17:40

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

Quantum Key Distribution (QKD) has developed into a commercially available technology in recent years. There are, however, many challenges that must be overcome in order to optimise this technology. One of the main bottlenecks in quantum communication is the short transmission distances that single photons are confined to, specifically in a fibre network. A free space channel can provide a longer transmission distance for the quantum signal.The ‘plug and play’ scheme of Muller, et al. [1] is an auto-compensating scheme which uses phase encoding to enable secure communication between two parties. This scheme has been implemented in fibre-based commercial QKD units in the form of the id3100 Clavis2. Using a concept analogous to the “plug and play” scheme, a comparative design will be implemented using polarisation encoding for a hybrid, two-way, free space QKD scheme. The laser source and single photon detectors are located in Bob’s unit. Bright pulses are emitted from Bob via a circulator and transmitted towards Alice’s unit. The pulses are then compensated for any turbulence effects and reflected and attenuated to a single photon level. Alice then encodes the information onto each photon and transmits them back to Bob. A second compensation technique is performed at Bob’s unit prior to measurement. The initial bright pulse can also be used as an inbuilt tracking unit for the system.Since the optics required for the transmitter’s unit is much smaller and cheaper than the receiver’s unit, the free space “plug and play” scheme is ideal for connecting multiple end users to form a star topology network.References:[1] Muller, A., Herzog, T., Huttner, B., Tittel, W., Zbinden, H. and Gisin, N., Plug and play systems for quantum cryptography. Applied Physics Letters, 1996. 70(7): p. 793-795.

102 - Modelling the light curves of Fermi LAT millisecond pulsars

Astro - Friday 12 July 2013 10:50

Primary authors: VENTER, Christo *(NWU)*
Co-authors: *JOHNSON, Tyrel (High-Energy Space Environment Branch, Naval Research Laboratory); HARDING, Alice (Astrophysics Science Division, NASA Goddard Space Flight Center); GROVE, Eric (High-Energy Space Environment Branch, Naval Research Laboratory)*

There are 40 millisecond pulsars (MSPs) in the second pulsar catalogue of the Fermi Large Area Telescope (LAT). This pulsar subpopulation is unique owing to their relatively small magnetospheres. This may result in radio emission originating at higher altitudes and covering larger solid angles than in the case of their younger counterparts. MSP magnetic fields may also be more complex and their masses larger. Furthermore, these MSPs exhibit some profile patterns that are not seen in younger pulsars. We modelled the MSP radio and gamma-ray light curves (LCs) using outer gap (OG), two-pole caustic (TPC), low-altitude slot gap, and pair-starved polar cap geometric models, combined with a semi-empirical conal radio model. We find that no model fits all cases, with the OG and TPC models providing best fits for comparable numbers of MSP LCs. We find a broad distribution of best-fit inclination angles as well as a clustering at large observer angles. The OG model furthermore seems to require relatively larger inclination angles, while the TPC model hints at an inverse trend between the inclination angle and pulsar spin-down luminosity. We expect these tentative trends to strengthen with the accumulation of more data, and we will discuss their significance in the context of our geometric models. Future work will include the implementation of new magnetic field geometries as well as higher-altitude and more complex radio emission patterns.

103 - The importance of damage tests

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: SINGH, Ann *(CSIR,National Laser Centre)*
Co-authors: *KARSTEN, Aletta (CSIR,National Laser Centre); VAN WYK, Henk (CSIR,National Laser Centre)*

Damage tests form an integral part of designing any system of apparatus for medical, industrial or personal use. These tests become even more important when the system incorporates a laser. This paper will look at a simple damage test experiments and discuss the parameters to be considered when doing such tests.Laser based devices rely on optics to deliver the laser light to a site e.g for inspection of a material surface or treatment of skin cancer or even cutting an automobile part. The power required by each of these applications is different. This results in a different level of risk associated with laser power/energy. Probably the most illustrative case is that of a laser system used in manufacturing. Such a system requires high power densities of atleast 1 MW.cm-2 to e.g weld a material. Now imagine if some element in the laser delivery system where to fail in the assembly and testing of the system or even in the operation of the system. Science fiction would be almost real.So a few steps to consider for optics or components used in a system would be the application, wavelength of the laser, the power required and duration of operation. This paper describes the process of testing an optic to determine what power density it can withstand. An unspecified mirror was subjected to power densities of 108-565 MW.cm-2 to determine the suitability of the mirror for high power applications. In this particular case the mirror has not been damaged and can be considered for high power applications or setups. References[1] L Lamaign`ere, T Donval, M Loiseau, J C Poncetta1, G Raz´e, C Meslin, B Bertussi and H Bercegol, 2009, Meas. Sci. Technol. 20 (2009) 095701

104 - Ultrafast photodynamics of charge transfer reactions in Indoline-sensitized ZnO solar cells

Photonics - Tuesday 09 July 2013 15:40

Primary authors: ROHWER, Egmont *(Stellenbosch University)*
Co-authors: *SCHWOERER, Heinrich (Stellenbosch University); SCHLETTWEIN, Derck (.); NYOKONG, Tebello (.); RICHTER, Christoph (.); LITWINSKI, Christian (.); MINDA, Iulia (Stellenbosch University); TAUSCHER, Gabriele (Stellenbosch University)*

The surprising efficiency of some dye-sensitized solar cells is largely attributed to the ultrafast efficient electron injection from the photo-excited state of the dye to the conduction band of the semiconductor. Femtosecond transient absorption spectroscopy measurements conducted on indoline-sensitized ZnO solar cells reveal this combination to be no exception. Primary charge transfer occurs on the 100 fs time scale. The measurements also reveal the rates of competing decay mechanisms and the regeneration rate of dye molecules after oxidation. The effect of different redox couples on the operation of the cell and the effect of an external potential, as under working conditions, on the primary charge transfer is discussed.

105 - Structural and electronic properties of transition metal chalcogenides (MoS2 , Mo2 S4 , and Mo6 S8)

Poster1 - Tuesday 09 July 2013 17:40

Authors: ONDZIBOU, Ninon Gildas *(University of the Witwatersrand)*

Layered transition metal chalcogenides are inorganic materials similar to the graphene, but in contrast to graphene some of the transition metal chalcogenides, such as molybdenum disulfide (MoS2), have an intrinsic band gap. A band gap is a property essential for many applications including low dimensional transitors, optoelectronic devices and solar energy harvesters. MoS2 has a layered structure with each layer consisting of S-Mo-S sheets, consisting ofan atomic plane of Mo sandwiched between two atomic planes of S in trigonal prismatic arrangement. While atoms in each layer are strongly bound, layers are attracted to each other by weak van der Waals forces conferring on MoS2 an anisotropic structure, and anisotropic electrical, optical, and mechanical proper-ties [1,2,3]. We present the structural and elastic properties of three materials (MoS2 , Mo2S4 , and Mo6S8) predicted using Density functional theory (DFT)with the inclusion of Van der Waals interactions. The obtained equilibrium structural parameters for these materials agree with experimental data. Thecalculated cohesive energy and formation energy show that these materials are stable. Apart from above properties we present also the electronic properties(band gaps) of these three materials by the many-body perturbation theory in the GW approximation, currently the most accurate first-principles approach for electronic band structure of extended systems. The obtained band gaps agree with the experimental data.[1] A. Kumar and P. Ahluwalia, Electronic structure of transition metal dichalcogenides monolayers 1 H-MX 2 (M=Mo, W; x= S, Se, Te) from ab-inition theory: new direct band gap semiconductors, The European Physical Journal B-Condensed Matter and Complex Systems, vol. 84, no. 6, pp. 1 – 7, 2012.[2] O. Sedelnikova, L. Bulusheva, and A. Okotrub, Ab initio study of dielectric response of rippled graphene, The Journal of chemical physics, vol. 134, no. 24,pp. 244707 – 244707, 2011.[3] D. Late, B. Liu, H. Matte, C. Rao, and V. Dravid, Rapid characterization of ultrathin layers of chalcogenides on sio2/si substrates, Advanced Functional Materials, 2012.

108 - Structural and electronic properties of chalcopyrite AlAgX2 and AlCuX2(X= S, Se, Te)

Poster1 - Tuesday 09 July 2013 17:40

Authors: DONGHO NGUIMDO, Guy Moise *(University of the Witwatersrand)*

A selection of ternary compounds AlAgX2 and AlCuX2 (X= S, Se, Te), that may be potential componentsof solar cells were investigated. First principles Density Functional Theory (DFT) calculations for bulkstructural and electronic properties were performed with three different approximations for the exchange-correlation energy.1. The Generalized Gradient Approximation (GGA) by Perdew, Burke and Ernzerhof (PBE) [1].2. The PBE DFT-D2 method of Grimme [2] which adds van der Walls interactions to PBE.3. The vdW-DF2 approach of Langreth and Lundqvist [3] which includes van der Walls interactionsand an optimised version of PBE.Results are given for the Equation of States (EOS), the optimized geometries, lattice constants, bulkmoduli, and its pressure derivatives, Density of States (DOS) and band structures. The formation en-ergies, cohesive energies and elastics constant were used to predict the stability of the structures. Wecompared our results with previous works and experimental data. Potential components for solar cells, candidates for further numerical investigation, were identified based on structural stability and electronic structure properties.[1] John P. Perdew, Kieron Burke, Matthias Emzerhof; Generalized Gradient Approximation Made Simple; Phys. Rev. Lett. 77, 3865 – 3868(1996).[2] Stefan Grimme; Semiempirical GGA-type density functional constructed with a long-range dispersioncorrection; Journal of Computational ChemistryVolume 27, Issue 15, pages 1787 – 1799, 30 November2006.[3] Kyuho Lee1, Eamonn D. Murray, Lingzhu Kong, Bengt I. Lundqvist and David C. Langreth; Higher-accuracy van der Waals density functional ; Phys. Rev. B 82, 081101(R)(2010).

109 - Exploring Star Formation in Dwarf Galaxies at z~1 with the Hubble Space Telescope

Astro - Tuesday 09 July 2013 11:10

Authors: RAMRAJ, Riona *(UCT, SAAO)*

In the currently-favoured hierarchical formation model, all galaxies in the Universe were formed from the mergers of smaller (dwarf) galaxies. By studying these systems we can therefore get a better understanding of galaxy formation and evolution. The Redshift One LDSS-3 Emission line Survey (ROLES) was designed to specifically target this interesting galaxy population using spectroscopy, looking back in time when the Universe was less than half its current age. My Masters thesis uses data from the Hubble Space Telescope to conduct a follow-up study of the ROLES sample with near-infrared slitless spectroscopy for the first time.

110 - Experimental Setup in Cold Atom Experiment

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: DLAMINI, Sanele *(University of KwaZulu-Natal)*
Co-authors: *SEMONYO, Malehohonolo (University of KwaZulu-Natal); MORRISSEY, Micheal (University of KwaZulu-Natal); PETRUCCIONE, Francesco (University of KwaZulu-Natal)*

Over the last two decades there has been much research in the field of cold atoms. This field has lead to many breakthroughs in numerous fields including atomic and molecular physics as well as precision meteorology. The importance of these breakthroughs has resulted in several Nobel Prizes in Physics being awarded in this field. The magneto-optical trap (MOT) has become the power-house of such experiments. It allows researchers to routinely cool, trap and manipulate a large number of atoms at sub-Doppler temperatures for various types of experiments.In this poster the experimental setup for laser cooling and trapping of 87-Rb atoms with the aid of a MOT is presented. Such an experiment has a diverse setup, which includes; a vacuum system in which the cooling and trapping takes place, a laser system, which provides optical power for cooling; a magnetic field, which creates a trapping force for the atoms; and an imaging system which can be used to determine many of the properties of the atomic cloud. An overview of these systems will be presented as well as their performance.

111 - The variation of dose rate dependence parameters of synthetic diamond detectors with electron energy

Applied - Tuesday 09 July 2013 16:00

Primary authors: ADE, Nicholas *(University of the Witwatersrand, Johannesburg)*
Co-authors: *NAM, Tom (University of the Witwatersrand, Johannesburg); MHLANGA, Sikhumbuzo (Charlotte Maxeke Johannesburg Academic Hospital)*

The dose rate dependence parameters of eight synthetic diamond detectors have been investigated in the dosimetry of therapy electron beams according to Fowler's model. As modelled by Fowler, electrical conductivity, σ, and absorbed dose rate, ■, are related by σ α ■^Δ where Δ is the dose rate dependence parameter. The aim of the study was to investigate, in particular the dependence of Δ on electron energy as it is often cited for diamond detectors that Δ is independent of radiation energy and type. The study was conducted on one HPHT and seven CVD synthesised diamonds using two electron energies of 7 and 12 MeV. It was observed that the Δ values obtained with the CVD specimens varied with electron energy whereas the Δ values obtained with the HPHT specimen were found to be independent of the two electron energies. Given that the surfaces of the crystals could be more sensitive to the lower energy 7 MeV electron beam compared to the 12 MeV beam, a greater fraction of charge carriers could be preferentially trapped on the surfaces of the crystals for the lower electron energy compared to the higher energy if electron traps are present on or near the surfaces of the crystals. In this study, C-H centres have been identified by IR absorption spectroscopy as defects possibly located on the surfaces of the crystals with a greater concentration occurring in the CVD diamonds compared to the HPHT sample. The observed dependence of Δ on electron energy for the CVD specimens could therefore be attributed to the greater presence of surface defects such as the C-H centres which could introduce electron traps causing a variation in the number of trapped electrons relative to the number of free electrons between the surfaces and the bulk of the crystals. This study concludes that Δ could vary with radiation energy depending on the characteristics of each diamond crystal.

112 - YVO4:Eu3+ thin films prepared by PLD

Poster1 - Tuesday 09 July 2013 17:40

Authors: FOKA, Kewele Emily *(University of the Fee Stae)*

Oxide thin film phosphors have been given attention because of its high resolution and high efficiency planar display. The oxide based phosphors appeared to be a potential candidate for a red emission display phosphor. YVO4:Eu3+ thin films is one of the most promising oxide-based red phosphor with application in high pressure mercury lamps, television cathode ray tube displays but mostly in plasma display panels [1]. Thin films of YVO4:Eu3+ have been prepared by pulse laser deposition (PLD) which is known as a unique process that provides stoichiometric transfer of target materials. The films were deposited at room temperature with different oxygen pressure. The structure and the luminescence of the YVO4:Eu3+ have been studied. Photoluminescence (PL) showed a strong red emission peak at the 5Do-7F2 transition at 619 nm. This is due to energy transfer to Eu3+ ions from absorption of UV light in the VO43- group [2]. X-ray diffraction spectra and PL indicated that YVO4:Eu3+ thin films phosphor material is successfully prepared by PLD. References[1] Georgescu, S.; Cotoi, E.; Voiculescu, A. M.; Toma, O.; Matei, C. Condensed Matter. 2010, 55, 750. [2] Kim, D.; Kang, W. Bull. Korian. Cham. Soc. 2004, 25, 12.

113 - Effect of zinc acetateconcentrations on the structure, morphology and optical properties of ZnOnanoflakes synthesized by chemical bath deposition method

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: DOLO, JAPPIE *(University of the free state); DOLO, Jappie (SAIP)*
Co-authors: *KOAO, Lehlohonolo (SAIP); DEJENE, Francis (SAIP); MOLEFE, Fokotsa (SAIP)*

FV Molefe,LFKoao, JJ Dolo,BFDejeneDepartment of Physics, University of the Free State (QwaQwa Campus), Private Bag X13,Phuthaditjhaba, 9866, South AfricaCorresponding Author Email address: koaolf@qwa.ufs.ac.zaZinc Oxide (ZnO) nanostructures were synthesized by chemical bath deposition method (CBD)from precursorscontaining varying molar concentrations of zinc acetate. The structure, morphology, optical and luminescence properties of the samples were investigated using X-ray diffraction (XRD), Scanning electron microscopy (SEM), ultraviolet spectroscopy (UV) and Photoluminescence (PL). The XRDresult shows that at low molar concentrations of zinc acetate the structure is modified cubic ZnO.As the molar concentration of zinc acetate increasesthe well-known hexagonal wurtzite structure of ZnOis developed.The average particle size estimated using Scherer's formula was about 37 nm. It was found that the average particle size increases with an increase in the molar concentration of zinc acetate. SEM observations showed the presence of nanocrystallites forming aggregated nanoflakes. The morphology was found to dependent on the concentration of zinc acetate.The UV-Vis spectra showed that the absorption band edge shift to the higher wavelength with an increase in molar concentration of zinc acetate. The band gap energy of ZnO nanostructures determined from UV reflectance spectra was found to decreasefrom 3.23 to 2.75 eV with an increase in the zinc acetate concentration. The PL results show that the luminescence intensities decrease with an increase in the molar concentration of zinc acetate. The maximum luminesce band was found around 464 nm without any significant shift in position.

116 - Line, LINER, linest - from micro-AGN to ultra-luminous LINERS. One and the same?

Astro - Wednesday 10 July 2013 11:10

Authors: WINKLER, Hartmut *(Dept. Physics, University of Johannesburg)*

This paper compares the optical spectra of a wide range of galaxies categorised as members of the Low Ionisation Nuclear Emission Region (LINER) class of active galactic nuclei (AGN). LINERs are defined by emission spectra with relatively faint high ionisation lines (compared to other AGN classes). The gas emission luminosity ranges from the weak flux eminating from some nearby galactic nuclei all the way to extremely luminous radio galaxies, where the line emission can completely dominate the host galaxy starlight component. In this study I analyse the Sloane Digital Sky Survey optical spectra of 20 LINERS identified in the course of the preparation of the new edition of the ZORROASTER AGN catalogue, spanning the largest possible luminosity range. I compare relative emission line strengths, focusing on uncommonly analysed ratios such as those involving [N I], line widths, profiles and even the spectral features of the host galaxy stellar continuum. The study identifies possible luminosity-dependent trends in the spectral properties of the studied objects. Possible reasons are presented to rationalise these trends, and the paper concludes with a discussion regarding the uniformity of the LINER class.

118 - The calculated vacancy formation energies of Al, Ni, Cu, Pd, Ag, and Pt.

DCMPM2 - Tuesday 09 July 2013 11:50

Primary authors: VAN DER WALT, Cornelia *(Physics Department, University of the Free State)*
Co-authors: *TERBLANS, Koos (Physics Department, University of the Free State); SWART, Hendrik (Physics Department, University of the Free State)*

A molecular dynamics simulation that made use of the Sutton-Chen many-body potential [1] calculated the bulk vacancy formation energies (Ev) for Al, Ni, Cu, Pd, Ag, and Pt single crystals. The Ev values for single crystals with the surface orientations of (111), (100) and (110) were calculated at temperatures ranging from 0 K to 1000 K. In the case of Cu and Al which showed premelting below 1000 K, Ev values were calculated up to below their respective premelting temperatures. The values obtained for vacancy formation energies at 0 K exhibited surface orientation dependence and compared well to values obtained from literature. [2-4] The (111) surface had the closest packed surface, with few atoms bonding to a surface adatom, and had the highest bulk vacancy formation energy. The (100) surface had average Ev values that compare well with surface-independent literature values. [4] The (110) surface had deep surface binding sites with the largest number of surface atoms able to bond to an adatom and had the lowest bulk vacancy formation energy. For an increase in temperature a slight decreasing trend in Ev values was observed, which is associated with atoms in the bulk that bond less strongly as a result of the crystal expansion at higher temperatures. Disordering was observed at temperatures well below the melting points of Al, Cu, Ag and Ni. At these temperatures where surface disordering occurred in (110), surface instability interfered with deep binding sites on the surface, reflected in a slight increase in Ev values. Disordering occurring in (111) and (100) surface orientations at high temperatures conversely allowed deeper binding sites in the tightly packed surfaces and resulted in a slight drop in Ev values. References[1] Sutton, A. P.; Chen, J., Phil. Mag. Lett., 1990, 61, 139-146.[2] Terblans, J. J. Surf. Interface Anal. 2002, 33, 767–770.[3] Terblans, J. J. Surf. Interface Anal. 2003, 35, 548–551.[4] Kraftmakher, Y. Phys. Rep. 1998, 299, 79-188.

119 - The role of catalytic residues in amidases as revealed by mutagenesis and X-ray crystallography

Applied - Tuesday 09 July 2013 11:30

Primary authors: *SERAH, Kimani (University of Cape Town)*
Co-authors: SEWELL, Trevor *(University of Cape Town)*

Nitrilase superfamily amidases are thiol enzymes that catalyze the conversion of amides to their corresponding acids and ammonia. A conserved Cys, Glu and Lys (CEK) catalytic triad has been identified in these enzymes, and catalysis shown to follow a 'ping pong bi bi' mechanism in which the substrate forms a thioester with the catalytic cysteine. A 'second', structurally conserved active site glutamate has been found to be essential for activity in amidases, but its role in catalysis has never been elucidated. This study was aimed at understanding the role of catalytic residues in amidases. The four catalytic residues (C165, E61, E139 and K131) were mutated individually in the model amidase from Nesterenkonia species (NitN). The mutants were reacted with a range of short aliphatic amide substrates and the resultant proteins characterized by mass spectrometry and X-ray crystallography. Mutation of the two catalytic glutamates and the lysine resulted in unstable mutants that were inactive, highlighting the importance of these residues in maintaining the protein fold and for enzymatic activity. Mass spectrometry showed that thioester acyl-enzyme intermediates could be trapped by mutating E61. In addition, incubation of the glutamate mutants with amide substrates resulted in two types of unexpected reactions: An SN2 substitution reaction leading to the displacement of the fluorine in fluoroacetamide was observed with the E61Q/L mutants, while Michael addition of acrylamide at the catalytic cysteine was observed with the mutants of both glutamate residues (E61Q/L and E139Q). These artifactual reactions not only emphasize the role that the two glutamates play in positioning the substrates but also demonstrate that E61 is not always necessary to catalyze nucleophilic attack by the cysteine. Mutation of K131 to a glutamine resulted in covalently modified protein that had a possible adipamide thioester intermediate trapped in the active site, suggesting a component of general acid catalysis. These results support a Cys, Glu, Glu and Lys (CEEK) catalytic tetrad in which the two glutamates and the lysine function as a modular assembly.

121 - AES and TOF-SIMS measurements of In segregation in a polycrystalline Cu crystal

DCMPM2 - Tuesday 09 July 2013 14:30

Primary authors: MADITO, Moshawe *(University of the Free State)*
Co-authors: *TERBLANS, Koos (University of the Free State); SWART, Hendrik (University of the Free State)*

Lately, Cu-In system receives attention particularly for applications in solar cells, thin-film transistor liquid-crystal display, ultra-large-scale integrated devices[1-3]. But studies on In segregating from the bulk to the surface and grain boundaries of a Cu crystal are not available in literature. In this study, the focus is on measuring the bulk-to-surface and boundary segregation of In in a polycrystalline Cu crystal using Auger Electron Spectroscopy (AES) and time-of-flight secondary ion mass spectrometry (TOF-SIMS) coupled with a programmable heater. AES measurements were carried out using constant temperatures in the temperature range 733 K to 853 K. The measured AES data showed that In segregate to the surface and it has reached a relative high surface concentration on the Cu surface. The AES In segregation data was fitted with the semi-infinite model of Fick to obtain the In bulk diffusion parameters (D_0 = 1.1 × 10^{-5} m^2 s^{-1}, Q = 191.9 kJ mol^{-1}). The AES segregation measurements were performed in the middle of a grain on the surface. The average grain size was 112 μm which is much larger than the primary electron beam (13 μm). However, these measurements could be affected by the surface orientation of the different grains. The effect that the surface orientation of the grains has on the In segregation was obtained with TOF-SIMS measurements (carried out using the linear temperatures method). The TOF-SIMS segregation data from two twin grains showed equal segregation rates, which is expected since the twin grains have the same surface orientation. However, segregation data from two different grains showed different segregation rates which confirm the effect surface orientation has on segregation.References(1) C.S. Hsu, H.Y. Hsieh, J.S. Fang, Journal of Electronic Materials 2008, 37, 6.(2) A.A. Wronkowska, A. Wronkowski, ■. Skowro■ski, Journal of Alloys and Compounds 2009, 479, 583.(3) J.S. Fang, H.Y. Hsieh, Journal of Electronic Materials 2007, 36, 2, 129.

122 - Simultaneous measurement of EFISH in transmission and in reflection from the Si/SiO2 interface of a thin Si membrane.

Photonics - Wednesday 10 July 2013 14:10

Primary authors: NDEBEKA, Wilfrid *(Laser Research Institute, University of Stellenbosch)*
Co-authors: *NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch); STEENKAMP, Christine (Laser Research Institute, University of Stellenbosch); STAFAST, Herbert (Institute of Photonic Technology (IPHT), Jena, Germany); ROHWER, Erich (Laser Research Institute, University of Stellenbosch)*

Optical second harmonic (SH) generation is a versatile tool to investigate charge separation processes at buried interfaces of centrosymmetric systems. Using femtosecond laser pulses (800 nm, 80 fs, 80 MHz), we perform a simultaneous measurement of the electric field induced second harmonic (EFISH) in transmission and in reflection at the silicon/silicon dioxide (Si/SiO2) interface from a thin silicon membrane (~10 μm). Experimental results will be presented and discussed. We find that, in the case of reflection, the SH signal increases quadratically with incident intensity, as could be expected, and eventually saturates. However in the case of transmission, the SH signal also initially increases quadratically, reaching a maximum before decreasing with even higher input intensities. Possible explanations are presented briefly and planned future work suggested.

123 - Progress towards a GIC prediction framework

Space Science - Tuesday 09 July 2013 15:40

Primary authors: LOTZ, Stefan *(SANSA)*
Co-authors: *CILLIERS, Pierre (SANSA); ALAMIREW, Netsanet (SANSA)*

This paper presents work in progress towards extending the lead time for forecasting space weather related geomagnetically induced currents (GICs) in power lines. The earth's magnetic field is connected to, and perturbed by the continuous outflow of solar plasma (the solar wind). At times the disturbances to the geomagnetic field caused by the buffeting received from the solar wind is strong enough to induce currents in earth that are closed in terrestrial conductor networks like power distribution lines. When these currents flow to ground via the neutral connection of Y-connected power transformers, they may cause disturbances on the power system and permanent damage to the power transformers. Forecasting these events will enable power utilities to mitigate the impact on the power system. We discuss progress toward an integrated GIC prediction framework. The first part of the talk outlines the chain of events leading to induced currents and the second part will address the progress towards a working prediction model. The model is based on an empirically developed neural network (NN) based predictor of perturbations in the northern (X) and eastern (Y) components of the geomagnetic field that uses solar wind plasma and magnetic field measurements as input. Solar wind measurements are streamed from spacecraft located in the upstream solar wind, resulting in a lead time of about 1 hour - depending on the speed of the solar wind. The Wang-Sheely-Arge (WSA) model is a magneto-hydrodynamic model that estimates solar wind plasma and magnetic field parameters from observations of the solar corona - up to days in advance of their arrival time at the bow shock. We investigate the feasibility of using WSA estimates of solar wind parameters with over 24 hours of lead time as input to the X, Y prediction model. If proved to be feasible, the model may significantly increase the mitigation time.

126 - Performance monitoring of a Field-Batch Biogas Digester fed with agricultural wastes at different mixing ratios

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MUKUMBA, Patrick *(university io Fort Hare Physics Department)*
Co-authors: *MAKAKA, Golden (University of Fort Hare); MAMPHELI, Sampson (University of Fort Hare)*

Biogas technology converts organic wastes into biogas, which consists of about 80% methane. The digester effluent after digestion can be used as manure. The co-digestion of cow dung, donkey dung, goat dung and horse dung at different mixing ratios was investigated. The investigation was carried out using a 1 m3 field batch biogas digester. The co-digestion of 25% cow dung and 25% donkey dung with 25% horse dung and 25% donkey dung produced the highest total biogas yield of 6.96 m3. However, the co-digestion of 37.5% cow dung and 37.5% donkey dung with 12.5% horse dung and 12.5% goat dung produced a total biogas yield of 6.3 m3. In addition, the co-digestion of 12.5% cow dung and 12.5% donkey dung with 37.5% horse dung and 37.5% goat dung produced the least total biogas yield of 5.82 m3. The substrates were analyzed for total solids, volatile solids, total alkalinity and calorific value before they were co-digested at different mixing ratios. The ammonia-nitrogen for all the mixtures was within the expected range (150 to 1000 mg/L) for optimum methane production while the pH values ranged from 6.8-8.1 for all co-digestion trials. The mixture of 25% cow dung and 25% donkey dung co-digested with 25% goat dung and 25% horse dung produced the biogas yield with the highest methane yield of 70% than the other mixing ratios.

127 - Observation of structural dynamics of 1T-$TiSe_2$ using femtosecond electron diffraction

Photonics - Tuesday 09 July 2013 16:00

Primary authors: SULEIMAN, Aminat Oyiza *(Laser Research Institute)*
Co-authors: *HEINRICH, Schwoerer (Supervisor); KERSTIN, Haupt (Research Colleague)*

Trilayered transition metal dichalcogenides such as our sample 1T-$TiSe_2$ have been studied for many years 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 whose detailed physical origin has been controversially determined.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 this crystal. Hence the dynamical structural behaviour can be observed in time with a subpicosecond temporal resolution. As a hexagonal close-packed structure, its signature is expected to be seen in the diffraction pattern as has been observed by Woo *et al* in steady state transmission electron diffraction. Time-resolved measurements as well as the behaviour of the charge density wave for various pump fluences shall be investigated. We investigate the suppression of the charge density wave (CDW) order, measure the electron-phonon coupling time, and determine the CDW recovery process. With sufficient pumping fluence we might see a high temperature CDW phase appearing in the diffraction patterns.Email: suleiman@sun.ac.za

128 - The Virtual Observatory - A New Era for Astronomy Education

Education - Tuesday 09 July 2013 11:10

Authors: BARWAY, Sudhanshu *(South African Astronomical Observatory)*

The Virtual Observatory (VO) is a powerful medium of training as it brings vast astronomical resources, along with very easy to use but highly sophisticated techniques. It allows students and teachers to conduct highly informative experiments/exercises with relatively simple and inexpensive tools. NRF has approved to establish South African Virtual Observatory (SAVO) which has already started programmes to train students within the National Astrophysics and Space Science Programme (NASSP) and has developed several student projects with the help from other VO projects across the globe. The SAVO aims to help other institutes and universities within South Africa and Africa to develop similar student projects with help from IAU Office of Astronomy for Development (OAD) hosted at SAAO. These projects demonstrate the latest, interesting results in astronomy and at the same time expose the students to modern developments taking place in the astronomy as well as IT domains. The projects deal with different astronomical topics ranging from our solar system to the most distant galaxies. They are developed in such a way that they can be adapted for students with different backgrounds in science. The student projects were applied at the NASSP summer school and NASSP honours course with great success. We intend to run a series of workshops within South Africa and Africa with the intention of providing access to the huge collection of astronomical data by making it understandable for students interested in Astronomy. Our goal is to make the VO a standard with a set of dedicated tools and exercises which teachers at the universities can use to introduce the knowledge and beauty of the sky which is hidden behind huge amounts of data.

129 - Degradation of organic solar cells with solution processed ZnO

DCMPM2 - Wednesday 10 July 2013 16:00

Primary authors: MBULE, Pontsho Sylvia *(University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); NTWAEABORWA, Martin (University of the Free State)*

Bulk heterojunction Organic photovoltaics devices have drawn a lot of attention as means for the renewable energy conversion due to the remarkable combination of prospective low cost of manufacturing and rapid improvement of performance approaching the traditional silicon solar cells [1]. However, bulk heterojunction organic solar cells can suffer from degradation of the top electrode, which is normally low work-function aluminium (Al) that is reactive and can easily be oxidized in air [2].In this study we present the performance data of the organic solar cell (OSC) device with ZnO nanoparticles as electron extraction layer. The device was fabricated by spin-coating poly(3,4-ethylenedioxythiophene) poly(styrenesulfonate) (PEDOT:PSS) polymer on a glass substrates pre-coated with a layer of transparent indium-tin-oxide (ITO) followed consecutively by layers of blend of poly(3-hexylthiopene) (P3HT) and [6,6] -phenyl C61-butyric acid methyl ester (PCBM), ZnO nanoparticles and evaporation of aluminium metal as cathode electrode. The configuration of the device is ITO/PEDOT:PSS/P3HT:PCBM/ZnO nanoparticles/Al. The power conversion efficiency (PCE) of 2.37 % was recorded from device with a concentration of 0.5 mg/ml, ZnO nanoparticles as electron extraction layer whereas the PCE of 0.20 % was recorded from the same device after 10 days of storage at ambient laboratory conditions. Furthermore, degradation mechanisms of organic solar cell devices are discussed.References[1] W. Ma, C. Yang, X. Gong, K. Lee and A.J Heeger, Adv.Funct.Mater 2005(1617-1622)15[2] H. Oh, J. Krantz, I. Litzov, T. Stubhan, L. Pinna and C.J. Brabec, Sol.Energy Mater.Sol Cells 2011 (2194-2199) 95

131 - The effect of SLM dependent dispersion on spatial beam shaping

Photonics - Wednesday 10 July 2013 14:30

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

Spatial light modulators (SLM) used for spatial modulation of lasers are often used in conjunction with very narrow bandwidth laser light where diffractive dispersion could be approximated as a constant. It is known that diffractive dispersion is inversely proportional to wavelength and this effect can be compensated for depending on the optical set-up. SLMs use birefringent liquid crystal pixels each with adjustable refractive index at a specific polarization. The range of the adjustable refractive index is wavelength dependent. This adds an additional SLM dependent dispersion effect when using SLMs. Note that we distinguish between diffractive dispersion and SLM dependent dispersion. SLMs are therefore calibrated in order to have linearly adjustable phase retardation of light incident on the pixels between zero and two pi for a specific wavelength. It is therefore unavoidable when using the same SLM, to do beam shaping of a source which emits multiple wavelengths or a wide bandwidth, that the device will not modulate all wavelengths between zero and two pi. We numerically and experimentally investigate the effect of SLM dependent dispersion on spatial modulation of light incident on a 2D SLM. We further show that it is possible to modulate multiple wavelengths between zero and two pi despite the SLM dependent dispersion.

132 - Analysis of electron diffraction patterns in DCNQI salts

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: OLAOYE, Olufemi Opeyemi *(SU)*
Co-authors: *ERASMUS, Nicolas (SU); VON FLOTOW, Andrea (SU); SMIT, Bart (SU); SCHWOERER, Heinrich (SU)*

We investigate a donor-acceptor quasi 1D organic molecular crystal, Cu [R1, R2 – DCNQI]2 (R1 and R2 are radicals), using ultrafast electron diffraction technique. These crystals are radical anion salts and are famous for their high anisotropic electric conductivities and their low temperature Peierl's transition from metal to insulator, with up to eight orders of magnitude conductivity change, depending on the radical used. The signature of the intensity distribution of the {h0l} Bragg reflections along the [010] Laue zone is analysed and compared with the theoretical simulation. The formation and dynamics of 3-fold periodicity charge density wave (CDW) in these crystals, which are mediated by d-p-π hybridization and the coordination angle α (N-Cu-N angle), forms an on-going research in our laboratory. The ultimate aim of the project is to study the photo-induced Peierl's transition with sub-picosecond temporal resolution by means of ultrafast electron diffraction. The poster will present the theoretical background of the project, and highlight the subtle and difficult analysis of our transient diffraction patterns.

133 - Relative stability of graphene and carbon nanotube structures

DCMPM1 - Tuesday 09 July 2013 11:50

Authors: SHAI, MOSHIBUDI *(university of limpopo); MOSUANG, Thuto (university of limpopo); RAMMUTLA, Erasmus (university of limpopo)*

Abstract. Molecular dynamics simulations were used to study properties of graphene and single walled carbon nanotube. The formulation of the Tersoff bond-order potential was used to investigate the structural properties and thermodynamics properties of these two carbon polymorphs through a range of temperature. The structural properties were studied using the radial distribution functions effects and the thermodynamics effects were studied using the energy-temperature and volume-temperature plots. Similarities and differences in graphene and carbon nanotubes are discussed.

134 - Search of invisible anomalous Higgs boson decays with the ATLAS detector at the LHC

NPRP - Wednesday 10 July 2013 11:10

Primary authors: *CARRILLO-MONTOYA, German David (University of the Witwatersrand)*
Co-authors: MOLEFI, Itumeleng

A direct search for evidence of Higgs boson decays to invisible particles performed at the CERN Large Hadron Collider is presented. The interpretation of the analysis results place limits on the branching fraction for the Standard Model (SM) Higgs boson to decay into invisible particles, where a non-zero invisible branching fraction could provide evidence for the production of possible dark matter particles and more generally provide hints of beyond the SM physics. In addition, limits are set on any neutral Higgs-like particle, produced in association with a Z boson and decaying predominantly to invisible particles. No deviation from the SM expectation is observed in the search, which uses 4.7fb^{-1} of 7TeV pp collision data and 20.7fb^{-1} of 8TeV *pp* collision data collected by the ATLAS experiment at the LHC.

135 - The Impact of Low Intensity Laser Irradiation on Lung Cancer Stem Cell Viability and Proliferation

Photonics - Wednesday 10 July 2013 09:20

Primary authors: CROUS, Anna Magdalena *(Anine)*
Co-authors: *ABRAHAMSE, Heidi (Heidi)*

A. Crous and H. Abrahamse Laser Research Centre, University of Johannesburg, P.O. Box 17011, Doornfontein, Johannesburg, 2028, South Africa Email: habrahamse@uj.ac.zaAbstract. Background: Cancer stem cells or tumour initiating cells are cells that have been attributed to metastatic drive and tumour genesis. These cells contribute to cancer recurrence, metastasis, aggressiveness and resistance to therapy. Laser irradiation has been shown to have a diverse range of clinical applications including wound healing and photo dynamic therapy (PDT). Middle infrared (MIR) radiation has shown to inhibit cellular proliferation and induce morphological changes to the cytoskeletal dynamics of A549 lung cancer cells. Recent studies done using Low Intensity Laser Irradiation (LILI) using near-infrared light with a wavelength of 636 nm and fluence between 5- 15 J/cm2 on adipose derived stem cells (ADSCs) which are adult mesenchymal stem cells (MSCs), have shown to have an increase in proliferation, viability and differentiation into smooth muscle cells. The effects of LILI on cancer stem cells have yet to be elucidated. Methodology: Isolated A549 lung cancer stem cells were exposed to a wavelength of 680 nm and a fluence between 10-20 J/cm2, where after cellular responses were monitored after several time intervals to evaluate proliferation and viability with the view to establish at what wavelength and fluence after a specific incubation time LILI causes increased or decreased proliferation and viability. Discussion: This study assists in the understanding of the effects of LILI on isolated lung cancer stem cells by evaluating the results produced and comparing the different effects of different laser parameters on these cells.

136 - Investigating the impact of equivalence ratio and temperature of input air on the conversion efficiency of a downdraft biomass gasifier.

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: NWOKOLO, Nwabunwanne *(University of Fort Hare, Institute of Technology)*
Co-authors: *MAMPHWELI, Sampson (University of Fort Hare); MEYER, Edson (University of Fort Hare)*

The need for a sustainable and renewable alternative to our fast depleting conventional energy source has been of great concern. The continuous climatic change, which is caused by the world 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 route 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. However a number of factors influence the efficiency of this type of gasifier system. Therefore this study is aimed at investigating the effect of two major factors; equivalence ratio and temperature of input air on conversion efficiency of a downdraft gasifier system. This will be achieved by using a downdraft gasifier computer simulation program. A detailed and graphical analysis of how these two factors affect efficiency, gas composition, and quality of gas as defined by its heating value will be presented in the final paper.Keywords: Biomass gasification, downdraft gasifier, equivalence ratio, temperature of input air

137 - Stability of a laser cavity with non-parabolic phase transformation elements

Photonics - Friday 12 July 2013 11:10

Authors: LITVIN, Igor *(CSIR NLC)*

In this work we present a general approach to determine the stability of a laser cavity which can include non-conventional phase transformation elements. We consider two pertinent examples of the detailed investigation of the stability of a laser cavity firstly with a lens with spherical aberration and thereafter a lens axicon doublet to illustrate the implementation of the given approach. In the particular case of the intracavity elements having parabolic surfaces, the approach comes to the wellknown stability condition for conventional laser resonators.

139 - Studies of the amplitude ratios in the atmosphere of the sun

Poster2 - Wednesday 10 July 2013 17:40

Authors: ABEDIGAMBA OYIRWOTH, Patrick *(North West University, Mafikeng Campus)*

Observational data of the line width measurement, surface luminositypulsation amplitude, surface velocity amplitude and pulsation amplitude ratio inthe solar atmosphere exists. We present an attempt to model the amplitude ratiousing a radial pulsation code that includes non-local convection and consistenttreatment of radiation. Previous attempts to model the above mentioned data werepartially successful because radiation treatment was approximate. In this talk Iwill discuss the models and some of the results we obtain

140 - Production and characterisation of silicon nanoparticles for printed electronics

Poster1 - Tuesday 09 July 2013 17:40

Authors: *UNUIGBE, David (University of Cape Town)*

The establishment of printing technologies, using nanoparticle based inks, promises inexpensive manufacture of electronic devices. However, to produce working devices, nanoparticles have to meet requirements on size, shape, and composition. In the application of silicon nanoparticles in electronics, it is important that a network of interconnecting particles is formed through which charge transport can take place. Of further importance is that there is an absence of surface oxide in order to maintain a direct silicon-silicon connection within the network. In this work, cheap and scalable production of silicon nanoparticles is achieved efficiently with a top-down process of mechanical attrition by high energy milling. Scanning electron microscopy studies reveal that silicon nanoparticles produced by this method have a range of shapes and sizes. Compositional studies using energy dispersive X-ray spectroscopy (EDX) and X-ray photoemission spectroscopy (XPS) reveal the impurities present in the milled silicon nanoparticles and their surface properties. Transmission electron microscopy (TEM) reveals a polycrystalline structure with a grain size of about 10 nm. The TEM micrographs do not show any presence of a thick oxygen layer, but a thin disordered layer less than 1 nm. The analysis of the high energy milled silicon nanoparticles reveals that the oxygen contamination during the milling process is low and that the termination of the dangling bonds by oxygen passivates the surface against complete oxidation leading to the formation of stable nanoparticles. These particles are not insulating, but allow charge transport through the surface making them ideal for producing semiconducting nanocomposites particularly for printed electronics.

141 - Thermodynamic Characteristics of a Large Scale Downdraft Gasifier in a Scalar Energy Field

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *ERO, Felix (University of Fort Hare)*
Co-authors: *MAKAKA, Golden (University of Fort Hare); MAMPHWELI, S.N (Fort Hare Institute of Technology(FHIT) University of Fort Hare, South Africa)*

Thermodynamic Characteristics of a Large Scale Downdraft Gasifier in a Scalar Energy Field Ero F.A1 , Makaka G.1 and Mamphweli S.2Department of Physics1, Institute of Technology2 University of Fort Hare, South Africa1AbstractA thermodynamic evaluation of parametric characteristics of a large-scale downdraft gasifier in a scalar energy field has been made, as a preliminary approach to assess the technical feasibility of electrical energy production from a large-scale downdraft gasifier. Thermodynamic equilibrium calculations have been made to predict conversion levels in a reactor using pine wood as a biomass feedstock and air as the gasifying agent. The performance of the biomass gasifier system is evaluated in terms of equivalence ratio, producer gas quality, and cold gas efficiency. Mass and energy balance in a 300m3/h gas production reactor to examine the reliability of the results generated. The allowable electrical efficiencies of the pine wood product-gas in a scalar energy field have been calculated for different gasifier operating conditions, namely air/biomass ratio and gasifier operating temperature. The final paper will present the results obtainedKeywords: Biomass; Gasification; Producer gas; Downdraft gasifier; Equivalence ratio, Scalar energy field

142 - Pulse Delay Chromatic Dispersion Measurements in Single Mode Fibre

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *WASSIN, Shukree (NMMU Physics Department)*
Co-authors: *ROTICH KIPNOO, Enoch (NMMU Physics Department); GAMATHAM, Romeo (NMMU Physics Department); LEITCH, Andrew (NMMU Physics Department); GIBBON, Tim (NMMU Physics Department)*

In recent years, there has been a rising demand for high bandwidth in long haul fibres to assist with high-speed data transmission. Chromatic dispersion limits high-speed data transmission making it essential to perform chromatic dispersion measurements. Chromatic dispersion measurements play an important role during the manufacturing processes of the optical fibre, in characterizing the different types of optical fibre, when designing optical networks and in transmission penalty estimations. In this paper, a unique laboratory setup based on the pulse delay technique was used to characterize the chromatic dispersion in a single mode fibre. The chromatic dispersion of a 6.1km long G.652 single mode fibre was measured within the 1550nm to 1553nm wavelength range. The dispersion values obtained were in the region of 15.3-20.0ps/nm.km, which compares well with the theoretical values for the G.652 optical fibre.

143 - Bessel-Gaussian entanglement

Photonics - Tuesday 09 July 2013 11:10

Primary authors: *MCLAREN, Melanie (CSIR National Laser Centre)*
Co-authors: *PADGETT, Miles (University of Glasgow); ROUX, FS (CSIR National Laser Centre); FORBES, Andrew (CSIR National Laser Centre)*

Quantum entanglement of Bessel-Gaussian (BG) modes in the orbital angular momentum (OAM) basis offers a number of advantages over the more commonly used Laguerre-Gaussian (LG) modes. Unlike the LG modes, the continuous scalable radial parameter of the BG modes, allows greater control over quantum state preparation, allows a greater number of OAM modes to be measured, thereby increasing the degree of entanglement of the measured quantum state. We demonstrate entanglement in terms of the BG modes and show that a greater number of OAM modes are measured than with the LG modes. Classically, another useful property enables the amplitude and phase of a BG beam to be reconstructed after encountering an obstruction. We demonstrate that the reconstruction property of BG modes can be observed in quantum entanglement by calculating the concurrence of the quantum state at different positions of the obstruction.

144 - Quantum entanglement with a Hermite-Gaussian pump

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *MCLAREN, Melanie (CSIR National Laser Centre)*
Co-authors: *ROMERO, Jacquiline (University of Glasgow); GIOVANNINI, Daniele (University of Glasgow); PADGETT, Miles (University of Glasgow); ROUX, FS (CSIR National Laser Centre); FORBES, Andrew (CSIR National Laser Centre)*

Typically, a Gaussian mode is used to pump a non-linear crystal to produce pairs of entangled photons. We demonstrate orbital angular momentum (OAM) entanglement when a non-fundamental mode is used to pump a non-linear crystal. An approximation to an HG10 Hermite-Gaussian beam is produced by introducing a phase step into the transverse profile of the pump beam. We show both OAM and angular position correlations between the entangled pair of photons, by using two separate spatial light modulators to perform the measurements. The transfer of the OAM spectrum of the pump beam to the entangled photons is clearly illustrated and corresponds well with previous results demonstrating OAM conservation. This is the first step towards tailoring the entangled quantum states.

145 - High Voltage Board for the Mobile Test Bench for the ATLAS Detector

Poster2 - Wednesday 10 July 2013 17:40

Authors: *REED, Robert (University of Witwatersrand)*

Wits is developing an electronics lab to serve the upgrade needs of read-out electronics of the ATLAS detector. A first step in this program is the development of a test bench, the MobiDick4 system, for the readout electronics of the Tile Calorimeter. The architecture of the MobiDick4 system will be reviewed. Emphasis will be made on the re-design of the High Voltage controller card. Additional functionality needs to be incorporated, absent in the previous design.

146 - Higgs to Four Lepton

Poster2 - Wednesday 10 July 2013 17:40

Authors: *REED, Robert (University of Witwatersrand)*

With the discovery of a Higgs-Like boson at the LHC a new era in particle physics opens up. Results on the investigation of the spin-CP properties of the newly discovered Higgs boson will be presented with the H->ZZ->4l decay.

147 - A 40 Gbps Wavelength Division Multiplexing (WDM) Optical Network for Data Transmission for MeerKAT

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *KOUROUMA, Hamed (Nelson Mandela Metropolitan University)*
Co-authors: *ROTICH, Enoch (Nelson Mandela Metropolitan University); GAMATHAM, Romeo (Nelson Mandela Metropolitan University); GIBBON, Tim (Nelson Mandela Metropolitan University); LEITCH, Andrew (Nelson Mandela Metropolitan University)*

The MeerKAT telescope, as a precursor to the Square Kilometre Array (SKA), is expected to have 64 dish antennas, each delivering data rates up to 40Gbps. This paper reviews the optical wavelength division multiplexing technique (WDM) and how the method can be used to drive the 40Gbps links required for each of the MeerKAT dish antennas. We report on a 8x5Gbps WDM optical system simulated under VPIphotonics, which led to bit-error-rates (BER) estimations for each channel that met the telecommunications target of BER < 10-9 at an optical receiver sensitivity around -22dBm for all 8 WDM channels considered. The results obtained show error free transmission for the 8 channels considered in the system. This demonstrates that the presented WDM setup could successfully be implemented for the optical data transport network of the MeerKAT telescope.

148 - The effects of substrate temperature on the structure, morphology and photoluminescence properties of pulsed laser deposited Y3 (Al, Ga)5O12:Ce3+ nano thin films.

DCMPM1 - Tuesday 09 July 2013 14:50

Primary authors: *DLAMINI, Sipho (University of the Free State: Physics Department)*
Co-authors: *SWART, Hendrik (University of the Free State: Physics Department); NTWAEABORWA, Odireleng (University of the Free State: Physics Department)*

LEDs have shown the potential to replace incandescent and fluorescent lamps as source of lighting. Recently, Ce3+-doped garnet phosphors such as Y3(Al,Ga)5O12:Ce3+are attracting attention in the application for white LEDs. The Ce3+ ion is responsible for nanosecond decay time and an intense yellow-green emission wavelength from its characteristic d-f transitions. Thin films offer several advantages due to their good luminescence characteristics and good adhesion to the substrate. The substrate temperature plays a critical role in the growth of the films during Pulsed laser deposition (PLD). The movement and interaction on the surface of the substrate of different particles that makes up the plume is mainly determined by substrate temperature and the energy of these deposited particles. Research on the influence of substrate temperature on Y3(Al,Ga)5O12:Ce3+ thin films is of great importance to establish the optimum substrate temperature range for high Photoluminescence (PL) intensity. this paper reports the effects of substrate temperature on luminescence and morphological properties of Y3(Al,Ga)5O12:Ce3+ thin films prepared by PLD with the variation of substrate temperature from 22°C to 500°C in vacuum, O2 and Ar gas background atmosphere. The X-ray diffraction spectra indicated Y3(Al,Ga)5O12:Ce3+ phosphor films are successfully grown using PLD. Atomic force microscopy revealed poorly defined grain growth for films ablated at substrate temperature of 22°C, 100°C and 500°C but well defined grain growth was observed for 300°C substrate temperature. Cross section measurement done with Nano Scanning Auger Microscope (SAM) indicated film thickness to be between 90 nm to 300 nm. NanoSAM maps showed homogeneous distribution of elements on the surface of the film deposited at 300°C. PL data revealed an optimum substrate temperature of 300°C for high PL intensity films and emission spectra of the films blue-shifted compared to the emission spectrum of the powder due to crystal field effect.

149 - Investigation of characteristic signals of a black-hole pulsar binary system on the grid

Astro - Friday 12 July 2013 09:20

Authors: *BECKER, Bruce (Meraka Institute); CARLSON, Bevan (University of the Witwatersrand); TUCKER, Bevan (University of the Witwatersrand)*

Binary Pulsars have been identified as important laboratories for the study of gravitational physics. In particular, binary systems comprising a pulsar and a black-hole present a scenario for the study of physics in the strong gravitational field regime. We use a numerical simulation to predict the arrival times and relative fluxs from a pulsar in a binary system. We use numerical methods to solve the set of four coupled, second order ODEs describing the general relativistic motion of a photon in the Kerr spacetime. Pulsar emission has been modelled by generating the necessary initial conditions for a large number of photons in a conical configuration. A sufficiently large number of these 'photon cones' are then used to describe a simple 'lighthouse-like' scenario, whereby the pulsar emits two conical beams in the plane of rotation. We evaluate an idealised case of a pulsar in a stable circular orbit around a significantly more massive black-hole, with the plane of rotation for the pulsar is in the equatiorial plane of the black-hole. In particular, we examine the superior and inferior conjunctions, with the hope of elucidating the theoretical behavior of a pulsar signal as seen by a distant observer. Since the investigation is done at scale, considerable computing resources are needed for the execution and post-processing. For this reason, we report also the experience of running the investigation on the South African National Grid.

150 - Characterization of TRINNI events

Space Science - Wednesday 10 July 2013 14:30

Primary authors: *GARAPO, Kevin (School of Chemistry and Physics, University of KwaZulu-Natal, Westville)*
Co-authors: *RASH, Jon (School of Chemistry and Physics, University of KwaZulu-Natal); MCCREADIE, Heather (School of Chemistry and Physics, University of KwaZulu-Natal)*

“Tailward reconnection for interplanetary magnetic field (IMF) northward, non-substorm intervals (TRINNIs)”, is a term which was introduced by Milan et al. [2005], to describe the events when ionospheric flow bursts, with speeds usually greater than 1 km/s, are observed during extended non-substorm periods of quasi-steady northward interplanetary magnetic field. The first such event, though not identified as a TRINNI then, was reported by Walker et al. [1998, 2002]. This event was characterized by quasi-periodic plasma flow bursts, with speeds above 2 km/s corresponding to electric fields in excess of 0.1 V/m, in the nightside ionosphere during an extended extremely quiet solar wind period, from 8 March to 10 March 1997. Following the reports on this event, Grocott et al. [2003, 2004, 2005, 2007] performed a series of analyses on similar events using data for the northern hemisphere. However, the individual events analysed differed significantly from each other, especially in terms of the magnitude of the IMF and its components, as well as the direction of the By component. This led to varying suggestions regarding how the various components of the IMF contribute to the formation of a TRINNI. We attempt to clarify the properties that constitute a TRINNI event.

151 - NON-SPECIALIST: Radio Astronomy at the Centre for High Performance Computing

Astro - Wednesday 10 July 2013 10:30

Authors: *CRESS, Catherine (CHPC/UWC)*

I will summarize results from our recent studies in galaxy evolution and cosmology which utilized the supercomputing facilities at the CHPC. These include cosmological-scale N-body simulations as well as the study of the clustering of radio galaxies. I will also discuss the various roles that the CHPC is playing in Astronomy in SA, including the provision of HPC for a variety of Astronomical applications, the provision of storage for "Big Data", our educational programs and our participation in planning for the SKA.

154 - Effect of synthesis temperature on the structure, morphology and optical properties of PbS nanoparticles prepared by chemical bath deposition method

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *KOAO, Lehlohonolo (UFS (Qwa Qwa Campus))*
Co-authors: *SWART, Hendrik (UFS); DEJENE, Francis (UFS (Qwa Qwa Campus))*

PbS powders were prepared by chemical bath deposition (CBD) method by varying the synthesis temperatures. The influence of the synthesis temperature on the structure, morphology and optical properties of PbS nanoparticles were investigated. The X-ray diffraction (XRD) patterns of the PbS nanoparticles correspond to the various planes of a single phase cubic PbS. It was observed that a decrease in the synthesis temperature results into extra diffraction peaks due to the presence of the impurity phase. The estimated average grain sizes calculated using the XRD spectra were found to be in order of 32 ± 1 nm. It is observed that the estimated average grain sizes increases slightly with an increase in the synthesis temperature. The crystallinity of the cubic PbS improves significantly with an increase in synthesis temperature. The surface morphology study revealed that the grains are cubic in structure confirming the XRD results. The morphology was found to be dependent on the synthesis temperature. The nanocubic solid powder shows good optical properties with high reflectance in UV region. The UV-Vis spectra showed a partially increase in percentage reflectance and shift of the absorption edge to the higher wavelength with an increase in synthesis temperature. An additional absorption band in the visible region (647 nm) emerges with an increase in the synthesis temperature. The band gap energy of PbS was found to decrease but the luminescence intensities increase with an increase in the synthesis temperature.

155 - Research progress in the $H \rightarrow ZZ^{(*)} \rightarrow \tau^+ \tau^- l^+ l^-$ decay channel

NPRP - Wednesday 10 July 2013 09:20

Authors: *HAMITY, Guillermo (Msc Physics (WITS))*

The Higgs to $ZZ^{(*)}$ to $l^+l'l^+l'$ decay channel has good signal to background ratio and can be used to reconstruct the Higgs invariant mass with quite good resolution for an intermediate mass range Higgs ($m_Z < m_H < 2m_Z$). This makes the $ZZ^{(*)}$ channel one the most relevant channels to study at the LHC, where it has been found that $m_H \approx 125$ GeV . Although the Higgs to $ZZ^{(*)}$ decay channel played an important role in this discovery, the decay leptons considered excluded Z bosons decaying into τ leptons. Reasons for this lie in the hard-to-detect hadronic or leptonic τ decays. A study which includes Z decaying into τ is beneficial to completing the picture of the Higgs search, particularly in the statistically limited vector-boson-fusion like search. Preliminary results of the search for Higgs channel $H \rightarrow ZZ^{(*)} \rightarrow \tau^+ \tau^- l^+ l'$, *(l = e or* μ*)* will be presented and discussed.

156 - Magnetic properties of the $(Cr_{100-x}Al_x)_{99}V_1$ alloy system

DCMPM2 - Tuesday 09 July 2013 14:10

Primary authors: *MUCHONO, Blessed (University of Johannesburg)*
Co-authors: *SHEPPARD, Charles (University of Johannesburg); PRINSLOO, Aletta (University of Johannesburg)*

The magnetic phase diagram of the $Cr_{100-x}Al_x$ alloy system is unique amongst Cr alloy systems because it exhibits a deep minimum at the triple point concentration $x_c \approx 2$, where the incommensurate spin-density-wave (SDW) and commensurate SDW phases coexist with the paramagnetic (P) phase [1]. The interesting properties of this system were previously explored by the addition of 5 at.% Mo to form a $(Cr_{100-x}Al_x)_{95}Mo_5$ alloy system [2]. Antiferromagnetism (AFM) in this system was suppressed to below 4 K in the range $2 \leq x \leq 6$ [2]. Mo suppresses AFM in Cr and its alloys through electron hole pair breaking effects due to electron scattering [1]. For comparison, the present study investigates the magnetic properties of the $Cr_{100-x}Al_x$ system further through the addition of V. This reduces the AFM in Cr alloys through a mechanism different to that associated with Mo by reducing the electron-to-atom ratio [1]. Electrical resistivity (ρ), Seebeck coefficient (S) and magnetic susceptibility (χ) measurements, as a function of temperature in the range $2\ K \leq T \leq 390\ K$, were carried out on the $(Cr_{100-x}Al_x)_{99}V_1$ alloy system, with $0 < x < 7$. Néel temperatures (T_N) obtained from all these measurements decrease with Al concentration, disappearing near $x \approx 1.5$, again reappearing for $x > 4.5$. $\rho(T)$ and $S(T)$ for samples with $x \geq 6.1$ show smeared anomalies making the determination of T_N difficult. However, these anomalies are sharp in $\chi(T)$, proving that it is an important tool in probing AFM in this system. The present results show that the addition of just 1 at.% V to the $Cr_{100-x}Al_x$ alloy system suppresses AFM in the concentration range $1.5 \leq x \leq 4.5$. This behaviour is similar to that of the $(Cr_{100-x}Al_x)_{95}Mo_5$ alloy system [2]. [1] Fawcett E, Alberts H L, Galkin V Yu, Noakes D R and Yakhmi J V 1994 Rev Mod. Phys. 66 25[2] Smit P and Alberts H L 1986 J. Phys. F: 16 L191

157 - Study of fast neutron irradiation induced damage on Graphite and Zircaloy-4

NPRP - Friday 12 July 2013 10:50

Primary authors: *MAHAFA, Tshepo (University of Johannesburg)*
Co-authors: *DANIELS, Graham (Necsa); CARLESCHI, Emanuela (University of Johannesburg); FRANKLYN, Chris (Necsa)*

Tshepo Mahafa1, Graham Daniels2, Emanuela Carleschi1, Chris Franklyn21Department of Physics, University of Johannesburg, Johannesburg, South Africa2South African Nuclear Energy Corporation, Pretoria, South Africa ABSTRACTIn order to understand the damage effects on nuclear reactor core structural materials by fast neutron irradiation, the South African Nuclear Energy Corporation (Necsa) in collaboration with the University of Johannesburg (UJ) commenced a study of fast neutron irradiation damage on graphite and zircaloy-4. Due to their unique neutronic and physical properties, graphite is used as a moderator and a reflector, while zircaloy-4 is used as a clad material for the fuel element in the reactor core. The damage of these materials is to be achieved through the use of the radio-frequency quadropole (RFQ) accelerator located at Necsa. The accelerator produces neutrons with an energy range of 1 to 10 MeV, dependent on the nuclear reaction chosen, with an associated neutron flux of about 1010 to 1012 neutrons per second (n/s) [1]. When these in-core structural materials are irradiated by fast neutrons in the reactor, physical property changes occur due to the damage caused by this radiation. The intention here is to effect the damage with the use of the accelerator as the damage can be achieved faster. Such changes have been observed in other materials and include harderning and embrittlement, creep and dimensional changes of the materials [2,3]. The focus of this study is to report on the mechanisms by which these changes occur and their effects on the reactor core materials. In order to characterize the damage after irradiation, surface and structural analysis of the materials will be conducted. Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) will be used for the analysis of the surface , while for the bulk crystal structure, X-ray diffraction, Raman spectroscopy and Ion-beam channeling will be exploited.[1] C.B. Franklyn, G.C. Daniels, Characterisation of an accelerator based fast neutron facility, Proceedings of FNDA2011, Ein Gedi, Israel[2] P.Rodriguez, R.Krishnan and C.Sundaram. Radiation effects in nuclear reactor materials – correlations with structure, Bull Material Science 6:339-367, 1984[3] D.G.Cacuci, Hand

158 - Aerosol measurements at the National Laser Centre, Pretoria and at the University of KwaZulu Natal, Durban using the CSIR mobile LIDAR system

Poster2 - Wednesday 10 July 2013 17:40

Authors: SHIKWAMBANA, Lerato *(CSIR-NLC); VENKATARAMAN, Sivakumar (University of kwaZulu Natal)*

Aerosols interact both directly and indirectly with the Earth's radiation budget and climate. As a direct effect, the aerosols scatter sunlight directly back into space. As an indirect effect, aerosols in the lower atmosphere can modify the size of cloud particles, changing how the clouds reflect and absorb sunlight, thereby affecting the Earth's energy budget. In this study we present preliminary LIDAR (LIght Detection And Range) aerosol measurements performed at the Council for Scientific and Industrial Research (CSIR), Pretoria (25°53'7"S 27°42'28"E) and at the University of KwaZulu Natal (UKZN), Durban (29°49'2.04"S,30°56'38.44"E) during the South African summer season . The CSIR-National Laser Centre mobile LIDAR system to receive Mie backscattered photons was used to make these measurements using the 532nm wavelength. The vertical aerosols backscattered coefficients as well as the aerosol extinction coefficient profiles were determined and they showed different profiles.

159 - The Quark Gluon plasma

Poster2 - Wednesday 10 July 2013 17:40

Authors: MHLANGA, sibaliso *(ithemba LABS)*; GUMBO, mervyn *(iThemba LABS)*

Ultra-relativistic heavy ion collisions are a unique tool to study the de-confined phase of matter which is thought to have existed a few microseconds after the big bang.Different observables are suggested to characterize this new phase of matter. This presentation will focus on some of these observables.

160 - Laser Penetration through different skin phototypes

Applied - Tuesday 09 July 2013 11:50

Primary authors: KARSTEN, Aletta *(CSIR, National Laser Centre)*
Co-authors: *SINGH, Ann (CSIR, National Laser Centre)*

Numerous laser treatments are done with lasers in the visible to near infrared wavelength bands. Human skin is considered a turbid medium for these wavelength bands. As light travels through the skin it gets scattered and absorbed. These two processes reduce the fluence rate (or power density). Computer modeling can be a valuable tool to determine the reduction in fluence rate of laser light as a function of depth into the skin. A computer model has been developed in a commercial raytracing software package. For this study, two skin layers (epidermis and dermis) were modeled with a skin cancer tumor (squamous cell carcinoma) embedded in the dermal layer of skin. The absorption of light in the epidermis is dependent on the skin phototype. The epidermal thickness differs from position to position on the skin and had to be accounted for. In the model three different skin phototypes (from very light to very dark) and three epidermal thicknesses were modeled. The epidermal layer thickness was varied between 0.04 mm and 0.09 mm. The model required the geometrical dimensions of each layer as well as the absorption and scatterings coefficients. The major advantage of the computer model was that the extent of the absorption effect could be quantified. Use of the model allows the clinician to compensate for the absorption and establish safe and effective treatment power and times before treatment commences. When comparing treatment time between skin of phototype I and V and keeping the fluence rate constant at 44.2 mW/cm2, the treatment time is increased from 235 s (phototype I) to 374 s (phototype V), an increase of more than 50 %.

161 - A multiple instrument investigation of the nature of geomagnetic pulsations

Poster2 - Wednesday 10 July 2013 17:40

Authors: MTUMELA, Zolile *(University of KwaZulu-Natal)*

Geomagnetic ultra low frequency (ULF) oscillations (frequency range 1mHz to 1Hz) have been observed for many years in magnetometer data and are endemic within the magnetosphere. A subset, pulsations in the Pc5 band (1-5mHz) are global magnetohydrodynamic (MHD) events in the magnetosphere. We use an IDL Automated Pulsation Finder (APF) program (Magnus et al., 2009) to identify suitable Pc5 pulsations events for study in the radar and magnetometer data. Those events which also have a good data from magnetometer chains in the field of view of HF radars are chosen for analysis. These two instruments complement each other. One strong in sensitivity and temporal resolution while the other in spatial resolution. We combined these two instruments to investigate the exact nature of the pulsations. Are they toroidal or poloidal? We present complex demodulation to determine amplitude and phase relationship between field components observed by the radar and magnetometer chains. We determine the time development and decay of the resonance after excitation and match magnetometer response to ionospheric currents observed by radar. Further, by determining their polarization and investigating amplitude and phase information, other characteristics can be determined, e.g. wave number. We present results in a graphical form and discuss them in the context of MHD theory of magnetic pulsations.

162 - Thermal aberrations in optical materials

Photonics - Friday 12 July 2013 11:30

Primary authors: BURGER, Liesl *(National Laser Centre)*
Co-authors: *FORBES, Andrew (National Laser Centre)*

Thermal lensing is ubiquitous in laser rods, and is well understood. However, thermal aberrations in transmissive optical materials (without gain) only become evident at high power densities. We present a theoretical model of a high-power laser beam passing through an optical material, which is derived from basic heat-flow considerations. This model predicts not only thermal lensing but also higher-order thermal aberrations.We test this model against measurements taken of the phase induced in fused silica by a 5 kW 1 micron fibre laser, and using a Shack-Hartmann wave-front sensor.In conclusion we discuss the effect of these aberrations on the transmitted laser beam, and possible methods of compensation.

163 - XRD, Mössbauer and magnetic properties of $Mg_xCo_{1-x}Fe_2O_4$ nanoferrites

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: DLAMINI, Wendy Bonakele *(School of Chemistry and Physics, University of KwaZulu-Natal, P/Bag X54001, Durban 400, South Africa)*
Co-authors: *MSOMI, Justice (School of Chemistry and Physics, University of KwaZulu-Natal, P/Bag X54001, Durban 400, South Africa); MOYO, Thomas (School of Chemistry and Physics, University of KwaZulu-Natal, P/Bag X54001, Durban 400, South Africa)*

We report the microstructural and magnetic properties of $Mg_xCo_{1-x}Fe_2O_4$ $0 \le x \le 1.0$) nanoferrites. The properties have been investigated by X-ray diffraction, transmission electron microscopy, ^{57}Fe Mössbauer spectroscopy and magnetometry. The XRD results indicate pure cubic spinel structure for all the compounds. The particle size varies between 9 nm and 16 nm. The evolution of the properties has been explained on the basis of Mg content and particle sizes. The magnetization measurements indicate paramagnetic or superparamagnetic nature of the fine particles.

164 - Elemental abundance determinations in photoionized nebulae

Astro - Tuesday 09 July 2013 16:00

Authors: PROZESKY, Andri *(Unisa)*

Elemental abundances of metals in photoionized nebulae can be determined using two different kinds of spectral emission lines, namely optical recombination lines (ORLs) and collisionally excited lines (CELs). However, there exists a significant discrepancy between abundances determined using these two methods and this problem in astrophysics has been recognised for almost four decades. Many suggestions have been put forward to resolve this issue, but thus far no convincing solution has been proposed. In this talk I will review the different physical mechanisms involved in producing the emission lines and describe models used to derive the elemental abundances in nebulae. A discussion of the present status of this conundrum is presented.

165 - A Mössbauer effect investigation of nanosized $Mn_x(Mg, Co)_{0.5-x}Zn_{0.5}Fe_2O_4$

DCMPM2 - Wednesday 10 July 2013 15:40

Primary authors: DLAMINI, Wendy Bonakele *(School of Chemistry and Physics,University of KwaZulu-Natal, P/bag X54001, Durban 4000, South Africa)*
Co-authors: *MSOMI, Justice (School of Chemistry and Physics,University of KwaZulu-Natal, P/bag X54001, Durban 4000, South Africa); MOYO, Thomas (School of Chemistry and Physics,University of KwaZulu-Natal, P/bag X54001, Durban 4000, South Africa)*

In this paper we report Mn substitution in Zn-Mg and Zn-Co spinel oxides. Single phase nanoferrite powders bearing the chemical formula MnxMg0.5-xZn0.5Fe2O4 and $Mn_xCo_{0.5-x}Zn_{0.5}Fe_2O_4$($0 \le x \le 0.5$ in steps of 0.1) have been produced by co-precipitation technique. The compounds were characterised by X-ray diffraction, Mössbauer and VSM measurements. The particle size varies between 9 nm and 15 nm. The variation of Mn concentration has significant effects on the structural and magnetic properties. ^{57}Fe Mössbauer effect spectra show ordered magnetic spin state in all the $Mn_xCo_{0.5-x}Zn_{0.5}Fe_2O_4$ compounds. Transformation from ordered to disordered magnetic state has been obsereved with increasing x in $Mn_xMg_{0.5-x}Zn_{0.5}Fe_2O_4$. The variation of the magnetic parameters such as coercive fields and saturation magnetization as a function of Mn concentration is also presented.

166 - Low Intensity Laser Irradiation (LILI) in combination with Growth Factors in a Co-culture System supports the Differentiation of Mesenchymal Stem Cells

Photonics - Wednesday 10 July 2013 09:00

Primary authors: MVULA, Bernard *(Doctoral Student)*
Co-authors: *ABRAHAMSE, Heidi (Head, Laser research Centre, University of Johannesburg)*

B Mvula and H AbrahamseLaser Research Centre, Faculty of Health Sciences, University of Johannesburg, P.O. Box 17011, Doornfontein 2028, Johannesburg, South Africa E-mail: habrahamse@uj.ac.zaAbstract. Mesenchymal stem cells have the capacity to differentiate into a variety of cell types that could potentially be used in tissue engineering and regenerative medicine. Low intensity laser irradiation (LILI) has been shown to have positive effects on different cell types, including a significant increase in cell viability and proliferation. Growth factors such as retinoic acid (RA) and transforming growth factor β1 (TGFβ1) have been shown to play important roles in the differentiation of cells. The aim of this study was to investigate whether LILI in combination with growth factors could induce the differentiation of adipose derived stem cells (ADSCs) co-cultured with smooth muscle cells (SMCs). The study used primary and continuous ADSC cell lines and a SMC line (SKUT-1). Cells were co-cultured directly at a ratio of 1:1 using established methods, with and without growth factors and then exposed to LILI at 5 J/cm2 using a 636 nm diode laser. The cellular morphology, viability and proliferation of the co-cultures were assessed over a period of one week. The study also monitored the expression of cell specific markers over the same period of time. Cell viability and proliferation increased significantly in the co-cultured groups that were exposed to laser alone, as well as in combination with growth factors. Furthermore, there was a significant decrease in the expression of stem cell markers in the ADSCs over time. The results indicate that LILI in combination with growth factors not only increases the viability and proliferation of co-cultured cells but also decreases the expression of ADSC stem cell markers. This could indicate the possible differentiation of ADSCs into SMCs.

168 - Synthesis of NIS nanostructures by microwave-assisted hydrothermal technique

DCMPM1 - Tuesday 09 July 2013 14:30

Primary authors: LINGANISO, Ella *(National Centre for Nano-structured Materials, CSIR)*
Co-authors: *MWAKIKUNGA, Bonex (National Centre for Nano-structured Materials, CSIR); MHLANGA, Sabelo (Wits); COVILLE, Neil (Wits)*

Microwave addition to hydrothermal reactions provides quick, straightforward, and inexpensive ways of attaining the desired products from a given chemical reaction with high product yield as well as enhanced purity, while eliminating hazardous by products and promoting the use of greener solvents. This has made the microwave heating technique to chemical synthesis one of the efficient methods. Nickel sulphide (NiS) nanostructures obtained using this technique were analysed by various techniques. It was observed that a narrow size distribution of the materials varying from 20 to 40 nm particle size can be obtained at optimised microwave conditions using water as a solvent. The effect of using different solvents on NiS morphology, particle size and phase distribution is discussed. Electronic properties of NiS nanostructures doped with metal impurities have been studied. The effect of metal dopants on the phase transition of NiS has been studied and discussed.

169 - High frequency Luttinger liquid excitations and ballistic transport in aligned CNTs range at room temperature

DCMPM2 - Wednesday 10 July 2013 14:10

Primary authors: CHIMOWA, George *(Wits)*
Co-authors: *BHATTACHARYYA, Somnath (University of the Witwatersrand)*

Direct experimental observation of one dimensional (1D) Plasmon low energy excitations in CNTs using high frequency ac voltages in the Giga Hertz (GHz) range is reported. Evidenced by periodic oscillations in the complex ac impedance of a few aligned single walled (SWNTs) and doubled walled (DWNTs) carbon nanotubes best described by the Luttinger liquid theory we show that this observation is strongly influenced by the number of conduction channels available. Using on-wafer microwave probing up to 65 GHz on coplanar wave guides and an industrially accepted open-short de-embedding technique we further report of a crossover from diffusive transport to ballistic transport at approximately 13 GHz (resulting in a possible 15 ps momentum scattering time) in SWNTs and DWNTs at room temperature. The results are further complimented by the low bias IV characteristics that show quantized conductance in SWNTs and differential conductance characterised by dI/dV α V0.46 consistent with the LL theory. This work provides a direct experimental proof of the LL behaviour which had long been predicted theoretically and indirectly inferred from resonant tunnelling experiments.

170 - Exploring Science Shows that Bridge the Gap between Indigenous Knowledge (IK) and Modern Science: The Lightning (Electricity) Show

Education - Wednesday 10 July 2013 11:30

Authors: NXUMALO, Mdumiseni *(University of Zululand Science Centre)*

Across cultures, human perception of natural phenomena has in the past been viewed through beliefs and mythology. Our knowledge development through inquiry and research has led us to much enlightenment about many wonders of nature. Our advancing knowledge still lives side-by side with lots of different beliefs that contrast with modern scientific knowledge. This is more evident in the usually feared natural phenomena such as lightning.In an approach that considers the fact that modern science is not perfect in as far as the understanding of lightning, IK is appreciated alongside modern science knowledge of the subject. The paper aims to explore the science of thunder and lightning and point out common beliefs and local ideas that are often associated with IK. There are some lessons from IK about lightning that are confirmed by modern science which need to be highlighted. Upon presentation of this paper, relevant demonstrations will be conducted and the science behind them will be discussed while reference is made to related IK. In the end, the presentation will have demonstrated how science communicators can use IKS and modern science to address some often stubborn roots of ignorance in our society. Appreciation of good local IK is believed to be a critical ingredient of this undertaking. Promotion of our local IK should in this approach be at the centre of science communication to enhance the embrace of science education as a local development. It is commonly believed that while Indigenous Knowledge Systems (IKS) is underutilized in most parts of the world, it has great potential to enhance different kinds of community development undertakings (Sillitoe et al, 2005).

171 - Chromatic dispersion compensation for VCSEL transmission for applications such as Square Kilometre Array South Africa

Applied - Wednesday 10 July 2013 14:10

Primary authors: ROTICH KIPNOO, Enoch *(Nelson Mandela Metropolitan University)*
Co-authors: *KOUROUMA, Hamed (Nelson Mandela Metropolitan University); GAMATHAM, Romeo (Nelson Mandela Metropolitan University); LEITCH, Andrew (Nelson Mandela Metropolitan University); GIBBON, Tim (Nelson Mandela Metropolitan University)*

In addition to attenuation, optical fibre transmission suffers significant penalty from dispersion related effects. We theoretically and experimentally investigate the compensation of chromatic dispersion of 4.25 Gbps 1550 nm vertical cavity surface emitting laser (VCSEL) transmission using inverse dispersion fibre. Simulated results show that inverse dispersion fibre can compensate up to 3.7 dB on a 35 km ITU-T G.652 fibre. The residual dispersion penalties are small, thus effective compensation is achieved. In an experimental demonstration, a 25 km low water peak (LWP) fibre with a low negative dispersion value was found to improve the signal clarity when combined with a G.652 fibre. Inverse dispersion fibres cancel the cumulated dispersion in transmitting fibres, hence improving the VCSEL transmission significantly. This is a cost effective and simple chromatic dispersion mitigation technique, suitable for Square Kilometre Array application as the transmission distances increase at different construction phases.Key words: VCSEL, Chromatic dispersion, compensation, Square Kilometre Array

172 - Leptons from J/ψ and heavy-flavour hadron decays in pp and Pb-Pb collisions studied with ALICE at the LHC

NPRP - Wednesday 10 July 2013 09:40

Authors: FöRTSCH, Siegfried *(iThemba LABS)*

Heavy quarks and quarkonium states are believed to be sensitive probes for the study of theevolution as well as the properties of the hot and dense medium, formed in ultra-relativistic heavyioncollisions, since they are produced at a very early stage in the initial hard scattering processes.Apart from providing the crucial reference for nucleus-nucleus collisions, proton-proton collisionsare also of great interest as they allow a test of perturbative QCD in a new regime of low Bjorken-xvalues at the LHC.The ALICE detector has proven to have excellent tracking, particle identification as well as precisevertexing capabilities. These specific detector characteristics result in a low momentum reach forquarkonia and open heavy-flavour hadrons which is unique to the LHC. One approach to e.g. J/ψ andheavy-flavour measurements is via their decay leptons which are measured at mid-rapidity in thecentral barrel and the muon spectrometer at forward rapidity.In this talk, after giving a brief description of the detector, we will present the latest results frommeasurements of J/ψ from di-leptonic decays and of leptons from heavy-flavour hadron decays atboth forward ($2.5 < \eta < 4.0$) and central ($|\eta| < 0.9$) rapidity in pp collisions at $\sqrt{s}$ = 2.76 and 7 TeV andtheir nuclear modification factor (RAA) in Pb-Pb collisions at $\sqrt{s}$NN = 2.76 TeV.

173 - Multicolour Photometric Study Of Pulsation on Pre-Main Sequence Star V351 Ori (HD 38238)

Poster2 - Wednesday 10 July 2013 17:40

Authors: FELEKE AYANE, Getinet *(North West University, Mafikeng Campus)*

V351 Ori is a member of the Herbig Ae stars that are characterized by large infrared excess,emission in hydrogen lines and non periodic photometric and spectroscopic variability. Some ofthem have been found to pulsate in radial and non-radial modes. V351 Ori has been fond to pulsatein different frequencies ranging from 11 c/d to 30 c/d in radial mode. We observed this star overthree weeks in December 2012 and February2013. Before 1986 the brightness of this star showedchanges due to dust obscuration. However after 1986 such variability disappeared. The lack ofvariability was explained as the disappearance of obscuring material around the star. Now we wishto compare the pulsation frequencies measured at different times to see if there are any systematicchanges and whether we can model the change.

174 - Synthesis and characterization of ZnO nanoparticles

Poster1 - Tuesday 09 July 2013 17:40

Authors: GONFA, Girma Goro *(Haramaya University); ZENA, Zewdu WM (Dilla University)*

This paper reports the synthesis and characterization of ZnO nanoparticles by a two-step synthesis procedure. The first step is the solution-free mechanochemical synthesis of zinc tartarate by grinding of zinc acetate dihydrate and tartaric acid at room temperature for 30 minutes. The second step is the thermal decomposition of zinc tartarate at 450°C for 30 minutes to form ZnO nanoparticles. The synthesized ZnO nanoparticles were characterized by XRD, Uv-Vis spectrophotometer, Transmission electron microscope (TEM), Scanning electron microscope (SEM), Energy dispersive x-ray spectroscopy (EDX) and Elemental mapping analysis techniques. X-ray diffraction pattern shows a wurtzite structure (hexagonal phase) with high crystallinity which is in good agreement with the TEM result. The lattice parameters of the synthesized ZnO nanoparticles were a = 3.258 Å and c = 5.199 Å calculated from XRD result. The absorption edge for ZnO nanoparticles synthesized by mechanochemical synthesis method was found to be 375 nm and the corresponding calculated band gap energy was 3.30 eV. The average particle size of the synthesized ZnO nanopowder investigated from TEM using histograms were found of 56 nm ± 8 nm. Transmission electron microscopy clearly showed that the produced image of ZnO nanoparticles with different size distribution. The nearly spherical morphology of ZnO nanoparticles were studied by scanning electron microscope. The required phase of zinc appeared at Kα1 = 8.639 KeV, Kβ1 = 9.572 KeV, Lα1= Lα2 = 1.012 KeV and oxygen appeared at Kα1 = 0.525 KeV x-ray emission lines in the synthesized nanopowder. The concentration of zinc and oxygen in the synthesized ZnO nanopowder were 94.14 % and 8.86 % respectively which is qualitatively confirmed by elemental mapping.

175 - Evaporation models for segregation

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: CRONJE, Shaun *(UFS)*
Co-authors: *ROOS, W.D. (Department of Physics, UFS, Bloemfontein, South Africa); KROON, R.E. (Department of Physics, UFS, Bloemfontein, South Africa); ASANTE, J.K.O. (Department of Physics TUT, Pretoria, South Africa)*

The search for alloys with better material properties such as strength, wear and corrosion resistance continues to this day. In addition to these desirable properties, the search for ways to reduce production costs and time has led to a large amount of research being conducted on the processes which determines the material properties of metals and alloys. An important one of these processes is segregation. Surface segregation is commonly regarded as the redistribution of solute atoms between the surface and the bulk of the material, resulting in a solute surface concentration that is generally higher that the solute bulk concentration. To improve the interpretation of segregation data the influence of surface evaporation should be considered. In spite of the immense scientific and technological importance of evaporation, this ubiquitous phenomenon is not well understood from a fundamental point of view. Currently there are three theoretical approaches to study evaporation: Continuum Mechanics, Classical Kinetic Theory and recently Statistical Rate Theory. As part of the development of a model to simultaneously predict segregation and surface evaporation, these three evaporation models will be discussed. In addition predictions obtained from various evaporation models will be compared to experimental data of pure elemental evaporation as measured in a modified Auger system containing a quartz crystal resonator.

176 - Simulating the position sensitivity of the iThemba LABS segmented clover detector

NPRP - Tuesday 09 July 2013 16:00

Primary authors: NONCOLELA, Sive *(UWC)*
Co-authors: *BUCHER, Daphney (iThemba LABS); LAWRIE, Elena (iThemba LABS); EASTON, Jason (UWC); SHIRINDA, Obed (iThemba LABS); ORCE, Nico (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. 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 inner core contacts provide high resolution measurements of gamma-ray energy deposition for each crystal whilst the outer contacts provide information about the locations of the gamma-ray interaction inside the detector. The position sensitivity of this segmented iThemba LABS HPGe detector is investigated through simulation using the Multi-Geometry Simulation code [1]. This code simulates the electric field, drift velocity, weighting potential and generate the expected pulse shape from an arbitrary gamma-ray interaction's position within the germanium detector volume. Using this code, the pulse shape response at the inner and outer contacts has been generated changing the radius, angle and depth of gamma-ray interaction positions within the germanium detector volume. Changes in the pulse shapes reflecting changes in the position of the interaction point were observed. This confirms that the detector is sensitive to the exact position of the gamma-ray interaction. The details about the simulated position sensitivity of the segmented iThemba LABS HPGe detector will be discussed.REFERENCES[1] A simple method for the characterisation of HPGe detectors, P. Medina, C.Santos, Di Villaume, Instr. Meas. Tech. Conf (2004)

177 - Investigation of W^{+\-} bosons production with different Parton Distribution Functions in proton-proton collisions

Poster2 - Wednesday 10 July 2013 17:40

Authors: SENOSI, KGOTLAESELE JOHNSON *(University of Cape Town/iThemba LABS)*

Analysis of Monte Carlo generated data using PYTHIA 6.4.21 with an emphasis ondifferent Parton Distribution Functions (PDFs) and center of mass energies with protons ascolliding systems. This study investigates the effect of PDFs and center of mass energy in the production of W^{+\-} bosons at forward rapidity.

178 - Digital signal processing algorithm for signal analysis and performance monitoring in an optical communication link

Poster2 - Wednesday 10 July 2013 17:40

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

Digital signal processing (DSP) algorithm is proposed to analyse and monitor the performance of a digital optical communication link. In this paper, an efficient offline and flexible reprogrammable DSP algorithm is developed, to determine the bit error rate (BER) as a measure of performance of an optical communication system. The 10 Gbps optical signal transmitted over the fibre is received, sampled and reconstructed in the digital electrical domain. Further a DSP algorithm is implemented offline to normalise and quantise the signal before it is digitized into respective transmitted bits. The DSP technique is an indispensable technology for next generation ultra-fast optical fibre communication. The developed offline DSP algorithm has outstanding advantages such as guaranteed accuracy, perfect reproducibility and high reliability. The effectiveness of the proposed algorithm is quantitatively verified by measuring the BER for different transmissions.Key terms: - Digital signal processing, optical communication, BER, Performance monitoring

179 - Conceptual Coherence By Contrast

Education - Friday 12 July 2013 09:40

Authors: SCHWARTZ, MJ *(Unizul Science Centre)*

Understanding for the promotion of the development of heuristic thinking should be at the crux of all science communication and education. In order for understanding to be gained the subject in question must be able to relate the imparted information with what they already know and to transfer relevant information between different intellectual cohorts. This builds up a framework in which comprehension can be achieved by placing new information in the correct context. This can be seen in Bransford & Johnson, 1973 "Context Sufficient to Make sense of Balloons Passage" analogy. It highlights that understanding is facilitated by relatability. This forms the basis on which conceptual coherence is built. Conceptual coherence is structured around 'big ideas.' These big ideas are defined as 'principles that are important for developing science literacy and that provide a foundation for future learning.'The Unizul Science Centre has placed a great deal of importance on conceptual coherence. Working within the framework of conceptual coherence, the Unizul Science Centre has taken a new approach in doing science shows through the use of contrasts. This approach is called conceptual coherence by contrast. It is where the nature of the idea is examined through contrasting two or more phenomena central to the big idea. The method of conceptual coherence by contrast was piloted on a programme based on waves, where wave nature was examined by contrasting the properties of waves in sound and light. The 'big idea' in this show is wave nature but the conceptual coherence is found in the underlying comparative structure that has been woven into the show where select properties of the wave nature were examined. These included wave type, amplitude, frequency, pure and impure frequency mixtures etc. A pre- and post-test was administrated that tested the knowledge of the students (grade 10-12) on the wave nature. These findings, together with the success of conceptual coherence by contrast, shall be presented.

180 - Control of Magnetism near Metal to Insulator Transitions of VO2

Poster1 - Tuesday 09 July 2013 17:40

Authors: NKOSI, Steven *(CSIR)*

We report on the presence of plasma expansion cross correlation among the deposition parameters. The fast intensified-charge-coupled-device (ICCD) photography imaging studies of the plasma generated by the KrF excimer laser ablation of VO2 in the presence of oxygen background gas is studied. The magnetic properties of ferromagnetic films are strongly affected by the proximity to materials that undergo a metal to insulator transition. Here, we show that under the depositions conditions associated with structural changes near the metal-insulator phase transition of VO2 produces magnetoelastic anisotropy. We observe intrinsic paramagnetic centres both at the film surface and bulk that are affected by the metal-insulator phase transition in VO2. Under similar conditions, we show that changing the substrate-to-target distance directly affect the observed nano-plateles of VO2 in 1-D

181 - Assessment of wind energy potential in the Amatole District in the Eastern Cape Province of South Africa

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MASUKUME, Peace-Maker *(University of Fort Hare, Department of Physics)*
Co-authors: *MAKAKA, Golden (University of Fort Hare, Department of Physics); TINARWO, David (University of Venda)*

South Africa is heavily depended on fossil fuels for its energy needs and is the highest emitter of greenhouse gasses in Africa and third largest in the world. However, South Africa is endowed with unexploited renewable energy resources. It is therefore imperative to shift to renewable energy sources for power production to mitigate the carbon emissions. The purpose of this paper is to investigate wind energy potential in the Amatole District in the Eastern Cape Province of South Africa. The Weibull density function was used to estimate the wind energy potential in this location. The Weibull parameters were determined basing on Meteorological data acquired from a local Meteorological Office. Preliminary results show that the values of k (the Weibull shape parameter), ranged from 1.72 to 2.41 while those for c (Weibull scale parameter) ranges from 3.9 to 5.4. The study shows that the area has reasonable wind energy potential for decentralized wind energy systems, exploitable at 10m or more for low speed wind turbines. It therefore follows that it is not suitable for large scale wind energy production.

182 - Characterization of epitaxial Cr thin films

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *MUDAU, patience (University of Johannesbug)*
Co-authors: *PRINSLOO, A R E (University of Johannesbug); SHEPPARD, C J (University of Johannesbug); VENTER, A M (Necsa);* FERNANDO, P R *(University of Johannesbug); FULLERTON, E E (University of Califonia)*

Cr and Cr alloys, known for their spin density wave (SDW) antiferromagnetism, exhibit a richness of magnetic phenomena that has attracted considerable interest for many years [1,2]. Thin films and heterostructures of Cr and Cr alloys show fascinating properties, not observed in the bulk material [2,3,4], giving insight into dimensionality effects in these materials [2]. This paper reports on the initial characterization of Cr thin films of thicknesses (t) 20nm to 320nm. These samples were produced using DC magnetron sputtering on MgO(100), MgO(110) and fused silica substrates. X-ray diffraction (XRD) was used to determine the crystallographic orientation of the deposited planes and quality of the films. XRD results showed good epitaxial growth for films prepared on the single crystalline substrates, with Cr(002) and Cr(110) growth obtained in specific growth directions, whilst those prepared on the fused silica were polycrystalline. The mosaicity and coherence length were determined from the XRD results. These properties reveal a general increase in the coherence length and a decrease in mosaicity with increase in t. Standard four-point probe measurements were done to obtain the resistivity (ρ) of the films as function of temperature (T). An anomaly, in the form of a hump was observed in the $\rho(T)$ curves when cooling through the Néel temperature (T_N). This anomaly was used to indicate the magnetic transition temperatures. It has been found that T_N varied as function of thickness with a value of 283 ± 5 K determined for the film with thickness 320 nm. This is in correlation with that obtained in bulk Cr [1], for which the Néel temperature is 311 K [1]. Internal strain effects could be partly responsible for the observed difference in the Néel temperature values between bulk material and the 320 nm thin film [2]. [1] E. Fawcett et al., Rev. Mod. Phys. 66 (1994) 25[2] H.J. Zabel, J. Phys.: Condens. Matter 11 (1999) 9303[3] E.E. Fullerton et al., Phys. Rev. Lett. 91 (2003) 237201[4] R. K. Kummamuru et al., Nature 452 (2008) 859

183 - Radiometric Survey at A Heavy Mineral Mining Company On The West Coast Of South Africa

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: SEHONE, Alfred Mogotsi *(Stellenbosch University, Military Academy)*
Co-authors: *JACOBS, Noel Mkhululi (Stellenbosch University, Military Academy); NEWMAN, Richard Thomas (Stellenbosch University); MALEKA, Peane P. (iThemba LABS)*

Heavy mineral sands are mined along our West Coast to produce, amongst others, titanium dioxide feedstock, zircon, rutile and high purity iron products. These products are used in applications including metal, ceramics and foundry production. The mined sands have relatively high levels of NORM (naturally occurring radioactive material). During the process of extracting minerals from the sands, tailings rich in TENORM (Technologically enhances NORM) are generated. Such mining operation therefore requires the on-site monitoring of ionizing radiation and the estimation of doses to critical groups.Here we present our first results from a radiometric survey at the heavy minerals separation plant. The survey was conducted using two in-situ measurement systems, namely a hand-held gamma-ray detector (RS-230 Super-SPEC using a bismuth germinate scintillator) and a MEDUSA (Multi-Element Detector for Underwater Sediment Activity) system (using a cesium iodide scintillator). Each system is linked to a GPS device to allow spatial radiometric mapping. We present a comparison of results from the two systems and results from a laboratory-based radiometric analysis of tailings samples.

184 - Three-body Bound state calculations

Theoretical - Wednesday 10 July 2013 09:00

Authors: *MUKERU, Bahati (UNISA)*

We employ the three-dimensional differential Faddeev equations, with nucleon-nucleon semi-realistic potentials to obtain ground state binding energies of the 3H nucleus. To be solved numerically, these equations are first transformed into an eigenvalue equation via the orthogonal collocation procedure using triquintic Hermite splines. Second, the resulting eigenvalue equation is solved using the Restarted Arnoldi Algorithm.

185 - Radiometric Characterisation Of Bricks For Use In A Planned Calibration Facility For In-Situ Gamma-Ray Detectors

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *SEHONE, Alfred Mogotsi (Stellenbosch University, Military Academy)*
Co-authors: *JACOBS, Mkhululi Noel (Stellenbosch University, Military Academy); NEWMAN, Richard Thomas (Stellenbosch University); MALEKA, Peane P. (iThemba LABS)*

In-situ gamma-ray measurement systems commonly use scintillator detectors to measure radioactivity content (natural and anthropogenic). One common geometry used in these measurements is that of detector mounted on a vehicle moving across flat ground. In order to obtain absolute radioactivity concentrations in the ground from such measurements it is necessary to know the detector response in terms of gamma-ray detection efficiency. Efficiency calibration of in-situ detectors can be performed in various ways. One approach is to use calibration pads that have well characterized radioactivity content. An alternative approach is to make measurements with the detector inserted inside a brick “castle” with the proviso that brick radioactivity (natural) content is accurately determined. The brick “castle” is best optimized by making use of Monte Carlo simulations. With the simulation one can optimize the dimensions of the brick “castle”, the type of material to be used and the geometry. We present here results from our radiometric analyses using high-resolution gamma-ray spectrometry of candidate brick types. We discuss these results and other brick selection criteria to propose a brick “castle” design for construction at iThemba LABS.

186 - Simulating Black-Hole Radiation.

Theoretical - Wednesday 10 July 2013 14:10

Authors: *CARLSON, Warren (University of the Witwatersrand)*

We study the emission spectrum for black-holes to better understand their thermodynamic properties. Angular momentum contributes significantly to the coupling of quantum fields to black-holes. This establishes a connection between the internal state of a black-hole and the characteristic radiation of the associated particles. We find that for each type of field there is a specific coupling to the black-hole and a characteristic emission spectrum, identified by a collection of emission frequencies called quasi-normal modes. These characteristic emission modes carry energy away from the black-hole in a way analogous to how energy is carried away from a ringing bell by sound waves. Since emission of each quantum of energy by the black-hole is statistically weighted, we use numerical simulations to build a collective particle emission signature which can be used to identify the decay of a given black-hole.

187 - Electrospun polyehylene oxide nanocomposite ■bers reinforced withVO2 nanoparticles: Fabrication and optical analysis

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *SIMO, Aline (PHD Student)*
Co-authors: *MALIK, Maaza (iThemba LABS Laboratory Research South Africa)*

The manufacturing of pure polyethylene fibers and electric PEO/VO2 nanocomposite fibers is explored by an electrospinning process. A uniform, bead-free fiber production process is developed by optimizing electrospinning conditions: polymer concentration, applied electric voltage. The experiments demonstrate that slight changes in operating parameters may result in significant variations in the fiber morphology and nanoparticules density. The nanocomposite fibers were characterized by optical electron microscopy,X-ray diffraction (XRD)and UV-Vis Spectrometer. Significant effecton the crystallinity of PEO and a strong interaction between PEO and VO2 nanoparticles is demonstrated. The electrical properties of the nanoparticles in the polymer nanocomposite fibers are different from those of the dried as received nanoparticles.

188 - Black-Hole Pulsar Binaries: Simulations on the Grid.

Theoretical - Wednesday 10 July 2013 14:30

Authors: *CARLSON, Warren (University of the Witwatersrand); BECKER, Becker (Meraka Institute); TUCKER, Bevan (University of the Witwatersrand)*

We simulate the signal timing and fluxes from a Pulsar orbiting a black hole. This requires the integration of photon trajectories. We use numerical methods to solve the set of four coupled, second order ODEs describing the general relativistic motion of these photons in the Kerr space-time. Pulsar emission has been modelled by generating the necessary initial conditions for a large number of photons in a conical configuration. To perform a reliable statistical analysis of timing events, we must compute a very large number of trajectories. Although a single trajectory is integrated in a relatively small amount of time, the time cost in integrating a large number of trajectories makes this problem intractable on a single CPU. Since a single trajectory calculation is independant of all other trajectory calculations, this problem is well matched to a computational model which is both massively parallel and massively distributed. This investigation was done at scale, hence considerable computing resources were required for execution and post-processing. We report on our experience of conducting the simulation on the SA grid.

189 - Development of Durban LIDAR system for aerosol and temperature measurements in the neutral atmosphere

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *SIVAKUMAR, Venkataraman (University of KwaZulu Natal)*
Co-authors: *MBATHA, Nkanyiso (University of KwaZulu Natal and South African national Space Agency)*

Durban (29.9°S, 31.0°E), a region of industrial activities in the South Coast together with sugar-cane burning along the KwaZulu Natal coast will affect the aerosols concentration and transport in the troposphere. LiDAR observation of these aerosols at Westville will help to characterize the regional extent of aerosol plumes and also their optical properties.We briefly describe the earlier Durban atmospheric LIDAR (Light Detection and Ranging) system for the measurements of vertical profiles of temperature and aerosol. Early years (1999 to 2004), the Durban LIDAR has been operated at University of KwaZulu-Natal (UKZN) as a part of co-operation between the Reunion University and the Service d'Aéronomie (CNRS, IPSL, Paris) for climate research studies. Currently, the LIDAR system in Durban is not in functional from it is being transported to Westville campus (back to 7 years), the current aim is to refurbish/develop the system into working condition. Here, we shall present the current status and different plans (including CSIR-NLC Rental Pool programme) aimed to overcome.

190 - Black-Hole Pulsar Binaries: Timing and Fluxes.

Poster2 - Wednesday 10 July 2013 17:40

Authors: *CARLSON, Warren (University of the Witwatersrand); TUCKER, Bevan (University of the Witwatersrand)*

Binary Pulsars have been identified as important laboratories for the study of gravitational physics. In particular, binary systems comprising a pulsar and a black-hole present a scenario for the study of physics in the strong gravitational field regime. We use a numerical simulation to predict the arrival times and relative fluxes from a pulsar in a binary system. We use numerical methods to solve the set of four coupled, second order ODEs describing the general relativistic motion of a photon in the Kerr space-time. Pulsar emission has been modelled by generating the necessary initial conditions for a large number of photons in a conical configuration. A sufficiently large number of these 'photon cones' are then used to describe a simple 'lighthouse-like' scenario, whereby the pulsar emits two conical beams in the plane of rotation. We evaluate an idealised case of a pulsar in a stable circular orbit around a significantly more massive black-hole, with the plane of rotation for the pulsar in the equatorial plane of the black-hole. In particular, we examine the superior and inferior conjunctions, with the hope of elucidating the theoretical behavior of a pulsar signal as seen by a distant observer.

191 - Influence of magnetic field on the transition temperature of the $(Cr_{84}Re_{16})_{89.6}V_{10.4}$ alloy

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *JACOBS, Bincy Susan (University Of Johannesburg)*
Co-authors: *SHEPPARD, Charles (University Of Johannesburg); PRINSLOO, Aletta (University Of Johannesburg); STRYDOM, Andre (University Of Johannesburg)*

In recent years interest in quantum critical behaviour (QCB) has intensified, as is reflected in literature [1,2,3]. A quantum critical point (QCP) is typically found in a material where the phase transition temperature has been driven or tuned to zero by the application of a tuning parameter such as magnetic field, pressure or through doping [1]. Previous studies on the $(Cr_{84}Re_{16})_{100-y}V_y$ alloy system, utilizing doping as a tuning parameter, showed the existence of a putative QCP at a critical concentration y_c of about 10.5 [4].The present study extends these results by focusing on the antiferromagnetic alloy with y = 10.4 and using a new tuning parameter. The $(Cr_{84}Re_{16})_{89.6}V_{10.4}$ alloy has a concentration very close to y_c and possible QCB in this sample is investigated through the application of magnetic field. Magnetic susceptibility (χ)was measured as function of temperature (T) in the temperature range 1.9 K < T < 200 K. The sample was cooled to 2 K in zero field, followed by measurements being collected upon warming the sample in static applied fields (H)in the range 0.01 T to 6.5 T. The $\chi(T)$curves obtained for the various applied fields each show a clear peak and the temperature associated with the peak was taken as the Néel temperature (T_N). Results indicate that the sharpness of the peak improves with field and that the application of field suppresses T_N. The $T_N(H)$curve shows a sharp gradient up to 2 T of approximately -6.177 K/T. In the region 2 T < H < 6 T a gradient of approximately -1.823 K/T is observed, above which the $T_N(H)$curve tends to level off. Interesting conclusions are drawn from the present work and future investigations utilizing higher fields are proposed.[1] Lee M, Husmann A, Rosenbaum TF and Aeppli G 2004 *Phys. Rev. Lett.* **92** 187201[2] Yeh A, Soh Y, Brooke J, Aeppli G and Rosenbaum TF 2002 *Nature* **419** 459[3] Takeuchi J, Sasakura H and Masuda Y 1980 *J. Phys. Soc. Japan* **49** 508[4] Jacobs BS, Prinsloo ARE, Sheppard CJ and Strydom AM 2013 *J.Appl.Phys.* **113** 17E126

192 - TIMED/SABER Observations of mesospheric inversion layers over Southern Africa

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MBATHA, Nkanyiso *(South African National Space Agency, Space Science, P. O. Box 32, Hermanus 7200, South Africa)*
Co-authors: *SIVAKUMAR, Venkataraman (School of Chemistry and Physics, University of KwaZulu-Natal, Durban 4000, South Africa); BENCHERIF, Hassan (Laboratoire de l'Atmosphère et des Cyclones, UMR 8105 CNRS, Université de La Réunion, 97715 Saint-Denis, Cedex 9, La Réunion, France); OLAKUNLE, Ogunjobi (School of Chemistry and Physics, University of KwaZulu-Natal, Durban 4000, South Africa)*

Mesospheric inversion layer (MIL) refers to the phenomenon of the temperature-gradient inversion from negative to positive that is frequently observed as a thermal structure in the mesosphere and the lower and middle atmosphere. Due to the importance of our comprehensive understanding of middle and upper atmospheric dynamics, it is now accepted that the study of MILs is essential. For instance, a positive temperature gradient at the bottom of a MIL enhances the atmospheric stability and reduces vertical mixing, while a negative gradient may lead to an atmospheric convective instability and enhance development of turbulence at the top of MIL. Moreover, MILs have a profound impact on the propagation of gravity waves (GWs), as well as the mean circulation in the middle atmosphere. Therefore, the present study will present seasonal and inter-annual variation of the MILs over the Southern Africa (centered at 30°S, 25°E) using vertical temperature profiles measured by the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) which is one of the four instruments on board the Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) satellite.

193 - A CW and Actively Q-switched Thulium-doped Fibre Laser

Photonics - Wednesday 10 July 2013 10:30

Primary authors: COETZEE, Riaan Stuart *(SU)*
Co-authors: *ESSER, Daniel (National Laser Centre, CSIR); STRAUSS, Hencharl (National Laser Centre, CSIR); JACOBS, Cobus (National Laser Centre, CSIR); KOEN, Wayne (National Laser Centre, CSIR); COLLET, Oliver (National Laser Centre, CSIR); ROHWER, Erich (SU); NEETHLING, Pieter (SU); RABE, Randle (UP)*

New 2 µm Thulium-doped fibre lasers have the potential to be used for a variety of applications such as eye-safe lidar systems, remote sensing, directed infrared countermeasures, non-linear wavelength conversion and range finding. In general, fibre lasers are robust, high brightness sources that offer high average output power with excellent beam quality and efficiency. A diode-pumped, CW & Q-switched (Pulsed) Thulium-doped fibre laser was designed, developed and characterized at the National Laser Centre in Pretoria. Two lengths of active fibre were used to construct the fibre laser. A variety of high-reflective mirrors as well as a Volume Bragg Grating (VBG) was utilized to constitute the laser resonator. The laser operating in CW mode was characterized with regard to its slope efficiencies, beam profile, polarization, spectral output and temporal behaviour. Results obtained compare favourably with those found in the literature and indicate current limitations and instabilities within the laser setup. Additionally, the influence of misalignment within the setup is observed.Pulsed mode of the fibre laser was facilitated with an Acousto Optic Modulator (AOM) acting as the Q-switch. Initial results indicate erratic pulse behaviour. To generate consistent, stable pulse trains, improvements to the laser setup and are implemented and outlined. The pulsed behaviour is partially characterized for a constant pulse repetition rate of 10 kHz and average power of 2 W. This yields pulse energies and durations of 200 µJ and 77 ns with a corresponding pulse peak power of 2.6 kW.

195 - Identifying Exclusive Proton-Proton Interactions in the ATLAS Experiment

NPRP - Wednesday 10 July 2013 10:30

Authors: SCHENCK, Ferdinand *(UCT)*

The Standard Model of particle physics provides our best description for most of the fundamental interactions between all known particles in the universe. Quantum Electrodynamics is the theory of electromagnetic interactions within the Standard Model which makes precise predictions on the probability an exclusive interaction. Exclusive interactions in this context occur when two hadrons interact via photon exchange and escape the interaction intact while at the same time creating particle anti-particle pair. This work will search for exclusive interactions in proton-proton collisions creating a muon anti-muon pair. We are considering di-muon production due to the accuracy with which muons can be tracked by the ATLAS detector. At high luminosities in the LHC, on the order of 20 interactions per beam crossing are to be expected. This pile-up of interactions creates a significant challenge by inducing a large amount of background which must be disentangled from the signal. In previous experiments exclusive interactions were measured in events with no pile-up. As the LHC reaches higher luminosities, such events become negligibly rare and thus a way of finding these events even in the presence of pile-up is essential.This work seeks to identify exclusive interactions in the presence of pile-up.

196 - AFM and SEM studies Zr thin films on SiC

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: NJOROGE, Eric *(university of pretoria)*
Co-authors: *THERON, Chris (university of pretoria); MALHERBE, Johan (university of pretoria)*

The Zr-SiC interface is of vital interest in nuclear fuel cladding, metal matrix systems and in the electronics field for applications in schottky diodes. The metal/SiC interface at high temperatures and different annealing durations were investigated under high vacuum conditions. The surface and interface evolution under annealing conditions of 600 to 1000C and annealing duration 30 minutes to 4 hours were investigated by secondary electron microscopy (SEM) and Atomic force microscopy (AFM). SEM surface images revealed development of mould-like structures from aggregation of surface materials. AFM analysis revealed that the surface roughness parameters increased with annealing duration at each annealing temperature.

197 - Overview of the Extended Curriculum Programme Physics at the University of the Western Cape

Education - Tuesday 09 July 2013 14:50

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

This paper reports on work that has been done in the Science Faculty at the University of the Western Cape (UWC). The Extended Curriculum Programme (ECP) Physics at UWC centers its focus on improving the students' success by giving them an epistemological access to the studies of the physical science, in particular physics. Central to the ECP Physics teaching philosophy and pedagogy is the socio-cultural perspectives on learning in the sciences. This has guided the development of our intervention strategies to direct students learning toward gaining access to the ways of knowing of the discipline. Such perspectives suggest that an exclusively individual or cognitivist approach may need to be complemented by those that recognise the social contexts in which science learning takes place, and which place a greater emphasis on learning as participation and identity development. The ECP Physics, curriculum design, pedagogical practice and learning environment will be presented and discussed.

198 - High temperature conductance fluctuations and Tomonaga - Luttinger liquid behaviour of aligned metallic SWCNT ropes.

DCMPM1 - Wednesday 10 July 2013 09:20

Primary authors: NCUBE, Siphephile *(Student)*
Co-authors: *CHIGUVARE, Zivayi (Polytechnic of Namibia (Namibia University of Science and Technology)); CHIMOWA, George (University of the Witwatersrand)*

One of the outstanding challenges in carbon nanotube research is to fully understand the effects of electron-electron interactions. To date most experiments can be understood by a combination of the non-interacting level spectrum embodied in the Coulomb blockade. In one-dimension (1D) electron-electron interactions are believed to more dramatic effects modeled by the Tomonoga-Luttinger liquid (TLL) theory. In this study TLL like behavior, within the 80 K – 300 K temperature range, was observed for ropes of metallic SWCNTs aligned by di-electrophoresis across a 1 micron gap between gold micro-electrodes. Current-Voltage characteristics of the devices showed conductivity steps that match theoretically predicted maxima in the DOS spectrum of nanotubes. Effects of confinement and electron-electron interaction distinctive to one dimension were identified in transport as a non universal power-law dependence of the differential conductance on temperature and source-drain voltage. Ballistic conductance at room temperature was confirmed from the high frequency transport of the SWCNT devices. The complex impedance showed some oscillatory behaviour in the frequency range 6 to 30 GHz, as has been predicted theoretically in the TLL model. By analyzing the low energy regime conductance (as function of voltage) characteristics at high temperatures we were able to observe the Coulomb blockade. In these devices the charging Coulomb energy of a single particle played a critical role in the overall device performance. This study can be used to understand the nature of plasmon dynamics which are the charge carriers in a TLL system and how the Coulomb interactions can be used in 1D to the design highly tunable systems for fabrication of single molecule devices.

199 - Measuring the performance of the iThemba LABS Segmented Clover Detector

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: SHIRINDA, O. *(iThemba LABS)*
Co-authors: *EASTON, J.L. (iTHEMBA LABS/UWC); LAWRIE, E.A. (iTHEMBA LABS); BUCHER, T.D. (iTHEMBA LABS); NONCOLELA, S.P. (iTHEMBA LABS/UWC)*

Large volume high-purity germanium (HPGe) detectors are commonly used in applications (such as gamma-ray spectroscopy) that require good energy resolution and high detection efficiency. iThemba LABS recently bought a new state of the art segmented clover detector. The new detector contains four cylindrical HPGe crystals housed in a common vacuum cryostat and held at temperature of around 75 K by a metal cooling structure that extends back into a dewar of liquid nitrogen. This detector has 32 outer contacts. These are in addition to the four inner-core contacts, and so the total number of electrical signals from the detector is thirty-six. The principal reason for this segmentation is to provide information about the three-dimensional localization of gamma-ray interactions within the detector. Charge sensitive preamplifiers allow all thirty-six electrical signals to be read out, providing precise energy information from the core contact and signals for position localization from the outer contacts. Due to its segmentation, the detector can be used not just as a standard clover detector, but also in a gamma-ray tracking mode. Details on the performance of this new type of germanium clover detector are now determined. The tests include measuring the depletion voltage for each crystal, measuring the energy resolutions for each crystal and for the outside electrodes at different rates, measuring rise and decay times, cross-talk, efficiency at different source-to-detector distance, etc. In addition the coincidence summing effect was studied. Tests were carried out mainly by means of Pixie-4 digital electronics. Results on energy resolution, detection efficiency, preamplifier response (i.e. signal rise and decay times) and noise characteristics will be presented.

200 - Acoustic resonators above sunspot umbrae

Space Science - Wednesday 10 July 2013 14:50

Primary authors: BOTHA, G.J.J. *(Northumbria University)*
Co-authors: *ARBER, T.D. (Warwick University); NAKARIAKOV, V.M. (Warwick University)*

The three-minute oscillations in the chromosphere above sunspot umbrae are explained by means of an acoustic resonator. In the vertical magnetic field above umbrae a cavity forms between the photosphere and transition region that acts as a leaky resonator, where the oscillations generate traveling waves that propagate upward into the solar corona. One-dimensional numerical simulations using the ideal magnetohydrodynamic equations demonstrate the existence of the resonator. The shapes and peaks in the resonating spectrum raise the possibility of using the resonator as a means to determine the chromospheric temperature profile above umbrae. A numerical study will be presented of different initiators of the oscillations, as well as the influence of the shape and height of the chromospheric cavity.

201 - The robustness of magnetic flux tubes surrounded by magnetoconvection

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: BOTHA, G.J.J. *(Northumbria University)*
Co-authors: *RUCKLIDGE, A.M. (University of Leeds); HURLBURT, N.E. (Lockheed Martin Solar and Astrophysics Laboratory)*

The formation and decay of large magnetic flux tubes, such as sunspots, in the solar photosphere are studied numerically in a domain shaped like a three-dimensional cylindrical wedge. The resistive magnetohydrodynamic equations are solved with parameter values that designate the upper layer of the solar convection zone. It is shown that the formation of magnetic flux tubes from an initial vertical magnetic field depends on the nature of the magnetoconvection, which in turn is dependent on the radial size of the cylindrical numerical domain. In order to study the decay of magnetic flux tubes, the simulations are initialised with an axisymmetric solution that consists of a well-defined central flux tube with an annular convection cell surrounding it. The nonlinear convection breaks the annular cell into many cells along the azimuthal direction, allowing magnetic field to slip between the cells as they push against the central flux tube. This process, known as turbulent erosion, will be demonstrated using numerical simulations.

202 - The effect of chemical pressure on the ferromagnetic (FM) ordering of Ce*TX* compounds

DCMPM2 - Wednesday 10 July 2013 09:00

Authors: SONDEZI, Buyi *(University of Johannesburg)*

The transport and thermodynamic properties of Ce*TX*(*T* = Au,Cu; *X* = Ge,Si) compounds have been studied. These well-ordered hexagonal compounds have shown (FM) ordering anomalies in magnetic susceptibility, electrical resistivity and specific heat at FM transition temperature T_C, (10K, 10K and 15K for CeAuGe [1], CeCuGe and CeCuSi [2], respectively). The location of magnetic ordering has been observed to be unstable under the influence of applied magnetic field [2], where the FM ordering has been observed to shift upwards in temperature. However, the application of chemical pressure as observed from physical properties as well as magnetic properties measurements revealed a continuous suppression of T_C, associated with Ce moments, resulting in the FM transition temperature approaching 0K as La content is increased. The calculation of the effective magnetic moment for small La contents was observed to be 2.54 μ_B/mol in agreement with the value of the full magnetic moment for Ce^{3+} ion. Despite the observed suppression of T_C, observed in these dilution compounds, it was observed from powder x-ray diffraction characterization that the crystal structures of the compounds were retained as hexagonal belonging to space group number 186 (($Ce_{1-x}La_x$)AuGe) and 194 for ($Ce_{1-x}La_x$)CuGe and ($Ce_{1-x}La_x$)CuSi. Rietveld refinement profile indicated that the lattice parameters *a* and *c* and the volume *V* of the dilution compounds were increased with the increase in La content. This work presents the first results of the effect of isostructural substitution of Ce with La (($Ce_{1-x}La_x$)AuGe; ($Ce_{1-x}La_x$)CuGe and ($Ce_{1-x}La_x$)CuSi) having various x contents. Measurements of magnetic susceptibility, electrical resistivity and specific heat for the dilution compounds gave the first evidence of the possibility of non-Fermi liquid behavior as chemical pressure was used to tune ferromagnetism to lower temperatures. [1] P■ttgen R, Borrmann H and Kremer R K, 1996 J. Magn. Magn. Mater. 152 196[2] Yang F, Kuang J P, Li J, Bruck E, Nakotte H, de Boer F R, Wu X, Li Z and Wang Y,1991 J. Appl. Phys. 69 470

203 - Emissions of Trace Elements from Motor Vehicles Monitored by Active Biomonitoring: a tunnel study in the Western Cape, South Africa using ICP-MS and neutron activation

NPRP - Friday 12 July 2013 09:00

Primary authors: NDLOVU, Ntombizikhona Beaulah *(Stellenbosch University)*
Co-authors: *NEWMAN, Richard Thomas (Stellenbosch University); FRONTASYEVA, Marina Vladimirovna (Joint Institute for Nuclear Research); MALEKA, Peane Peter (iThemba LABS)*

Application of mosses and lichens as biomonitors, analyzed by nuclear and related techniques, has been extensively used to provide information about air quality. These plants possess efficient accumulation capacity for many air pollutants (heavy metals and other trace elements) from atmospheric deposition (Markert et al., 2008; Steinnes, 2011). Studying air pollution with plants, instead of the commercial air filters is a simple, low-cost, effective method to estimate levels of air pollutants and their impact on humans and animals. A steady global increase of the use of active biomonitoring, whereby biomonitors are collected from relatively pristine habitats and transplanted to different environments, is due to the scarcity or total absence of native biomonitors in certain environments e.g large cities with heavy technogenic load and industrial regions as well as in arid areas (Frontasyeva, 2011). Biomonitoring studies about emission of trace elements resulting from road traffic, specifically from tunnels, has not yet received adequate attention in the research world. In our pilot study in the Western Cape, moss and lichen species were deployed inside the Huguenot tunnel and the results are presented in this work. Samples were analysed by the multi-elemental Ion-Coupled Mass Spectrometry (ICP-MS). Moreover, samples will later be subjected to the non-destructive instrumental neutron activation analysis (INAA), thus facilitating an intercomparison of the results obtained by INAA and ICP-MS. We present first results on the elemental uptake by the moss and lichen samples.This study was undertaken in the framework of a JINR-SA co-operative program with SU. References:B. Markert, S. Wuenschmann, S. Fraenzle et al. On the road from environmental biomonitoring to human health aspects: monitoring atmospheric heavy metal deposition by epiphytic/epigeic plants: present status and future needs. Int. J. Environment and Pollution, Vol. 32, No. 4, 2008, p. 486-498.E. Steinnes, T. Berg, H.T. Uggerud. Three decades of atmospheric metal deposition in Norway as evident from analysis of moss samples. Science of the Total Environment, Vol. 412-413, 2011, p. 351–358.M.V. Frontasyeva. Neutron activation analysis for the Life Sciences. A review. “Physics of Particles and Nuclei”, 2011, Vol. 42, No. 2, p. 332-378.

204 - Comparison of two Software Packages for High Resolution Gamma Spectrometry Used for Neutron Activation Analysis of Biomonitors

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: NDLOVU, Ntombizikhona Beaulah *(Stellenbosch University)*
Co-authors: *NEWMAN, Richard Thomas (Stellenbosch University); FRONTASYEVA, Marina Vladimirovna (Joint Institute for Nuclear Research); MALEKA, Peane Peter (iThemba LABS)*

Neutron Activation Analysis (NAA) is a sensitive radioanalytical method used to determine elemental composition of a sample (Frontasyeva, 2011). Elements to be determined are assayed using nuclear reactions (mostly (n,γ)) via irradiation of samples with neutrons whereby stable isotopes are converted into radionuclide(s) subject to decay process in which γ-rays (among other modes) are being emitted. Gamma-ray detectors are then used to convert the energy of nuclear radiation into an electrical signal. The radiation with suitable properties for measurement, i.e. energy and emission rate, in the γ-ray spectrum of radioactive sources is frequently measured using γ-ray spectrometry (Kucera, et.al., 2004). Gamma-spectrometry is recognized world-wide as a multi-nuclide method of analysis based mainly on the use of high resolution semiconductor detectors (e.g. HPGe). Gamma-ray spectrometric analysis of environmental samples aims to identify and determine the activity concentration of gamma-ray emitting radionuclides and the associated uncertainty of the results (Dovlete and Povinec, 2004). To process γ-ray spectra by identifying nuclides and calculating activity concentrations of elements in our biomonitoring study of the atmospheric deposition of trace elements in the Western Cape, γ-ray spectra analysis was performed in FLNP-JINR, Dubna, Russia, using Genie2000 Gamma Analysis Software package complemented by a program allowing calculate concentrations based on the known activity of the relevant isotope in the sample. We present a comparison of results with those from the FitzPeaks Gamma Analysis Software package (http://www.jimfitz.demon.co.uk/fitzpeak.htm, 2009). This study was undertaken in the framework of a JINR-SA co-operative program with SU. ReferencesC. Dovlete and P.P. Povinec. Report on the Research Co-ordination Meeting, Vienna, Austria, July 2004, IAEA-TECDOC-1401, IAEA, Vienna (2004), p.103-126.Fitzpeaks Gamma Analysis and Calibration Software, http://www.jimfitz.demon.co.uk/fitzpeak.htm, (2009).J. Kucera, P. Bode, and V. Štepánek. Report on the Research Co-ordination Meeting, Vienna, Austria, July 2004, IAEA-TECDOC-1401, IAEA, Vienna (2004), p.77-102. M.V. Frontasyeva. A review. “Physics of Particles and Nuclei”, 2011, Vol. 42, No. 2, p. 332-378.

205 - Fibre Bragg grating Sensor For Real Time Fence Monitoring

Photonics - Friday 12 July 2013 09:20

Primary authors: MUKARUGINA, Stephanie *(University of Johannesburg)*
Co-authors: *MARTINEZ, Rodolfo (University of Johannesburg)*

The development of a fibre Bragg grating (FBG) sensor for real time fence monitoring is reported. Fibre Bragg grating consists in a periodic modulation of the effective refractive index in the core of an optical fibre. The modulation in the refractive index is achieved by exposing the core of the fibre to intense ultraviolet interference pattern. The periodic modulation produced in the fibre, allows the fibre to reflect a specific wavelength, known as the Bragg wavelength, and transmit the others. The Bragg wavelength shifts when external mechanical or thermal perturbations are applied to the FBG, making FBG useful for optical sensing applications such as intruder’s detection via strain, vibration or breakage in fence and perimeter monitoring. Multiple FBGs can be inscribed in one optical fibre; thus allowing multipoint sensing. We report a system that consists of a broadband source sending light in the FBGs cable where each FBG reflects a specific wavelength. Through the scanning process of a tuneable fibre Fabry-Perot filter, and a photo-detector, the optical spectrum in wavelength domain is converted to time domain for real time signal processing. By increasing the scanning frequency of the filter, perturbations of several kHz are detected. The FBGs cable is embedded in the fence where perturbations are applied. These perturbations cause quasi-static or dynamic shift in the Bragg wavelength of the affected FBG, while the Bragg wavelengths of other FBGs will not shift; therefore these FBGs can be used for other intruder attempts at the same time. By monitoring the shift in the Bragg wavelengths, we can detect an intruder to the perimeter. We conduct real time signal processing in LabVIEW and introduce the gravity centre algorithm for an increase in the system resolution. The data are sent to internet for remote monitoring. An indoor fence with four FBGs was monitored and perturbations were successfully detected. This fully automated real time running system can be used to detect breaking in or out of military bases, government’s facilities and prisons by activating an alarm; consequently no human power is needed. The proposed configuration makes use of standard components for telecommunication; therefore the system is relatively inexpensive and easy to implement.

206 - Modelling the atmosphere of A-Stars using the ATLAS9 program with OPAL EOS.

Poster2 - Wednesday 10 July 2013 17:40

Authors: LEKWENE, Papi *(North-West University (Mafikeng Campus))*

Our project presents an analysis of our results for a stellar modelling project. These results were obtained using the Equation Of State (EOS) by modelling main sequence A-stars. This has been donewith the aim of making the elusive transition between the envelope and the atmosphere as smoothly as expected for some of the stellar variables. However, the bigger goal has been to create an equilibrium model that will prove useful in stellar pulsation studies. In our bid to achieve the elusive transition, we have invoked the well known ATLAS9 program that is used to model stellar atmospheres along with the OPAL EOS tables provided by the Livermore laboratory, to make good models in the stellar atmosphere. We have satisfactorily achieved this by comparing theATLAS9 EOS variables with the OPAL EOS in the atmosphere regime. The results obtained matched quite well for the density, the adiabatic exponent, temperature gradient and the third adiabatic exponent. For instance, the superposition of the density profile done for the two methods, implies that the OPAL EOS is to a great degree equivalent to the ATLAS9 EOS counterpart in the atmosphere. The signi ficance of carrying out this comparison calculations was to probe the feasibility of our project and thus see if the OPAL EOS works in the atmosphere regime. In addition, this gave credence to our research work as well as an intuitive feel of how the OPAL EOS evaluated for low temperatures and pressures fared in the atmosphere regime. Furthermore, we have calculated the ATLAS9 models using the OPAL EOS tables in the atmosphere regime, this was done to see if we could create logical models with the OPAL EOS that agree well enough with the original ATLAS9 models. The new models that were created with the inclusion of the OPAL EOS agreed well with the original ATLAS9 models. This implies the results we have obtained have shown the success of the OPAL EOS in the atmosphere regime. Thus our research work successfully replaced the ATLAS9 EOS with the OPAL EOS as well as calculating the thermodynamic variables using the new EOS. We have done the spectrum using the new EOS to see how it compares with the original spectrum of ATLAS9. We have also used our new model and compared it to Medupe's pulsation code. We have also ran the matching code to see if the matching improved between th atmosphere and the envelope.

207 - Quark Gluon Plasma (QGP)

Poster2 - Wednesday 10 July 2013 17:40

Authors: GUMBO, Mervyn *(Ithemba Labs)*; SIBALISO, Mhlanga *(Ithemba Labs)*

Ultra-relativistic heavy ion collisions are a unique tool to study the de-confined phase of matter which is thought to have existed a few microseconds after the big bang.Different observables are suggested to characterize this new phase of matter. This presentation will focus on some of these observables.

209 - Dust in the Radio Galaxy and Merger Remnant NGC 1316 (Fornax A)

Astro - Wednesday 10 July 2013 11:30

Primary authors: ASABERE, Bernard Duah *(Department of Physics, University of Johannesburg)*
Co-authors: *HORELLOU, Cathy (Onsala Space Observatory, Chalmers University of Technology, Sweden); WINKLER, Hartmut (University of Johannesburg, Johannesburg); LEEUW, Lerothodi (University of South Africa, Pretoria)*

We present large-scale dust maps of NGC 1316 (Fornax A), a well-studied early-type galaxy in the outskirts of the Fornax cluster. We used the Large APEX BOlometer Camera (LABOCA, operating at 870 μm with angular resolution of 20arcseconds) on the Atacama Pathfinder EXperiment (APEX) 12 m telescope in Chile and the Wide-field Infrared Survey Explorer (WISE). WISE operates in the continuum at four mid-infrared bands at central wavelengths of 3.4, 4.6, 12 and 22 μm with angular resolutions ranging from 6 to 12arcseconds. Dust constitutes only about 1% of the total mass of the interstellar medium in galaxies, yet, it plays major roles by absorbing starlight in the ultraviolet and optical wavelengths and re-radiating about 90% of the absorbed starlight into the infrared and submillimeter bands. Dust is a tracer of star formation and stellar evolution and contributes to the evolution of galaxies (e.g. Spitzer 1978; Blain et al. 2002). The WISE and LABOCA maps reveal emission from dust in the central 2 arcminutes of NGC 1316. The distribution is suggestive of an interaction between the inner radio jet (Geldzahler & Fomalont 1984) and the northern dusty gas concentration. The complex distributions of atomic and molecular gas (Horellou et al. 2001), the disturbed optical morphology with many shell and loop structures (Schweizer 1980), and our dust maps are evidences of past merger or gas accretion activity. Combining the WISE and LABOCA observations with existing mid- and far-infrared measurements, we report the amounts of both the cold (~20 K) and warm (~60 K) dust masses in NGC 1316. This study will be extended to four other southern radio galaxies and merger remnants. Those galaxies are good targets for future observations at higher angular resolution and sensitivity with ALMA to probe the interaction of the radio jets with the dusty molecular gas near active galactic nuclei.

211 - Blue luminescence from Bi doped $MgAl_2O_4$ prepared by the combustion method

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: TABAZA, Wael *(University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); KROON, Ted (University of the Free State)*

Magnesium aluminate ($MgAl_2O_4$) has received special attention as a technologically important material because of its attractive properties such as mechanical strength, chemical inertness, wide band gap, relatively low density, high melting point, high thermal shock resistance, low thermal expansion coefficient, resistance to neutron irradiation and low dielectric loss. It has also been considered as a phosphor host activated by a variety of transition metal and lanthanide ions. As an alternative to such ions, luminescence can often be obtained from the ns^2-type ions such as Tl^+, Pb^{2+}, Bi^{3+} and Sb^{3+}. For trivalent bismuth ions luminescence is attributed to electron transitions between the $6s^2$ ground state and the 6s6p excited states. A simple combustion method was employed for the preparation of Bi doped $MgAl_2O_4$ nanocrystals using metal nitrates as precursors and urea as a fuel in a furnace preheated to 520■C. The samples were characterized by x-ray diffraction, UV-Vis spectroscopy, scanning electron microscopy and photoluminescence spectroscopy. For an excitation wavelength of 330 nm, the Bi doped $MgAl_2O_4$ produced a blue emission band centred near 410 nm, indicating that Bi^{3+} ions were successfully incorporated in the lattice. The maximum emission intensity was obtained for the sample doped with 0.5 mol% Bi. The results indicate that doping $MgAl_2O_4$ with Bi ions may be an attractive alternative to doping it with Ce ions, which give broad blue-green luminescence in this host but requires reducing at a high temperature (1400■C) to convert non-luminescent Ce^{4+} ions to the luminescent Ce^{3+} charge state.

212 - Effect of Ag nanoparticles on the luminescence of Tb doped sol-gel silica

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: ABBASS, Abd Ellateef *(University of the Free State)*
Co-authors: *SWART, Hendrik (University of the Free State); KROON, Ted (University of the Free State)*

Much attention has been paid to the study of optical properties of nanometre size particles dispersed in glass matrices from the viewpoint of scientific interest. If such ultrafine particles can be uniformly dispersed in a solid matrix, the stability of the particles increases and the solid can be handled easily. Recently, active research has been focused on the optical properties of rare-earth ions near metal nanoparticles, since luminescence may be increased due to local field enhancement around the rare earth ions which could lead to applications in optoelectronics devices. However, the addition of metal nanoparticles can also lead to quenching of the luminescence. A basic interest in these composite materials is to see under what conditions the emission yield, which is a balance between emission and quenching, can be optimized. Tb doped silica has been synthesized using the sol-gel method and emits green light of wavelength 544 nm. X-ray diffraction (XRD) results show that these samples remain amorphous even after annealing at 1000■C. In other samples, silver nitrate was added during the synthesis. The presence of silver nanoparticles in the silica matrix was confirmed by XRD analysis and the average crystallite size was found to be 20-30 nm by the Scherrer equation. The effect of the silver nanoparticles on the luminescence of the Tb ions will be presented. Reference[1] Tomokatsu Hayakawa, S. Tamil Selvan and Masayuki Nogami 1999 Appl. Phys. Lett. 74 1513

213 - Implementation of an offset-dipole magnetic field in a geometric pulsar emission code

Astro - Friday 12 July 2013 11:30

Primary authors: BREED, Monica *(NWU Potchefstroom)*
Co-authors: *VENTER, Christo (NWU Potchefstroom); HARDING, Alice (NASA Goddard Space Flight Center); JOHNSON, Tyrel (NRC Fellow, High-Energy Space Environment Branch, Naval Research Laboratory)*

The field of gamma-ray pulsars (rapidly spinning and highly magnetized neutron stars (NSs)) has been revolutionized by the launch of *Fermi* Large Area Telescope (LAT) in June 2008. *Fermi* LAT will soon release its second pulsar catalogue describing the properties of some 117 gamma-ray pulsars. The light curves (LCs) of these pulsars show great variety in profile shape, and may be divided into three general profile classes based on the relative phase differences between their radio and gamma-ray pulses. Such diversity hints at distinct underlying magnetospheric and / or emission geometries for the individual pulsar classes. Detailed geometric modelling of the radio and gamma-ray LCs may therefore provide constraints on the magnetospheric and emission characteristics. We implemented an offset-dipole magnetic field in an existing geometric pulsar modelling code which already includes static and retarded dipole fields. The magnetic field lines of an offset dipole undergo small distortions due to retardation and asymmetric currents, therefore shifting the NS's polar caps (PCs) by different amounts and directions. This offset is characterized by a parameter ε, which gives the relative shift in units of the stellar radius (with ε = 0 corresponding to the static dipole case). We constructed sky maps and LCs for several pulsar parameters, magnetic fields, and geometric models, studying their effect on the resulting LCs. Standard two-pole caustic (TPC) and outer gap (OG) emission geometries were used. As an application, we compared our model LCs with *Fermi* LAT data for the bright Vela pulsar, and inferred the most probable configuration based on the *Fermi* data, thereby constraining Vela's low-altitude magnetic structure and system geometry.

214 - If 1+1=3, then E=1/2mc!

Education - Tuesday 09 July 2013 15:40

Primary authors: CARLESCHI, Emanuela *(Department of Physics, University of Johannesburg)*
Co-authors: *JACOBS, Bincy Susan (Department of Physics, University of Johannesburg)*

We report on the results of a mathematics entry test given to 160 first year students of the 2013 intake enrolled for an introductory physics course (non-major) in the Faculties of Science and Health Sciences at the University of Johannesburg. The test was written without the use of calculators and was based on grade eleven and grade twelve syllabi. The test aimed at assessing the background knowledge and mathematical skills deemed to be necessary for the students to successfully undertake a non-calculus-based first year physics course.On comparison of the entry test marks with the matric marks for mathematics, it has become apparent that the latter are inflated and reflects neither the real skills nor the success rate of students at university level. Comparison between the class average of the test (45%) and the class average of the mathematics matric marks (65%) and also the correlation analysis between the individual marks serves as proof. Moreover, the use of calculators from an early age has undermined the capability of students to solve even simple numerical expressions containing exponents, square roots and priority of multiplication and division over addition and subtraction. The analysis of the most common misconceptions and mistakes will be reported in detail. It is well documented in literature that a solid mathematical background is an indispensable prerequisite for success in physics learning. The results of this mathematics test already show a good correlation with the physics marks in the first term of 2013 academic year. We are thus inclined to consider this as predictive of the academic success in our physics module. However, the June 2013 exam marks are required to establish this.

215 - First year astronomy students' interpretation of the term "radiation"

Education - Wednesday 10 July 2013 09:00

Primary authors: TAKANE, Mpeli *(Universtity of Cape Town- Masters student)*
Co-authors: *RAJPAUL, Vinesh (University of Cape Town); ALLIE, Saalih (University of Cape Town)*

One of the difficulties when dealing with issues relating to language is that apparent familiarity with terms can often mask differences between their popular usage and their technical definitions. The result is that while a superficially intelligible exchange might occur between a novice and an expert (or even between experts), their "mental pictures" might be quite different. The present study forms part of a larger project in which we aim to probe students' interpretation of the terms "radiation" and "radioactivity", with a public understanding of science in mind. As part of the piloting phase of the main project we included a question regarding the term "radiation" in a recently designed instrument, the Introductory Astronomy Questionnaire (IAQ), discussed in an accompanying presentation. The IAQ was given to the first year astronomy class at the University of Cape Town prior to instruction. The responses which included short written answers were analysed using an approach suggested by grounded theory. We present results from the preliminary analysis of the data. We also comment on how the term "radiation" is used and defined in various physics textbooks and dictionaries.

216 - Femtosecond spectroscopy of the carotenoids in the main light-harvesting complex of plants

Applied - Tuesday 09 July 2013 11:10

Primary authors: BOTHA, Joshua *(CSIR NLC)*
Co-authors: *KRüGER, Tjaart (University of Pretoria); OMBINDA-LEMBOUDA, Saturnin (CSIR National Laser Centre); VENGRIS, Mikas (Vilnius University); VAN GRONDELLE, Rienk (VU University Amsterdam); UYS, Hermann (CSIR National Laser Centre)*

The first step in photosynthesis constitutes highly efficient light harvesting and energy transfer in a set of membrane-bound pigment-protein complexes. One surprising aspect of the light-harvesting complexes of plants is that they are self-protected against damage due to over-illumination. A major component of the self-protection mechanism involves efficient switching between light-harvesting and energy-dissipating states. The role of the embedded carotenoids in this switching process is only little understood. Here, the excited-state dynamics of the carotenoids in the main light-harvesting complex of plants was investigated by performing a multi-colour, intensity-dependent femtosecond pump-probe study. It will be demonstrated how using this technique new electronic states can be resolved and how these states may be active in energy-quenching mechanisms.

217 - Beam shaping with a laser amplifier

Photonics - Tuesday 09 July 2013 11:50

Primary authors: LITVIN, Igor *(CSIR NLC)*
Co-authors: *COLLET, Oliver (CSIR NLC)*

We propose a new technique for laser beam shaping namely the reshaping of the laser beam into a desirable beam profile by the use of a laser amplifier with a pump beam that has a modified intensity profile. We developed the analytical formula which describes the transformation of the seed beam into the desired beam profile in the amplifiers small signal regime. In the case were high pump power saturated the laser crystal we have shown the method of reshaping of the seed beam into desirable beam by a numerically obtained pump intensity profile.

218 - Extraction of surface impedance from magnetotelluric data

Space Science - Tuesday 09 July 2013 16:00

Authors: KHANYILE, Sfundo *(SANSA Space Science)*

This paper presents the analysis of South African magnetotelluric (MT) data in the time and frequency domain for the purpose of extracting representative values of surface impedance. The surface impedance is used in the derivation of geo-electric fields produced by rapid variations in the geomagnetic field, as occurs during geomagnetic storms. The magnetotelluric method uses the spectra of associated time varying horizontal electric and magnetic fields at the Earth's surface to determine a frequency dependent impedance tensor and an equivalent surface impedance. The theory of operation of MT devices will be presented, as well as typical data obtained from the MT installations in Hermanus, Vaalputs and Middelpos. The various steps in the analysis are aimed at reducing noise and outliers. In the time domain, a Hanning window is used to select data from successive periods during a day, while reducing the end effect (Gibbs' phenomenon) by tapering the series towards the start and ends of each selected time period. The spectral transformation is performed by means of a fast Fourier transformation (FFT). Spectral bands are selected by frequency domain filtering. Typical results and challenges in performing this analysis will be presented.

219 - Is long distance free-space quantum communication with the OAM state of light feasible?

Photonics - Friday 12 July 2013 09:00

Primary authors: *HAMADOU IBRAHIM, Alpha (CSIR, National Laser Center)*
Co-authors: *ROUX, Filippus (CSIR, National Laser Center);* MCLAREN, Melanie *(CSIR, National Laser Center); FORBES, Andrew (CSIR, National Laser Center); KONRAD, Thomas (UKZN)*

There has been a great interest recently in the use of the orbital angular momentum (OAM) state oflight as information carrier in free-space quantum communication. This is mainly because the OAM state can be used to implement a higher dimensional state space for a single photon, allowing for the encoding of more than one bit per photon. To transmit quantum information successfully through a free-space optical channel, one needs to understand the effects of atmospheric turbulence on quantum entanglement.In this work, we study both theoretically and experimentally the effects of atmospheric turbulence on the OAM entanglement between two photons. We try to answer the following question: what is the maximum distance over which one can propagate a pair of OAM entangled photons in turbulence before they lose their entanglement? We generate photon pairs via spontaneous parametric down-conversion and we propagate them through turbulence. We use Laguerre-Gaussian modes and the turbulent atmosphere is simulated with a single phase screen based on the Kolmogorov theory of turbulence. Only two level quantum systems (qubits) are considered. A full quantum state tomography is performed to reconstruct the state of the two-photons and we quantify entanglement with the concurrence. Our results show that OAM entanglement is severely affected by atmospheric turbulence and question the feasibility of long range free-space quantum communication with the OAM state of light.

220 - A matched quadruplet of terbium radionuclides for nuclear imaging and radionuclide therapy

Applied - Tuesday 09 July 2013 14:50

Primary authors: STEYN, Deon *(iThemba LABS)*
Co-authors: *VERMEULEN, Etienne (iThemba LABS)*

Terbium offers four clinically useful radionuclides with complementary physical decay characteristics, namely Tb-149, Tb-152, Tb-155 and Tb-161. The identical chemical characteristics of these radionuclides allow the preparation of radiopharmaceuticals with identical pharmacokinetics, useful for positron emission tomography (PET, using Tb-152), single-photon emission tomography (SPECT, using Tb-155), alpha-particle radionuclide therapy (using Tb-149 labelled compounds) and beta/Auger radionuclide therapy (using Tb-161 labelled compounds). Terbium is the only element in the periodic table that offers this unique matched quadruplet of radionuclides, suitable for all modalities of nuclear imaging and radionuclide therapy. All four radionuclides are currently being evaluated in preclinical studies for the diagnosis and treatment of so-called FR-positive tumours. For this purpose, small animals containing human tumour xenografts are used.Only Tb-152 and Tb-155 can be produced with a cyclotron. Large-scale production of Tb-161 is possible with a nuclear reactor. Proton-induced spallation reactions followed by an online isotope separation process are used to produce Tb-149. Currently, the only facility producing Tb-149 in sufficient quantities for purposes of experimental and preclinical studies is the ISOLDE facility at CERN. Until recently, almost no production data existed for these radionuclides. Excitation functions for the cyclotron production of Tb-152 and Tb-155 have been measured simultaneously but independently at iThemba LABS and at the National Institute of Radiological Sciences (NIRS), Chiba, Japan and published in the same paper. This made an immediate comparison possible as well as validation of the data. This work will be briefly discussed as well as aspects of the initial results of the preclinical studies.

221 - Dependance of central spot sixe, propagation distance, and number of rings of a Bessel beam on the axicon's apex angle.

Poster1 - Tuesday 09 July 2013 17:40

Authors: RATSIBI, Edzani *(Student)*

Bessel beams are non-diffractive light beams that have a large focal depth and a micron-sized focal spot which makes them ideal for laser micromachining Bessel beams can be generated using various methods and one such method is through the use of an axicon. In this study we generate Bessel beams by illuminating an axicon with a Gaussian beam. A CPA-Series Ti: Sapphire femtosecond laser (λ_0=795nm) was used as the source laser for the Gaussian beam and three axicons with different apex angles; ■170■^0, ■175■^0, and ■178■^0 were used to generate non-diffractive beams. The apex angle of the axicon has a huge impact on the size of the Bessel beam and it is defined as β=■180■^o-2γ, where γ is the base angle of the axicon. In this study, the central spot size r_0, propagation distance Z_max, and the number of rings N, were measured for each axicon. It was found that a large apex angle results in a long propagation distance, a large central spot diameter, and less number of rings on the Bessel beam. These properties of the Bessel beam are ideal for laser drilling of micron sized holes on different materials.

222 - ^{194}Tl as the first example revealing chiral symmetry breaking in the pair of four-quasiparticle bands

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MASITENG, Paulus (University of Johannesburg)
Co-authors: LAWRIE, Elena (iThemba LABS, National Research Foundation, P.O. Box 722, 7129 Somerset West, South Africa); RAMASHIDZHA, Marius (University of the Western Cape, Private Bag X17, 7535 Bellville, South Africa); BARK, RA (iThemba LABS, National Research Foundation, P.O. Box 722, 7129 Somerset West, South Africa); CARLSON, BG (Division of Mathematical Physics,, 221 00 Lund, Sweden LTH, Lund University); LAWRIE, JJ (iThemba LABS, National Research Foundation, P.O. Box 722, 7129 Somerset West, South Africa); MULLINS, SM (iThemba LABS, National Research Foundation, P.O. Box 722, 7129 Somerset West, South Africa)

A study of ^{194}Tl has revealed the presence of two strongly coupled negative-parity rotational bands up to the 24^- and 23^- states, respectively. These two bands are associated with the two-quasiparticle configuration at lower spins and the four-quasiparticle configuration at higher spins. The two 4-quasiparticle bands show exceptionally close near-degeneracy in the excitation energies as well as close similarity in their alignments and *B(M1)/B(E2)* reduced transition probability ratios. This is one of the best cases of near degeneracy in partner bands observed to date, probably resulting from a chiral geometry in the angular momentum space. This is the first pair of 4-quasiparticle bands associated with chiral symmetry.

223 - Luminescent properties of Dy3+, Eu3+, Tb3+ and Sm3+ doped barium borate phosphors synthesized by solution combustion process.

Poster1 - Tuesday 09 July 2013 17:40

Authors: DEJENE, Francis (University of the Free State)

Powder phosphors of Dy3+, Eu3+, Tb3+ and Sm3+ doped barium borates were prepared by solution combustion reactions from mixed metal nitrate reactants and theourea (C2H4O) with ignition temperature of 500 oC. The X-ray diffraction patterns of as–synthesized powders revealed binary phases and that the barium borate phase does not crystallized directly from the combustion reaction with fuel to oxidizer ratio of ■2.0. Scanning electron microscope images powders showed agglomeration and a continuous three-dimensional hexagonal network. The large hexagonal agglomerates range in size between 20 and 50 ■m, while the primary spherical nanoparticles ranged in size between 50 and 100 nm. The phosphors prepared by combustion reaction were photo luminescent immediately after combustion without additional heating. The phosphors exhibited the characteristic emission spectrum of Dy3+, Eu3+, Tb3+ and Sm3+. Gridding was shown to reduce but heat treatment was shown to increase the PL intensities. The initial luminescent intensities were found to be dependent on concentration of RE3+ dopant while Tb doped materials displayed the longest afterglow properties.

224 - Characterization of the 2+ excitation of Hoyle state in 12C

NPRP - Tuesday 09 July 2013 10:30

Primary authors: NEMULODI, fhumulani (University of stellenbosch)
Co-authors: SMIT, Frederick (iThemba LABS); NEVELING, Retief (iThemba LABS); PAPKA, Paul (University of Stellenbosch); SWARTZ, Jacobus (University of Stellenbosch); USMAN, Iyabo (University of the Witwatersrand)

Even though numerous investigations have been performed to study the 12C nucleus in the past, questions still remain regarding some of its unbound states. One of the mysteries of this nucleus involves the 0+2 , Ex = 7.654 MeV state also known as the Hoyle state. This state was first predicted by Fred Hoyle [1] in 1954 and discovered three years later [2]. Through several theoretical and experimental studies, it has been reported that it possesses an α-cluster structure. One of the long standing problems is connected with the existence of a 2+ excited state build upon the Hoyle state. Recently the search for this state has attracted much interest both theoretically and experimentally, leading to several candidates of this state reported in Ref [3,4,5,6]. Up to date, there are still questions regarding the exact nature of this state.This talk gives an overview of the preliminary results of the 14C(p,t)12C [$\alpha\alpha\alpha$] reaction. The experiment was performed at iThemba LABS, with the high resolution magnetic spectrometer in conjunction with particle telescopes consisting of silicon detectors. The telescopes were placed in the target chamber and their primary use was to detect alpha particles to identify the break up decay path of 12C, while the spectrometer was used to detect the ejectile (triton) to determine the excitation energy with high resolution.[1]. F. Hoyle, Astrophys. J. Suppl. 1, 121 (1954).[2]. C.W. Cook et al ,Phys.Rev. 107, 108 (1957).[3]. H. Horiuchi, Progr. Theor. Phys. 53, 447 (1975).[4]. M. Freer et al., Phys.Rev.C80, R041303 (2009)[5]. M. Itoh et al., Phys.Rev.C84, 054308 (2011)[6]. W.R. Zimmerman et al., Phys. Rev. Lett., 110 (2013)

226 - Energy transfer and photoluminescence properties of Ce3+ and/or Tb3+-doped PbS nanorods.

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: DEJENE, Francis (University of the Free State)
Co-authors: KOAO, LF (University of the Free State)

A series of luminescent material phosphors PbS:Ce3+;Tb3+ have been synthesized by low temperature chemical bath deposition (CBD) method. The UV-vis reflectance, photoluminescence (PL) emission and excitation spectra, and the effect of Ce:Tb molar ratio are investigated in detail. The X-ray diffraction (XRD) spectra of the PbS nanorods correspond to the various planes of a single hexagonal PbS phase. This observation was confirmed by the SEM micrograph. The morphology (e.g. size of nanorods) was found to be partially dependent on the amount and type of dopants. The nano powders show good optical properties with high reflectance in UV region. The UV-Vis spectra display an initially increase in percentage reflectance and shift of the absorption edge to the higher wavelength with an increase in Ce:Tb mole ratio up to 1:2 and reduces thereafter. The PL spectrum monitored at 450 nm exhibits two overlapping excitation bands at 276 and 282 nm, which is assigned to the 4d-5f transitions of Ce3+. Under excitation (λ_Exc=282), the PL spectrum exhibits an asymmetric blue emission band that extends from 430 to 550 nm with a maximum at 450 nm. The presence of the broadband transition from Ce3+ ions in the PL spectrum monitored at the 5D4 – 7F5 transition of Tb3+ proves the occurrence of energy transfer from Ce3+ to Tb3+.

227 - A solar-thermal cooker using oil for heat transfer

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: HEILGENDORFF, Heiko (UKZN)
Co-authors: LOVSETH, Jorgen (NTNU (Norway)); MATTHEWS, Alan (UKZN)

A solar-thermal cooker was constructed and tested at the Westville Campus of the University of KwaZulu-Natal. The system comprised a half-parabolic collector dish with trapezoidal mirror tiles, and a coiled-pipe receiver connected to a pebble-based storage. The dish tracked the sun using a computer program. Solar radiation was focused onto the receiver by the collector and thermal energy was transported from the receiver to the storage by pumping oil through a closed loop. Two receivers were tested: a flat coil and a concave cup coil. We present results of the tests, in particular the efficiency of energy transfer from collector to storage.

228 - A solar-thermal cooker using high-pressure steam for heat transfer

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: GOVENDER, Paulene (UKZN)
Co-authors: LOVSETH, Jorgen (NTNU (Norway)); MATTHEWS, Alan (UKZN)

A solar-thermal cooker was constructed and tested at the Westville Campus of the University of KwaZulu-Natal. The system comprises an off-axis parabolic dish with reflective film, a receiver and a thermal energy storage. The dish tracks the sun using a light-sensing device. The receiver is a rounded, cylindrical steel chamber connected to a closed pipe loop that passes through a storage vessel containing solar salt. The concept is that when solar radiation is concentrated on the receiver by the dish, water in the receiver is converted to high-pressure, high-temperature steam that serves as heat transfer fluid. At sufficiently high temperature the solar salt melts, thereby adding extra energy storage capacity. We present experimental results.

229 - On the characterisation of photovoltaic solar cells by means of device parameter extraction algorithms.

Applied - Friday 12 July 2013 09:00

Primary authors: BEZUIDENHOUT, Lucian (NMMU Physics Department)
Co-authors: VAN DYK, Ernest (Supervisor); VOSTER, Fredrick (Co-Supervisor); DU PLESSIS, MC (Co-Supervisor)

The semiconductor materials used to create solar cells reduces the electrical performance of the device. Light beam induced current (LBIC) measurement is a technique that utilises focused light to probe a solar cell device and characterise it with respect to the spatial variation of photo-generated current. By scanning the beam probe across a solar cell while measuring the I-V characteristics at each point, a map of photo-response and various device performance parameters may be extracted.In this study a high resolution LBIC system was designed and constructed. In order to determine the effect of various parameters on the performance of a solar cell, a device parameter extraction gradient-decent optimization algorithm was created. The algorithm minimizes the area between the light current-voltage (I-V) curve generated from the device under point-illumination and the I-V curve generated using the diode equation. The algorithm thus locates the optimal parameters to the diode equation to yield a best-fit to the experimental data. This paper discusses the optimisation of the design of the LBIC system, the software interfacing of the data acquisition system and parameter extraction algorithm used.

230 - Quasi-free nucleon knockout contribution in 40Ca(p,p') inclusive scattering at 200 MeV

NPRP - Wednesday 10 July 2013 14:50

Primary authors: USMAN, Iyabo (University of the Witwatersrand, Johannesburg.)
Co-authors: CARTER, John (University of the Witwatersrand, Johannesburg.); COOPER, Gordon (University of the Witwatersrand, Johannesburg.); BUTHELEZI, Zinhle (iThemba LABS, Somerset West); NEVELING, Retief (iThemba LABS, Somerset West); SMIT, Fredrick (iThemba LABS, Somerset West); FORTSCH, Siegie (iThemba LABS, Somerset West); VON NEUMANN-COSEL, Peter (Technische Universitaet Darmstadt, Germany); RICHTER, Achim (Technische Universitaet Darmstadt, Germany); FEARICK, Roger (University of Cape Town, Rondebosch); SIDERAS-HADDAD, Elias (University of the Witwatersrand, Johannesburg); PAPKA, Paul (Stellenbosch University); JINGO, Maxwel (University of the Witwatersrand, Johannesburg); KUREBA, Oscar (University of the Witwatersrand, Johannesburg); DONALDSON, Lindsay (University of the Witwatersrand, Johannesburg); LATIF, Mouftahou (University of the Witwatersrand, Johannesburg); FUJITA, Hirohiko (Research Center for Nuclear Physics, Osaka University, Ibaraki, Japan); FUJITA, Yoshitaka (Research Center for Nuclear Physics, Osaka University, Ibaraki, Japan)

The Distorted Wave Impulse Approximation (DWIA) has been used to measure the extent of contributions due to quasi-free proton and neutron knockout in inclusive inelastic proton-scattering reactions from 40Ca(p,2p)39K and 40Ca(p,pn)39Ca. Such reactions contribute to the underlying background in the continuum of the Isoscalar Giant Quadrupole Resonance (ISGQR) region. In the DWIA, the three-body cross-section for a reaction is considered with final relative nucleon-nucleon energy prescription (FEP) in the evaluation of cross sections. Three distorted waves are generated using different optical potentials for different channels involved. The two-body cross-section is then evaluated using on-shell amplitude interpolated from phase shifts for projectile-ejectile scattering. Quantitative description of proton and neutron contributions and the influence on the ISGQR will be discussed.

231 - Search for the 5 alpha cluster state in 20Ne

NPRP - Tuesday 09 July 2013 11:10

Primary authors: SWARTZ, Jacobus (Stellenbosch University); PAPKA, Paul (Stellenbosch University); SMIT, Ricky (iThemba LABS); NEVELING, Retief (iThemba LABS)
Co-authors: ORCE, Nico (University of the Western Cape); STEYN, Deon (iThemba LABS); BUTHELEZI, Zinhle (iThemba LABS); FORTSCH, Siegfried (iThemba LABS); FREER, Martin (University of Birmingham); KOKALOVA, Tzany (University of Birmingham); NEMULODI, Fhumulani (iThemba LABS)

The primary aim of this experimental investigation was to search for the elusive 0+ 5 alpha cluster state in 20Ne, which is expected in the energy region above the 5 alpha threshold in 20Ne (Ex = 19.17 MeV) [1]. It would be an analogue to the Hoyle state in 12C [2,3], which plays a crucial role in stellar nucleosynthesis and has a well established 3 alpha cluster structure [4]. The secondary aim was to search for new low spin states at high excitation energy in 20Ne. During four weekends between April and July of 2012, the 22Ne(p,t)20Ne reaction was investigated with the iThemba LABS K600 magnetic spectrometer. A proton beam with an energy of Elab = 60 MeV from the Separated Sector Cyclotron (SSC) facility impinged on a 22Ne gas target at lab angles of θlab = (0■, 7■, 16■, 27■). At least three new states in 20Ne have been observed. Two of these appear to be isobaric analogues of known states in 20O. There is also a tentative candidate for the 5 alpha cluster state at around Ex = 22.49 MeV in 20Ne.[1] K. Ikeda, N. Takigawa and H. Horiuchi, Suppl. Prog. Theo. Phys., Extra Number p 464 (1968).[2] F. Hoyle, The Astrophysical Joumal, Supplement Series, Vol. 1 p. 12 (1954).[3] C.W. Cook, W.A. Fowler, C.C. Lauritsen and T. Lauritsen, Phys. Rev. 107, 508 (1957).[4] A. Tohsaki, H. Horiuchi, P. Schuck and G. R■pke, Phys. Rev. Lett. 87, 192501 (2001).

232 - Validation of a passive beam Monte Carlo model for measuring prompt gamma rays during proton radiotherapy

NPRP - Wednesday 10 July 2013 16:20

Primary authors: JEYASUGITHTHAN, Jeyasingam (University of Cape Town)
Co-authors: PETERSON, Stephen (University of Cape Town); NIETO-CAMERO, Jaime (iThemba LABS); SYMONS, Julyan (iThemba LABS)

In proton beam radiotherapy, secondary gamma rays are produced by proton-nuclei inelastic collisions within the treatment volume. A Monte-Carlo model of the iThemba proton treatment nozzle was developed using the Geant4 toolkit to detect these secondary or prompt gamma rays, which will be used for on-line treatment verification. The passive beam proton treatment facility at the iThemba labs in Cape Town, South Africa was studied in detail and all the nozzle components that interact with the proton beam were built and positioned in the model at the locations specified by the manufacturer. NaI detectors with different dimensions of 2x2 inch, 3x3 inch, 4x4 inch and 6x6 inch were modeled and standard gamma emitting sources (energy range from 0.661 to 4.438) were used to determine Gaussian broadening (Detector Response Function). The selected physics model (QGSP_BIC_EMY) is recommended and validated for medical applications. The simulated treatment nozzle was validated against depth dose and lateral profiles in a water phantom for therapeutic proton ranges of 24cm, 15cm and 10cm. The beam range was measured at the 50% distal falloff position in water. The position of the double graphite wedge energy degrader (used to produce the proton range) was calibrated within the model and used to select the different ranges. Range uncertainties due to secondary production energy threshold were calculated and 0.01 cm range cut was selected. We found that the Geant4 treatment nozzle model is in good agreement with measurements and has the ability to produce depth dose profiles and lateral profiles in different proton range. Finally the simulation was carried out to detect prompt-gammas produce in the water phantom and the resulting energy spectra will then be compared with measured data.

233 - Static electrical characteristics of silicon diodes at different temperatures: For radiation-hard detectors.

Poster1 - Tuesday 09 July 2013 17:40

Authors: MOLOI, Sabata (University of South Africa)

In this work the diodes were fabricated on undoped and on gold-doped p-type silicon. The diodes were characterised by Current-voltage measurements in the temperature range of 283 – 333 K. The temperature dependence of the saturation current, the Schottky barrier height and the ideality factor was investigated. The main indication is that effects due to the temperature are more pronounced on the undoped p-type silicon diodes than on the gold-doped p-type silicon diodes. The obtained results are interpreted in terms of defect levels that are induced by gold in the energy gap of silicon. These levels act mainly to recombine the thermal generated carriers and are responsible for the conversion of silicon from lifetime to relaxation material. The diodes fabricated from relaxation material are characterized by the Ohmic behaviour and high resistivity due to recombination of charge carriers by the defect levels. Properties of the relaxation diodes are not affected by the incident radiation. Thus, the diodes can be used to devise the radiation-hard detectors.

234 - Applications of JIMLWK Evolution to Exclusive J/ψ Production in the ATLAS Detector

NPRP - Wednesday 10 July 2013 11:30

Authors: RAMNATH, Andrecia (University of Cape Town)

The current framework for our fundamental understanding of matter and interactions is the Standard Model of particle physics. Hand-in-hand, theoretical and experimental physicists have built this theory using cutting-edge mathematical tools and innovative experimental techniques. One such experimental endeavor is the Large Hadron Collider (LHC) located at the European Centre for Nuclear Research (CERN) in Geneva, Switzerland. The ATLAS experiment uses the proton and heavy ion collisions produced in this 27 km long particle collider to probe the predictions and limitations of the Standard Model. Due to the high energies employed at the LHC, collisions are able to probe a regime known as the Colour Glass Condensate (CGC): a medium characterized by a part of the hadronic wavefunctions being dominated by nonperturbatively large gluon occupation numbers. The JIMWLK equation is a mathematical tool used to predict some of the physical observables within the CGC framework. By exploiting appropriate exclusive interactions (where at least one of the protons does not break), this work attempts to calculate the exclusive J/ψ production cross-section using a truncation of the JIMWLK equation and to measure this cross-section in the ATLAS experiment.

235 - Analysis of Self-Calibration Artefacts

Astro - Wednesday 10 July 2013 14:50

Authors: NUNHOKEE, Chuneeta Devi (Rhodes University)

Calibrating a synthesis array is one of the most challenging aspects in radio astronomy and in many cases, the most important factor in image synthesis. The main aim of this project is to acquire a deep understanding of calibrating artefacts. Current self-calibration methods are known to generate substantial imaging artefacts. These are caused by incomplete sky models and/or calibration errors in amplitude and phase. Here, we are going to use the MeqTrees software to first locate the artefacts and then analyse them. This work will have both theoretical and practical outputs. On the theoretical side, we will develop a better understanding of self-calibration and direction dependent effects (DDE) calibration artefacts, which is extremely important for science projects such as the upcoming MeerKAT surveys. The practical output will be a set of simulations tools that will allow us to predict the artefact and flux suppression level for any given observation.

236 - Measuring and correcting primary beam instability in radio interferometry

Astro - Wednesday 10 July 2013 14:30

Authors: MAKHATHINI, Spheshile (Rhodes University)

An ideal interferometer assumes that the primary beam patterns of all antennas are to first order identical, pointed in exactly the same direction, and stable during the time of the observation. In practice this is not true for several reasons (a) parallactic rotation in an alt-az mount, (b) pointing errors, and (c) mechanical deformations of the telescope structure. This causes direction-dependent calibrations errors, which result in dynamic-range-limiting artefacts in the images. In the first phase of this project, we will quantify this effect via simulations, answering questions such as, how much deviation from the ideal primary beam can we tolerate to keep the resulting errors within a certain budget. In the second phase, we will build on existing approaches (such as pointing error solutions) to find new methods for solving and correcting for primary beam deformations directly from the interferometric data itself.

240 - Advanced simulation techniques for the design of next generation radio interferometers

Astro - Wednesday 10 July 2013 13:50

Authors: ATEMKENG TEUFACK, Marcellin (Rhodes University)

We are interested in radio telescope that uses interference patterns from two (or more) antennas separated by a very large distance, or more generally modern radio interferometers with a large baseline. The Square Kilometre Array (SKA) will be an example of such radio interferometers. This project will economic development a comprehensive analytical and simulation based framework (using the software MeqTrees) that will enable us to analyse the impact of various design characteristics telescope on ultimate image quality, and study the future of calibratability such as the SKA Telescope. Ultimately, we want a system simulations that can answer issues such as “if we build a telescope with characteristic X or Y, how will this affect our image quality and science goals”?

241 - A Theoretical Investigation of the Structural, Electronic and Phase transition of Molybdenum Selenide compounds

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: ABDULSALAM, Mahmud (University of the Witwatersrand, Johannesburg)
Co-authors: JOUBERT, Daniel (University of the Witwatersrand)

Molybdenum selenide structures may be potential may be potential materials for constructing solar cells. In this study, we numerically investigate the structural, electronic structure and pressure phase transition properties of some molybdenum selenide structures using density functional theory (DFT). Three DFT approximations are used to determine trends and properties. Pressure phase transitions up to 10 Gpa and elastic properties are examined to identify structurally stable systems. The electronic structure of the most stable systems are explored to determine the best potential candidates for solar energy harvesting.

242 - New minimization techniques, solvers and calibration algorithms

Astro - Wednesday 10 July 2013 14:10

Authors: GAZOYA, Emmanuel (Rhodes University)

The aim of the new generation of radio synthesis arrays such as Square Kilometre Array (SKA) and LOw Frequency ARray (LOFAR) is to achieve much higher sensitivity, resolution and frequency coverage than what is available now. To accomplish this goal, our project aims to develop advanced solving techniques that will focus in particular on linearized approaches such as Stefcal with extension to direction-dependent gains, direction-dependent gain solutions with coupling between directions and timeslots, solving for pointing errors and other beam parameters, Bayesian solvers; simultaneous solutions for calibration and sky model parameters. Furthermore, we provide a fundamental statistical understanding of self-calibration which is currently missing. The output of this project is a set of new solving techniques, augmented by software implementations of such. These will be tested on real data from SKA pathfinders (KAT-7 and early MeerKAT data, LOFAR, etc).

243 - Orbital simulations for a satellite with a corona ionization thruster

Poster2 - Wednesday 10 July 2013 17:40

Authors: *FERRER, phil (wits)*

The corona ionization thruster works by ionizing a gas propellant emerging from a thin needle tip, and accelerating the resulting ions through the neutral propellant, creating an ionic wind. New thrust and electrical measurements for such a system have recently been obtained. The results allow for a simulation of the possible orbital manoeuvres of a small nano-class satellite. Various such manoeuvres are simulated, ranging from orbit raising to controlled de-orbiting the results of which are presented in the poster.

244 - What is problem-solving?

Education - Wednesday 10 July 2013 09:40

Primary authors: *NAIDOO, Deena (School of Physics, University of the Witwatersrand)*
Co-authors: *DOUGLAS, Clerk (School of Physics, University of the Witwatersrand)*

The meanings of terms such as “problem“ and “problem-solving” are generally assumed to be known, however an ongoing investigation into this issue has revealed that there is no universally agreed definition. The literature shows variation in the meanings attached to these terms, both from individual to individual within a discipline and from discipline to discipline. At the beginning of year 2013, the new cohort of first Engineering students were given a questionnaire probing their understanding of these terms and their experience of being taught problem-solving at school. The results revealed considerable variety of responses which were classified into categories indicating to an extent the level of problem-solving being practiced at high school. The presentation will also include a discussion of lecturer’s perceptions of the meanings of these terms.

245 - Modelling the gamma-ray and radio light curves of the double pulsar system

Astro - Friday 12 July 2013 11:10

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

Guillemot et al. (2013) recently reported the discovery of gamma-ray pulsations from the 22.7 ms pulsar (pulsar A) in the famous double pulsar system J0737-3039A/B. The gamma-ray light curve of pulsar A has two peaks separated by approximately half a rotation, and these are non-coincident with the observed radio and X-ray peaks. This suggests that the gamma-ray emission originates in a part of the magnetosphere distinct from where the radio and X-ray radiation is generated. Thus far, three different methods have been applied to constrain the viewing geometry of pulsar A (its inclination and observer angles): geometric modelling of the radio and gamma-ray light curves, modelling of the position angle sweep in phase seen in the radio polarization data, and independent studies of the time evolution of the radio pulse profile of pulsar A which constrain the viewing angle. These three complementary methods have yielded consistent results: pulsar A's rotation axis is likely perpendicular to the orbital plane of the binary system, and its magnetic axis close to lying in the orbital plane (making this pulsar an orthogonal rotator). The observer is furthermore observing emission close to the magnetic axis. Thus far, however, current models could not reproduce all the characteristics of the radio and gamma-ray light curves, specifically the large radio-to-gamma phase lag. In this talk we discuss some preliminary modelling attempts to address this problem, and offer ideas of how the light curve fits may be improved by adapting the standard geometric models in order to reproduce the profile positions more accurately.

246 - Spin-dependent electronic properties of random layered semiconductor systems

Poster1 - Tuesday 09 July 2013 17:40

Authors: *MPSHE, Kagiso (unisa)*

Abstract: The electronic properties of random superlattices and quantum wells of lattice-matched III-V semiconductors are investigated by employing the extended empirical pseudopotential method. The model includes the important spin-orbit coupling terms in the single electron Hamiltonian. The numerical calculations are, in this case, facilitated by a highly optimises python-Fortran code, following a large basis approach. The effect of the lack of periodicity in these systems, on their electronic properties, is simulated and one possible application of the simulation results is proposed.

248 - Advanced Power Sources for Electronic Devices and Electric Vehicles.

DCMPM1 - Wednesday 10 July 2013 09:00

Primary authors: *MASEDI, Cliffton (University of Limpopo-Material Modelling Centre)*
Co-authors: *NGOEPE, Phuti (University of Limpopo-Material Modelling Centre); SITHOLE, Happy (CSIR)*

The growing global energy demand of modern society is urging to find large-scale sources, which are more sustainable and environmentally friendly of the oil-based ones. The increase of CO< sub >2< /sub > emissions and also the limited availability of oil, call for the search for sources of clean energy. Electrochemical systems for energy production, conversion and storage, including super capacitors, fuel cells and batteries, may play a relevant role. In particular, rechargeable lithium batteries are expected to play a key role also in future energy storage, including both stationary and automotive applications. Li-ion batteries have transformed portable electronic devices. However, even when fully developed, the highest energy storage that this batteries can deliver is too low to meet the demands of key markets. Reaching beyond the horizon of Li-ion batteries is a formidable challenge; it requires the exploration of new chemistry, especially electrochemistry and new materials. Here we consider a study on: Li-air, Li-S and Zn-air batteries. All this batteries are potentially viable ultrahigh energy density chemical power sources, which could potentially offer higher specific energy being rechargeable.In the current work we present a comparative study on stability, structural and electronic properties of the discharge products of sulphur and oxygen formed in Li-air, Li-S and Zn-air batteries using planewave pseudopotential methods. Lattice parameters for the suggested compounds were calculated and compare well with experimental results. The elastic constants of all the discharge products of sulphur and oxygen formed in Li-air, Li-S and Zn-air batteries accord reasonably with experimental results, and the corresponding stability conditions are satisfied. Furthermore, the lattice dynamics of the products were calculated. The phonon dispersions of Li< sub >2< /sub >O and Li< sub >2< /sub >S suggested that the structures are stable and compare well with those obtained from neutron scattering experiments.

249 - Influence of the proton core on the fine structure of the Isovector Giant Dipole Resonance as a function of nuclear deformation across the neodymium and samarium isotope chains

NPRP - Wednesday 10 July 2013 14:30

Primary authors: *DONALDSON, Lindsay (Wits)*
Co-authors: *BUTHELEZI, E. Z. (iThemba LABS); MIRA, J. (iThemba LABS); NEMULODI, F. (iThemba LABS); VON NEUMANN-COSEL, P. (Institut fur Kernphysik, Technische Universitat Darmstadt); NEVELING, R. (iThemba LABS); PAPKA, P. (iThemba LABS); RICHTER, A. (Institut fur Kernphysik, Technische Universitat Darmstadt); SIDERAS-HADDAD, E. (Wits); SMIT, F. D. (iThemba LABS); STEYN, G. F. (iThemba LABS); TAMII, A. (Research Center for Nuclear Physics, Osaka University); CARTER, J. (Wits); USMAN, I. (Wits); SWARTZ, C. (iThemba LABS); COOPER, G. R. J. (Wits); FEARICK, R. (UCT); FORTSCH, S. V. (iThemba LABS); FUJITA, H. (Research Center for Nuclear Physics, Osaka University); FUJITA, Y. (Department of Physics, Osaka University); JINGO, M. (Wits); KUREBA, C. O. (Wits)*

The decay of giant resonances in nuclei is a prime example of how a well-ordered collective excitation dissolves into a disordered motion of internal degrees of freedom in fermionic quantum many-body systems. Fine structure in the 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. Data on the samarium isotope chain will be taken early in 2014. 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 $^{148}_{60}$Nd and $^{150}_{62}$Sm as well as between $^{150}_{60}$Nd and $^{152}_{62}$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. Studying the ^{150}Sm and ^{152}Sm isotopes in conjunction with the neodymium isotope chain will also allow for the influence of the proton number, Z, on the fine structure of the IVGDR as a function of nuclear deformation to be studied. It is important to note that because data for the samarium isotope chain will only be obtained in 2014, the preliminary results from the analysis of the data from the neodymium isotope chain will be presented along with a theoretical overview of the comparison between the two chains and existing photo-absorption data.

250 - Efficient Ho:YLF laser pumped by a Tm:fiber laser

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *KOEN, Wayne (CSIR National Laser Centre)*
Co-authors: *JACOBS, Cobus (CSIR National Laser Centre); COLLETT, Oliver (CSIR National Laser Centre)*

Laser sources emitting in the 2 micron region is of particular interest for applications in medicine, remote sensing (LIDAR) and directed infra-red countermeasures. In addition, they are also desirable pump sources for efficient optical parametric oscillators operating in the 3-5 μm band as both the signal and the idler generated from 2 micron pump light can fall within the band. This is not the case with 1 micron pump sources used in the past.However; while solid state laser sources in the 1 micron region (Neodymium based lasers) are well established, sources in the 2 micron region are still maturing.Ho:YAG based solid-state lasers pumped with Thulium-doped fibre lasers has been a popular approach for several years to generate coherent light at 2 micron, delivering high average powers and good optical-to-optical efficiencies, while Ho:YLF was used for low pulse repetition frequency Q-switched applications due to its long upper state lifetime. Ho:YLF had more limited use in high average power applications as it was believed that the low thermal fracture of YLF would pose a problem. In this paper we present a comparison between Tm:fiber laser pumped Ho:YAG lasers published in literature and several Tm:fiber laser pumped Ho:YLF lasers we developed. It is shown that Ho:YLF based lasers can deliver high average powers and optical-to-optical efficiencies, comparing favourably to Ho:YAG lasers. The best performing laser delivered an average power in excess of 45 W with an optical-to-optical efficiency of 53 %, in a near diffraction limited beam.

251 - Fine structure of the Isoscalar Giant Quadrupole Resonance using proton inelastic scattering at 200 MeV in spherical to highly deformed neodymium isotopes

NPRP - Wednesday 10 July 2013 14:10

Primary authors: *KUREBA, Chamunorwa Oscar (Wits)*
Co-authors: *CARTER, J (Wits); FOURIE, D. T. (iThemba LABS); HEILMAN, A. M. (Institut für Kernphysik, Technische Universität Darmstadt); KRUGMANN, A (Institut für Kernphysik, Technische Universität Darmstadt); MABIALA, J (SU); MIRA, J. P. (iThemba LABS); MURRAY, S. H. T. (iThemba LABS); VON NEUMANN-COSEL, P (Institut für Kernphysik, Technische Universität Darmstadt); NEWMAN, R. T. (SU); PAPKA, P (SU); SMIT, F. D. (iThemba LABS, SU); NEVELING, R (iThemba LABS); STEYN, G. F. (iThemba LABS); SWARTZ, J. A. (iThemba LABS, SU); TAMII, A (Research Center for Nuclear Physics, Osaka University); RICHTER, A (Institut für Kernphysik, Technische Universität Darmstadt); COOPER, G. R. J (Wits); SIDERAS-HADDAD, E (Wits); USMAN, I. T. (Wits); JINGO, M (Wits); BUTHELEZI, E. Z. (iThemba LABS); CONRADIE, J. L. (iThemba LABS); FEARICK, R. W. (UCT); FõRTSCH, S. V. (iThemba LABS)*

Proton inelastic scattering measurements have been performed at iThemba Laboratory for Accelerator Based Sciences, using the state-of-the-art K600 Magnetic Spectrometer. This is one of the only two facilities in the world with a unique capability of high energy-resolution measurements at medium energies. The 200 MeV proton beams were delivered by the Separated Sector Cyclotron (SSC). As a result, fine structure has been observed in the region of the Isoscalar Giant Quadrupole Resonance (ISGQR) in five stable even-even neodymium (from spherical to highly deformed) target nuclei, namely, ^{142}Nd, ^{144}Nd, ^{146}Nd, ^{148}Nd and ^{150}Nd. Nuclei with mass number $A \approx 150$ and neutron number $N \approx 90$ are particularly of special interest since they occupy that region of the nuclide chart wherein the onset of permanent prolate deformation occurs. The stable even-even neodymium ($Z = 60$) isotopes have been chosen in the present study in order to investigate the influence of the onset of deformation on the excitation energy spectra in the ISGQR region ($9 \leq E_x \leq 15$ 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 enhance the ISGQR in the excitation energy spectra measured, a Discrete Wavelet Transform (DWT) background subtraction was carried out. A comparison of the resonance widths extracted shows a systematic broadening of the ISGQR, moving from spherical to highly deformed nuclei as has already been observed for the Isovector Giant Dipole Resonance (IVGDR) excited by γ-capture.; Energy scales were extracted for the resonance region using the Continuous Wavelet Transform (CWT) technique. Another important further step which has been conducted is the extraction of 2^+ nuclear level densities from the fine structure in the region of the ISGQR. Experimental details, data extraction and analysis techniques, together with preliminary results will be presented.

252 - Temporal variation of line radiation from the GTS-ECRIS at iThemba labs

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *SAKILDIEN, Muneer (iThemba LABS)*
Co-authors: *THOMAE, Rainer (iThemba LABS)*

Measurement of the radiation emitted from a plasma has been used for the determination of the electron density and temperature in space physics. We will report here on a first attempt to use these plasma diagnostics on the ECR ion source at iThemba LABS. Our investigation will be on the processes leading to a transient current phenomenon known as the Pre-glow affect in ECR ion sources operated in pulsed mode. Therefore the investigation has to be performed with unprecedented time resolution, which will yield new information on this plasma breakdown process.

253 - Active Learning 101

Education - Wednesday 10 July 2013 10:50

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

“Active learning” has attracted attention as a successful and desirable way of enhancing student performance – but what exactly is “active” learning”? Instructors will generally agree that what really matters is what you make the students do – as opposed to what the instructor does. With this in mind some changes were made last year to the way tutorial sessions were conducted in the physics course for first year engineering students. The traditional tutorial had for some decades been conducted as a 45 minute session starting with 30 minutes of free student-tutor interaction, where students were expected to work on their “prepared” tutorial exercises and request assistance from tutors when in difficulty. The balance of the session was devoted to either a “spot test” or a “discussion question” which contributed to their continuous assessment mark. The majority of students have been frequently observed simply to waste their time during the first 30 minutes of a session, and then to apply their minds diligently in the last 15. The pass rate for the mid-year examination in 2012 was extremely poor, which resulted in a simple intervention - which was to increase the time to 30 minutes, spent on compulsory, mark-bearing tasks performed by the students. This change was implemented for the second semester. At the end of the year the examination pass rate improved dramatically, which could be attributed at least partially to this intervention. This intervention shows that “active learning” need not be complex or inconvenient – the intervention consisted in a simple quantitative change: only the duration and quantity - not the type - of learning activity was changed.

254 - Efficient sorting of Bessel beams

Photonics - Tuesday 09 July 2013 11:30

Primary authors: *MHLANGA, Thandeka (CSIR National Laser Centre)*
Co-authors: *DUDLEY, Angela (CSIR National Laser Centre); FORBES, Andrew (CSIR National Laser Centre, UKZN); ROUX, Stef (CSIR National Laser Centre); PADGETT, Miles (Department of Physics & Astronomy, University of Glasgow); LAVERY, Martin (Department of Physics & Astronomy, University of Glasgow)*

High order Bessel beams are characterized by the azimuthal mode index, ■ and radial component, kr, as a result they carry orbital angular momentum (OAM) and their far-field forms an annular ring of radius, R .These beams form in a region where parallel plane waves interfere in a conical manner. A method of separating the azimuthal, ■ and radial, kr components of the Bessel Beams using cylindrical lenses [1] and an efficient orbital angular momentum (OAM) sorter [2] optical system is illustrated here. A conformal mapping technique [2] was used to achieve the sorting of Bessel beams, where the annular ring (Fourier transform of a Bessel beam) was mapped to a linear phase variation along the horizontal direction. A series of cylindrical lenses simultaneously Fourier transformed the transverse momentum states and imaged the unraveled annular ring to a detector plane, where the position of the detected spot is dependent on the amount of OAM it carries and its radial wave vector.[1] A. Dudley, T. Mhlanga, M. Lavery, A. Mcdonald, F. Roux, M. Padgett, A. Forbes, “Efficient sorting of Bessel beams,”Opt.Express 21(1), 165-171, (2013)[2]Gregorius C. G. Berkhout, Martin P. J. Lavery, Marco W. Beijersbergen, Miles J. Padgett, “Efficient sorting of angular momentum of light,” *PhysRevLett.105 (16).153601 (2010)

255 - A survey of the fine structure phenomenon of the Isovector Giant Dipole Resonance in nuclei across the periodic table at a forward scattering angle

NPRP - Wednesday 10 July 2013 13:50

Primary authors: *JINGO, Maxwell (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa)*
Co-authors: *KUREBA, C. O. (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa); NEVELING, R. (iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa); NEWMAN, R. T. (Department of Physics, University of Stellenbosch, Matieland 7602, South Africa); PAPKA, P. (Department of Physics, University of Stellenbosch, Matieland 7602, South Africa); POLTORATSKA, I. (Institut für Kernphysik, Technische Universität Darmstadt, D-64829, Darmstadt, Germany); RITCHER, A. (Institut für Kernphysik, Technische Universität Darmstadt, D-64829, Darmstadt, Germany); SIDERAS-HADDAD, E. (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa); SMIT, F. D. (iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa); SWARTZ, J. A. (Department of Physics, University of Stellenbosch, Matieland 7602, South Africa, iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa); TAMII, A. (Research Center for Nuclear Physics, Osaka University, Ibaraki, Osaka 560-0047, Japan); USMAN, I. (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa); CARTER, J. (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa); MIRA, J. (iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa, Department of Physics, University of Stellenbosch, Matieland 7602, South Africa); COOPER, G. R. J. (School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa); STEYN, D. (iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa); CONRADIE, J. L. (iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa); FEARICK, R. W. (Physics Department, University of Cape Town, Rondebosch 7700, South Africa); FõRSTCH, S. V. (iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa); FOURIE, D. T. (iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa); HEILMAN, A. M. (Institut für Kernphysik, Technische Universität Darmstadt, D-64829, Darmstadt, Germany); MURRAY, S. H. T. (iThemba Laboratory for Accelerator Based Sciences, Somerset West 7129, South Africa); VON NEUMANN-COSEL, P. (Institut für Kernphysik, Technische Universität Darmstadt, D-64829, Darmstadt, Germany)*

A survey of the fine structure phenomenon of the Isovector Giant Dipole Resonance (IVGDR) was carried out, using proton inelastic scattering at an incident energy of 200 MeV for a wide target-mass range of closed and near-closed nuclei: ^{27}Al, ^{40}Ca, ^{56}Fe, ^{58}Ni and ^{208}Pb. The data obtained will provide an unique insight into the role of different damping mechanisms contributing to the decay of the IVGDR. In this work, a model-independent background subtraction procedure which eliminates the contributions due to the Isoscalar Giant Quadrupole Resonance (ISGQR) and the phenomelogical background effects was initially implemented before the cross-section spectra were converted to the equivalent photo-absorption cross-sections. The equivalent photo-absorption cross-sections were then compared with γ-capture; reactions as a check for consistency. Characteristic energy scales from the experimental data will be extracted using the wavelet analysis technique. Three mother wavelets namely, the Morlet, Complex Morlet and Complex Lorentzian mother wavelets will be used to extract these energy scales. Recent studies have shown that, the Complex Lorentzian mother wavelet produces clearer, better defined, wavelet coefficient plots i.e. its power spectra have better separations of scales, therefore, this study promises a re-affirmation of this observation. Furthermore, experimental level densities will be 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 critical in removing the remaining physical background from other multipoles excited and any remaining instrumental background. The experimentally extracted level densities will then be compared with different theoretical parameterisations of the Hartree-Fock Bogoliubov (HFB), Hartree-Fock-Bardeen-Cooper-Schrier (HF-BCS) and Back-shifted-Fermi-Gas model (BSFG). Finally, the state-of-the-art microscopic models for excitation of the IVGDR e.g. the Quasi-particle phonon model (QPM) and the Second Random Phase Approximation (SRPA) will be compared to the experimental data.

256 - Comparison of neutron fluence spectra measured with NE213 proton recoil spectrometer and NE230 deuteron recoil spectrometer

NPRP - Friday 12 July 2013 10:30

Primary authors: MASONDO, vusumuzi *(student)*
Co-authors: *HERBERT, Mark (supervisour); NCHODU, Rudolph (Co-supervisour); MULAUDZI, Immanuel (colligue); MAKHUBELA, Matthews (colligue)*

Measurements and detail knowledge of neutron fluence spectra are required in research and application. In application such as neutron radiotherapy, neutron fluence spectra in and near the treatment area is required for characterization of the quality of radiation and determination of absorbed dose. These fluence spectra can be measured or calculated.Recoil spectrometry with time of flight is used to measure the fluence spectra; in particular the NE213 proton recoil spectrometer with time of flight is used widely and is well established. However, in water phantom (a simulation of a human tissue) recoil protons from the water causes distortions in the measured fluence spectra, a way to overcome this is to use a deuterated organic liquid scintillator NE230 which is based on deuteron recoil. 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. Neutron fluence measurements were carried out separately with either NE213 or NE230 scintillation detectors, using time of flight methods. Preliminary results will be presented and discussed.

257 - Monte Carlo simulation of Neutron Transport in Nuclear Reactors

NPRP - Wednesday 10 July 2013 16:00

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

The neutron transport equation is used widely to model the dynamics of neutrons in nuclear reactors. However, it is not feasible to use it for a complex, non-uniform structure like a reactor core as there are no analytical solutions and the complexity is demanding for numerical methods and therefore it becomes computationally expensive. To reduce the complexity, one needs to make drastic approximations such as the diffusion theory class approximations. In practice the neutron transport equation is used to solve for small parts of the reactor core, which then form the homogenized simplified components from which the full reactor core can be constructed and treated by the diffusion equation. The disadvantage of the diffusion theory is the loss of the microscopic detail of neutron interactions. In this presentation the development of a Monte Carlo model using Geant4, to simulate neutron transport in a nuclear reactor will be discussed. This study will be benchmarked against the conventional codes and also compare the results with measurements. The results expected are an improved treatment of the detail of the reactor and ability to overcome the shortcomings of the other simulations. Geant4 is a modern open source object oriented code that has proven success at a very high level of complexity for the geometry construction, materials specification and tracking algorithms.

258 - Scalable implementation scheme for quantum walks using classical light

Theoretical - Friday 12 July 2013 09:20

Primary authors: GOYAL, Sandeep *(UKZN)*
Co-authors: *KONRAD, Thomas (UKZN); FORBES, Andrew (CSIR); ROUX, F. S. (CSIR)*

Quantum walks are the quantum analog of the classical random walks. They have been proved to be universal for quantum computation and quantum algorithms. However, not many scalable experimental realization of quantum walks have been reported so far. Here we present an implementation scheme for quantum walk in the orbital angular momentum space of a laser beam. The scheme makes use of a ring interferometer, containing a quarter-wave plate and a q-plate. This setup enables one to perform an arbitrary number of quantum walk steps by means of amplification. In addition, the classical nature of the implementation scheme makes it possible to observe the quantum walk evolution in real time. We use non-quantum entanglement of the laser beam's polarization with its orbital angular momentum to implement the quantum walk.

259 - Adaptive quantum coherent control of a multilevel molecular system in the time-frequency domain

Photonics - Tuesday 09 July 2013 16:20

Primary authors: BOTHA, Lourens *(CSIR:NLC)*
Co-authors: *SMIT, Andre (CSIR:NLC); DE CLERCQ, Ludwig (ETH Zurich)*

Adaptive quantum coherent control of a multi-level system in the time-frequency domain utilizing the von Neumann representation is demonstrated and compared to the results obtained with time domain only representation. A numerical model of the coherent interaction of a shaped femtosecond pulse with a multilevel quantum system was developed. This model was used with a learning algorithm to optimize the population in an arbitrarily chosen quantum level within the multi-level system.

260 - Quantum teleportation, quantum scissor and quantum transcription

Theoretical - Friday 12 July 2013 09:00

Primary authors: GOYAL, Sandeep *(UKZN)*
Co-authors: *KONRAD, Thomas (UKZN)*

Quantum teleportation is a process by means of which quantum information is transmitted from one location to another without transmitting the information carrier itself. The fragile nature of quantum systems and nearly omnipresent dissipative environments make it challenging to perform quantum teleportation in real systems. However, photonic systems are less susceptible to the environmental effects. We present here a photonic teleportation scheme based on ``quantum transcription''. A qudit encoded into a single excitation of d light modes (in our case Laguerre-Gaussian modes which carry orbital angular momentum) is transcribed to d mono-rail photonic qubits, which are spatially separated. Each mono-rail qubit consists of a superposition of vacuum and a single photon in each one of the modes. After successful teleportation of each of the d mono-rail qubits by means of ``Quantum Scissors'' they are converted back into a qudit carried by a single photon which completes the teleportation scheme.

261 - Modal decomposition of Bessel-Gaussian beams

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: MHLANGA, Thandeka *(1.CSIR National Laser Centre, PO Box 395, Pretoria 0001, South Africa 2 . College of Agriculture, Engineering & Science , University of Kwazulu-Natal, Westville Campus, Durban,4000, South Africa.)*
Co-authors: *MCLAREN, Melanie (1. CSIR National Laser Centre, PO Box 395, Pretoria 0001, South Africa , 2. Stellenbosch University, Private Bag x1, Matieland, 7602, South Africa); FORBES, Andrew (1. CSIR National Laser Centre, PO Box 395, Pretoria 0001, South Africa 2 . College of Agriculture, Engineering & Science , University of Kwazulu-Natal, Westville Campus, Durban,4000, South Africa. 3. Stellenbosch University, Private Bag x1, Matieland, 7602, South Africa); ROUX, Stef (. CSIR National Laser Centre, PO Box 395, Pretoria 0001, South Africa)*

Bessel beams have many properties which make them to be an interest of study. Their known properties include that they are non-diffractive of a certain region, they form an annular ring at far distances and they self reconstruct after encountering an obstruction. In this poster we will demonstrate an efficient way of measuring the Bessel beam parameters using a simple experimental setup where spatial light modulators will be used to generate Bessel-Gauss beams and to measure the orbital angular momentum (OAM) state they carry as well as their radial component using a modal decomposition technique.

262 - A review of generalized and unsharp measurements

Theoretical - Friday 12 July 2013 10:50

Primary authors: BASSA, Humairah *(University of KwaZulu-Natal and NLC, CSIR)*
Co-authors: *KONRAD, Thomas (University of KwaZulu-Natal)*

Unlike in the classical world, the act of quantum measurement has an effect on the state of the system that is being measured. This impact depends on the type of quantum measurement that was carried out. The usual notion of projective measurements can be generalized and used to reformulate the measurement postulate. Due to the growing interest in quantum information processing, it is useful to have a toolkit of generalized and unsharp measurements that can be utilized for realistic experiments, which will be presented here.

263 - Mott's Variable Range Hopping Model: an Easy Method for Identification of Phase Transition

DCMPM1 - Wednesday 10 July 2013 11:30

Primary authors: AKANDE, Amos *(CSIR National Center for Nano-Structured and Materials, P.O.Box 395, Pretoria 0001, South Africa / Department of Physics and Mineral Science, University of Limpopo, Private Bag x1106, SOVENGA 0727 South Africa.)*
Co-authors: *MWAKIKUNGA, Bonex (DST/CSIR National Center for Nano-Structured and Materials, P.O.Box 395, Pretoria 0001, South Africa); RAMMUTLA, Erasmus (Department of Physics and Mineral Science, University of Limpopo, Private Bag x1106, SOVENGA 0727 South Africa.)*

Thermally induced metal-semiconductor phase transition nano crystalline film of VO2 was synthesized by dipping glass substrate into concentrated solution of NH4VO3 and exposing them to the atmosphere at room temperature for 3 days. At the end of the third day, part of the solution was evaporated and the remaining formed thick film deposit on the substrate. This film was then annealed at 700 degree C in hydrogen environment in a CVD reactor. Electrical measurement of the annealed film was examined from 24 degree C to 80 degree C for heating cycle and 80 degree C to 24 degree C for cooling cycle. The transition temperature (TC) of VO2 has been reported to be approximately 70 degree C (340K), VO2 as transition metal oxide however exhibit semiconductor properties below TC and metal properties at TC. Phase transition identification which has been a challenge in the study of poly crystalline material is also addressed in this work, using Mott's variable range hopping model (VRH). Mott in 1974 proposed that charge transport is responsible for electrical conduction as electron hops from one localize state to another; this conduction is mainly due to the thermally-assisted tunneling of the hopped electrons from one state to another within the band-gaps of a material. When temperature is low, the probability that electron thermal activation energy between the states that are close in space but far in energy becomes smaller than that of electron hopping between some more remote states whose energy level happen to be close to each other. In this case, the characteristic hopping length increase with decrease in temperature and thus this hopping theory is referred to as VRH. In this work Mott's VRH model is used to identify phase transition in VO2 film by fitting the logarithm of the product of conductivity and temperature against the temperature inverse for heating cycle data and cooling cycle data, this result to steps in loop with two separate phases. The first phase, semiconducting (monoclinic, emerges at room 304 K, and this shows that VO2 could exhibit semiconductor properties at room temperature. Other phase is metallic rutile, this emerge at 332K, a temperature which is comparable to the transition temperature of VO2 of 340 K in literature.

265 - Search for chirality in 193Tl

NPRP - Tuesday 09 July 2013 14:50

Authors: *NDAYISHIMYE, Joram (Stellenbosch University)*

Chirality refers to an object or a system which is not identical to its mirror image and was proposed in atomicnuclei by Fauendorf and Meng. Nuclear chiral system is a triaxially deformed odd-odd nucleus where the collective rotational angular momentum favors alignment along the intermediate axis, while the odd proton and odd neutron (having particle and hole nature respectively), favor alignments along the nuclear short and long axes respectively. In the laboratory reference frame, a doublet $\Delta I = 1$ bands with similar excitation energy levels and the same spins and parities are observed. Some chiral doublet bands were suggested in different mass regions and it was revealed at iThemba LABS that the Tl isotopes form a new region where chiral symmetry could develop. It was recently shown that 194Tl could perhaps be the best chiral candidate up to date. 193Tl as a neighbor of 194Tl is thus likely to be a very good chiral candidate. In order to extend the chirality studies in the 190 mass region and to continue the search for a pair of bands that fulfill all fingerprints of chirality, an experiment was performed at iThemba LABS to investigate the excited states in 193Tl using the 160Gd(37Cl,4n) reaction. The analysis to extend the level scheme, and to determine the spins and parities is in progress. We will present the results obtained so far.

266 - Effect of spectral changes on I-V parameters of triple junction solar cells

Applied - Friday 12 July 2013 09:40

Primary authors: *KWARIKUNDA, Nicholas (Nelson Mandela Metropolitan University)*
Co-authors: *VORSTER, Frederik (Nelson Mandela Metropolitan University); OKULLO, Willy (Makerere University)*

Characterisation of multi-junction solar cells presents more challenges compared to single junction solar cells due to the series connection of multiple subcells. In monolithically integrated solar cells, the subcells are epitaxially grown and internally connected through tunnel junctions. As a result of series connection of the subcells, the current from the solar cell device is determined by the subcell producing the lowest current. Each of the subcells in the multi-junction solar cell is optimised to absorb a given range of wavelengths of the solar spectrum. However, changes in the spectral content of the incident beam may lead to changes in the photogenerated current from the subcells leading to current mismatch. This will affect the current-voltage (I-V) characteristics, the operating voltage and performance of the multi-junction solar cell device. It is therefore important to investigate the effect of the spectral content on the device and performance parameters of multi-junction solar cells. In this study, current and voltage values were obtained while simultaneously carrying out light beam induced current (LBIC) measurements on an InGaP/InGaAs/Ge triple junction solar cell under different spectral conditions to obtain point illuminated I-V characteristics. A curve fitting algorithm was then applied to obtain I-V parameter maps under different spectral conditions from which changes in device and performance parameters due to changes in the spectral content of the beam probe were studied. This paper will discuss the impact on device and performance parameters of InGaP/InGaAs/Ge triple junction solar cell due to changes in the spectral content of the beam probe illuminating the solar cell device

267 - Synthesis, characterization and gas sensing applications of Tungsten Trioxide

DCMPM2 - Wednesday 10 July 2013 09:40

Primary authors: *GOVENDER, Malcolm (CSIR)*
Co-authors: *MWAKIKUNGA, Bonex (CSIR-NCNSM); MACHATINE, Augusto (University of Pretoria); KUNERT, Herbert (University of Pretoria)*

Tungsten trioxide film was RF-sputtered onto alumina substrates. SEM studies over the sample area (1 cm^2) showed uniform topology while FIB cross-sectioning showed the thickness to vary between 0.75-1.50 µm and this variation stems from the alumina roughness. The measured film resistance using a two-probe setup was found to be 5 kΩ at room temperature, and decreased to 2 kΩ at 300^oC which is expected for n-type semiconducting materials. Raman spectroscopy of the films showed Raman shifts at approximately 267 cm^{-1}, 700 cm^{-1} and 800 cm^{-1} which are indicative of tungsten trioxide. The films were used to sense ppm concentrations of NO_2 and NH_3 gas, and it was found that the film gave best response to both gases at 200^oC. The film showed higher sensitivity to NO_2 than to NH_3, presumably due to the adsorption mechanism between sensing an oxidizing gas and reducing gas.

268 - Structural and Magnetic Properties of MgxSrxMnxCo1-3xFe2O4 Nanoparticle ferrites

DCMPM2 - Wednesday 10 July 2013 09:20

Primary authors: *OSMAN, Nadir (University of KwaZulu-Natal)*
Co-authors: *MOYO, Thomas (University of KwaZulu-Natal); ABDALLAH, Hafiz M I (University of KwaZulu-Natal)*

A series of nanoferrites (with = 0, 0.1, 0.2, 0.3, 1/3) were synthesized by glycol-thermal technique. X-ray diffraction (XRD) patterns of the as-prepared samples show single-phase cubic spinel structure. The average crystallite sizes, lattice parameters, XRD densities and porosities were estimated from XRD data. The average crystallite sizes were found in range of 7 to 9 nm. Mössbauer spectroscopy measurements were performed in order to investigate the magnetic order of the materials and the distribution of Fe3+ ions in the tetrahedral and octahedral sites. Room temperature magnetic measurements of the series were studied using a vibrating sample magnetometer. The results show that the values of the coercive fields and saturation magnetizations which increase with increase in Co content from 15 Oe and 56.51 emu/g for x=0.3 to 114 Oe and 76.61 emu/g for x= 0.1 respectively. Significant correlations between magnetizations and coercive fields are observed. A significant change in properties is observed for the compound. These results are contrasted with low temperature measurements from 2 K to 300 K and magnetic fields to 5 Tesla.

269 - Investigation of Phase Transitions in Tungsten Trioxide

Theoretical - Tuesday 09 July 2013 11:10

Primary authors: *GOVENDER, Malcolm (CSIR)*
Co-authors: *MACHATINE, Augusto (University of Pretoria); MWAKIKUNGA, Bonex (CSIR-NCNSM); KUNERT, Herbert (University of Pretoria)*

It is well known that tungsten trioxide shows temperature-dependant structural phases, starting from a mixture of triclinic-monoclinic symmetry at room temperature, and transitions to tetragonal symmetry above 900^oC. However, the order of these transitions are not well understood which can predict if the phase transition is reversible. The allowed symmetries of the polymorphic modifications after the phase transitions are determined using group theoretical arguments in the framework of the Landau-Lifshitz theory of second-order phase transitions. The theoretical calculations predicted that the phase transition to the highest temperature phase is second-order and is therefore reversible, and this was verified using the experimental techniques of x-ray diffraction, Raman spectroscopy and thermogravimetric analysis.

270 - Spectral shaping and subcell modeling of the current density of a HCPV device as a function of operational conditions.

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *SCHULTZ, Ross (Nelson Mandela Metropolitan University)*
Co-authors: *VAN DYK, Ernest (Nelson Mandela Metropolitan University); VORSTER, Frederik (Nelson Mandela Metropolitan University)*

Multijunction concentrator photovoltaic (CPV) cells comprise of a number of semiconductor materials, with multiple monolithically junctions integrated in series. These devices offer a better absorption of energy from a wider spectral range than that of conventional PV cells. This is achieved by means of the monolithically stacked junctions having their own specific spectral response absorbing in different wavelength regions (operating from 300-1800nm). The basic structure of a triple junction (TJ) CPV device consist of a series connection of 3 subcells where the photo generated current of whole device is determined by the lowest current producing subcell. Under AM1.5D and standardized operating conditions, the subcells' current densities are well matched. Current mismatch within the device can occur as a result of changes in the incident solar spectrum throughout the day, spectral absorption by the optics of the CPV system and an increase in operational temperature of the device. The current mismatch is a result of the combination of the above resulting in, 1) a decreased spectral intensity incident on the device and 2) a spectral response shift of the materials to longer wavelengths. In this paper, the change in the current density of a CPV device as a function of the optics and temperature is discussed. Additionally, a spectral shaping and spectral response subcell model is proposed to optimize the operation of the device. This proposed model could possibly increase the devices longevity by offsetting the subcell current mismatch between the materials within the CPV device.

271 - Preliminary results of a Monte Carlo study of neutron beam production at iThemba LABS

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *IMMANUEL, Mulaudzi (UWC)*
Co-authors: *MALEKA, Peane (iThemba LABS); MAKHUBELA, Mathews (UWC); MASWONDO, Vusimuzi (UWC); HERBERT, Mark (UWC)*

Abstract Many applications in nuclear and applied nuclear physics require well-characterized fast neutron beams in terms of their fluence spectra, since neutron interactions cross sections are energy dependent. Fast neutron beams are widely used in radiation therapy for cancer treatment, radiation protection for detector calibration and basic research in nuclear physics for neutron cross section measurement. Monitoring these neutron beam fields and determining their fluence spectra pose a challenge. In principle, these fluence spectra can either be calculated by Monte Carlo Methods or measured experimentally. At research facility namely iThemba LABS fast neutron beams characterization in terms of their fluence spectra are important for detector calibration and neutron cross section measurement. Monte Carlo methods are widely used to optimise neutron beam delivery system of such facilities and to predict their source spectra. In this work it was decided to use the Monte Carlo Code MNCPX to investigate neutron production at IThemba LABS because it had be widely used and validated in the energy range of interest.This paper present preliminary results in which the Monte Carlo code MCNPX was used to simulate neutron production by different targets either Li (1.0 mm), Be (10.0 mm) or C (10.0 mm), for fast neutron beams facility at iThemba LABS. Neutron production was investigated in terms of proton neutron ratio and fluence spectra as a function of target thickness, incident proton energy and angular distribution.

272 - Tuneable Gaussian to Flat-top resonator by amplitude beam shaping

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *NGCOBO, Sandile (CSIR)*
Co-authors: *LITVIN, Igor (CSIR); AIT-AMEUR, Kamel (Université de Caen); FORBES, Andrew (CSIR)*

We outline a simple laser cavity comprising an opaque ring and a circular aperture that is capable of producing spatially tuneable laser modes, from a Gaussian beam to a Flat-top beam. The tune-ability is achieved by varying the diameter of the aperture and thus requires no realignment of the cavity. We demonstrate this principle using a digital laser with an intra-cavity spatial light modulator, and confirm the properties of the resonator experimentally.

273 - Electrical and magnetic properties of NdAuGe compound

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: BASHIR, Aiman *(University of Western Cape)*
Co-authors: *TCHOULA TCHOKONTE, Moise (University of the Western Cape); STRYDOM, Andre (University of Johannesburg); SNYMAN, Jasper (University of Johannesburg)*

We report the electrical and magnetic properties of the hexagonal NdAuGe, through the measurement of X-ray diffraction (XRD), electrical resistivity (■(T)), magnetic susceptibility (■(T)) and magnetization (■(■0H)). XRD data indicate a hexagonal NdPtSb■type structure with space group P63mc. Result of electrical resistivity shows a metallic – like behavior below 150 k and a broad curvature above 150 k. The law temperature ■(T) data indicate the onset of a magnetic transition. ■(T) data at low temperature in zero field-cooled (ZFC) indicates a magnetic phase transition at temperature TN =7.8 k. The high temperature ■(T) data follow the Curie – Weiss relation and give effective moment value ■eff slightly reduced from the expected value 3.62 ■B of the free Nd+3 -ion. ZFC and FC (field cooling) ■(T) shows a bifurcation below Tf = 13 k.

274 - NON-SPECIALIST: Classical optics in the language of quantum mechanics

Theoretical - Friday 12 July 2013 11:10

Primary authors: KONRAD, Thomas *(UKZN)*
Co-authors: *GOYAL, Sandeep (UKZN)*

There is a close relationship between physical optics and quantum mechanics. Therefore problems form one of these fields can solved by methods from the other. We review the application of Dirac notation and operator algebra to the optics of paraxial light beams at the example of deriving the lens equation. In addition, we formulate paraxial optics in terms of postulates in order to compare them with those of quantum mechanics and find -remarkably- a great similarity, except for measurements.

275 - LED Board for the mobile test bench

Poster2 - Wednesday 10 July 2013 17:40

Authors: MASIKE, Titus *(University of Witwatersrand)*

Wits is developing an electronics lab to serve upgrade needs of read-out electronics of the ATLAS detector. A first step in this program is the development of a test bench, the MobiDick4 system, for the readout and control electronics of the Tile Calorimeter. The architecture of the MobiDick4 system will be reviewed. Emphasis will be made on the re-design of the LED card.

276 - The digital laser

Photonics - Wednesday 10 July 2013 15:40

Primary authors: NGCOBO, Sandile *(CSIR)*
Co-authors: *LITVIN, Igor (CSIR); BURGER, Liesl (CSIR); FORBES, Andrew (CSIR)*

It is well-known how to control the spatial output from a laser, with most solutions to date involving customized intra-cavity elements in the form of apertures, diffractive optics and free-form mirrors. These optical elements require considerable design and fabrication effort and suffer from the further disadvantage of being immutably connected to the selection of a particular spatial mode. Consequently, most laser systems are designed for the ubiquitous Gaussian mode, whereas it is clear that there are many instances when a customised mode would be preferable. We overcome these limitations with the first digital laser, comprising an electrically addressed reflective phase-only spatial light modulator as an intra-cavity holographic mirror. The phase and amplitude of the holographic mirror may be controlled as simply as writing a new gray-scale image (computer generated hologram) to the device: on-demand laser modes. We show that we can digitally control the laser modes with ease, albeit with higher round-trip losses and thus requiring higher gain, and demonstrate the versatility of the technique by switching between several spatial modes in an otherwise standard solid-state laser resonator.

278 - Galaxy peculiar velocities in the Zone of Avoidance

Astro - Tuesday 09 July 2013 14:10

Primary authors: SAID, Khaled *(Msc. student university of Cape town)*
Co-authors: *KRAAN-KORTEWEG, Renee (Astronomy Department (HOD)); JARRETT, Tom (South African Research Chair in Astrophysics and Space Science)*

Dust extinction and stellar confusion of the Milky Way prevent the detection of galaxies at low Galactic latitude, creating the so-called Zone of Avoidance (ZoA). This has hampered our understanding of the local dynamics, cosmic flow fields and origin of the CMB dipole. For similar reasons, the ZoA was excluded from the so-called "whole-sky" Two Micron All-Sky Survey (2MASS) Tully-Fisher Survey (2MTF), which aims to provide distances and peculiar velocities for all bright inclined galaxies with a limit of $K_s \leq 11.25$ mag in the 2MASS Redshift Survey (2MRS). Correspondingly, knowledge about the density distribution in the ZoA remains limited to statistical interpolations. We have pursued two different surveys to fill in the northern and southern ZoA. This data will for the first time allow a direct measurement of galaxy peculiar velocities. We have derived an optimized Tully-Fisher (T-F) template relation that will result in accurate measure of galaxy distances and flow fields in the ZoA. Derivation of the T-F template relation, magnitudes and biases corrections and preliminary results on flow fields in the southern ZoA will be presented.

279 - New Techniques for Determining Dopant Concentrations In Nitrogen Doped Carbon Nanospheres

DCMPM2 - Wednesday 10 July 2013 10:30

Authors: MARSICANO, Vincent *(University of the Witswatersrand)*

Carbon nanostructures have been the object of intensive research over the last two decades due to their potential to have a positive impact on materials. While carbon nanotubes have been studied extensively, there is still relatively little research conducted on doped carbon nanospheres . As part of a continuing characterization study of doped carbon nanospheres and their synthesis a new technique is being developed to determine the quantity and quality of dopant concentration in the spheres using different synthesis techniques. The spheres are synthesized in a CVD reactor using different ratios of reagents in an attempt to tune the nitrogen concentration of the doped nanospheres. An EPR spectrometer allows for an accurate determination of the mass concentration of paramagnetic sites using techniques developed over the last four years. It is suggested that the paramagnetic sites are due to substitutional nitrogen. The experimentally determined concentrations can then be used to provide useful feedback to the synthesis process. Raman Spectroscopy studies allow for investigation of structural changes, and to probe the type of bond the dopants form with the carbon lattice. AC susceptibility studies on the spheres provide complementary information on the magnetic properties of the doped nanospheres.

280 - A Search for Pulsations in the Infrared region of Herbig Ae star V589 Mon

Poster2 - Wednesday 10 July 2013 17:40

Authors: NTAMEHLO, Luvo *(University of North West(Mafikeng Campus))*

V589 Mon is a member of the Herbig Ae/Be stars that have delta Scuti type pulsations. There are 20 oscillation frequencies detected by using ground based telescopes and they range from 1,8691 per day to 11,1723 per day with amplitudes from 1,19mmag to 10,68mmag. We obtained time series observations of V589 Mon over 3 nights in the infrared J,H,K filters using the 1.4m Japanese telescope of the South African Astronomical Observatory in Sutherland. The aim was to search for pulsation frequencies that were seen in the optical band by other authors. The infrared amplitudes would be compared with models to see the effects of circumstellar disk on the pulsations of the star.

281 - Preliminary results of a Monte Carlo study to determine neutron fleunce using activation

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MAKHUBELA, Mathews *(University of The Western Cape)*
Co-authors: *HERBERT, Mark (University of the Western Cape); ESAU, Andrew (Dept. Of Health); MASONDO, Vusi (University of the Wester Cape); MULAUDZI, Immanuel (University of the Western Cape)*

In nuclear physics applications, such as fast neutron radiotherapy where neutron beams are used for cancer treatment and research, detailed knowledge of neutron fluence spectra are required since neutron interaction cross sections is energy dependent. There are a variety of methods that can be used to measure neutron energy spectra which includes time-of-flight, recoil spectrometry, threshold (activation or fission) spectrometry and methods based on neutron moderation. Although the time of flight measurement is most accurate for in air measurement in neutron radiotherapy facilities were flight path is small due space limitation in the treatment room threshold (activation or fission) spectrometry can be used as an alternative.In this work a Monte Carlo study, using MCNPX was carried out to investigate the feasibility of using neutron activation to measure fast neutron beam fluence spectra for a water phantom at iThemba Labs neutron beam line. MCNPX simulations were used to model the experiments. In these simulations the activation reactions for 1 cm× 2.54 cm diameter activation foils Aluminium, copper, iridium, Holmium, Tantalum, indium, Titanium, Terbium, Gold and Bismuth were calculated as well as the response for each of the activation reactions. These simulated activation reactions were unfolded into neutron fluence spectra, using the Bayesian unfolding code MAXED. This study reports on preliminary results obtained.

282 - The elastic properties and the phonon dispersions of TiPtCo shape memory alloy using the supercell approach

Poster1 - Tuesday 09 July 2013 17:40

Authors: MAHLANGU, Rosinah *(University of Limpopo)*

Shape memory alloys (SMAs) are classified as a group of metallic materials that has the ability to retain or remember their original shape or size when subjected to the appropriate thermal deformation processes. In general, these materials can easily be elastically or plastically deformed at some relatively low temperature, and upon exposure to some higher temperature can return to their original shape. The effect of substituting Pt with Co as the third element in the TiPt shape memory alloy system has been investigated using the supercell approach. The elastic properties of the TiPtCo high temperature SMAs were investigated by using the *ab initio* approach employed in VASP. Furthermore the electronic structure mechanisms behind the elastic properties are discussed based on the phonon dispersions.

283 - Prediction of foF2 from GPS TEC over AFRICA

Space Science - Tuesday 09 July 2013 14:10

Authors: *SSESSANGA, Nicholas (South African National Space Agency (SANSA) Space Sceince))*

The International Reference Ionospheric (IRI) model has been one of the most consistent in predicting ionospheric parameters over most of the geographical locations around the world. However, the model fails to predict accurately in regions where data was not available during its development, hence the use of data from Global Positioning System (GPS) receivers and other models. This paper describes a method (TEC2F2) of extracting foF2 values from GPS Total Electron Content (TEC). The method was first developed over the region of South Africa using the available Ionosondes stations; Grahamstown (33 .20 S, 26.30 E), Hermanus (34.4 0 S, 19.20 E), Louisvale (28.5 0 S, 21 .2 0 E) and Madimbo (-30.90 S, 22.20 E), to verify the results. The analysis of the results showed that the TEC2F2 method was more accurate at predicting the foF2 parameter over South Africa than the IRI-2007 model. The application of this method over the rest of Africa is proposed in order to more accurately predict the foF2 parameter in regions where Ionosondes do not exist.

284 - Comparison of indoor and outdoor current-voltage characterisation of photovoltaic modules

Applied - Friday 12 July 2013 09:20

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

Photovoltaic modules are specified based on their power output and thus it is very important that the maximum power (Pmax), voltage (V) and current (I) of photovoltaic (PV) modules be accurately determined. The power measurements are made at standard test conditions (STC) of irradiance (1000W/m2), temperature (25°C) and spectral distribution (AM 1.5). Temperature and irradiance can be corrected within a certain range but spectral distribution is related to the atmospheric conditions and tilt of the earth. Indoor PV module testing allows the performance parameters of a module to be determined under controlled conditions. The current-voltage (I-V) characteristic are determined by measuring the current and voltage of the module with a varied load either outdoors in natural sunlight or using a xenon flash lamp in a solar simulator. The solar simulator takes all these measurements during the very short period of time the light flash. In this paper indoor and outdoor testing procedures are presented and compared, and advantages and disadvantages of the two approaches are discussed. The uniformity of intensity of the flash light over the test area is investigated and discussed. I-V curves acquired using the different methods will also be presented and discussed.

285 - Recent Results on Spatially Resolved Molecular Gas Star Formation Law from CARMA Survey Towards Infrared-bright Nearby Galaxies (STING)

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *RAHMAN, Nurur (University of Johannesburg)*
Co-authors: *BOLATTO, Alberto (University of Maryland)*

The STING is a CARMA 3mm survey of nearby galaxies. We will present a comprehensive analysis of the relationship between the star formation rate surface density and molecular gas surface density at sub-kpc level in the STING sample. To construct the tracers of molecular gas surface density and star formation rate, respectively, we have used high resolution (3-5") CO (J=1-0) data from CARMA and the mid-infrared 24-micron data of comparable resolution (6") from Spitzer Space Telescope. Observational determinations of the functional relationship between star formation rate and molecular gas surface densities, commonly known as the star formation law, in galaxies require taking into account a number of factors. Extinction, contributions from non star-forming populations affect many measures of star formation, treatment of the diffuse emission, and statistical methodologies employed all have impacts on the precise relation between gas and star formation.We find that precise observational constraint on the linear or non-linear functional form of the relationship requires an accurate estimate of the fraction of the diffuse emission. Our results show that the treatment of the diffuse emission has significant impact on the intrinsic scatter in the Schmidt-Kennicutt type canonical star formation law. The scatter varies substantially with the choice of the star formation tracer used. For example, the non-linear 24-micron star formation tracer shows the tightest correlation with the molecular gas content whereas (azimuthally averaged) extinction corrected Halpha, as a tracer, appears to be the noisiest. Measuring the relationship in the bright, high molecular gas surface density (Sigma H_2 => 20 Msun/pc^2) regions of the disks to minimize the contribution from diffuse extended emission. Using mid-infrared emission as a tracer of star formation, we find an approximately linear relation between molecular gas and star formation rate surface densities with a molecular gas depletion time ~2.30 Gyr.

286 - Synthesis and Characterization of CaBxOy:Eu3+ nano-phosphors prepared using Solution - Combustion Method

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *SITHOLE, THOKOZANE MOSES (University Of the Free State)*
Co-authors: *KOAO, LF (University Of the Free State)*

Calcium borate (CaBxOy:Eu3+) phosphors with different Ca:B molar ratio and holding Eu concentration constant have been synthesized by a solution combustion method at reaction temperatures of 5000C for 15 minutes. The morphology, structure and luminescence properties of the synthesized nanostructures were investigated using X-ray diffraction (XRD), Scanning Electron Microscopy (SEM) and Photoluminescence (PL) spectroscopy. The XRD spectra of all the as prepared samples show an amorphous phase. SEM micrograph show that the surface aspect are nanorod like for Ca:B mole ratios but the grains become flake-like as the Ca:B molar ratio increased, giving rise to the increase in particle size resulting from agglomeration. PL results analysis showed that as the excitation wavelength increases the luminescence intensity also increases. The maximum luminescence intensity was found to be maximum at an excitation wavelength of 395 nm. The PL results also shows that the luminescence intensity of these emission spectra increased with the addition of more Ca:B molar ratio. The narrow emissions between 590-688 nm are due to transitions Eu3+. Keywords: CaB4O7:Eu3+, Nano-phosphors, Solution-Combustion

287 - Mathematical model for interferometric noise in a Raman distributed fiber sensor

Poster1 - Tuesday 09 July 2013 17:40

Authors: *SHIMAPONDA, Mulundumina (University of Johannesburg)*

Distributed fiber optic sensors (DFOSs), like all other fiber optic sensors (FOSs), have advantages of electromagnetic interference immunity, excellent measurement resolution and water and corrosion resistance. Strain, pressure and temperature are some of the physical parameters measured and monitored by DFOSs. One of the techniques employed by DFOSs is the Optical Time Domain Reflectometry (OTDR). In this technique, a short pulse of light, in the order of nanoseconds, is coupled into an optical fiber. Measurement of the backscattered power as a function of time/position on the fiber gives information about the local loss distribution. However, the power of the backscattered signal is very weak; its amplitude is comparable to that of the noise, affecting the measurement accuracy. This noise consists of the detection and system noise components. Detection noise comes from the photodetector and is easily quantified. The major contributor to the system noise is interferometric noise. Interferometric noise results from the interference of backscattering waves and is a function of the laser coherence length; the longer the coherence length the bigger the interferometric noise and vice versa. In this work, we propose a mathematical model for the interferometric noise of DFOS systems based on the OTDR technique. Using this model, we simulate a 10km Raman DFOS system. Input pulse durations of 20ns and 40ns and considering coherence lengths of 4m and 8m respectively are simulated. We report that the noise level due to an 8m coherence length source is about four times greater than that due to 4m coherence length. Our model agrees with established literature and can therefore be applied in Raman (DFOS) system to ascertain the level of system noise. Studies have demonstrated that the use of coding techniques in Raman DOFS systems based on the OTDR technique improves the signal to noise ratio (SNR). Our model includes two correlation coding based techniques, noisy pulse and bit stream, to enhance the system's SNR, and achieve temperature and spatial resolutions of 2■ and 2m respectively, suitable for application of temperature monitoring in power lines, conveyer belts, oil and gas pipelines.

288 - Correlation between the social background of a selected group of grade 10 learners and their views on the nature of science.

Education - Wednesday 10 July 2013 11:10

Primary authors: *BALOYI, Vonani (University of Pretoria)*
Co-authors: *BRAUN, MHW (University of Pretoria); GAIGHER, E (University of Pretoria); NORDHOFF, HI (University of Pretoria)*

This paper presents results of a questionnaire on the nature of science completed by a group of 82 grade 10 applicants to a science enrichment programme at the University of Pretoria. The questionnaire was composed of eleven open-ended questions examining learners' views on seven aspects of the nature of science. We discuss the results obtained and investigate the correlations between the student's 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. There was not a strong correlation between the grade 10 marks obtained in Mathematics, Science and English, neither did the pass rate of the school correlate with the test scores.

289 - The determination of critical behavior of ferromagnetic CeCuGe using magnetocaloric effect

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *SONDEZI, Buyi (University of Johannesburg)*
Co-authors: *SNYMAN, Jasper (University of Johannesburg); STRYDOM, Andre (University of Johannesburg)*

Critical behavior of magnetic systems associated with a second order phase transition is of general interest in condensed matter physics as a tool with which to study universal behavior across a wide range of magnetic systems. Typically a specific universality class is characterized by a set of critical exponents, the latter determining the type of divergences occurring in thermo-magnetic quantities (or their derivatives) as the phase transition temperature is approached. Here we present results obtained from specific heat and magnetization measurements of CeCuGe. It has been established that this compound exhibits an anomaly associated with ferromagnetic ordering at T_C = 10 K [1]. The associated critical exponents have been determined in this study employing Arrott plots technique [2, 3]. This technique yields the location of the phase transition temperature as well as the values of the critical exponents, the latter relegating CeCuGe to a class of mean field ferromagnets. An independent analysis of these results in terms of the magnetocaloric effect (MCE) are presented. The MCE is defined as an isothermal change in entropy upon magnetization, or alternatively, an isentropic change in sample temperature upon the removal of an externally applied magnetic field. Of interest is the scaling behavior of the isothermal MCE at the phase transition temperature with applied field, which has been shown to occur in ferromagnetic alloys [4]. Informed by the Arrott-plot analysis, we compare the behavior of the MCE with the predicted scaling behavior of a mean field ferromagnet. [1] Yang F, Kuang J P, Li J, Bruck E, Nakotte H, de Boer F R, Wu X, Li Z and Wang Y,1991 J. Appl. Phys. 69 4705[2] Mohan C V, Seeger M, Kronmuller H, Murugaraj P and Maier J, 1998 J. Magn. Magn.Mater. 183 348[3] Said M R, Hamam Y A, Abu-Aljayaresh I and Mahmood S, 1999 J. Magn. Magn. Mater.195 679[4] Franco V, Blazquez J S and Conde A, 2006 Appl. Phys. Lett. 89, 222512

290 - Molecular dynamics simulations of Ti and Y impurities in tin-dioxide (SnO2)

Poster1 - Tuesday 09 July 2013 17:40

Authors: *MOSUANG, Thuto (University of Limpopo)*

The present study use classical molecular dynamics technique to report the effect of Ti and Y impurities in tin-dioxide.Empirical Buckingham potential has been chosen to describe the interatomic interations in tin-dioxide. Total energy NPT nose-hoover ensemble at various temperatures has been calculated in order to determine the effect of Ti and Y substitutional defects in tin-dioxide. The results obtained suggest that Ti defect lowers the energy of the host tin-dioxide. The radial distribution functions of Ti doped tin-dioxide suggest the transfromation of anatase to rutile phase at ambiemt temperatures.

292 - Developing gamma-ray tracking with a segmented Ge detector

NPRP - Tuesday 09 July 2013 15:40

Primary authors: *LAWRIE, Elena (iThemba LABS)*
Co-authors: *BUCHER, T.D. (iThemba LABS); EASTON, J.L. (iThemba LABS, UWC); NONCOLELA, S.P. (iThemba LABS, UWC); SHIRINDA, O. (iThemba LABS)*

This presentation is an overview of the basic techniques that make possible to trace the gamma-ray interactions inside a segmented Ge detector and reconstruct the gamma-ray trajectory. The presentation will outline the process of developing gamma-ray tracking in general and also the plans for developing the position sensitivity of the iThemba LABS segmented clover detector. The talk is intended as an introduction to four more presentations on this topic, which will discuss the progress made so far and the plans for the future. In addition ideas about possible applications of this new generation gamma-ray detector will be presented.

293 - Effect of annealing on undoped and Ce, Dy, Eu, Ni-doped ZnO properties synthesized by sol-gel method using zinc acetate and sodium hydroxide in aqueous ethanol solution.

Poster1 - Tuesday 09 July 2013 17:40

Authors: *UNGULA, Jatani (University of the Free State)*

AbstractIn this study, un doped and Ce, Dy, Eu, and Ni-doped zinc oxide (ZnO) was prepared by sol-gel method from zinc acetate, metal nitrates and sodium hydroxide with water and ethanol as solvents. Doping with selective elements offers an effective method to enhance and control the electrical and optical properties of ZnO nanostructures, which is crucial for its practical application. The effect of the annealing temperature on the particle size, morphology and photo-luminescence (PL) properties of the synthesized ZnO nanoparticles were studied by XRD, SEM, UV-VIS, and PL measurements. The XRD results indicated that the synthesized ZnO nanoparticles had the pure wurtzite structure. It is found that with annealing the crystalinity improved and the particle size increases while the band gap energy of the materials reduces. The grain sizes of as-prepared doped ZnO nanoparticles calculated using the Scherer formula are in the range of 30 - 40nm. The dopants were also observed to have slight effect on the grain sizes. The high intensities of calcined ZnO nanostructure peaks with narrower width reveal a highly crystallized wurtzite structure. The absorption spectra of the products show that the percentage absorption in visible range increases with annealing temperature. The SEM micrograph of ZnO revealed that the surface aspect dependents on both the dopant used and annealing temperature. Furthemore, PL spectra showed strong, broad and intense emission in visible region for Ce-doped ZnO samples while other dopants suppressed this green emission.Keywords: ZnO:Ce3+, Sol-gel, , Nanoparticles, Luminescent, RE3+-dopants

295 - Challenges in the simulations of the iThemba LABS segmented clover detector

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *BUCHER, T.D. (iThemba LABS)*
Co-authors: *NONCOLELA, S.P. (iThemba LABS); LAWRIE, E.A (iThemba LABS); EASTON, J.L. (iThemba LABS, UWC); SHIRINDA, O. (iThemba LABS)*

In June 2012, iThemba LABS acquired a Multi Geometry Simulation (MGS) code [1] from France. This code is capable of simulating the field and the response of the segmented detector from an arbitrary gamma-ray interaction in the detector active volume. With this code, the sensitivity of our iThemba LABS segmented clover detector to the exact position of the gamma-ray interaction was determined and it is the topic of another presentation [2]. In this presentation we evaluate how realistic are the obtained, so far, simulations with MGS code are in comparisons with simulations performed with other simulation packages such as FEMLAB on TIGRESS [3] detector. In additions simulations of other segmented detector such as AGATA performed with MGS and ADL code [4] will also be discussed. Taking into account all the presented data, the way forward for obtaining the realistic pulse shapes with the iThemba LABS segmented clover detector will be formulatedRERENCES[1] A simple method for the characterisation of HPGe detectors, P. Medina, C. Santos, Di Villaume, Instr. Meas. Tech. Conf (2004)[2] Simulation of the position sensitivity of the segmented iThemba LABS HPGe detector, S.P. Noncolela et. al, SAIP 2013.[3] Pulse shape characterization and simulation of TIGRESS gamma-ray detector, R. Prest, Bachelor of Applied Science degree thesis, Simon Fraser University, 2005.[4] Space charge reconstruction in highly segmented HPGe detectors through capacitance-voltage measurements, B. Bruyneel, B. Birkenbach, P. Reiter, Nucl. Instr. Meth. A, 641, 92-100, 2011

296 - Shedding light on the invisible - Radio signals from Dark Matter

Astro - Wednesday 10 July 2013 16:00

Primary authors: *ORFORD, Nicola (University of the Witwatersrand)*
Co-authors: *REGIS, Marco (University of Torino - Italy); COLAFRANCESCO, Sergio (University of the Witwatersrand)*

Dark matter is everywhere, but is elusive to any direct or indirect probe. We thus explore new astrophysical methods for indirect dark matter detection. Annihilation of dark matter particles produces emission signals that populate the whole electromagnetic spectrum, from radio to gamma-rays. In particular, we consider diffuse radio emission probes from dwarf spheroidal galaxies such as the Carina dwarf galaxy. Investigation of these emissions allows us to place strong limits on the mass of the dark matter particles and the velocity averaged annihilation rate and possibly arrive at a positive detection in the near future.

297 - The effect of EWG and EDG on the HOMO and LUMO levels of Alq3.

DCMPM2 - Wednesday 10 July 2013 11:10

Primary authors: *DUVENHAGE, Mart-Mari (University of the Free State)*
Co-authors: *NTWAEABORWA, Martin (University of the Free State); SWART, Hendrik (University of the Free State); VISSER, Deon (University of the Free State); SWARTS, Jannie (University of the Free State); SWARTS, Pieter (University of the Free State)*

Tris-(8-hydroxyquinoline) aluminium (Alq3) is used as both the emission and electron transporting layer in organic light emitting diodes (OLEDs). One way to tune the emissive colour of Alq3 is to introduce electron-withdrawing and electron-donating groups (EWG and EDG) onto the hydroxyquinoline ligands. These groups will have an effect on the energy gap between the highest occupied molecular orbital (HOMO) and the lowest unoccupied molecular orbital (LUMO). In this study Alq3 powders were synthesized with an EDG (-CH3) substituted at position 5 and 7 ((5,7-dimethyl-8-hydroxyquinoline) aluminium) and EWG (-Cl) at position 5 ((5-chloro-8-hydroxyquinoline) aluminium). Absorption and photoluminescence spectra were measured for the different samples and a red shift were observed for both 5,7Me-Alq3 and 5Cl-Alq3. The optical band gap calculated using Tauc's relation and the absorption data showed that there was a decrease in the bandgap of 0.3 - 0.5 eV. Cyclic voltammetry (CV) were performed on the samples. The HOMO levels of 5,7Me-Alq3 and 5Cl-Alq3 showed a bathochromic shift with respect to Alq3.

298 - Sn and Sb segregation in single and polycrystalline Cu

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *ASANTE, Joseph (Tshwane University of Technology)*
Co-authors: *ROOS, Wiets (UFS)*

Ternary alloys Cu-(100) and Cu-(111) single crystals and a Cu polycrystalline were doped with the same concentrations of 0.14 at.% Sn and 0.12 at.% Sb. A linear temperature ramp was used to heat each of the samples at a constant rate of 0.05 K/s while the surface concentrations were monitored simultaneously by Auger electron spectroscopy. The segregation parameters of Sn and Sb in the three samples were determined by simulating the experimental data with the modified Darken equations. It was found that the Sn surface fractional concentration, in the low index Cu, peak around 700 K and in the polycrystalline sample the peak was much reduced and at a higher temperature around 780 K. On the other hand, the Sb segregated profiles in the three samples follow the normal Cu-Sb binary alloy profile with the same equilibrium temperature region. The quantified segregation parameters will be used to explain the Sn and Sb profiles.

299 - Probing the Cosmological Model With Meerkat and the SKA

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *MATSHAWULE, Siyambonga (University of the Western Cape)*
Co-authors: *MAARTENS, Roy (University of the Western Cape); JOHNSTON, Russell (University of the Western Cape); MCALPINE, Kim (University of the Western Cape); SMITH, Mathew (University of the Western Cape)*

Understanding how the growth of structure in the Universe evolves over cosmic time remains a key science driver in modern observational cosmology. The two-point correlation function is a fundamental probe of the galaxy distribution that allows us to quantify how galaxies cluster over a range of scales.The forthcoming MeerKAT radio telescope array (the precursor instrument for the Square Kilometre Array - SKA) is currently being built in the Karoo and will be the most sensitive radio telescope in the southern hemisphere. Observations from MeerKAT will thus discover orders of magnitude more galaxies than current experiments and provide greater insight into the growth of structure of radio sources which we can compare to current and upcoming multi-wavelength data. In this project we have constructed state of the art simulations of the expected MeerKAT observations, to understand the optimum calibration strategy for future surveys and provide predictions of the clustering statistics of radio galaxies.

300 - Depletion voltage measurements of the iThemba LABS segmented clover detector.

NPRP - Tuesday 09 July 2013 16:20

Authors: *EASTON, Jayson (iThemba LABS and University of the Western Cape)*

J.L. Easton1,2, O. Shirinda1 , E.A. Lawrie1,T. D. Bucher1 , S.P. Noncolela1,2, N. Orce2,1 iThemba LABS, PO Box 722, 7129 Somerset West, South Africa2 University of the Western Cape, Privare Bag X17, 7535 Bellvile, South AfricaThe measured depletion voltages of the four crystals of the iThemba LAB segmented clover detector was compared to the manufacturer specifications. We measured the depletion voltage by measuring the peak centroids and peak areas as a function of applied voltage. We had used three sources namely 137Cs, 60Co and 241Am. A reduced chi squared analysis was then used to infer depletion voltages. It was found that the depletion voltage was higher than the manufacturer specifications for all four crystals. The depletion voltages depend on the amount of the impurities in each crystal, which are very important for simulating correctly the gamma-ray interaction points inside the detector.

301 - South African night sky brightness during high aerosol epochs

Applied - Wednesday 10 July 2013 11:10

Primary authors: WINKLER, Hartmut (Dept. Physics, University of Johannesburg)
Co-authors: VAN WYK, Francois (SAAO); MARANG, Freddy (SAAO)

Sky conditions in the remote, dry north-western interior of South Africa are now the subject of considerable interest in view of the imminent construction of numerous solar power plants in this area. Furthermore, the part of this region in which the core of the SKA is to be located (which includes SALT) has been declared an Astronomical Advantage Zone, for which sky brightness monitoring will now be mandatory. In this project we seek to characterise the sky brightness profile under a variety of atmospheric conditions. Key factors are of course the lunar phase and altitude, but in addition the sky brightness is also significantly affected by the atmospheric aerosol loading, as that influences light beam scattering. In this paper we chose to investigate the sky characteristics soon after the Mount Pinatubo volcanic eruption in 1991, which resulted in huge ash masses reaching the stratosphere (where they affected solar irradiance for several years). We re-reduced photometric sky measurements from the South African Astronomical Observatory archives (and originally obtained by us) in different wavelengths and in a variety of directions. We use this data explore relationships between the aerosol loading and the sky brightness in a range of conditions, including several post-Pinatubo phases and during the passage of biomass burning induced haze and dust clouds. We discuss the impact of our findings on the applicability of light scattering models and light scatterer properties.

303 - Plasma dynamics and species emission study of vanadium (IV) oxide (VO2) in oxygen background

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: MASINA, Bathusile (CSIR National Laser Centre)
Co-authors: LAFANE, Slimane (Centre de de´veloppement des technologies avance´es); WU, Lorinda (CSIR National Laser Centre); FORBES, Andrew (CSIR National Laser Centre); TAHAR, Kerdja (Centre de de'veloppement des techonologies avance`es); SAMIRA, Abdelli-Messaci (Centre de de'veloppement des techonologies avance`es)

Optical emission spectroscopy diagnostic of VO2 plasma created by an excimer KrF laser pulse at 2 J/cm2 laser fluences was performed under range of oxygen pressure. A spatio-temporal evolution study of different species such as VI (437.85 nm), VII (326.1 nm), VIII (237.1 nm) and VO (608.56 nm) are presented and compared. The plume expansion dynamics of an ablated target of VO2 was also investigated using fast imaging. Free expansion, splitting and stopping of the plume were observed at different pressure and time delays. It was observed that at early time delays, the expansion is linear. However, as time evolves, the plume is decelerated and comes to rest. The plasma plume dynamics was analysed in the framework of Predtechensky and Mayorov model and drag model. It was discovered that Predtechensky and Mayorov model gives a general description of the plume expansion. However, at a later time delays, it is rather the drag model which is valid.

309 - New iThemba-LABS and Wits University Ion Implantation Facility

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: DERRY, Trevor (University of the Witwatersrand)
Co-authors: NAIDOO, Mervin (University of the Witwatersrand); MULLINS, Simon (iThemba LABS (Gauteng))

Ion implantation is one of the most versatile techniques for preparing solid surfaces for many different applications -- in physics, chemistry, engineering or even biology, as users of the former University of the Witwatersrand facility will be aware. Wits has now joined forces with iThemba LABS (Gauteng) to acquire a "new" second-hand ion implantation accelerator in a joint venture, and to equip it with a universal ion-source able to produce beams from the entire periodic table. The facility has been installed and commissioned and is available for collaborative research, with a resident operator-technician.Some of the current research is described.

311 - Implementation and security analysis of fiber-based B92 QKD protocol

Applied - Wednesday 10 July 2013 14:30

Primary authors: SENEKANE, Makhamisa (Quantum Research Group, School of Chemistry and Physics, University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa)
Co-authors: MAFU, Mhlambululi (University of KwaZulu-Natal); MIRZA, Abdul (University of KwaZulu-Natal); PETRUCCIONE, Francesco (University of KwaZulu-Natal)

Quantum Key Distribution (QKD) is an encryption scheme which uses two concepts of quantum mechanics, namely No-cloning Theorem and Uncertainty Principle, to allow a secure exchange of a cryptographic key between two communicating parties; Alice (sender) and Bob (receiver) in such a way that the presence of an eavesdropper (Eve) could be detected.In this paper, we report our work on the implementation of the B92 QKD protocol on id3100 Clavis2 `plug-and-play' cryptosystem. Traditionally, this cryptosystem only supports two four-state QKD protocols, namely BB84 and SARG04 protocols. However, we show in this work that it is possible to implement a two-state protocol (B92) in such a system, by changing the number of encoded state. Additionally, we provide a security analysis of our approach, in order to ascertain its feasibility.

318 - Validation of the calculated efficiency parameters for the gamma-ray detector using 152Eu standard sources

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MAIBANE, Kutullo (Student)
Co-authors: LINDSAY, Robbie (co-supervisor)

For radioactivity measurement of environmental samples, gamma-ray spectrometry with high resolution semiconductor detectors (e.g. HPGe) has been widely used. For these detectors, absolute peak efficiency for each gamma-ray energy with given measuring conditions (e.g. geometry, density, chemical composition) has to be determined or known. Efficiency calibrations of the detectors are mainly performed using standard radioactive sources with multiple gamma-ray lines covering the energy range of interest. Although the experimental determination of the detector efficiency is the most accurate method, volume sources containing 152Eu are mainly affected by coincidence or cascade summing. One effective method to overcome these deficiencies, Monte Carlo calculations has been incorporated for full-energy efficiencies calibrations of the detectors. Monte Carlo simulations provide flexibility in terms of geometrical dimensions, density and gamma-ray energy, thereby also minimising the use of radioactive materials.In this study, we validate the simulated detector efficiency parameters by analysing three liquid standard radioactive sources. We present a comparison of the results for every gamma-ray energies in 152Eu as a function of the expected activity concentration in the three sample sources.

320 - FPGA-based emulation of qudit quantum Fourier transform circuit

Applied - Wednesday 10 July 2013 14:50

Primary authors: SENEKANE, Makhamisa (Quantum Research Group, School of Chemistry and Physics, University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa)
Co-authors: MIRZA, Abdul (University of KwaZulu-Natal); PETRUCCIONE, Francesco (University of KwaZulu-Natal)

Quantum computing is the exploitation of quantum mechanical concepts such as entanglement and superposition to process quantum information. In some aspects of computing, quantum computing is known to outperform its classical counterpart. However, a full-scale quantum computer has not yet been realised. Therefore, in order to gain a deeper understanding of quantum circuits; which are building blocks of quantum computers, they are modelled either in software or hardware. Software simulation of quantum circuits is however limited, since it does not efficiently use parallelism, which is intrinsic in quantum computation. On the other hand, hardware-based emulation closely mimics quantum computation due to its parallelism, and the fact that emulation gives further insight on the issues of signal propagation delays and errors. Currently, the emulation of quantum circuits has focused mainly on emulating two-dimensional quantum circuits [1-3]. In this paper, we report on the emulation of d -dimensional Quantum Fourier Transform (QFT) circuit using Field Programmable Gate Array (FPGA). We also compare the performance between software-based simulation and FPGA- based emulation.REFERENCES[1] Negovetic G, Perkowski M, Lukac M and Buller A 2002 Evolving quantum circuits and an FPGA-based quantum computing emulator Proc. Fifth Intern. Workshop on Boolean Problems pp 15-22[2] Khalid A, Zilic Z and Radecka K 2004 FPGA emulation of quantum circuits Computer Design: VLSI in Computers and Processors, 2004. ICCD 2004. Proceedings. IEEE International Conference on pp 310-315 ISSN 1063-6404[3] Aminian M, Saeedi M, Zamani M and Sedighi M 2008 FPGA-Based circuit model emulation of quantum algorithms Symposium on VLSI, 2008. ISVLSI '08. IEEE Computer Society Annual pp 399-404

322 - Synthesis, structural and magnetic properties of MnxNi1-xFe2O4 nanoferrites

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: ABDALLAH, Hafiz M I (University of KwaZulu-Natal)
Co-authors: MOYO, Thomas (University of KwaZulu-Natal)

Glycol-thermal technique was used for the synthesized MnxNi1-xFe2O4 (x = 0.1, 0.3, 0.5) nanoparticle ferrites from high-purity metal chlorides. Structure parameters and magnetic properties were investigated using X-ray powder diffraction (XRD), 57Fe Mössbauer spectroscopy, vibrating sample magnetometer (VSM) on a cryogen free measurement system. XRD results confirmed single-phase formation of the as-prepared samples with average crystallite sizes of about 8 nm having Fd3m space group. The microstrains for the as-prepared samples were relieved by increasing Mn- concentration, x, while the coercivity and lattice parameters were decreased. Temperature and magnetic field dependences as a function of magnetization for the as-prepared sample at = 0.5 in external field of up to 5 T and at isothermal temperatures ranged from 2 K to 300 K. Tiny values of coercive fields indicate superparamagnetic like-behavior of studied compounds are also investigated.

326 - Synthesis and magnetic characterizations of MnxFe3-xO4 nanoferrites

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: ABDALLAH, Hafiz M I (University of KwaZulu-Natal)
Co-authors: MOYO, Thomas (University of KwaZulu-Natal); MASINA, Patrick (University of KwaZulu-Natal)

Manganese ferrite nanoparticles with in steps of 0.1 have been produced using the glycol-thermal method at 200 oC. Single-phase formation was confirmed by X-ray powder diffraction (XRD) which revealed a well-defined cubic spinel structure with space group Fd3m. structure parameters were also estimated from XRD data. Average crystallite sizes ranged from 8.91 to 9.77 nm. The Vibrating sample magnetometer measurements show that the produced nanoparticles exhibit superparamagnetics behavior at room temperature. Magnetic properties as a function of the manganese content measured at 300 K were also investigated. The Fe3+ ions distributions among tetrahedral and octahedral sites, hyperfine parameters and magnetic state of the as-prepared samples were studied using 57Fe Mössbauer spectroscopy technique.

346 - Thermal stability studies on Palladium Schottky contacts on n- Si (111) and the defects introduced during fabrication and annealing processes.

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: DANGA, Helga *(University of Pretoria)*
Co-authors: *DIALE, Mmanstae (University of Pretoria)*

Palladium (Pd) Schottky contacts were fabricated on epitaxially grown n-type Silicon (111) by electron beam deposition. Current-voltage (I-V), capacitance- voltage (C-V) and deep level transient spectroscopy (DLTS) measurement techniques were used to characterise the as deposited and annealed and Pd/n-Si Schottky contacts. These contacts were annealed at temperatures ranging from 100°C to 400°C, in steps of 25°C for twenty minutes at each temperature. The ideality factor increased from 1.02 for as deposited to 2.61 after annealing at 400°C while the Schottky barrier height (SBH) decreased from 0.80 to 0.70 eV for the as deposited and annealed at 400°C contacts. DLTS revealed that electron beam deposition introduced defects which were identified as the E-centre (VP centre), the A-centre (VO centre), the interstitial carbon (Ci) and the interstitial carbon-substitutional carbon (CiCs) pair. Isochronal annealing at twenty minute intervals revealed that the E-centre vanishes between 125 and 175°C annealing while the concentration of the A-centre increased in this range. The A-centre annealed out above 350°C and after 400°C.

349 - Effects of Combinational Doping on the Phase Transformation of Nano Titanium Dioxide

Poster1 - Tuesday 09 July 2013 17:40

Authors: NUBI, Olatunbosun Nubi *(University of Limpopo)*

Single and double doped nanometric powders of TiO■ were synthesised by the sol-gel process using titanium isopropoxide as the precursor. The metal dopants used were Ag and Cu. In order to investigate the TiO■ phase transformation, the samples were calcined at various temperatures and then characterised by XRD, Raman and SEM techniques. The results suggests that the co-doped TiO■ powders are constituted by anatase and brookite phases while in the case of pure and singly doped samples only anatase is observed. 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.

355 - The Sutherland site seeing conditions and the prospect of an AO system for SALT

Astro - Tuesday 09 July 2013 11:50

Authors: CATALA, Iaure *(SAAO-UCT)*

A site monitoring campaign of the Sutherland site was initiated in 2010 to support the potential development of an adaptive optics (AO) system for the Southern African Large Telescope (SALT). As part of that campaign, continuous monitoring with the SAAO MASS-DIMM instrument provided 3 years of data so far. Two campaigns, over a shorter period of time, using instruments from collaborators at the University of Durham (U.K.) and the University of Nice Sophia Antipolis (France), provided complementary and comparative data. The Sutherland campaign with the PBL (Profileur de Bord Lunaire - “Lunar Limb Profiler” in French) instrument, from the Nice group, was also part of the instrument development and commissioning to which we participated. The PBL provides atmospheric profiles which reconstruction was calibrated using results from the MASS-DIMM. However, the PBL produces profiles with a higher vertical resolution than the MASS-DIMM. Results from the site monitoring instruments are currently used in simulations, in order to demonstrate the potential capabilities of an AO system on SALT.In this talk I will give an overview of the seeing monitoring instruments suite used at Sutherland. Then I will present the results from the past 3 years of data together with the results from the AO simulations. Finally, I will discuss our future plans towards the feasibility and design study for such a system on SALT.

357 - Microstructural Characterization of Sub-micron Copper Powder Consolidated by Spark plasma sintering for Heat Sink.

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *SULE, RASIDI (DTech Student at TUT)*
Co-authors: ASANTE, Joseph *(TUT); SIGALAS, Lakovos (Wits)*

AbstractsSemiconductor electronics industry has made considerable advancement over the last decade. Meanwhile, the essential requirements of heat sink among all types of components in all electronics system remain unchanged because electronics component need to dissipate power densities. In electronic systems, heat sinks are devices that cool the hotter body by dissipating the heat and this heat is conveyed out of the component by air to avoid the problem of overheating. With the increasing performance and packing density required in microelectronic devices, copper has shown to be a material of choice for thermal management due to its attractive properties of high conductivity of 385 W/m-K) and low electrical resistivity of 1.67μΩ-cm (Lanford et al., 1995; Chai and Chen, 2010). Despite the attractive thermal management properties of Cu achieving full densification of this material is still a challenge due to the oxidation of copper at room temperature. Powder metallurgy is a promising method of fabricating copper and copper composites due to its good densification and ease of operation with cost effective. Spark plasma sintering technique is a short time sintering process where powder particles are compacted by uniaxial pressing and heating simultaneously. This study presents characterization of Cu fabricated by spark plasma sintering for thermal management in microelectronics packaging. The microstructure of the Cu powders will be investigated using high resolution scanning electron microscopy (HRSEM). Phase present will be investigated with X-ray diffraction (XRD) analysis. Density, porosity, electrical resistivity, thermal conductivity will be measured to evaluate the performance of sintered samples.

358 - The IAU Office of Astronomy Development

Education - Tuesday 09 July 2013 16:20

Authors: MAUDUIT, Jean-Christophe *(International Astronomical Union Office of Astronomy for Development)*

The International Astronomical Union (IAU) is the largest body of professional astronomers in the world and has set up the Office of Astronomy for Development (OAD) in partnership with the South African National Research Foundation (NRF). The OAD is located at the South African Astronomical Observatory (SAAO) in Cape Town. Its mission is to realise the IAU's Strategic Plan, which aims to use astronomy as a tool for development. In 2012 the first open Call for Proposals was launched, focusing on three main areas: "Universities and Research", "Children and Schools" and "Public Outreach". Eighteen projects worldwide have been approved for 2013 and are currently under way. The OAD is also setting up regional nodes and language expertise centres around the world. This presentation will describe the ongoing activities of the OAD and plans for the future.

365 - The Emergence of Gravitational Spaces

Theoretical - Wednesday 10 July 2013 13:50

Authors: MOOLMAN, Simon *(University of the Witwatersrand)*

There is a large amount of evidence to indicate that gravity, like pressure, is an emergent phenomenon which may appear as the limit or average of another, more fundamental, theory. I will review the evidence for the emergent interpretation of gravity, discuss how the Einstein Field Equations can be derived as an equation of state like the ideal gas law, and also explore whether or not there exist other gravitational equations of state. This would imply the existence of alternate gravitational field equations and hence a possible departure from the predictions made by Einstein's gravity.

387 - Analysis of the spatial and spectral neutron distribution of various conceptual core designs with the aim of optimising the SAFARI-1 research reactor.

Applied - Wednesday 10 July 2013 15:40

Primary authors: OLAUWALEYE, olakunle *(University of Johannesburh)*
Co-authors: *PRINSLOO, Rian. H. (South Africa Nuclear Energy Cooperation (NECSA)); ADETULA, Bolade (South Africa Nuclear Energy Cooperation (NECSA)); CONNELL, Simon. H (University of Johannesburg)*

SAFARI-1 is a 20MW research reactor which is over 45 years old, and is expected to reach the end of its operating life between 2020 and 2030. The purpose of this study is to investigate various alternative conceptual core layouts of the SAFARI-1 reactor in order to facilitate more efficient use of the reactor, while potentially extending its operating life. The spatial and energy neutron distribution is one of the most important parameters in the characterization of such an alternative core layout. This neutron distribution is a result of basic physics processes such as particle matter interactions, nuclear reactions, material properties, effect of temperature and the time evolution of the system. In this study we will focus on the steady-state neutron distribution within the highly heterogeneous and complex geometry of the reactor core for the various alternative core layouts. Basically, we are looking for a different inhomogeneous neutron distribution within the core, arising from a different core layout, which can nonetheless still achieve efficiency in the operation for various design purposes, but with a lower power output.The safety and utilization requirements for the SAFARI-1 research reactor are quantifiable in terms of its steady-state neutron flux distribution. A SAFARI-1 reference core, obtained via an equilibrium cycle calculation, was used to generate a set of safety and utilization targets against which alternative designs may be measured. Alternative core layouts were developed by using a parametric study to scope the size and power level of potential candidate conceptual cores with the aim of minimizing the power level while adhering to the safety requirements. Utilization parameters of interest include isotope production capability, thermal flux levels in beam tubes and production levels in the silicon doping facility.Results indicate that an alternative core with a power of 17MW can achieve similar performance as the current 20MW SAFARI-1 design, by simply rearranging components in the core. Additional power reduction is only possible if significant core design changes are allowed.

427 - Improvement of calibration accuracy in fibre optic wavelength for DWDM applications

Photonics - Friday 12 July 2013 10:30

Authors: ADRIAAN, van Brakel *(NMISA)*

Accurate wavelength measurement is of great importance in optical fibre networks, particularly due to the architectures such as dense wavelength division multiplexing (DWDM). DWDM allows different ‘channels’ (or data streams) to be transmitted simultaneously along the same fibre, with each channel occurring at a specific wavelength. As the number of channels increases, so the channel spacing (or wavelength ‘gap’) decreases between consecutive data-carrying streams. This allows for a single fibre to transmit vastly greater amounts of data – thus improving network capacity. For DWDM applications, in particular, the range of optical communications wavelengths for which the highest accuracies are required is that between 1460 nm and 1625 nm. NMISA’s Fibre Optics Laboratory relies on an optical spectrum analyser (OSA) to measure optical power as a function of wavelength. Traceability for optical wavelength used to be derived solely from the absorption spectrum of an acetylene-filled reference cell built into the OSA. However, acetylene’s near-infrared rotational vibrational absorption spectrum ends just beyond 1540 nm. This meant that, in the past, fibre optic wavelength could not be measured with an accuracy that is small enough to distinguish between consecutive DWDM channels in the most important wavelength regions: near 1550 nm and 1620 nm.This paper details the improvements made at NMISA in the accuracy of measuring fibre optic wavelengths in the near-infrared. These improvements have been achieved as the result of using an external gas reference cell containing hydrogen cyanide (HCN) and carbon monoxide (CO). The absorption spectra of these gases are centred at 1534 nm and 1610 nm, respectively. This has allowed measurements to be made at accuracies of less than 0,2 nm near these wavelengths – as is necessary for DWDM applications. Comparisons between measured and modelled absorption spectra show the practical implications involved in providing traceability for fibre optic wavelength based on gas reference cells.

429 - Correlation between SQUID data and ionospheric and/or seismic events

Space Science - Wednesday 10 July 2013 14:10

Primary authors: *MATLADI, Thabang (South African National Space Agency)*
Co-authors: *FOURIE, Coenrad (Stellenbosch); SAUNDERSON■, Elda (South African National Space Agency); GOUWS, Danie (South African National Space Agency)*

The Superconducting QUantum Interference Devices (SQUIDs), are fairly recent types of magnetometers, that use flux quantization combined with Josephson tunneling to detect very faint (~fT) magnetic fields. Recent studies have shown that these highly sensitive magnetometerslocated in an ultra-low-noise environment, are capable of observing Earth-ionosphere couplings, such as: P waves emitted during earthquakes or magnetic storms in the upper atmosphere; S and T breathing modes of the Earth during quiet magnetic & seismic periods. Since SQUIDs are much more sensitive compared to conventional magnetometers, they are arguably the best tool for understanding space weather and natural hazards, whether they are produced from space,within the ionosphere by magnetic storms for instance, or natural disturbances, including magnetic disturbances produced by earthquakes or as a result of the dynamics of the Earth's core. A study was conducted at SANSA Space Science in Hermanus (WC), to find the correlation between SQUID and Fluxgate data sets, with the aim of validating the use of SQUID as reliable instrument for Space Weather observations. In this study, SQUID data, obtainedfrom the Low Noise Laboratory (LSBB) in France was compared to fluxgate data sets from three closest observatories to LSBB, namely; Chambon la Foret (France), Ebro (Spain) and Furstenfeldbruck (Germany), all further than 500 km from LSBB. As a follow-up study, our aim is to correlate SQUID data at Hermanus with ionospheric and othermagnetic data available on-site.In the previous study, the three-axis SQUID used comprises of threelow–Tc devices operated in liquid helium in an underground, magneticallyclean environment shielded from most human interference. The SQUIDmagnetometer operated at Hermanus for the duration of this study is ahigh-Tc two-axis device (measuring the z and x components of the geomagnetic field). This SQUID magnetometer operates in liquid nitrogen, andis completely unshielded in the field of about 26 μT. The environment ismagnetically clean to observatory standards, but experiences more humaninterference than that at LSBB. The high-Tc SQUDs also experience 1/fnoise at low frequencies which the low-Tc SQUIDs do not suffer from, butthe big advantage to the current study is that the SQUIDs are within 50m from the observatory fluxgates.

431 - Synthesis and characterization of novel semiconductor nanocrystals for third generation solar cells

DCMPM2 - Friday 12 July 2013 09:40

Primary authors: *MOLOTO, Nosipho (University of the Witwatersrand)*
Co-authors: *KALENGA, Mubiaya (University of the Witwatersrand); MOHOTLHOANE, Sifiso (University of the Witwatersrand); AIRO, Mildred (University of the Witwatersrand)*

Semiconductor nanocrystals are attractive materials for use in photovoltaic devices mainly as a result of their tuneable absorption spectrum, large surface area (because of their small size), their adaptability, their ability to generate multiple excitons as well as their capability of hot carrier injection from excited state i.e. by minimizing energy losses during the thermalization of excited state. Semiconductor nanocrystal solar cells are projected to achieve higher efficiencies than silicon based solar cells while reducing the cost of (1) each kilowatt of electricity produced, (2) the raw materials and (3) the processes used to convert the raw materials into functional cells. Semiconductor nanocrystals in solar cells are very versatile and can be used in various types of photovoltaic cells, such as metal junction solar cells, hybrid solar cells, infrared solar cells, multi-exciton generating solar cells, quantum dot dye sensitized solar cells, rainbow solar cells, intermediate band solar cells, and luminescent solar cells. Herein novel synthesis and characterization of various types of semiconductor nanocrystals is reported. Their properties and relevance to application in photovoltaics is discussed.

433 - Using Astronomy to enhance Physics teaching at undergraduate level

Education - Tuesday 09 July 2013 14:30

Authors: *CATALA, Iaure (SAAO-UCT)*

In this talk I will present a project targeting historically black universities at the undergraduate level, which I have been involved in as part of my internship at the IAU Office of Astronomy for Development (OAD). Our goal is to include Astronomy within the curriculum as a support to Physics teaching. In order to fulfill this objective we plan to offer course material as well as hands-on tutorials together with an instrumentation package based on off-the-shelf material. Within the framework of that project, the OAD invited lecturers from the Universities of Fort Hare, Venda, Limpopo and Zululand to attend a workshop at the OAD in October 2012. During the workshop we gave introductory talks on astronomy, and organized some hands-on activities demonstrating ways of using Astronomy as a tool to enhance Physics teaching. A discussion was initiated on how to implement it within the universities. Here I will present our project, its purpose, vision and the outcomes from the workshop. The idea behind this presentation is to engage with the members of Physics and Physics Education communities in order to take further the discussion initiated during the October workshop, on the best ways to implement this project in universities across South Africa.

434 - Tomographic imaging of the ionospheric structure and disturbances in the region of the East-Central Africa region

Space Science - Tuesday 09 July 2013 14:50

Primary authors: *MUTALE, Mubela (University Of Zambia)*
Co-authors: *SIBANDA, Patrick (University Of Zambia)*

Knowledge of the ionospheric electron density distribution and its fluctuations are essential for models such as the International Reference Ionosphere (IRI) for predicting ionospheric characteristics for radio wave propagation and for other applications such as satellite tracking and navigation, etc. the Global Navigation Satellite Systems (GNSS), such as the Global Positioning System (GPS), can be used to determine the Total Electron Content (TEC) in the ionosphere. TEC is an important characteristic of the Earth's ionosphere that carries information on time and position variability of the ionosphere and has proved to be useful as a sensor of ionospheric climatology. However, such satellite to ground-based receiver measurements can only produce information about the density in the form of path-integrated snap-shots of the TEC. The challenge is to decompose its integral properly into the different values of Ne in order to generate the distribution of the Ne with altitude. In this study, we use the tomographic reconstruction techniques to successfully reconstruct the altitude structure of the ionosphere from TEC data. Using the data from the recently installed Africa Array GPS stations in the Central-Southern Africa region, we calculate three-hour average Ne profiles over this wide region using ionospheric tomography. The advantage of tomographic ionospheric Ne profiles is that they provide information of the Ne distribution up to global positioning system (GPS) orbiting altitude (with the coordination of space-based GPS tomographic profiles), and can be incorporated into the next generation of the IRI model. Since it uses real measurement data, tomographic average Ne profiles describe the ionosphere during quiet and disturbed periods. The computed average Ne profiles are compared with IRI model profiles. The study provides a good indication of the ionospheric electron density distribution and its fluctuations and how it compares with the IRI model in this region. This knowledge is essential in the adaptation of the IRI model for the locations and epochs of interest to enable data ingestion and assimilation necessary for transforming it into a real-time or near-real time ionospheric ionization Ne characterization model.

435 - Outdoor perfomance parameters, temperature effect and irradiance measurements in Photovoltaic home system

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *NJINGANA, Primrose Nosicelo (FHIT); MEYER, Edson (University of Fort Hare)*
Co-authors: *MEYER, Edson (University of Fort Hare)*

Photovoltaic Home Systems (PHS) have the potential to become a major role player in reducing the fossil fuel dependence of the residential sector in South Africa. It is however imperative to understand the dynamics between the different components of the system and moreover to correctly design and size the system. This study evaluates a PHS suitable for low-income housing in South Africa. Current and voltage parameters from the photovoltaic modules, to and from the battery and to the load were carefully monitored. The system is regulated by a pulse-width modulation (PWM) regulator and the energy produced and "wasted" by the system is quantified. This paper reports on the current and voltage characteristics of the PHS under varying outdoor conditions. It also discusses the effect of irradiance, temperature and wind speed on the overall performance of the PHS. Preliminary results indicate that a correctly sized system can successfully produce the current Free Basic Electricity (FBE) of 50 kWh/month supplied by local municipalities to low-income households.Keywords: PHS, regulator, module, load, temperature, energy output and irradiance

438 - Hot-Spot Detection and Location over an Optical Fibre

Photonics - Friday 12 July 2013 09:40

Authors: *KABOKO, Jean-Jacques Monga (University of Johannesburg)*

Fibre-based distributed sensors for real-time temperature monitoring have been intensively studied and developed for several years. These fibre sensor systems offer tremendous advantages compared to conventional electronic sensors which includes anti-electromagnetic interference, corrosion resistant and multi-sensing points. The most common applications comprise pipeline monitoring, for oil and gas transportation, and power cables as well as fire detection systems. Spontaneous Raman scattering effect is commonly exploited to implement Distributed Temperature Sensor systems. In general, temperature sensing along the fibre is achieved through optical time domain reflectometry (OTDR), where light pulses are coupled into the fibre, and backscattered Stokes and anti-Stokes light are detected. In Raman-based schemes, by monitoring the anti-Stokes power and normalizing it with Stokes power, one can measure the value of the temperature along the sensing fibre. One limitation of the OTDR schemes is that high peak power must be used to ensure good spatial and temperature resolution. An alternative approach of Raman based temperature sensor is the optical frequency-domain reflectometry (OFDR). In OFDR the spatial signatures of a fibre are obtained as the inverse Fourier transform of the Optical frequency domain reflectometry data. In this abstract, investigation on a distributed Raman temperature sensor using Incoherent optical frequency domain reflectometry (IOFDR) is reported. We develop a mathematical model to obtain the temperature profiles over a fibre under various conditions. In our IOFDR system the modulation frequency is changed stepwise to obtain an exact inverse Fourier transform. Temperature measurements on 10km of standard single mode fibre with a spatial resolution varying from 1m to 6m are simulated. The effects of starting frequency, frequency increment, and highest modulation frequency on IOFDR temporal response on the sensing performance are examined. A temperature resolution of 1oC to 3oC range is achieved with measurement time of a few minutes. Furthermore, linear filters and wavelet denoising are used for signal-to-noise ratio improvement in IOFDR technique.

439 - Comparative analysis of fabricated Titanium Schottky doides on silicon and gold doped silicon

Poster1 - Tuesday 09 July 2013 17:40

Authors: *NAMBALA, Fred Joe (University of Pretoria)*

Titanium (Ti) Schottky contacts were fabricated on (100) p-type silicon (p-Si). An Indium Garium (InGa) ohmic contact was deposited on the highly doped surface of the p-Si wafer. IV and CV measurements were conducted and results are presented. Also, detailed measurements of thin gold films fabricated by vacuum resistive deposition on the (111) n-type and (100) p-type silicon (Si) wafers are reported. The gold were diffused into Si at 1000 °C for times ranging from 15 minutes to 120 min. Diffusion profiles by Rutherford backscattering spectroscopy (RBS) are presented. Ti Schottky contacts were deposited on the gold doped (100) p-Si with an InGa ohmic contact for a diode sample. IV and CV were performed on this sample. A comparative analysis of above-mentioned samples is presented.Keywords: Schottky, resistive deposition, diffusion.

440 - Effect of air dynamics in the concentrator and behind the rotor on power output of a Concentrator Augmented Wind Turbine (CAWT)

Applied - Friday 12 July 2013 10:50

Primary authors: *SHONHIWA, Chipo (University of Fort Hare)*
Co-authors: *MAKAKA, Golden (University of Fort Hare)*

The installation of commercially available conventional wind turbines is limited by the fact that they are generally designed for wind speeds greater than $3ms^{-1}$. This limits the choice of physical locations where wind farms can be implemented. The installation of a concentrator can significantly improve the efficiency of the wind energy extraction system. This paper focuses on the improvement of performance efficiency for turbines in areas which experience wind speeds that are less than $3ms^{-1}$. It also seeks to gain more insight into the air dynamics in the concentrator and behind the rotor and its impact on generator power output.To maximize wind energy extraction there is need to understand various flow features that may be present in the system which include: turbulence, eddys, veer and wake effects and their influence on power output. Computational fluid dynamics was used simulate pressure and velocity distributions from the point of air entrance to the concentrator to behind the rotor and their impact on turbine power output. A DAQ system was used to monitor the CAWT system in LabVIEW. Smoke and ribbons were used to demonstrate air dynamics in the CAWT and behind the rotor. Preliminary results show that the speed-up and pressure across the blade plane is not uniform. The speed-up is greatest towards the hub. The net result is that CAWTs encourage a greater overall mass-flow as well as extract more energy per unit of mass-flow passing through the blade-plane than a conventional bare turbine.

441 - Polarized Compton scattering in cosmic structures

Astro - Wednesday 10 July 2013 16:20

Primary authors: *EMRITTE, Mohammad Shehzad (University of Witwatersrand)*
Co-authors: *COLAFRANCESCO, Sergio (University of Witwatersrand)*

During the last decades astrophysicists have been interested in the origin of the microwave background radiation. Compton scattering is the main process by which the microwave background radiation photons are scattered by electrons and this causes a deviation from the Planckian spectrum (historically referred to as Sunyaev Zeldovich effect). Lots of studies have been done about the change in intensity of the CMB radiation due to Compton scattering in non-relativistic and relativistic regime. In galaxy clusters the microwave photons are constantly being hit by relativistic electrons via Thomson scattering which induces a polarization in the CMB. This polarization effect has gained particular interest both in experimental and theoretical point of view. We present here a generalixed description of the polarization in Compton scattering in the Thomson regime in a covariant relativistic approach. We show here how from the Relativistic Polarized Boltzmann equation we can describe the polarization in Compton scattering for any population of electrons, whether thermal or non-thermal, in a very consistent manner by extracting the Stokes parameters from the distribution function of the photons and compute them. In order to arrive at our results we assume single scattering approximation, Thomson's scattering and un-polarized CMB prior to first scattering. In the relativistic regime the Stokes parameters are no longer independent on the galaxy cluster parameters and this gives a lot of information about the galaxy cluster itself such as temperature and optical depth. This method is used to compute the Stokes parameters for non-thermal population of electrons which are the main source of radio halos in clusters. Applications to various cosmic structures and radio (SKA, MeerKAT) and mm (MILLIMETRON, SPT) experiments are discussed.

443 - Computational modelling studies of structural, electronic and mechanical properties of palladium sulphide

DCMPM1 - Tuesday 09 July 2013 15:40

Primary authors: *MASENYA, Mamogo (University of Limpopo)*
Co-authors: *NGOEPE, Phiti (University of Limpopo)*

First-principle calculations of $Pd_{50-x}Pt_xS$ were carried out using density functional theory within the local density approximation. The structural, electronic and mechanical properties have been studied using the planewave pseudo-potential calculations, where the virtual crystal approximation was invoked. The lattice parameters were found to be in good agreement with the experimental values, within 2 % for a and c values. The results show that an increase in platinum content stabilises the $Pd_{12.5}Pt_{37.5}S_{50}$ structure. Furthermore, the effect of pressure was investigated at different concentrations, and the lattice parameters were found to decrease with an increase in pressure. The elastic constants show a positive shear modulus which indicates mechanical stability.

444 - Spectral selectivity of doped Zinc and Aluminium oxide thin films prepared by spray pyrolysis for Solar Energy applications

DCMPM1 - Tuesday 09 July 2013 16:20

Primary authors: *SIMPEMBA, Prospery C. (Copperbelt University)*
Co-authors: *KAUMBA, K. G. (Copperbelt University); MLYUKA, N. R. (Department of Physics, Faculty of Science, University of Dar-es-Salaam); SIMFUKWE, J. (Copperbelt University)*

Metal oxide thin films have been used in thin film solar cells and other solar energy applications. The main concern now is to improve their physical, electrical and optical properties in order to increase their efficiency and lower their production costs. In this presentation, thin films of zinc oxide doped with aluminium (ZnO:Al)and aluminium oxide doped with zinc (Al2O3:Zn) have been synthesized by spray pyrolysis onto standard microscope glass slides. The spectral selectivity of these oxide thin films and their applicability in producing efficient solar energy devices has been investigated. Optical measurements in the ultraviolet, visible near infrared and infrared ranges were performed using UV/VIS/NIR spectrophotometers. Further optical characterizations in the far infra-red were done using FT-IR measurements. Structural characterization for determination of surface morphology and film thickness was carried out using Atomic Force Microscopy and the Tencor Alpha Step IQ Profiler. The electrical properties were investigated using the four-point probe method. The film thicknesses fall in the range 0.14 - 87.7μm. Solar transmittance of ~88% has been achieved for the ZnO:Al films whereas ~72% has been obtained for Al2O3:Zn samples. The films have generally been found to have low reflectance of ~10%. Peak reflectance of 25% was recorded for the wavelength range 8-12μm. The film sheet resistance values of 0.75-9.5 Ω and 5.56 -12 Ω, and the corresponding resistivity values of 2.43 x 10-4- 9.59x 10-4Ωm and 4.47 x 10-4 - 11.80 x 10-4Ωm have been obtained for ZnO:Al and Al2O3:Zn, respectively. Features of the film surface microstructure have been analyzed in terms of how they affect the general properties of the films. These film properties have been correlated to applications in thin film solar cells.Key words: characterization, spectral selectivity, production cost, thin film.

445 - Raman spectroscopy of biological and chemical samples

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *NEETHLING, Pieter (Laser Research Institute, University of Stellenbosch)*
Co-authors: *ROHWER, Erich (Laser Research Institute, University of Stellenbosch)*

The Laser Research Institute at Stellenbosch University has recently developed a high resolution Raman spectroscopy setup. The setup consists of an Ar-ion laser, an old, re-commissioned double monochrometer and a state of the art ICCD detector. The setup was constructed with main aim in mind of being able to perform novel interdisciplinary research, mainly in collaboration with chemists and biologists. In the very short time that the system has been operational, great strides have been made in this regard. This talk will give an overview of the system as well as a background tutorial on the theory of Raman spectroscopy. Some relevant examples from our laboratory, demonstrating the sensitivity of our setup as well as the applicability to the fields of chemistry and biology, will be shown. Lastly, the main research focus of our efforts, namely Surface Enhanced Raman Spectroscopy (SERS), will be discussed, along with future plans for improvements.

446 - Material characterization using Terahertz time-domain spectroscopy

Photonics - Wednesday 10 July 2013 14:50

Primary authors: *SMITH, Shane (Physics Post Graduate Student)*
Co-authors: *HISSEN, Huzifa (Physics Post Graduate Student); NEETHLING, Pieter (Supervisor); ROHWER, Erich (Co-Supervisor)*

Terahertz time-domain spectroscopy (THz-TDS) has proven itself an invaluable tool to investigate the dielectric properties of technologically important materials non-invasively. The technique is sensitive to small changes in the complex refractive index of a material, as a result of stress or defects. In order to be able to accurately extract these sensitive material properties, experience needs to be gained by performing measurements on well-known samples. THz radiation is generated using a biased photoconductive antenna. The emitter antenna is a dipole antenna with a photo-switch. The substrate material of the antenna is low temperature grown GaAs, which has an extremely short (200fs) carrier lifetime. Due to this short carrier lifetime, the antenna will undergo only a single oscillation when triggered by an femtosecond laser pulse and emit a single oscillating pulse of terahertz radiation.To measure the THz pulse, a duplicate unbiased antenna is used as receiver. The receiver is again triggered by a femtosecond laser pulse, generating charge carriers. These charge carriers are accelerated by the electric field of the incident THz pulse. Since the life time of the charge carriers are so short, only a specific portion of the incident electric field is measured. By repeating the measurement for different relative arrival times of the trigger pulse (femtosecond pulse) with respect to the THz pulse, the THz pulse is mapped out in time. The measurement of the electric field of the THz pulse contains both amplitude and phase information and hence information about the real and imaginary parts of the sample's refractive index. As examples, we will look at polyethylene, which is nearly transparent in the terahertz regime, and sapphire, which is birefringent in the terahertz regime. Future work, which entails the construction of a THz time domain spectrometer for measurements in reflection, will also be discussed.

448 - Modelling interacting filaments in motility assays

Applied - Tuesday 09 July 2013 14:30

Authors: *MüLLER-NEDEBOCK, Kristian (University of Stellenbosch)*

Motility assays are two-dimensional arrays in which certain types of biofilaments are pushed along the surface in a direction given by the orientation of the the filament. The filaments interact with each other and with geometrical obstacles. We present a theoretical description for the resulting collective motion of the filaments. This rests on a suitable formalism for the directional re-orientation mechanism, that will be described in detail in this talk. We shall also discuss stochastic aspects of the velocity profile of individual filaments.

449 - Induced Stress studies of RF Magnetron Sputtered FeCr thin films by surface Brillouin scattering and GIXRD

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: WAMWANGI, Daniel *(wits university)*
Co-authors: *WITTKOWSKI, Thomas (4IEE SA ZAE Weirgewan, Contern Luxembourg); COMINS, Darrell (Wits University)*

Thin hard films of FeCr are widely used as protective coatings on steel due to their chemical inertness, low wear and tear and high hardness under extreme environments. In this work FeCr thin films on etched (100) Si substrates have been grown by RF sputtering at 0 and - 60V bias to observe stress evolution using a combination of glancing x-ray diffraction and surface Brillouin scattering. RF powers between 100W - 200W in steps of 50W and Ar2 working gas pressure of 1.0 x10-3mbar were used for film synthesis. X-ray Reflectometry has been used to extract the deposition rate, the film thickness and density requisite parameters for simulation of velocity dispersion curves. Surface Brillouin studies on the - 60V biased and pristine samples have shown higher order resonance modes thus indicating a high film quality. The low surface roughness has been determined by X-ray Reflectometry to be less than 0.2nm for all the films. The dispersion curves have shown an increase in sound velocity corresponding to an increase in elastic constants upon biasing. We correlate the elastic constants with stress values measured by glancing angle X-ray diffraction to establish the nature of the stress evolution upon Ar+ bombardment and incorporation.

450 - A reflection setup for Terahertz time-domain spectroscopy

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: SMITH, Shane *(Physics Post Graduate Student)*
Co-authors: *HISSEN, Huzifa (Physics Post Graduate Student); NEETHLING, Pieter (Supervisor); ROHWER, Erich (Co-Supervisor)*

Traditional THz time-domain spectroscopy (THz-TDS) has proven itself an invaluable tool to investigate semiconductors and technologically important polymers. Although it has found application in examining biological samples, a problem with water absorption has always hampered its usefulness. We propose a novel reflection THz time domain spectroscopy setup, which will allow the investigation of adsorbed biological samples in an aqueous environment. This setup can also easily be extended to be able to perform ellipsometry measurements on relevant thin films.A traditions THZ-TDS setup is normally used for transmission spectroscopy, but this limits the samples that can be investigated, since aqueous samples will absorb all the THz radiation. The same holds for samples that are optically dense in the terahertz regime. This problem can be overcome by performing the measurements in reflection. This of course has its own challenges such as the alignment of a calibration sample relative to the sample under investigation (within 4µm). One possibility to overcome this difficulty is to perform ellipsometry measurements. In ellipsometry, instead of looking at a calibration sample and a sample, one simply looks at the s- and p-polarisation of the radiation reflected from the surface of a sample. In essence one looks to derive the nature of a material by observing how it changes the polarization of incoming light. In the case of THz-TDS this process is simplified, since via a Fourier Transform it is possible to extract both the phase and amplitude information in the frequency domain for a single measurement.

451 - Modelling the stability of a semiflexible network tethered to a membrane

Theoretical - Wednesday 10 July 2013 10:30

Authors: MüLLER-NEDEBOCK, Kristian *(University of Stellenbosch)*

In red blood cells a network of spectrin is tethered to the outer membrane of the cell. We present a model for both the network and the membrane coupled to it. This enables the analysis of the coupled fluctuations, but also the development of criteria for the stability of the tethering and potential failure of the joined structures. We present a paradigm in which networks of stiff molecules can be described. The statistical mechanics theory takes into account the finite extent of the networks and the transmission of stresses into such networks from surfaces.

452 - Modelling and simulation of a Distributed Feedback Erbium Ytterbium doped fiber laser

Poster1 - Tuesday 09 July 2013 17:40

Authors: MPOYO, Justice Sompo *(university of johannesburg)*

A complete theoretical approach for modelling a Distributed feedback fiber laser using coupling mode theory is presented. The method presented emphasized on linking actual physical concepts to their mathematical expressions. In a DFB Fiber Laser, the rare earth doped fiber constitute the gain medium. Resonant feedback is provided by a single fibre Bragg grating written into the fiber gain medium. To model the distributed feedback fiber laser, the rate equations derived from Erbium and Ytterbium ions transitions are first solved to determine the electron populations at each energy level; which is then used in the propagation equations for the pump and the laser fields. To analyse the distribution of the fields inside the DFB Fiber Laser, the well known coupled mode theory for periodic structure is used. The coupled mode equations are derived by defining and solving the modes of the fiber laser without the grating first, and then a linear combination of these modes is used as a trial solution to Maxwell equations for the structure with a grating. The derived coupled mode equation can be solved analytically or by numerical methods. A straight forward method is the numerical integrations of the coupled mode equations. However because of the complicated nature of the electromagnetic field in the DFB Fiber Laser, such a numerical integration could be very slow. In the present work the resultant coupled mode equations are solved using the fast and accurate iterative transfer matrix method .The solutions obtained allowed the simulation of the spectral response, output power, and slope efficiency of the distributed feedback fiber laser.This model is simple, accurate and describes in a detailed manner a DFB fiber laser.

453 - Quantum coherence and transport processes in photosynthesis

Applied - Tuesday 09 July 2013 10:30

Primary authors: MARAIS, Adriana *(UKZN)*
Co-authors: *SINAYSKIY, Ilya (UKZN and NITheP); PETRUCCIONE, Francesco (UKZN and NITheP)*

Sunlight energy far exceeding human consumption is constantly incident on the Earth's surface. A class of organisms has perfected a method of harvesting this energy over a period of billions of years: this process is called photosynthesis. Understanding photosynthesis on a microscopic scale is necessary to engineer biologically-inspired artificial photosynthetic systems, which would allow us to utilise renewable sunlight energy with greater efficiency than is presently possible.While vast scale separation has meant a traditional distinction between quantum mechanics and biology, recently evidence of quantum coherence in the primary stage of energy transfer in photosynthetic light-harvesting complexes at physiological temperatures [1,2] has raised the intriguing question of whether non-trivial quantum effects play a role in the efficiency of photosynthesis. While quantum effects in the subsequent stage of primary electron transport in photosynthesis were identified nearly 50 years ago [3], many aspects of this stage of the process are also not well-understood microscopically.We give a brief overview of the success and shortcomings of existing models of the primary stages of energy and charge transfer in photosynthesis, and discuss the open quantum systems models that we have proposed [4,5] in the context of a selection of open questions about the processes.[1] Panitchayangkoon G et al 2010 Proc. Natl. Acad. Sci. USA 107 12766 [2] Collini E et al 2010 Nature 463 08811 [3] Devault and Chance 1966 Biophys. J. 6 825 [4] Sinayskiy et al 2012 Phys. Rev. Lett. 108 020602 [5] Marais et al 2013 New J. Phys 15 013038

458 - Spin-lattice relaxation in Fe implanted ZnO

DCMPM2 - Wednesday 10 July 2013 10:50

Primary authors: MASENDA, Hilary *(Wits)*
Co-authors: *GEBURT, Sebastian (Institue of Solid State Physics, University of Jena); GíSLASON, Haflidi Pétur (Science Institute, University of Iceland); ÓLAFSSON, Sveinn (Science Institute, University of Iceland); LANGOUCHE, Guido (Instituut voor Kern-en Stralings fysika, University of Leuven); WEYER, Gerd (Department of Physics and Astronomy, Aarhus University); BHARUTH-RAM, Krish (DUT); NAIDOO, Deena (Wits); GUNNLAUGSSON, Haraldur Páll (Department of Physics and Astronomy, Aarhus University); MANTOVAN, Roberto (Laboratorio MDM, IMM-CNR,); JOHNSTON, Karl (PH Dept, ISOLDE/CERN); MøLHOLT, Torben (Science Institute, University of Iceland); NCUBE, Mehluli (Wits); RONNING, Carsten (Institue of Solid State Physics, University of Jena)*

ZnO doped with 3*d* metals has attracted much attention since the theoretical prediction of Curie temperatures above room temperature resulting from carrier mediated magnetic interactions due to itinerant holes coupling with localized dopant spins. Several published reports reveal that these materials exhibit different forms of magnetism, the origin of which is still under debate. We have undertaken emission ^{57}Fe Mössbauer spectroscopy measurements following implantation of radioactive $^{57}Mn^{+}$ ions ($3{\cdot}10^{12}$/cm^2) at ISOLDE/CERN, on virgin and ^{56}Fe pre-implanted ZnO samples with fluences of $2{\cdot}10^{13}$/cm^2, $5{\cdot}10^{13}$/cm^2 and $7{\cdot}10^{13}$/cm^2. The samples were held at temperatures between 77 – 726 K in an implantation chamber and spectra were collected at gamma emission angles of 60^o relative to the sample *c*-axis. The spectra reveal magnetic structure in the 'wings' on a wide velocity scale (±12 mm/s) which were analysed using a semi-empirical relaxation model utilizing five Blume-Tjon sextets. The observed temperature-dependent magnetic effect may be explained by a slow spin-lattice relaxation due to paramagnetic Fe^{3+} weakly coupled to the lattice. The central part of spectra were fitted with two quadrupole split doublets assigned to Fe in regular crystalline sites (Fe_C) and in interstitial sites (Fe_I) in the lattice. The spin–lattice relaxation rates of Fe^{3+} in the ^{56}Fe pre-implanted ZnO samples increases with increasing fluence, and in the virgin ZnO sample follows a T^9 temperature dependence but in the pre-implanted samples show a transition towards a T^2 dependence. This result suggests that an increase in implantation fluence favours the two phonon process. The annealing behaviour and variation of hyperfine parameters in these materials will also be discussed.

459 - Modelling Stellar Convection

Poster2 - Wednesday 10 July 2013 17:40

Authors: JOHNSON, Matthew *(The University of the Witwatersrand)*

Current stellar models rely on mixing length theory for the description of convection in the stellar material. Mixing length theory is an attempt to construct a computationally tractable theory of convection by analog with molecular transport mechanisms. It is used in all current stellar models. However, it suffers from several faults because of its simplistic representation of convection. In this project, I am investigating the possibility of replacing mixing length theory with alternative, more realistic theories of convection which are nevertheless computationally tractable. For example, a finite difference based simulation of the incompressible Navier-Stokes and Boussinesq equations. With the use of MPI to facilitate parallelisation, these simulations can be run on an appropriate scale for studying stellar convection. Preliminary investigations indicate the rate of heat transfer as predicted by mixing length theory is grossly underestimated in some regions. Results of this study may ultimately impact on the understanding of galaxy evolution.

461 - Tsallis entropy and quantum uncertainty in information measurement

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MAFU, Mhlambululi *(Centre for Quantum Technology, University of KwaZulu-Natal)*
Co-authors: *PETRUCCIONE, Francesco (Centre for Quantum Technology, University of KwaZulu-Natal)*

The Tsallis entropy defines an important generalization of the usual concept of entropy which depends on parameter α. Our goal is to establish a connection between the quantum uncertainty principle and the Tsallis entropy for single discrete observables. In particular, we show that there exist a generalized uncertainty bound reached in order to appropriately express the quantum uncertainty principle in terms of the Tsallis entropy. This kind of connection forms an initial important step towards finding an important application of this α-entropy in the area of quantum communication particularly in quantum key distribution for which they have not been extensively investigated.

462 - Design and evaluation of a low-cost photovoltaic system with semi-diffuse structured Aluminium reflectors

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: SIMFUKWE, Joseph *(The Copperbelt University)*
Co-authors: *HATWAAMBO, Silvester (The University of Zambia); CHINYAMA, Kaumba (The Coppelt University); SIMPEMBA, Prospery (The Coppelt University)*

AbstractThe current energy production from fossil fuels and nuclear materials has serious environmental drawbacks. These include the creation of nuclear waste and the pollution associated with fossil fuels leading to global warming and climate change. It is therefore critical that an alternative and sustainable source of energy is found. A potential solution to this problem is solar electricity. Currently, solar panels are expensive and hence un-economical for most usage. The use of solar concentrators creates the possibility for less expensive electricity because concentrators raise the amount of incident radiation over a relatively small area of the absorber. The reduction in cost is achieved by reducing the module area and the use of low-cost reflectors. However, specular reflectors cause high concentrated heating and form hot spots on the solar module cells. The overall effect is the reduced fill-factor and overall efficiency of the system. In this paper, we report an alternative solution to the problem of non-even illumination by using locally available low-cost semi-diffuse reflectors with four different groove orientations scribed on it so as to scatter the radiation flux onto the module. This work therefore compared the following reflectors with no grooves or the plain sheets, with horizontal grooves, with vertical grooves, and the crisscross grooves orientations. Our results show that the locally purchased semi-diffuse aluminium materials can be used as a booster reflector compared with the commercial high specular reflector. The plain sheet with no grooves had the least fill-factor. The results also showed that the drop in the fill-factor from the reference value was about 3% for the crisscross and horizontal grooved structures, while that for vertical grooves and the plain sheet was about 8% and 12% respectively. The power output increased by 33% for the crisscross grooved, 52% for the horizontal grooves orientations. The vertical grooved and the plain sheet had 65% and 64% increase in power respectively. Although these two had high power, they resulted into high currents that cause hot spots. Hence the crisscross and horizontal grooved ones were the best materials as these scattered radiation flux and better fill-factor. Key words: Semi-diffuse, specular, fill-factor, non-even illumination, low-concentration

463 - Quantum Measurements Along Accelerated World-Lines

Theoretical - Wednesday 10 July 2013 16:20

Primary authors: HARTMAN, Jonathan *(University of Johannesburg)*
Co-authors: *CONNELL, Simon (University of Johannesburg); PETRUCCIONE, Francesco (University of Kwa-Zulu Natal)*

In this research, we are working with a formalism for quantum measurements that takes special relativity into account. The ultimate goal is to modify this framework to work with more general space-times rather than just Minkowski space-time and determine how the metric would affect quantum entanglement by doing calculation of Bell's Theorem in curved space-time.As a first step in that direction, in this paper, we calculate the case for quantum measurements along an accelerated world line by solving the Schwinger-Tomonaga equation.

464 - Surface Brillouin scattering characterization of Diamond-like carbon thin films on silicon substrate

Poster1 - Tuesday 09 July 2013 17:40

Authors: MBIOMBI, Wilfred *(University of wits)*

In this work we have used un-doped Diamond-like carbon (DLC: a-C:H) and silicon doped DLC(a-C:H:Si) thin film using tetramethysilane (TMS) at 20 standard centimetre cubic per minute (sccm) and both at the same bias voltage (VB) of 400 V . These thin films were deposited on silicon substrate by plasma enhanced chemical vapour deposition with a thickness of 150nm.A Brillouin scattering technique was used to characterise the mechanic property of these diamond –like carbons such as Young's modulus, shear's modulus and bulk's modulus. .Brillouin spectra were obtained at room temperature in a back scattering geometry using a(3+3) Sandercock-type tandem Fabry-Perot interferometer with a probe of 514nm. Brillouin spectra have been observed and two different acoustic modes were present that are identified as the Rayleigh mode and the Sezawa mode. The elastic constants of the films were obtained by utilising the density of the films, and the measured the Rayleigh velocity of each sample, together with the known Poisson 's ratio. Finally, we established a correlation between the microstructure with the shear's modulus, Young's modulus and Bulk's modulus.

466 - Thermoluminescence study of beta -irradiated SrAl2O4:Eu2+,Dy3+ phosphors.

Poster1 - Tuesday 09 July 2013 17:40

Authors: WAKO, ALI *(UFS (Qwa Qwa Campus))*

The Eu2+ doped and Dy3+ co doped strontium aluminate (SrAl2O4:Eu2+,Dy3+) phosphors were synthesized by solution - combustion synthesis technique using urea as a reducer at initiating temperature of 500oC, a widely known method for preparing nano sized phosphors. Sr(NO3)2, Al(NO3)3.9H2O, CH4N2O, Eu(NO3)3.5H2O and Dy(NO3)3 are used as the raw materials for the preparation of SrAl2O4 (RE: Eu, Dy) precursor. The thermoluminescence (TL) properties of beta irradiated Eu2+ doped and Dy3+ co doped strontium aluminate (SrAl2O4:Eu2+,Dy3+) have been studied. The optical properties in terms of TL glow curves are discussed in detail. The TL intensity was recorded for different beta doses and heating rates as a function of temperature. The influence of repeated measurements on peak temperature and TL intensity was also recorded. The different parameters like activation energy (E), frequency factor (S) and shape factor are calculated using TL glow curves. We have also calculated the trap depth by different methods including initial rise, variable heating and peak shape methods. The dependence of the peak position on the Tm-Tstop confirmed first order kinetics of the obtained glow curves.

468 - 5 Watt Zinc Germanium Phosphide Optical Parametric Oscillator

Photonics - Wednesday 10 July 2013 11:10

Primary authors: JACOBS, Cobus *(CSIR National Laser Centre)*
Co-authors: *KOEN, Wayne (CSIR National Laser Centre)*

Lasers operating in the mid-infrared region from 3 – 8 µm find use in industrial, medical, military and scientific applications. Spectral fingerprints of molecular gasses in this region allow trace gas and chemical agent detection. High atmospheric transmission in this region also facilitates free-space communications, active imaging and other remote sensing or long distance applications.Laser sources emitting in the mid-infrared include quantum cascade lasers, optically-pump semiconductor lasers and parametric sources (converting from 1 or 2 µm Q-switch solid-state lasers). Quantum cascade lasers with high wall-plug efficiencies, compact size and continuous wave output below 5 W suit the criteria for a number of applications. However when high power or pulsed operation is required, an optical parametric oscillator (OPO) remain the source of choice.Traditional mid-infrared OPO's utilise periodically-poled lithium niobate (PPLN) or potassium titanyl phosphate (PPKTP) pumped with readily available 1 µm laser sources. A more efficient route for parametric conversion is to pump a zinc germanium diphosphide (ZGP or ZnGeP2) non-linear crystal with a 2 µm laser source, such as a Q-switched Holmium solid-sate laser.We previously reported on a 1 W, 5 kHz ZGP OPO at SAIP 2012. In this paper we present the recent results of a redesigned high power high repetition rate doubly-resonant ZGP OPO, single-pass pumped with a new 45 W Ho:YLF 2 µm pump laser (pump laser to be discussed by W. Koen in a separate SAIP 2013 paper). The OPO and pump telescope was redesigned for a smaller mode-size and improved mode-matching. Output powers were scaled to 4.2 W at 25 kHz and 5.2 W at 20 kHz.

470 - Acousto vs. Electro Optic Modulators in Short pulse, high peak power Q-switched lasers

Photonics - Wednesday 10 July 2013 11:30

Primary authors: MAWEZA, Loyiso *(CSIR)*
Co-authors: *ESSER, Daniel (Herioy-Watt University); COLLETT, Oliver (CSIR); KING, Gary (CSIR); STRAUSS, Hencharl (CSIR)*

Compact short pulse high peak power lasers are highly sought after in ranging applications. This research seeks to develop an actively Q-switched source which emits peak powers of ~10 kW in 1 ns at 100 kHz since there are almost no such commercial sources available with these optimum parameters. To obtain such short Q switched pulses a high gain material must be end-pumped with high intensity diode laser beams and have a fast Q-switch. Traditional switching methods that can be used are Acousto- Optic Modulators (AOMs) and Electro Optic Modulators (EOMs). An AOM uses an RF generated acoustic grating to diffract light out of the cavity, inducing a variable loss, which Q-switches it. The advantages are that AOMs do not require high voltages, are usually polarisation insensitive and well understood. However, the switching speed is limited by the speed of sound through them and their restricted modulation depth often causes hold-off problems. EOMs have traditionally been shunned because they require high voltages (causing EM noise when not well shielded) and ringed, which caused a loss when the EOM is switched off. EOMs use the Kerr effect to rotate the polarization which, in addition with polarizing elements, causes a varying loss within the cavity. This makes it possible to switch very fast since the switching time depends only on the high voltage source (~1 ns or shorter). They are also compact and have a high extinction ratio, eliminating the hold-off problems of AOMs. The aim of this study is to directly compare the performance of AOMs and EOMs as Q-switching elements for high peak power, short pulse lasers and to identify the regimes where each can be effectively and economically used. Results highlighting the limitations of AOMS will be shown, as well as initial results from an EOM Q-switched laser.

471 - Kinetic analysis of the various biomass / coal blends for co-gasification purpose

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MABIZELA, Polycarp *(FHIT)*
Co-authors: *MAMPHWELI, Sampson (University of Fort Hare (FHIT)); MABUDA, Iren (University of Fort Hare (FHIT))*

Abstract. The paper reports on kinetic analysis of various biomass / coal blends at different mixing ratios for determination of kinetic parameters (activation energy (Ea) and pre-exponential factor (A)) of best mixture for co-gasification purpose. Biomass materials (chicken litter, corn stover, pine wood, eucalyptus wood and cow dung), and coal (sub-bituminous) were used in the study. Thermogravimetric analysis (TGA) was conducted to investigate the kinetic parameters and thermal stability for various biomass/coal blends. A mixture of 90% corn stover and 10% coal resulted in the highest thermal stability compared to others with the activation energy value and pre-exponential factor of 3.7728 x 10-3 J/mol and 1.4979 x 10-4 min-1 respectively. The thermal analyses obtained for the different blends will be presented and discussed in detail in the paper.Keywords: Biomass, coal, TGA, Activation energy and pre-exponential factor

474 - Computer Simulation Study Of Manganese Dioxide Nanotubes

DCMPM1 - Tuesday 09 July 2013 16:00

Primary authors: TSHWANE, DAVID *(UNIVERSITY OF LIMPOPO)*
Co-authors: *MAPHANGA, Regina (University of Limpopo); NGOEPE, Phuti (University of Limpopo)*

The field of nanotubes is undergoing an explosive growth, fueled by a breakthrough in synthesis and promise of unique applications. Manganese dioxide is a widely used material in supercapacitor because of low-cost and high energy density. Manganese dioxide nanotubes play an important role in electrochemical applications, including serving as cathode material in lithium-ion batteries. Computer simulation methods were used to generate various structures of manganese dioxide nanotubes, where index, size, symmetry and diameter are varied. Molecular dynamics was used to investigate the local structure of manganese dioxide nanotubes at different temperatures ranging from 300K to 3300K. The nanotubes structures were described using the radial distribution function. The structural stability of nanotubes generated from low index surfaces was investigated and found that {110} surface produced the most stable nanotube.

475 - Photoluminescence properties of rare-earths and manganese doped strontium aluminate phosphors prepared by combustion method.

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *MMAKGABO, Manaka (Student)*
Co-authors: *B.M, Mothudi (Supervisor); M.S, Dhlamini (Co-supervisor)*

Alkaline earth aluminate hosts have attracted a lot interest, due to their stable crystal structure, high physical and chemical stability. Strontium Aluminate ($SrAl_2O_4$) host material have been proven to be efficient with a wide band gap, which offers the possibility of generating broad band emission. In this study $SrAl_2O_4$ doped with Eu^{2+}, Dy^{3+} and Mn^{2+} phosphor powders were prepared by combustion method at 600°C. The X-ray diffraction (XRD) patterns of the samples were performed using a Bruker AXS D8 advanced automatic diffractometer with Cu-Kα radiation (λ = 1.5418 A), operating at 40 kV and 30 mA. The photoluminescence (PL) and photoluminescence excitation (PLE) spectra were measured at room temperature using a Spex Fluorolog-3 spectrofluorometer (Instruments S.A., N.J., U.S.A) equipped with a 450 W Xe light source and double excitation monochromators. The PL emission spectra of $SrAl_2O_4$ doped with Eu^{2+} and Dy^{3+} shows the influence of excitation wavelength on the emission spectra of the sample. The broad and sharp emission bands observed are typical transitions of Eu^{2+} and Eu^{3+} respectively. The broad emission bands from these spectra are attributed to the typical transitions from the lowest ^2D level of the excited $4f^65d^1$ configuration to the ground $^8S_{7/2}$ level of the $4f^7$ configuration of Eu^{2+} ion. The sharp emission lines can be attributed to the ($^5D_0$ - $^7F_{1-5}$) electronic transition of Eu^{3+} ions present in the host matrix. The particle morphologies of the powders were investigated using Zeiss High resolution SEM.

476 - *Ab initio* simulation study of spinel $LiMn_2O_4$ and nickel doped $LiMn_2O_4$

DCMPM1 - Wednesday 10 July 2013 15:40

Authors: *MALATJI, kemeridge Tumelo (University of Limpopo)*

Lithium ion batteries have been successful in portable electronics market due to their high energy density. However, increasing interest in lithium ion batteries for electric and hybrid electric vehicle applications require alternative cathode materials due to the high cost, toxicity, and limited power capability of the layered $LiCoO_2$ cathode. Doping in batteries improves the efficiency in maintaining electrochemical capacity over a large number of cycles without sacrificing initial reversible capacity at room temperature. Density functional theory employing the pseudo-potential plane-wave method within the generalized gradient approximation was used to investigate structural properties, density of states and elastic constants. The lattice parameters are in agreement with the available experimental results. Analysis of calculated elastic properties of $LiMn_2O_4$ system predicts mechanical stability when the system is subjected to various strains.

477 - White Cathodoluminescence $Zn_{0.3}Mg_{0.7}Al_2O_4:Tb^{3+};Eu^{3+}$ phosphor

DCMPM2 - Wednesday 10 July 2013 11:30

Primary authors: *SHAAT, Samy (Department of Physics at University of Free State)*
Co-authors: *ODIRELENG, Ntwaeaborwa (epartment of Physics at University of Free State); HENDRIK, Swart (epartment of Physics at University of Free State)*

Nowadays, researchers are working to prepare and develop white light emitting phosphors that can be used in solid state lighting applications such as flat panel displays, phosphor lamps and light emitting diodes (LEDs). The white color is the combination of the primary colors namely blue, green and red. It is, however, not easy to have one phosphor to emit these three colors simultaneously. Traditionally, the production of white light by different routes can be achieved by two routes. These routes are combining yellow phosphor such as YAG:Ce3+ with a InGaN-based blue diode or by combining a UV chip with a three converter system of red, green and blue phosphors. The problems with these are poor rendition and high thermal quenching of the yellow phosphor and reabsorption of the blue emission by the red or green phosphor in the three converter system 1. To overcome these problems, a new generation of single host phosphors prepared mostly by doping alkali earth aluminates with divalent alkali earth and/or trivalent rare-earth ions has been developed. Alkali earth aluminates are chemically stable, environmentally friendly 2 and they can be easily produced cost-effectively. For example, a white emission from a tunable Mg3Al2O5Cl2:Ce3+,Eu2+ phosphor based on energy transfer from Ce3+ to Eu2+ by a down-conversion process was by Song et al 1, while Shaat et al 3 generated white light from CaxSr(1-x)Al2O4:Tb3+;Eu3+ phosphor.In this study, a white cathodoluminescence was generated from Zn0.3Mg0.7Al2O4:Tb3+;Eu3+ phosphor prepared by combustion route using urea as a fuel metal and nitrates as precursors. The XRD diffraction patterns from the samples showed phases associated with cubic structures of ZnAl2O4 and MgAl2O4. The optical properties of the phosphor were studied with UV-Vis, and cathodoluminescence. White cathodoluminescence was a result of the simultaneous emission of tricolor blue and green from Tb3+, and red from Eu3+ when the phosphor was excited by a low voltage (2 keV) electron beam. White cathodoluminescence with the CIE coordinates (x = 0.343, y = 0.323) was observed. References(1)Song, Y.; G. Jia, M.J.; Huang, Y.; You, H.-P. Appl Phys. Lett. 2009, 94, 091902. (2)Mothudi, B.M.; Ntwaeaborwa, O.M.; Pitale, S.S.; Swart, H.C. J. Alloys Compd. 2010, 508, 262.(3)Shaat, S. K. K.; Swart, H.C.; Ntwaeaborwa, O.M. Optical Materials Express 2012, 7, 962.

478 - Development of a Large Area Light Beam Induced Current scanner

Applied - Friday 12 July 2013 11:10

Primary authors: *VORSTER, Frederik (NMMU)*
Co-authors: *VAN DYK, Ernest (NMMU)*

The planned large scale deployment of photovoltaic (PV) modules for utility scale electricity generation in South Africa has placed a renewed interest on new module characterization techniques that can be used to predict the long term performance of modules. A Large Area Light Beam Induced Current (LA-LBIC) scanning technique has been developed that enables the mapping of the induced photocurrent (Iph) over the whole module at different applied module bias voltage levels. The Iph at different bias levels is a good indicator of latent module defects such as various cell mismatch features, weak or broken cell interconnect tabbing, EVA delamination or non-uniformities across the module surface. Cell mismatch features refer to the inability of a string of series connected cells to produce the same current as well as parallel connected strings of cells in large modules to produce the same matching voltages.This paper presents the results of LBIC scanned images of a variety of different PV technologies, using laser light or white light as a beam probe. This paper also offers an in depth assessment of the LBIC technique as a useful tool that is applied on encapsulated series and parallel connected PV cells in modules. Future development of this technique such as the inclusion of simultaneous RAMAN - LBIC scanning will also be discussed.

479 - A 2-crystal high-power CW and Q-switched Nd:YLF laser at 1314nm

Photonics - Wednesday 10 July 2013 10:50

Primary authors: *BOTHA, Roelf (HartRAO)*
Co-authors: *STRAUSS, Hencharl (CSIR National Laser Centre); COMBRINCK, Ludwig (HartRAO); VON BERGMANN, Hubertus (Stellenbosch University)*

A 1314 nm Nd:YLF laser was designed and operated in both CW and actively Q-switched mode. 2 crystals were used inside the same resonator, both were end-pumped by laser diodes operating at 808 nm. The resonator mirrors were chosen to be highly transmittive at 1053 nm and highly reflective at 1314 nm, to force lasing at 1.3 um. CW output, with good beam quality, of up to 20 W resulted. Active Q-switching was obtained by inserting an brewster-cut AOM in the cavity. The experimental setup and results will be discussed.

480 - Phase stability and martensitic transformation of TiPt shape memory alloys

DCMPM1 - Wednesday 10 July 2013 16:20

Primary authors: *MASHAMAITE, Mordecai (University of Limpopo)*
Co-authors: *CHAUKE, Hasani (University of Limpopo); NGOEPE, Phuti (University of Limpopo)*

The TiPt structure with the B2 phase has been reported to undergo a reversible displacive transformation to B19 martensite at about 1000°C. However, this system could serve in principle as the basis of high-temperature shape memory alloys. Molecular dynamics study of martensitic transformation in platinum and titanium alloy was performed to investigate the effect of temperature dependence on B2, B19 and B19' structures at 50 at.%Pt. The NPT ensemble was used to determine the properties of these systems and we found good comparisons with recent experimental work. It was found that the thermal expansion coefficient against temperature shows potential martensitic change when B19 and B19' were heated to extreme high temperatures of 500K up to 2000K.

481 - Computer simulation studies of SPINEL $LiTi_2O_4$

DCMPM1 - Wednesday 10 July 2013 16:00

Primary authors: *LEDWABA, Raesibe Sylvia (University Of Limpopo)*
Co-authors: *NGOEPE, Phuti (University Of Limpopo); MATSHABA, Malili (University Of Limpopo)*

The spinel $LiTi_2O_4$ system is of interest in battery applications and used as an anode material... Molecular dynamics calculations were carried out to investigate the effects of temperature on spinel lithium titanate. The NVE ensemble was used, whereas the temperature was varied, ranging from 300K-3000K. The radial distribution functions, diffusion coefficient and x-ray diffractions were analysed. It was observed that the $LiTi_2O_4$ system undergoes structural transformation from spinel to ramsdellite at 1148.15K, which gives a good agreement with experimental data acquired.

482 - computer modelling studies of pressure dependance on cobalt pentlandite mineral

Poster1 - Tuesday 09 July 2013 17:40

Authors: *MPHAHLELE, Mallasaitiwa (University of Limpopo)*

The study employs molecular dynamics to investigate the pressure dependence of cobalt pentlandite ($Co_9S_{8)}$ mineral at high temperatures using interatomic potentials. Amongst the transition metal sulphides, the cubic Co9S8 is the most stable. Simulations were performed at various temperatures (1100K, 1300K and 1500K) and pressures (0GPa – 50GPa) in increments of 5GPa for each temperature. It was found that as the pressure is increased, the high form to low form inversion is reversible and the structure at high pressures transforms into liquid.

483 - DFT+U study of Li adsorption on (110) β-MnO_2 surface

DCMPM1 - Friday 12 July 2013 09:20

Primary authors: MAENETJA, khomotso (University Of Limpopo)
Co-authors: MELLAN, Thomas (University College London); GRAU-CRESPO, Ricardo (University College London); NGOEPE, Phuti (University of Limpopo)

Lithium-air batteries are actively being developed worldwide because of their potential to deliver ultra-high energy density. Currently, the li-ion batteries are being used in electric vehicle however; their energy is much lower than that of Li-air batteries. Density Functional Theory is used to investigate lithium adsorbed manganese dioxide surfaces in the context of lithium-air battery development. In this study, we calculate the surface energies of low Miller index planes and the most stable surface orientation was found to be the (110). It was observed that the triply-coordinated lithium, bonded to two bridging and one in-plane oxygen atoms (bbp) has lowest adsorption energy which is the favorable site. Surface oxidation becomes favorable when concentration of lithium adsorbets increases at the surface of which bridging-peroxo is most stable.

484 - SSC-DFTB parameterization of Pd and TiO_2 systems

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: CHUMA, Moyahabo Hellen (University of Limpopo)
Co-authors: CHAUKE, Hasani (Material Modelling Centre, University of Limpopo); NGOEPE, Phuti (Material Modelling Centre, University of Limpopo); JONES, Glenn (Johnson Matthey Technology Centre, Blounts Court Road, Sonning Common, Reading RG4 9NH, United Kingdom)

The self-consistent-charge density functional tight binding (SCC-DFTB) approach has been used to describe large scale systems with less computational cost than the density functional theory method [1]. DFTB+ has been used to develop a set of SCC-DFTB parameters for Pd-Pd and Ti-X (X = Ti, O) also considering O-O atomic pairs of elements. The SCC-DFTB parameterization has been performed to describe periodic systems Pd and TiO_2 respectively. It was found that the structural properties obtained from the parameters were good. Comparison to the lattice parameter obtained from geometry optimization for bulk Pd and TiO_2 was found to be within 0.1% with the available literature data [2-4]. The SSC-DFTB+ set of parameters obtained within this study have also been successful in describing the electronic properties of TiO_2. The calculated electronic band structure of TiO_2 yielded an energy band gap of 3.21 eV, in excellent agreement with the experimental value of 3.2 eV [5]. References [1] A. F. Oliveira, G. Seitfert, T. Heine, H. A Duarte, J. Braz. Chem. Soc. 20 (2009) 1193[2] D. Schebarchov and S. Hendy, Phys. Rev. B 73 (2006), 121402[3] M. Horn, C.F. Schwerdtfeger and E.P.Z. Meagher, Kristallogr. 136 (3-4) (1972) 273[4] G. Dolgonos, B. Aradi, N.H. Moreira and T. Frauenheim, J. Chem. Theory Comput. 6 (2010) 266[5] F. Labat, P. Baranek, C. Domain, C. Minot and C. Adamo, J. Chem. Phys. 129 (2007) 154703

485 - SDSS J12002-0204: Unusual I Zw 1 object or a nearby BAL Seyfert?

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: RAHMAN, Nurur (University of Johannesburg)
Co-authors: WINKLER, Hartmut (University of Johannesburg)

Emission line diagnostics in active galactic nuclei (AGN) provide vital clues about the physical conditions of gas responsible for the emission. We typically identify a region of narrow-line formation that normally includes oxygen, nitrogen and other forbidden lines. In some objects (Type 1 Seyferts) we in addition detect broad Balmer lines, helium lines and, in some instances, emission features attributed to FeII. During a search for AGN in the Sloan Digital Sky Survey (SDSS), we discovered a spectrum of SDSS J12002-0204, a z~0.091 Seyfert galaxy that displayed some unusual features. The narrow forbidden lines were all but absent (with only [OII] very barely visible), the FeII spectrum was prominent and NaI absorption was clearly detected. In these respects, the object resembled the usually much more distant "broad absorption line" (BAL) quasars with strong FeII lines (e.g., IRAS 07598+6508). The emission lines are in addition comparatively narrow, which makes this object an interesting hybrid between the BAL Seyferts and the class of AGN referred to as “narrow line Seyfert 1 galaxies" with weak forbidden lines (also called I Zw 1 objects).We performed spectral line fitting on the SDSS data and compare line ratios in an attempt to shed light on the nature of the nuclear region of this interesting object. We discuss the limitations of the available data, and conclude that a better signal to noise spectrum would allow us to determine the relative strengths of any other forbidden lines in the spectrum, get better profiles of the absorption features and better define the FeII spectrum. We use this to motivate for follow-up observations using the SALT IRS spectrometer in the upcoming round of proposals.

486 - Computational Modelling Study of nickel-rich pentlandite {111} surface

DCMPM1 - Friday 12 July 2013 11:30

Primary authors: MKHONTO, Peace Prince (University of Limpopo)
Co-authors: CHAUKE, Hasani Richard (University of Limpopo); NGOEPE, Phuti E. (University of Limpopo)

Ab-initio density functional theory was employed to investigate the interaction of oxygen, water and ligands molecules on the nickel-rich pentlandite $Fe_4Ni_5S_8$ {111} surface. Pentlandite is the major source of the world's suppliers of nickel. In this study, we focus on the oxidation, hydration and addition of collectors on the nickel-rich pentlandite mineral. During adsorption, we observe that the oxygen-metal interaction showed preferential iron oxidation than nickel on the surface. Moreover, the iron preferential oxidation is extensively observed when O_2 is adsorbed on nickel. The oxidation of the iron atom showed the presence of superoxo isomer species on the surface, while the migration of the oxygen molecule from nickel to iron shows a peroxo species. The hydration on iron-nickel surface termination show that the water molecule migrate from nickel atom to bond with iron, suggesting that more water is required on the surface to hydrate the nickel atoms. Deposition of sodium ethyl xanthate (SEX) ligand on the surface enhances the bridging interaction, the iron-SEX-nickel.

491 - Computational study of anatase TiO_2 nanotube as an anode material for lithium ion batteries

DCMPM1 - Friday 12 July 2013 09:00

Authors: GANDAMIPFA, Mulatedzi (University of Limpopo)

In lithium-ion battery, graphite is a widely used anode material, but it has some disadvantages as compare to anatase TiO_2 nanotube anode such as electrical disconnection, structural deformation, and initial loss of capacity. The choice of the anode material is very important for an effective development of a high energy density batteries and the use of high capacity electrode materials (anode & cathode) is an essential factor. The anatase TiO_2 nanotube anode is a material that conducts electric current and they do not expand to more than three times their volume during charging and then shrink again during discharge. Given these exciting properties, it becomes necessary not only to synthesize such solid-state and molecular systems but also to model their properties at an appropriate size and time scale. In this work we study anatase TiO_2 analogues (bulk and nanotubes) in an effort to understand how the DFTB+ potentials influence structural parameters and electronic properties. Our structural and electronics parameters are in good agreement with the experimental results.

502 - Evaluation of the NeQuick model in Southern mid-latitudes using South African co-located GPS and Ionosonde stations data

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: AHOUA, Sylvain Malan (South African National Space Agency (SANSA) Space science)
Co-authors: OBROU, Olivier Kouadio (Laboratoire de Physique de L'Atmosphère, Université F.H.B de Cocody, Côte d'Ivoire); HABARULEMA, John Bosco (South African National Space Agency)

This work investigates the performance of the NeQuick model in southern mid-latitudes. The NeQuick is used among others for the European Geostationary Navigation Overlay Service (EGNOS), developed to supplement the GNSSs systems by reporting on the reliability and accuracy of the positioning data. It is used by recommendation of the ITU-R, to compute the estimated TEC presumed along the ray path of the signal from satellite to the GNSS receiver. The performance of the NeQuick is evaluated after it is adapted to the local conditions by ingesting the Fof2 and M(3000)F2 recorded by the means of Ionosonde at Hermanus (34.40S; 19.20E, South Africa). It is then used to compute a theoretical TEC above Hermanus and compared to the observed TEC derived from co-located GPS receiver which belongs to the TrigNet network. The TEC is directly extracted from the data stocked by the Gopi GPS-TEC software. To evaluate the model under different geomagnetic contexts we select three days each of quiet and disturbed magnetically according to different solar activity indicators. The results will be useful to advise users of GNSS equipment.

503 - To study the mobility of the naturally radioactive materials (NORMs) in the sediments as a function of changing environmental conditions

NPRP - Friday 12 July 2013 09:40

Primary authors: SHONGWE, Nkosinathi Sipho (University of Johannesburg)
Co-authors: FAANHOF, Arnaud (Applied Nuclear Analytical Sciences)

This presentation examines the radiological environmental issues associated with the nuclear fuel cycle as affected by the recent increase of the effects of acid mine drainage (AMD) and considering the role played by solid-to-liquid distribution ratio (Kd). The convective-diffusion transport model is used to discuss the mobility of radionuclides in the sediments. The Kd value predicts the rapidity and reversibility between the dissolved (Cw, Bq.■-1) and the adsorbed (Cs, Bq.kg-1) phases of Uranium and Thorium (and some of their progeny). The identification and quantification of radioactive species using radiometric and non radiometric techniques was done. Low background Gamma-Spectrometry, ICP-MS (Inductively Coupled Plasma-Mass Spectrometry), NAA (Neutron Activation Analysis) and LSC (Liquid Scintillation Counting) techniques were used. The distribution of the radionuclides in the solid and liquid phases obtained in the simulated AMD (acid mine drainage)leaching experiments was evaluated.

504 - A Theoretical Model and Simulation of Low-Reflectivity Active Linear Cavity for temperature and vibration sensing

Photonics - Friday 12 July 2013 10:50

Primary authors: DELLA TAMIN, Michelin (University of Johannesburg)
Co-authors: OKAFOR, Emmanuel E. (University of Johannesburg); MARTINEZ MANUEL, Rodolfo (University of Johannesburg); MONGA KABOKO, Jean Jacques (University of Johannesburg)

A mathematical model describing the signal oscillation and amplification of an active linear cavity fibre sensor is presented. Passive low-reflectivity fibre Bragg grating (FBG) sensors have been developed and implemented in various applications. The major draw-back of these sensors is a low signal to noise ratio (SNR) when used in a noise prone environment. A mathematical model for low-reflectivity active linear cavity fibre sensor is reported. In our model, two identical FBG form the cavity. The cavity is made of an amplifying gain medium which in our model is an Erbium doped fibre (EDF). In the model, the F-P active cavity generates interference pattern. The interference pattern is captured on the detection system. An optical spectrum analyzer can be used as detection system for slow varying parameters such as temperature. For sensing dynamic parameters, a F-P tunable filter and a photo detector is used because of its scanning frequency which is in the order of kHz to MHz. In this model, the detected signal is demodulated using phase modulation. In phase modulation, a perturbation in the active sensor generates a change in its reflected interference pattern. The change of the reflected interference pattern produces a change in phase in its Fourier transform. By evaluating changes in phase, changes in the perturbation can be measured. Several sensors can be cascaded onto a single fibre using a well known frequency division multiplexing (FDM) with cavities of different lengths. The mathematical model parameters including gain, cavity length, pump power, absorption are optimized in our simulation. The results of the simulation present an improved performance of the SNR as compared to passive sensor. From simulation results, the model can apply to slow varying parameters (temperature) as well as dynamic parameters (vibration). Index terms: Fabry-Perot cavity, signal-to-noise ratio, Erbium doped fibre.

505 - Finite-size key in QKD protocols for Renyi entropies

Theoretical - Wednesday 10 July 2013 11:30

Primary authors: MAFU, Mhlambululi *(Centre for Quantum Technology)*
Co-authors: *GARAPO, Kevin (University of KwaZulu-Natal); PETRUCCIONE, Francesco (Centre for Quantum Technology, University of KwaZulu-Natal)*

A realistic quantum key distribution protocol necessarily runs with finite resources. This is in contrast to the existing quantum key distribution security proofs which are asymptotic, in the sense that they only work if certain parameters are exceedingly large as compared to practical realistic values. In this paper, we spell out the bounds and formalism to derive bounds on the secret key rates for the B92 protocol [Phys. Rev. Letter, 68. 3121 1992] which includes a preprocessing step. This is expressed as an optimization problem by using the recent results on the uncertainty relation and the smooth Renyi entropies.

506 - Computational studies of the bulk cobalt pentlandite (Co_9S_8): Validation of the potential model.

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: MEHLAPE, Mofuti *(University Of Limpopo (Turfloop Campus))*
Co-authors: *NGOEPE, Phuti (University of Limpopo (Turfloop Campus)); PARKER, Steve (Univeersity of Bath (UK))*

We investigate various forms of the cobalt pentlandite, Co_9S_8, at different temperatures, using classical atomistic simulation methods with the support of electronic structure calculations. The first interatomic potentials of Co_9S_8 based on the Born model, were derived with input data such as structure and elastic properties from experiments and electronic structure calculations respectively. The interatomic potentials were validated by running energy minimization and molecular dynamics calculations. The structure, elastic properties and phonon spectra corresponded well with those determined by electronic structure methods. The calculations further reproduced the complex high temperature transformation to high form pentlandite and the melting of Co_9S_8; as deduced from the crystal structure and radial distribution functions. The interatomic potentials can be used for studies of surfaces and nanostructures.

507 - Effects of tides on the occurrence of pulsations in components of binary star systems

Astro - Friday 12 July 2013 09:00

Authors: PREDIERI, Massimo *(University of the Witwatersrand)*

The Kepler satellite, launched in March 2009, has by almost uninterrupted observation produced light curves of unprecedented precision. These newly acquired high quality data offer new opportunities for detailed testing of the hydrodynamic processes that drive stellar evolution. Asteroseismology is one of the most important tools for studying stellar structure - by comparing observed pulsations with the predictions of theoretical models. I report on my theoretical study of the effects that tides generated by the companion star have on pulsations in binary star components.

508 - Analysis of controlled structural disorder in few layer graphite and graphene

DCMPM1 - Wednesday 10 July 2013 10:30

Primary authors: SANDERS, Kirsty *(university of the witwatersrand); COLEMAN, Christopher (university of the witwatersrand)*
Co-authors: *MCINTOSH, Ross (university of the witwatersrand); BHATTACHARYYA, Somnath (university of the witwatersrand)*

Although the electronic transport properties of graphene have been widely researched, systematic studies on the effect of structural disorder on electronic transport remain crucial to an understanding of this contemporary material and yet are still lacking. We present a comprehensive analysis of the role of defects in thin graphene-like layers grown through laser-ablation assisted chemical vapor deposition. The level of disorder, determined through Raman spectroscopy was controlled through the variation of synthesis parameters such as temperature, laser fluence, flow rate, and sample position. Transport measurements were performed at low temperatures. Combined with the Raman data these results showed the activation energy (equal to half the bandgap) to be directly related to the level of disorder, thereby demonstrating the formation of localized states due to defects. A tight binding transport model, incorporating bond length disorder in the sp2 phase, was applied to understand the origin of the disorder induced bandgap and localization in the films. Analysis of the transmission coefficient as well as the calculated localization length as a function of the disorder parameter within this model allows for interpretation of the effects of structural disorder. Similar analysis can be applied to disordered graphene. To this end graphene has been grown by Chemical Vapor Deposition (CVD) where the process has been optimized to reduce the level of disorder. This work will provide crucial information regarding the understanding and control of disorder in graphene; a prerequisite for nano-electronic applications.

509 - Nitrogen-Vacancy colour centre in diamond characterization using QUANTUM ESPRESSO

Theoretical - Wednesday 10 July 2013 16:00

Primary authors: ZULU, Bheki *(University of KwaZulu-Natal)*
Co-authors: *PETRUCCIONE, Francesco (University of KwaZulu-Natal)*

The model of electronic structure and calculations using Quantum Espresso is presented. Defects in diamond, the nitrogen-vacancy in particular, is a promising candidate for realizing qubits for a number of applications such as quantum computing, high spatial resolution imaging, quantum information processing, magnetic field sensing, single photon emission and biocompatibility. Diamond defects can be identified by means of density functional theory (DFT) electronic calculations using traditional local functionals. Time-dependent DFT (TD-DFT) is used to calculate the electron – hole interactions of the system of the NV centre. This allows the study of the energetic stability and electronic structure of the negatively charged NV centre. The charge and spin distribution of the centre in diamond for both ground and excited states are analysed by the use of ab initio supercell calculations.

510 - Thermodynamic, structural, electronic and mechanical stability study of olivine $LiMPO_4$ (M: Mn, Fe, Co)

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: LETHOLE, NDANDULENI LESLEY *(SAIP)*
Co-authors: *CHAUKE, Hasani (University of Limpopo); NGOEPE, Phuti (University of Limpopo)*

The ever growing demand of portable electronic devices and the vision of massive commercial use of electric powered vehicles have led to a call to pursue more effective batteries. These batteries should contain vital socio-economic and useful physical properties. Amongst these batteries lithium rechargeable batteries have shown great signs in achieving desired performance. Previous investigations have shown the olivine $LiFePO_4$ is of interest in portable electronic appliances as a future cathode battery material. Consequently, attention has also been shifted to other olivine lithium transition metal phosphates such as LiMnPO4, $LiCoPO_4$ and $LiNiPO_4$. In this study, we investigate the structural, thermodynamic, electronic and mechanical properties of $LiMPO_4$ (M; Fe, Mn, Co) to determine their stability. Calculations have been performed within DFT+U method as implemented in the Vienna Ab initio Simulation Package code. The lattice parameters were found to be in good agreement with the experimental results. According to our DFT+U calculations, olivine $LiMnPO_4$ has the lowest heat of formation (-1340.5kJ/mol), suggesting stability.

511 - NON-SPECIALIST: Numerical Modelling of Pavement Materials

Applied - Wednesday 10 July 2013 09:20

Primary authors: GLEDHILL, Irvy (Igle) *(CSIR)*
Co-authors: *DE VILLIERS, Rosalie (Consultant); GREBEN, Jan (Consultant)*

In the field of transport infrastructure, the properties of the pavement of roads and rail tracks play critical roles. The aim of this project is to understand the performance of roads as a function of particle shape using laser characterisation and laboratory tests (Anochie-Boateng et al., 2012). Statistical physics theories for simple shapes have been developed (Onsager, 1949), but numerical simulations provide a way to analyse the bulk properties of granular media for angular particle shapes. Rigid body dynamics are assumed. Discrete Element Models, DEM (Cundall and Strack, 1979), are becoming widely used, and a parallel investigation of dynamics in polyhedral particle DEM is under way (Munjiza, 2011). A more approximate, but much faster, method for hundreds of particles is to use physics engine software, which was developed for the fast-growing market for animation, robotics and virtual environments. The physics engine chosen for present purposes is PhysX™ (www.nvidia.com). The rigid body models are based on the constraint formulation of Hahn (1988) (Hahn, 1988) and further developed by Müller et al. (2008), and are based on stick-slip friction coefficients and coefficients of restitution which model inelastic collisions. An additional mechanism for kinetic energy damping is deactivation of particles having less than a defined threshold velocity.Spherical or polyhedral particles are confined to a rigid frictionless cylinder with a fixed base, and a frictionless platen is lowered into contact with the top particles. Axial stress is imposed by adding masses to the platen, and the axial strain is measured. Initial problems with imposed axial stress, and mitigation, are described. Stress-strain curves have been obtained. The failure mode of the numerical model under high stresses differs from the fracture of material particles. The effects of particle deactivation, friction coefficient, and particle shape (for regular solids) on the elastic modulus are shown and discussed.

512 - Using the Higgs as a portal to the "hidden sector"

NPRP - Wednesday 10 July 2013 10:50

Primary authors: CASTANEDA, Elizabeth *(University of Johannesburg)*
Co-authors: *CONNELL, Simon (University of Johannesburg); ASSAMAGAN, Ketevi (BNL); AUROUSSEAU, Mathieu (University of Johannesburg)*

The ATLAS experiment at the Large Hadron Collider at CERN provides an opportunity for studying the physics of the Standard Model (SM) and beyond. In particular, one may search the so called “hidden sector” for a possible new neutral boson which could be revealed by the study of the decay of the recently discovered Higgs-like boson or alternatively any other as yet undiscovered Higgs boson. The search is motivated by theoretical models which predict that this hidden sector Higgs is accompanied by new (non SM) gauge bosons, which are observable through mixing with SM Higgs. The well studied “golden” channel for the Higgs is H -> ZZ -> 4l (where l can either be an electron or a muon). This is the basis of the investigation, which is represented as H -> Z’Z‘ -> 4l. The Z’ represents the new gauge boson in the hidden sector and its mass is as yet unconstrained and could be quite low. Because of its low mass and the weak coupling to fermions, the Z' decays into SM fermions (leptons or light quarks) with a significant branching ratio and narrow width. This talk discusses the phenomenology of this channel using published ATLAS data as well as the strategy for the search which is still in progress.

513 - Is there a gap between the high school curriculum and first year university experience?

Education - Tuesday 09 July 2013 11:50

Primary authors: SONDEZI, Buyi *(University of Johannesburg)*
Co-authors: *MOLEFE, Paul (University of Johannesburg)*

The transition of high school curriculum from the previous Senior Certificate Examination (SCE) (which offered both Higher Grade (HG) and Standard Grade (SG)) to National Curriculum Statement (NCS) (subjects offered at one level) yielded a number of learners who pass their National Senior Certificate (NSC) with the minimum admission point score (APS). However, the expected knowledge and understanding of the content of the subject matter is rather contrary. This has been a recent observation experienced by first year physics lecturers at University of Johannesburg (UJ). One area of difficulty for the first year students is the basic understanding of vectors. A study performed previously [Molefe, 2012] indicated that some intervention(s) were necessary in an endeavor to improve vector concepts’ understanding. This section has been given more attention and a closer look at UJ, to a point that lectures around this section are modified so as to achieve better conceptual understanding. A study performed indicated that most of the students treated this section in their NCS level, yet the application of the knowledge to their first year physics and to the related concepts is problematic for most students. This study reports on the outcomes obtained from interventions employed within the first semester of the first year physics lectures at UJ.

514 - Physics foundation program: Implications for second year mainstream physics module

Education - Friday 12 July 2013 09:00

Primary authors: MOLEFE, Paul *(University of Johannesburg)*
Co-authors: *SONDEZI, Buyi (University of Johannesburg)*

There has been much concern about the university physics pass rates over the years. South Africa's economic prosperity depends to a large extent on the availability of sufficient highly educated and highly trained personnel in science, mathematics and technology (SMT). However, the status quo remains as the country still suffers from an acute shortage of trained personnel in these fields notwithstanding difficulties experienced by students coming from disadvantaged backgrounds. The huge gap between school and post-school education has placed universities under considerable pressure to in particular adapt undergraduate physics curricula in order to provide adequate mathematics foundation required to navigate the physics curricula. As a consequence of the dilemma, the duration of the three-year undergraduate physics program at the University of Johannesburg (UJ) was elevated to four years in order to make provision for additional tuition. This study examines the impact of physics foundation program on students' academic performance on their first encounter with physics mainstream curriculum at UJ by providing a comparative analysis of the performance of students from foundation program and their counterparts in the mainstream curriculum. The results of the investigation in this regard seem to suggest that some students from the foundation program appeared to have gained a somewhat adequate knowledge, understanding and confidence. In addition, the envisaged impact of foundation program on the confidence of students in coping with the mainstream module has also been acknowledged by the academic personnel.

515 - Magnetic Properties of CoFe2O4/CoFe2 nanocomposites reduced by activated charcoal in argon atmosphere

DCMPM1 - Wednesday 10 July 2013 11:10

Primary authors: EZEKIEL, Itegbeyogene *(University of KwaZulu-Natal)*
Co-authors: *MOYO, Thomas (University of KwaZulu-Natal); ABDALLAH, Hafiz M. I. (University of KwaZulu-Natal)*

The core-shell architecture of CoFe2O4/CoFe2 nanocomposites was synthesized in a controlled-argon atmosphere by reduction reaction process with activated charcoal at 900 ■C. The parent sample (CoFe2O4) was synthesized at 200 oC by glycol-thermal method which was followed by its subsequent partial and full reductions to CoFe2. Full reduction was achieved at a molar ratio of CoFe2O4 to C at 1:8. The phase identification and magnetic properties of the parent sample and nanocomposites were performed by X-ray diffraction, 57Fe Mössbauer spectroscopy and vibrating sample magnetometer. The average crystallite size of the parent sample changed from about 10 nm to about 60 nm after calcination at 900oC. A reduction in coercive field was observed from 337 Oe to about 20 Oe after activation by charcoal. The nanocomposites show enhanced magnetizations with increased carbon or CoFe2 content. The reduction process appears to increase the energy product from 0.86 MGOe for the annealed parent sample to 1.39 MGOe for the fully reduced sample.

516 - Elemental analysis of Kimberlite and associated Country Rock

Applied - Wednesday 10 July 2013 16:20

Primary authors: TCHONANG POKAHA, Marius *(University of Johannesburg)*
Co-authors: *COOK, Martin (University of Johannesburg); BORNMAN, Faan (Multotec Process Equipment (Pty) Ltd); CONNELL, Simon (University of Johannesburg); BALLESTRERO, Sergio (University of Johannesburg)*

The elemental analysis of Kimberlite and Country Rock was performed as part of an ongoing study into the Mineral-PET online rock sorting technique. This is a technology proposed to locate high densities of carbon in kimberlite and country rock using the very well known medical physics technique called Positron Emission Tomography (PET). Carbon in kimberlite is not a natural positron emitter; one has to convert the naturally occurring Carbon into a positron-emitting isotope. In this case it is done through a photonuclear transmutation reaction that transforms Carbon(12) into Carbon(11) . We accomplish this reaction by irradiating the host rock using gamma rays with energies in the Giant Dipole Resonance (GDR) region. It is then important to determine the full inventory of radioisotopes produced in this process. The irradiation of Kimberlite was performed using the 100 MeV electron microtron at Aarhus University in Denmark. In this paper, we first describe the experiment, and then perform a complete analysis of the data. This provides quantitative identification of the prompt, short, mid-term and even long-term radioactivity of irradiated Kimberlite, together with the nuclear processes that lead to them. This is necessary in order to assess more efficiently the radiation safety of the equipment and people working in the facility. A unique feature of this analysis in the unambiguous identification and quantification of each radioisotope formed by the two dimensional spectroscopy of the energy and the emission time of the signature gamma lines using time differential spectroscopy.

517 - Electronic Transport Properties of Silicon-germanium Nanowires

DCMPM1 - Wednesday 10 July 2013 10:50

Primary authors: ASLAN, Tahir *(University of the Witwatersrand)*
Co-authors: *COLEMAN, Chiristopher (University of the Witwatersrand); MCINTOSH, Ross (University of the Witwatersrand); NCUBE, Siphephile (University of the Witwatersrand)*

Silicon (Si) –germanium (Ge) nanowire field effect transistors (SGNWFET) are important semiconductor devices. Si/SiGe can be used in many different ways to improve conventional nanoelectronic devices. Further research on the synthesis and fabrication of SiGe is needed for the use of SiGe in field effect transistors for exploring the different ways that conventional nanoelectronic devices can be improved. Germanium, being a low bandgap material, increases the conductivity of Si nanowires and may improve the transport properties. In this work we study the electronic transport properties of SiGe nanowires at low temperatures and high frequencies. Silicon-Germanium nano-wires have been synthesized through the laser ablation of a target composed of Si and Ge using Ni as a catalyst. Characterization in the form of Raman spectroscopy as well as transmission electron, scanning electron and atomic force microscopy was performed. Low temperature transport measurements were performed to determine the transport mechanism. This work can be extended to high frequency transport (up to 67 GHz) in the co-planer waveguide configuration. In 1-D nanowires, confinement of charge carriers can generate interesting quantum transport features, such as Coulomb blockade effects and Luttinger liquid behavior. In addition, at high frequencies ballistic transport might be observed. Beyond the rich physics of correlations in low dimensional systems, this work may inform the development of novel electronic devices such as molecular level sensing and solar energy harvesting.

518 - CFD simulation of the CSL

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: MAHLASE, Conrad *(SAIP)*
Co-authors: *MICHAELIS, Max (UKZN); GLEDHILL, Igle (CSIR)*

Colliding Shock Lenses (CSL) are one of the better known applications of gas structures. They are real optical elements, sometimes have very good optical qualities and are made out of air. CSL's are dynamic lenses, which last for a few microseconds and are always evolving. The lens exploits the interference of shock waves in air to form a region high pressure, temperature and density that then changes the refractive index of air, hence making it possible to focus laser light. The limitations with the above experiments is that physical probes positioned at points of interest would interfere with the experiment, hence making it impractical to determine the parameters of interest as mentioned above. Computational Fluid Dynamics (CFD) is employed in this paper to try and alleviate the above problem.

520 - Determination of U-235 in the context of interference with Ra-226 for the study of the disequilibrium in the U-238 decay series

NPRP - Friday 12 July 2013 09:20

Primary authors: KHUMALO, Thokozani *(Student at University of Johannesburg (Physics Department))*
Co-authors: *WATTERSON, John (iThemba LABS); CONNELL, Simon (University of Johannesburg); KWELILANGA, Abie (iThemba LABS)*

In a gamma-ray spectrum from the uranium decay series the most intense peaks are from the decay of Pb-214 and Bi-214. These isotopes follow the gaseous Rn-222, the daughter of Ra-226 in the uranium decay series. It is relatively easy to compensate for the radon problem so that these peaks are a direct measure of the Ra-226 content of the samples. Because of the constant ratio between U-235 and U-238, the 185.72 keV peak from U-235 can be used as a measure of the uranium content. In order to do this it must be de-convoluted from the 185.25 keV peak from Ra-226. In this study, an IAEA uranium standard, known to be in equilibrium has been analysed by gamma-ray spectroscopy at iThemba LABS, Gauteng, using a new Broad Energy, HPGe detector (BEGE by Canberra Electronics) with the sample in a Marinelli beaker geometry. Spectral data were collected using spectrum analysis software in the Genie2000 system. The actual positions of the Ra-226 and U-235 peaks are known. Although these two lines are separated by only 0.5 keV, it is possible to obtain reliable values for the two peak intensities by using this modem detector and with appropriate data manipulation strategies. The FWHM of the detector and its variation with energy were therefore determined experimentally to reduce the free parameters in the fit; a least squares fit of a sum of the two Gaussians superimposed on a second degree polynomial background was then performed on the U-235/Ra-226 186KeV peak convolution using the MIGRAD minimizer in ROOT (an object oriented C++ data analysis platform developed at CERN). The varying parameters in the fit were the magnitudes (representing the intensities of the two peaks) of the two Gaussians and the background parameters. A numerical method for determining the intensity of U-235 and hence its concentration in an environmental sample, independent of Ra-226/Rn-222 equilibrium state has been established and the Chi squared surface has been studied to determine the errors in the important intensity parameters and to compare these values with the case where the FWHM is also a free parameter.

521 - Shining Light through walls using dark matter - Axion-photon mixing in astrophysics

Poster2 - Wednesday 10 July 2013 17:40

Authors: *BECK, Geoff (University of Witwatersrand); COLAFRANCESCO, Sergio (University of Witwatersrand)*

Axions or axion-like particles remain a prime candidate for a component of dark matter. Not only do they have the potential to resolve open questions about the structure of QCD but they are also ubiquitous in high-energy theories and possess the novel property of mixing with photons in the presence of magnetic fields. This mixing process provides a mechanism which allows for the conversion of photons to axions and vice-a-versa. Mixing could also manifest in an observable flux of photons emanating from dark matter halos or in particular distortion effects on the spectra of astrophysical sources and may also serve to increase the transparency of the universe to high energy radiation by "hiding" high energy photons from being lost to pair production processes (or similarly allowing light to shine through walls). Thusly, this process not only provides strong avenues for the potential observation of axionic dark matter but also bears many resemblances to Compton scattering phenomena and the physical basis of this comparison is examined and illustrated in this work.This central focus of this study is the astronomical search for axionic dark matter by examining the effects of axion-photon mixing on observable astrophysical phenomena.

522 - Astereoseismology of Beta Cepheid Stars using multicolor photometry: Mode Identi cation.

Poster2 - Wednesday 10 July 2013 17:40

Authors: *KEELEY, LLOYD (NORTH WEST UNIVERSITY)*

The thesis involves the study of young population B type Cepheidvariable stars using seismic waves to study their oscillation modes. Thegoal is to identify the modes associated with the frequencies over theranges of the quantum numbers n and l so that deductions can be madeabout the internal structure and composition of the star. For the Cepheids there are two types of pulsation modes p, or pressure modes,and g, or gravity modes, each of which penetrate to di erent depths inthe star thus probe conditions in the outer and inner parts of the star.Time series data collected from observations at Sutherland will be Fourieranalyzed and modes identi ed from the frequency peaks in the spectrum.In the theoretical model, the amplitude ratios are calculated for di er-ent values of the degree l of the spherical harmonic and wavelength ■and the computed values then compared with amplitude ratios obtainedfrom observational measurements at the same wavelengths. The theoret-ical model includes information about metallicity, temperature, density,pressure and the known atmospheric parameters with regards to the hy-pothetical Cepheid star. Once the theoretical amplitudes are matchedwith the observational amplitudes, within a certain error bar, then themode l can be identi ed. My goals will be to analyze the observed pulsa-tions in certain Cepheid stars to obtain information about their physicalparameters such as size and evolutionary state.

524 - Quantum Teleportation of photonic multi-level systems

Theoretical - Wednesday 10 July 2013 15:40

Primary authors: *KONRAD, Thomas (UKZN)*
Co-authors: *GOYAL, Sandeep (UKZN); ROUX, F. S. (CSIR); GOSH, Sibasish (IMSC, Chennai, India)*

This is the first of two new teleportation schemes for photons with multidimensional state space which we would like to discuss at this conference. In this scheme the transfer of the state of one multi-level photonic system to another remote system is achieved by means of implementing a measurement that projects onto an entangled state of several photons using a certain beam splitter array and photo detectors. The scheme generalizes an earlier version for polarization states based on the Hong-Ou-Mandel effect to excitations of an arbitrary number n of spatial modes of the electromagnetic field by using the properties of multi-particle interference. This teleportation scheme can be used to transfer the state of a single photon as well as the joint state of many photons simultaneously. In addition, it requires less additional photons per teleported unit of quantum information than earlier versions. However, the additional photons have to be prepared in a special entangled state. Reference: http://arxiv.org/abs/1212.5115.

525 - Magnetic properties of Sn0.2Cr1.8-xFexO4 nanooxides.

Poster1 - Tuesday 09 July 2013 17:40

Authors: *MBELA, Kalengay (UKZN)*

We report the magnetic properties of Sn0.2Cr1.8-xFexO4 (x = 0.3, 0.5, 0.7 and 0.9) compounds. The oxides were produced by hydrothermal process and sintered at 600 ºC for 12 hours. The X-ray diffraction (XRD) data indicate formation of single phase corundum structure in all the samples. The Mössbauer spectra recorded at about 300 K show transition from paramagnetic to ordered magnetic spin state at x = 0.5. The magnetization data have been obtained by using a VSM (PPMS) of Quantum design make. The exchange bias effect has been observed at low temperatures in all the samples. Keywords: Exchange bias, Nanoparticles, Magnetization,

526 - The properties and suitability of various biomass/coal blends for co-gasification in a downdraft biomass gasifier

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *GAQA, Sibongiseni (University of Fort Hare)*
Co-authors: *MAMPHWELI, Sampson (Fort Hare Institute of Technology)*

Gasification is a promising technology for the production of mainly gaseous fuels such as syngas, which is produced from the hydrocarbon-based materials. Currently, coal is the main feedstock that is used for the gasification process because of its large reserves and higher energy per volume. However, the use of coal has been a more concern because of the environmental impacts caused by the emission of toxic gases such as the sulphides, sulphates and nitrates as well as the ash slagging problems forming inside the gasifier. On the other hand, biomass is a renewable energy resource of interest as a replacement for coal to reduce the environmental impact associated with fossil fuel usage. Much consumption of fossil fuels has caused serious energy crisis and environmental impacts, globally. Co-gasification of coal and biomass is considered as a connection between energy production based on fossil fuels and energy production based on renewable fuels. The utilization of biomass by co-gasification with coal causes reductions of carbon dioxide, nitrogen and sulfur emission due to the renewable character of biomass and low contamination content in biomass. This study seeks to determine the properties of various biomass/coal blends and their suitability for co-gasification in a downdraft biomass gasifier. Energy Dispersive X-ray (EDX) analysis was carried out to determine the elemental analysis of the material. Fourier Transform Infrared (FT-IR) spectrophotometer was used to determine the functional groups present in the material. Thermogravimetric analysis (TGA) was conducted to investigate the thermal degradation of the material. The kinetic analysis of the various feedstocks allows the prediction of the rate at which co-gasification takes place. The results suggested that blending coal with biomass result in faster reaction rate at lower temperatures than that of coal alone and lower activation energy due to the high quantity of volatile matter in biomass.

527 - Back surface influence on Brillouin scattering in ion-implanted chemical vapor deposited diamond

DCMPM2 - Wednesday 10 July 2013 13:50

Primary authors: *MOTOCHI, Isaac (University of the Witwatersrand); BEKHUMUSA, Mathe (University of Witwatersrand)*
Co-authors: *NAIDOO, Mervin (University of Witwatersrand); TREVOR, Derry (University of Witwatersrand)*

Brillouin scattering measurements on thin opaque films seems to work nicely as long as the scattering surface is optically smooth. In transparent materials the measurements become complex due to the combination of surface ripple mechanism and elasto optic scattering occurring within the sample bulk. Condition for observing a Brillouin spectra is an optically smooth surface. Even in transparent surfaces the surface where light interacts with the surface need to be optically smooth. For materials that transmit light like diamond, the reflection from the backside plays an important role in obtaining a meaningful spectrum. Brillouin scattering measurements have been made to find out how the nature of the back surface for both pristine and ion-implanted diamond affects the spectra. While the spectra for a diamond sample polished on both sides and fixed to an aluminium holder using a double sided tape had other features, the same sample lacked them when fixed without the tape. The case where the unpolished side was held to the back side, no spectrum for both pristine and heavily ion implanted samples was observed. This implies that the nature of the surface, front and back plays a vital role on what can be measured in Brillouin scattering. Using Green's elastodynamic functions, further analysis has been done to calculate sound velocity in the different samples.

528 - Synthesis and characterization of tin oxide nanostructures for gas sensing applications

Poster1 - Tuesday 09 July 2013 17:40

Authors: *THABETHE, Bongani (Msm csir)*

Tin oxide (SnO2) is an important wide-bandgap (3.6 eV) n-type semiconductor with a rutile structure which has received a great deal of attention over the past few years due to its high transparency in the visible part of the spectrum, structural and chemical stability. It has been investigated for advanced functional use such as solid state gas sensors, transparent conductors, oxidation catalysts and optoelectronic devices. In this work we report on the successful formation of SnO2 nanostructures by using the Chemical vapour deposition process. As synthesized SnO2 samples were characterized using scanning electron microscopy (SEM), X-ray powder diffraction (XRD), and nitrogen adsorption analysis (BET). X-ray analysis of the tin oxide nanomaterial showed a highly, pure crystalline material

529 - Phenomenological interpolation of quarkonia cross sections

NPRP - Wednesday 10 July 2013 09:00

Authors: *BOSSU, Francesco (iThemba LABS)*

Nuclear matter under extreme conditions of temperature and energy density undergoes a phase transition. In this new state, lattice Quantum Chromodynamics (lQCD) calculations predict that partons (quarks and gluons) are no longer confined. Such a state is called Quark-Gluon Plasma (QGP). Quarkonia resonances (J/ψ and Υ families) are considered to be one of the most promising probes of the deconfined phase since the heavy quark pairs are produced in the early stages of the collision and their bound states are very sensitive to the QGP temperature.One of the experimental methods to quantify the nuclear medium effects in the production of quarkonia is the measurement of the nuclear modification factor (R_AA), defined as the ratio between the yields in A-A and binary rescaled pp collisions.In the first years of operation, the LHC delivered Pb-Pb and p-Pb collisions at the centre of mass energy per nucleon pair of 2.76 TeV and 5.02 TeV, respectively. The knowledge of quarkonia cross sections in pp collisions at the same energy is therefore crucial for a correct interpretation of the data. Available experimental data for quarkonia production at mid-rapidity are interpolated and then the rapidity and the transverse momentum dependence of the production cross sections are studied in order to provide reference in the kinematical region of interest for the LHC experiments.This presentation will focus on the description of such a method which is developed to provide a pp reference for the LHC experiments at energies which are partially or not at all explored.

530 - Characterization and Optimization of P3HT and PCBM blends for Photo-absorbance

DCMPM1 - Friday 12 July 2013 11:10

Authors: *KALONGA, Given (Zambia Bureau of Standards)*

ABSTRACTThin films were developed, characterized, and optimized for photo-absorbance from blends of the organic polymer poly (3-hexylthiophene-2, 5- diyl) (P3HT) and a fullerene derivative [6, 6] Phenyl-C61-butyric acid methyl ester (PCBM). The materials of both pristine and blends of P3HT and PCBM were analyzed using X-ray diffraction (XRD) spectroscopy and high resolution transmission electron microscopy (HR-TEM) for the structural properties, and Fourier transform infra-red (FTIR) and UV-VIS spectroscopy for the optical properties. The study evaluated the effects of blend ratio and annealing temperature on photo-absorption of the blends. Blend ratios examined in the study fell within the range of 1:0.8 to 1:1 by weight of P3HT to PCBM. The scope was divided into 11 intervals with a step increment of 0.02 for PCBM while P3HT was kept constant. The optimum blend ratio was determined and found to be 1:0.96 at 130 oC annealing temperature for 30 minutes. The annealing temperature dependence of each blend ratio with respect to photon-absorbance was found not to be symmetric but random. Each blend ratio was found to have its own optimum annealing temperature.INTRODUCTIONSemi-conducting organic polymers play a crucial role towards the possible realization of commercial solar energy absorbers that are flexible and light in weight [1- (1), 1-4]. Among the promising polymers in this category is poly (3-hexylthiophene-2, 5- diyl) also known as P3HT. P3HT is a conjugated polymer with a band gap of 2.1 eV and lowest unoccupied molecular orbital (LUMO) levels at 2.7 eV. It a

535 - Measuring low concentrations of naturally occurring uranium by analysing the gamma ray decays of 234Pa.

Poster2 - Wednesday 10 July 2013 17:40

Authors: *BEZUIDENHOUT, Jacques (Stellenboch University)*

Concentrations of natural occurring radionuclides is traditionally determined by utilising gamma ray spectra analyses. A count rate is typically extracted for a gamma ray energy window of one of the daughters of the parent isotope. Secular equilibrium between the isotopes in the decay chain of uranium (238U), like 234U, 230Th and 226Ra is however essential. The physical and chemical interaction of uranium, thorium and radium with their environment however differs substantially. This consequently creates disequilibrium amongst the daughters in the uranium decay chain which ultimately results in differences in the concentration of these daughters. The 1764 keV decay of 214Bi is predominantly preferred for this determination of uranium concentrations when utilising detectors with low resolution. Measuring of the 1764 keV decay of 214Bi would therefore provide an indication of radium concentrations opposed to natural uranium concentrations. This article investigates the prospect of utilising the 131 keV decay of 234Pa when determining the concentration of natural occurring uranium nuclides (238U and 234U). Samples were collected from various locations around South Africa and laboratory gamma ray spectra for each were obtained and analysed. The uranium and radium concentration were extracted by analysing the 214Bi and 234Pa gamma ray peaks, respectively. Comparisons were also made based on accuracy and detection limit.

536 - A study of the relationship between the activity concentrations of naturally occurring uranium and radium in various locations in the South Africa.

Poster2 - Wednesday 10 July 2013 17:40

Authors: *BEZUIDENHOUT, Jacques (Stellenboch University)*

Potassium, thorium and uranium are naturally occurring radionuclides of primordial origin. The characteristic concentrations of these radionuclides can be utilized as indicators in geological exploration. Radium is a long-lived daughter of uranium but with different chemical and physical interaction characteristics. This article investigates the general relationship between the concentrations of uranium and radium in various natural settings. Samples were collected from diverse locations around the South Africa and laboratory gamma ray spectra for each were obtained and analysed. The concentrations were extracted and compared and distinctive relationships between the concentrations of these nuclides are demonstrated and discussed. The relationships were then related to the physical properties of these nuclides and the environment.

538 - A circular current's duo Cartesian magnetic dipolar model and limitations on fields as spatial derivatives of potentials

Poster1 - Tuesday 09 July 2013 17:40

Authors: *CHIRWA, Max (Walter Sisulu University)*

It is shown that spatial derivatives of the general component and total magnetic vector potentials in the circular current's duo Cartesian magnetic dipole model successfully yield the correct related component and total magnetic fields. This is unlike the functionally limited traditional component magnetic vector potentials derived in specific Cartesian planes. We attributable the limitation to such component magnetic vector potentials' lack of the minimum number and type of variable coordinates, which is exactly that set of coordinates completely describing the position of the source. When the circular current lies in the xy-plane, the minimum coordinate set is the Cartesian x and y, or the cylindrical rho and phi or the spherical r and phi coordinates. A similar effect is found in the determination of the electric field from the electric scalar potential of an axially (z-axis) orientated electric dipole, for which the minimum set of variable coordinates is simply the single Cartesian or cylindrical z or the spherical r coordinate. Thus in the xy-plane, spatial derivatives of the component magnetic vector potentials yield the related magnetic fields, while the spatial derivative of the electric scalar potential does not give the electric field in that plane. Meanwhile, on the z-axis no magnetic field is obtainable as a partial derivative of a corresponding magnetic vector potential, but the electric field is obtainable from the related electric scalar potential. Thus it is not surprising that the traditional ad hoc definition of a circular current's magnetic dipolar moment, based on the functionally limited component magnetic vector potentials, is incorrect by a factor of 2.

539 - SALT Observations of Herschel Discovered Gravitationally Lensed Galaxies

Astro - Tuesday 09 July 2013 10:30

Authors: *LEEUW, Lerothodi (University of South Africa)*

We present early results of the Southern African LargeTelescope (SALT) observations of gravitationally lensedgalaxies. The systems were discovered by Herschel SpaceObservatory in large area maps conducted by theHerschel-ATLAS team and typically comprise a foregroundoptically-bright lensing galaxy and a background submm-bright lensed galaxy. The SALT observations are aimed atdetermining the redshifts of the lensing galaxies andexploiting them to characterize the individual lensingsystems and the sample, in conjunction with observationsat other international telescopes.

540 - The discovery of a Higgs boson at the LHC and future prospects

Poster2 - Wednesday 10 July 2013 17:40

Authors: *MELLADO, Bruce (University of the Witwatersrand)*

With the discovery of a Higgs boson at the LHC a new era in particle physics opens up. The discovery will be reviewed. Reviewed will also be the status of the elucidation of the spin-CP of the new boson. Prospects for Higgs physics at the LHC and other facilities will be outlined.

541 - Ion Beam Modification of the Structure and Properties of Hexagonal Boron Nitride

Applied - Wednesday 10 July 2013 16:00

Primary authors: *ARADI, Emily (University of the Witwatersrand)*
Co-authors: *NAIDOO, Mervin (University of the Witwatersrand); WAMWANGI, Daniel (University of the Witwatersrand); DERRY, Trevor E (Unversity of the Witwatersrand)*

Cubic boron nitride (c-BN) nanocrystals have been produced by boron ion implantation of hexagonal boron nitride (h-BN) at various fluences and implantation energies. The optimum fluence was found to be $5x10^{14}$ions/cm^2 at 150 keV. The presence of these nanoparticles was investigated using glazing angle XRD (GIXRD) and Fourier Transform Infrared Spectroscopy (FTIR).Glazing angle XRD pattern after implantation exhibited c-BN diffraction peaks with high intensity at the glazing angle of 3^o whose penetration depth corresponded to the implantation depth. After implantation, Fourier transfore Infrared spectroscopy indicated a peak at 1090 cm^{-1} which corresponded to the vibrational mode for nc-BN.

542 - AC/DC performance of a fully printed current switching silicon based transistor

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: *ZAMBOU, Serges (University of Cape Town)*
Co-authors: *WALTON, Stanley Douglas (University of Cape Town); NUESSL, Rudolph (University of Cape Town); FLORENCE, Idowu (University of Cape Town); BATSIRAI, Magunje (University of Cape Town); JONAH, Emmanuel (University of Cape Town); BRITTON, David (University of Cape Town); MARGIT, Harting (University of Cape Town)*

We present a novel, large area, fully printed nanoparticulate silicon based transistor which is produced by a simple screen printing process under ambient conditions without the need for post processing steps. It functions as a high voltage unit gain two-way current switch for both direct and alternating current. The uniqueness of our device is its principle of operation, which is distinct from those of conventional transistors which rely on electric field modulation or charge injection. Its mode of operation is based on activated transport of charge through the active silicon layer. In the new transistor, switching is achieved by applying a signal to the base which results in change of the direction of the current from between the collector and base to between the base and emitter. We demonstrate the operation of the device printed on flexible substrates using silver as the conductive layer and highly doped P-type nano-silicon as the active layer. It is further demonstrated that the operation of the transistor is independent of the dominant carrier type in the semiconductor and the nature of the junction between the semiconductor and the three contacts.

543 - Synthesis and magnetic properties of Mg1-xZnxFe2O4 nanoferrites

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *MASINA, Patrick (University of KwaZulu-Natal)*
Co-authors: *MOYO, Thomas (University of KwaZulu-Natal); ABDALLAH, Hafiz (University of KwaZulu-Natal)*

Mg1-xZnxFe2O4 nanoparticles (0<x<1 in steps of 0.1) have been produced by centrifugation using the low temperature glycol-thermal method at 200 C. Single-phase formation was confirmed by X-ray powder diffraction which revealed a well-defined cubic spinel structure with space group Fd3m. The crystallite size of the compounds ranged from 10.6-22.2 nm. A strong correlation was found between X-ray density and Zn-concentration (x). The magnetic properties as a function were investigated by using a 57Fe Mössbauer spectroscopy and magnetization measurements using vibration sample magnetometer at room temperature. The results show Zn-concentration induced transformation from paramagnetic state to magnetic ordered for x<0.8 for the studied nanosized samples.

544 - First-Principles Study of Thermodynamic and Dynamic Stability of Ru-Cr Alloys

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *TIBANE, Malebo (University of South Africa)*
Co-authors: *NGOEPE, Phuti (University of Limpopo)*

Planewave pseudopotential calculations were conducted to predict the thermodynamic stability of five different phases, L12, A15, DOC, DO′C and tP16 of Ru3Cr and RuCr3 alloys. The heats of formation of all studied compositions and phases of Ru-Cr are positive. We have investigated the dynamic stability at 0 GPa for RuCr3 A15 phase, which was found to be dynamically stable.

545 - Structural studies of Y and Zr doped nano-crystalline tin oxide using EXAFS and Raman Scattering techniques.

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: RAMMUTLA, Erasmus Koena *(University of Limpopo)*
Co-authors: *CHADWICK, AV (University of Kent, School of Physical Sciences, Canterbury, UK); ERASMUS, RM (University of the Witwatersrand, School of Physics, Johannesburg, 2050, RSA)*

Nanocrystals of Y and Zr doped SnO2 have been prepared by sol-gel route and annealed at 200, 400, 600, 800 and 1000 0C. The X-ray diffraction (XRD) results showed the average size of the particles in the freshly prepared samples to be ~ 3 nm. The Extended Absorption Fine Structure (EXAFS) technique was used to study the dopant environments in nanocrystalline tin oxide. In all Y-doped samples, except the one annealed at 1000 0C, there is clear evidence that Y has not entered the SnO2 lattice. This is clearly supported by the Raman scattering results. In all Zr-doped samples, there is a simple substitution for Sn by Zr.

546 - Redesign of the High Voltage Controller Card in Mobidick4

Poster2 - Wednesday 10 July 2013 17:40

Authors: ASARE, JOSEPH *(UNIVERSITY OF WITWATERSRAND)*

This research redesigns the HV drive to provide high voltage to the photo multiplier tubes during tests relating to the verification of the electronics pertaining to the upgrade of the Atlas Tile Calorimeter (TileCal). This HV drive forms part of MobiDICK4 which is an improvement of the MobiDICK test bench used to analyze the front-end electronics of the TileCal. This stand alone test bench, Mobidick4, combines a front-end GUI (Willy), ADC trigger read out, CAN bus interface, HV drive, LED pulse generator, a power distributor, and an external low voltage power supply for the full certification of the front-end super-drawer electronics. This work has reviewed the architecture of the HV drive which is the high voltage controller card in MobiDICK4 by simulating a printed circuit board with Cadence tools adding more functions that are deficient in the previous design.Keywords: HV drive, Test bench, MobiDICK4

547 - Graphene substrates for increased embryonic stem cell optical transfection efficiency

Photonics - Wednesday 10 July 2013 09:40

Primary authors: MTHUNZI, Patience *(CSIR - NLC)*
Co-authors: *HE, Kuang (University of Oxford, UK); WARNER, Jamie (University of Oxford, UK)*

Embryonic stem cells as well as the recently discovered induced pluripotent stem cells play an exceptional role in the advancement of current therapies in tissue regeneration and/or engineering. However, to achieve repair as well as the eventual improvement in tissue functions following tissue engineering; different biocompatible materials must be combined with living cells. Among the many tested nanomaterials, graphene has been reported as one of the promising biocompatible scaffolds that promote cellular proliferation in various mammalian cells including human mesenchymal stem cells. In previous literature, the two most popular techniques, namely electroporation and liposome-mediated methods were the most frequently used techniques to transfect mouse embryonic stem (mES) cells. Nonetheless, mES cell transfection efficiencies of lower than 10 % were obtained using electroporation and chemical transfection may be cytotoxic. Contrarily, femtosecond laser pulses have been reported to allow mammalian cell plasma membrane permeability thereby allowing intracellular introduction of foreign genetic species into both multipotent and pluripotent stem cells. As a result, a “chemical-free” cell transfection procedure that utilises micro-litre scale volumes of reagents was established. In this work we report for the first time transient and non-invasive photo-transfection of the ES-E14TG2a pluripotent cells on graphene coated substrates. Our results showed significant increase in the photo-transfection efficiency of mES cells plated on graphene.

548 - Optical delivery of anti-HIV-1 drugs into CD+ cells through a diffraction limited femtosecond laser beam spot

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: BOITUMELO, Mokae *(CSIR-NLC, University of Pretoria)*
Co-authors: *MEYER, Debra (University of Pretoria); MTHUNZI, Patience (CSIR-NLC)*

In cell biology, cytoplasmic expression of genetic materials and other macromolecules has a crucial role in medicine and biology. Essential applications involve delivery of a wide selection of potentially therapeutic agents e.g. proteins, oligonucleotides, ribonucleic acid, and deoxyribonucleic acid. For example, the delivery of antisense oligonucleotides and ribozymes to HIV-1 infected cells by antibody-targeted liposomes, certain cationic lipid formulations and pH sensitive liposomes has been reported to result in significant anti-HIV-1 activity. Various methods including chemical, cationic polymers and lipids, viral, or physical approaches have been developed to promote uptake of foreign genes, drugs and other macromolecules into living mammalian cells. However, each of these delivery systems harbours limitations. For both in vitro as well as in vivo procedures a drug delivery scheme possessing minimum cytotoxicity, which can be applied under sterile tissue culture protocols and can offer targeted treatment of a large number of individual cells is highly desirable. Optical translocation (drug delivery) techniques using femtosecond (fs) laser light sources satisfies these criteria. Additional benefits are that optical translocation setups are non-invasive and can be easily integrated with other optical techniques such as confocal laser scanning microscopy and optical tweezers systems. In this work, we investigate the possibility of targeted optical drug delivery within populations of TZM-bl cells. Thus, opening the future prospect of coupling this optical translocation methodology with endoscopes for in vivo applications, that could lead to a possibility of treating HIV-1 within human lymph nodes administered via optical fibers.

549 - Synthesis and characterisation of carbon nanostructures, for hydrogen storage and gas sensing application.

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: THETHWAYO, Charles Thulani *(University of Zululand)*
Co-authors: *CEPEK, cinzia (istituto dei materiali); NDWANDWE, Muzi (university of Zululand); MBUYISA, Puleng Nontobeko (university of Zululand)*

In this work, we study carbon nanofibers(CNFs) grown on zinc oxide nanorods for hydrogen storage. Zinc Oxide nanodots have been deposited using DC magnetron sputtering. We have then grown aligned ZnO nanorods on the ZnO nanodots and then grown carbon fibres in vacuum using acetlylene as a source of carbon. The structure and morphology of ZnO:CNFs and ZnO nanorods have been studied using scanning electron microscopy (SEM). Carbon nanofibers have small diameters, a pore-size distribution which leads to excellent adsorption capacity and improved gas-sensing ability. Initial Elastic Recoil Detection Analysis (ERDA) results are presented and they show promise that these fibres are promising candidates for hydrogen storage.

550 - Life time measurements in the transitional nucleus 150Sm

Poster2 - Wednesday 10 July 2013 17:40

Primary authors: BVUMBI, Suzan Phumudzo *(University of Johannesburg)*
Co-authors: *CONNELL, Simon (University of Johannesburg)*

The high spin states of the nucleus 150Sm were populated via the 4n channel following a fusion evaporation reaction 136Xe(18O, 4n)150Sm. The de-excitation gamma-rays were detected using the AFRODITE spectrometer array at iThemba LABS. Life time measurements were performed using the Doppler shift attenuation method technique (DSAM) [1]. Experimental transition strengths (BE2) obtained using the life times are presented together with the measured angular intensity ratios and linear polarization anisotropy. A new decay scheme of 150Sm with the rearrangements of some mystery decay paths seen from Urban et al. [1] is also presented. [1] T. K. Alexander, J. S. Foster, M. Baranger, and E. Vogt. Advances in nuclear physics education, Vol. 10, pg. 197. Plenum Press, NY, London, (1978). [2] W. Urban, J. C. Bacelar, and J. Nyberg. Fast nuclear rotation and octupole defor- mation. ACTA, Physica Pol. B, 32:2527, (2001) .

551 - Preliminary site survey for a laser interferometer gravitational-wave observatory (LIGO) for South Africa

Theoretical - Tuesday 09 July 2013 10:50

Authors: COMBRINCK, Ludwig *(HartRAO)*

Within the framework of the LIGO Scientific Collaboration, a preliminary site survey was done to establish whether a suitable location could be foundfor the establishment of a laser interferometer gravitational wave observatory in South Africa. Certain criteria such as accessibility, geological stability, suitable topography, access to high speed internet, electricity and feasibility where considered. The Great-Karoo was targeted, as it has large flat areas, which is a prerequisite for such a site, due to the length (4 km) of the interferometer arms.The objective of the site survey is to garner local and international support for the construction of a gravity wave observatory in South Africa and to facilitate inclusion of South Africa in the LIGO Scientific Collaboration. This will improve the observation of gravitational waves from cosmic sources, and will include the South African scientific and engineering community in the field of gravitational wave astronomy.A description of a suitable site is given, this site could be included in future modelling scenarios of the LIGO Scientific Collaboration. As external forces on the test masses of the interferometers limit their sensitivity, a proposal is made for the establishment of a long-term monitoring site equipped with suitable instrumentation to provide a time-series of data which can be used as site validation data.

552 - One step synthesis and characterization of Indium Monoselenide nanoparticles for photovoltaic application

Poster1 - Tuesday 09 July 2013 17:40

Authors: AIRO, Mildred *(MSc student, School of Chemistry, University of Witwatersrand)*

Nano-sized indium monoselenide, InSe nanoparticles have been synthesized by a novel simple route. The route is based on the thermolysis and selenium and indium (iii)chloride in oleylamine. The role of oleylamine in this method is to reduce selenium while acting as both the solvent and capping agent. This method provides feasible and homogeneous environment for the formation of layers of InSe which later break down to quantum dots as the time progresses. This is contrary to the two processes involved in the growth of nanocrystals in solution phase; the nucleation stage which is followed by the growth of the nanocrystals. The InSe samples were synthesized at a temperature of 200■C, the mole ratio of Se:InCl3 was 1:1. Time was varied and its effect on the process studied. At the same reaction conditions, the effect of changing the solvent (mixture of oleylamine and oleic acid) on the size and morphology on the final nanoparticles was investigated. The optical properties of the resulting nanoparticles have been studied by obtaining their photoluminescence and absorption spectra. In addition, the morphology and phase structure of the Indium monoselenide nanoparticals have been determined by X-ray diffraction and transmission electron microscopy.

554 - University students' performance in different types of exam questions informs on their problem solving skills as well as studying ability

Education - Tuesday 09 July 2013 16:00

Primary authors: ALBERS, Claudia *(WITS university)*
Co-authors: *CLERK, Douglas (WITS)*

An evaluation of students' performance in different questions in an exam at the end of a Physics first year major course, at the University of the Witwatersrand, in terms of the different skills required to answer each question, leads to insight into their level of problem solving and studying skills. The students in this evaluation found questions that were new and required more intuitive, or lateral and logical type thinking, the most difficult to answer. The students, surprisingly, also found some questions that required the memorization of material only, also difficult to answer. Problems that only required a routine operation, or plugging into an equation, seen many times before, were perceived by the students as the easiest type of question to answer. These results also inform on the type of learning and studying the students have been acclimatised to due to the type of instruction received prior to arriving at university.

555 - Carbon in Modern Nuclear Reactors

DCMPM2 - Friday 12 July 2013 09:00

Authors: MALHERBE, Johan *(University of Pretoria)*

The image of the nuclear power industry is tarnished mainly because of two factors, the release of nuclear waste from accidents such as Chernobyl and Fukushima, and fears around suitable and safe long-term storage of nuclear waste. The talk will deal with some steps taken by the industry to address these two points and how carbon can play a central role in both these aspects. Many of the next generation (i.e. Generation IV) nuclear power plants will use coated fuel particles to contain the radioactive fission products within the fuel particles and thereby prevent release of radioactivity during accidents. In the TRISO fuel particle the coatings consist of layers of pyrolytic carbon and SiC. The functions of the different pyrolytic carbon layers will be discussed. Examples of analyses done on these layers and their relevant properties in our laboratory will be shown and discussed.Glassy carbon is a possible containment material for long-term storage of high level radioactive waste. Reasons why glassy carbon is a suitable material for such a purpose will be given. Two important properties of a containment material are low diffusivity for nuclides and radiation resistance. Since radiation damage can enhance or induce diffusion, a review will be given of radiation damage in graphitic and in glassy carbons. In our studies we used Raman spectroscopy to determine the effect of radiation damage on glassy carbon at different bombardment and annealing temperatures. The diffusion of implanted radiological important elements in glassy carbon has been investigated using RBS. Examples will be given of some of our investigations. Chemical interaction between the implanted species and the glassy carbon is investigated using SEM.

556 - Annihilation of Positrons with High Momentum states in Lithium Flouride using Local Density Approximation and Generalized Gradient Approximation

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: JILI, Thulani *(University of Zululand)*
Co-authors: *BUTHELEZI, Tsepiso (University of Zululand); SIDERAS-HADDAD, Elias (University of the Witwatersrand); WAMWANGI, Daniel (University of the Witwatersrand)*

High momentum components of electron-positron annihilation radiation in ionic lithium flouride are obtained via annihilation of positrons with core electrons. The ratios of annihilation probabilities for various electronic levels as a function of momentum are calculated within the local density approximation (LDA) and generalized gradient approximation (GGA). Annihilation rates associated with defects and in the bulk are also calculated

557 - Ab initio calculations on the structural, electronic and optical properties of the hazardous silver nitrides

DCMPM2 - Friday 12 July 2013 11:30

Primary authors: SULEIMAN, MOHAMMED S. H. *(University of the Witwatersrand)*
Co-authors: *JOUBERT, Daniel P. (University of the Witwatersrand)*

Despite its earlier discovery, silver nitride may be the least theoretically studied compound in the late transition-metal nitrides family. The experimental characterization of silver nitride is hindered by its unstable nature. We employed first-principles calculation methods to investigate the structural, stability, electronic and optical properties of bulk crystalline Ag3N, AgN and AgN2 based on density functional theory (DFT) and many-body perturbation theory. The equation of state (EOS) and structural preferences for these three stoichiometries were analyzed and the equilibrium lattice parameters were determined. Bulk modulus and its pressure derivative and thermodynamic stability of all phases have been investigated. The electronic structure of the relatively most stable phases were investigated via thier band diagrams and total and orbital-projected density-of-states (DOS). Moreover, single-particle spectra of the quasi electrons and quasi holes were obtained via the GW approximation to the self-energy operator, and frequency-dependent optical constants were derived. Obtained results were comprehensively compared to previous calculations and to experimental data.Reference:* Mohammed S. H. Suleiman and Daniel P. Joubert. Theoretical calculations on the structural, electronic and optical properties of bulk silver nitrides [http://arxiv.org/abs/1212.6507]. ArXiv e-prints, December 2012.

558 - Sol-gel synthesis and characterization of terbium ion doped zinc oxide nanoparticles

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: KABONGO, Guy Leba *(University of South Africa)*
Co-authors: *MHLONGO, Gugu Hlengiwe (Council for Scientific and Industrial Research); MOTHUDI, Bakang Moses (University of South Africa); HILLIE, Thembela (Council for Scientific and Industrial Research); DHLAMINI, Mokhotjwa Simon (University of South Africa)*

Zinc oxide (ZnO) nanoparticles doped with terbium (1 mol %) was synthesized by sol-gel process. The samples were characterized by X-ray diffraction (XRD), Ultra Violet – Visible (UV-VIS) spectroscopy and Photoluminescence (PL) spectroscopy. The XRD patterns revealed that the diffraction peaks of both undoped and doped samples were readily indexed to ZnO wurtzite structure without any other phase and that the prepared materials were of crystalline nature. The UV-VIS was used to study the absorption characteristic of the samples. Infrared absorption spectra were also measured and discussed. The PL study revealed that Tb3+ ions were emitting in the host through the f-f internal orbital transitions. It was also observed that the radiative transitions from the 5D4 state to 7Fj (j=6, 5, 4, 3, 2) state of Tb3+ appeared at 501 nm, 542 nm, 604 nm, 652 nm, 702 nm position, respectively. Moreover, 5D4-7F5 (542 nm) electric dipole transition was the most intensive. The optical properties of the as prepared and annealed samples are compared.*Corresponding author. Tel.: +2712 429 2716; Fax: +2712 429 3643;Email: gmhlongo@csir.co.za (G.H.M); dhlamms@unisa.ca.za (M.S.D)

559 - Synthesis and characterization of luminescence properties of CaAl2O4:Eu2+,Tm3+ phosphors powder

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: DHLAMINI, Mokhotjwa Simon *(University of South Africa)*
Co-authors: *MOTHUDI, Bakang Moses (University of South Africa); MHLONGO, Gugu Hlengiwe (Council for Scientific and Industrial Research); NTWAEABORWA, Odireleng Martin (University of the Free State); SWART, Hendrik (University of the Free State); HILLIE, Thembela (Council for Scientific and Industrial Research)*

Photoluminescent powders of CaAl2O4 co-doped with Eu2+ and Tm3+ ions prepared by combustion method were studied. The reaction temperature used was about 500oC. The effect of different excitation wavelength on the luminescent properties of the phosphor is discussed. The as prepared samples were compared with the samples annealed in air at the temperature of 450 oC. The annealing temperature of 450oC used was estimated from the TGA curve of the CaAl2O4:Eu2+,Tm3+ sample. Red emission peaks from the unreacted Eu3+ ions were measured. The emission spectra of the as prepared and annealed samples were compared. Wavelength selective excitations show that the 200 and 360 nm give the intense emission from Tm3+ ions. Bright emission from all emitting centers (Tm3+, Eu3+ and Eu2+ ions) was measured when the excitation wavelengths of 250, 260, 285 and 300 nm were used. The most intense red emission from Eu3+ ions was observed at the excitation wavelength of 230 nm. Corresponding author: e-mail dhlamms@unisa.ac.za Fax: +27 12 429 2716, Tel: +27 12 429 3643Keywords: Photoluminescence, Excitation wavelength, Phase transition, Combustion, Luminescence

560 - Benefits of the circular current's duo Cartesian magnetic dipolar model

DCMPM2 - Friday 12 July 2013 11:10

Authors: CHIRWA, Max *(Walter Sisulu University)*

After the realization of the circular current's model of two merged distributions of distinct Cartesian x and y component line current elements, we show its added benefits. These include how magnetic dipolar functions of dipolar moments, torques, magnetic vector potentials, and fields differ from their counterparts for a simple axial electric dipole. Further, as the traditional ad hoc definition of magnetic dipolar moment is incorrect by a factor of 2, inherently a factor of 2 or ½ should be inserted in certain magnetic relations involving the concept of magnetic moment per unit volume. Finally, the model affirms the magnetic Gauss' law as well as the irrelevance of the traditional fictitious magnetic scalar charge to magnetic phenomena

561 - Magnetic Symmetry for Hexagonal Manganite RMO3

Poster1 - Tuesday 09 July 2013 17:40

Authors: MACHATINE, Augusto *(University of Pretoria)*; NIYONGABO, Prime *(University of Pretoria)*

We study the symmetry of hexagonal manganite RMO3 (R = Sc, Y, Ho, Er, Tm) at room temperature with non-magnetic space group P63mc and below the transition temperature TN = 7 0 …130 K with magnetic space groups (P6'3cm, P6'3c'm, P6'3) for parallel and (P63c'm', P63cm, P63) for anti-parallel orientation in planar -triangular structures. We calculate and tabulate the irreducible representations and the co-representations of non-magnetic and magnetic space groups respectively at high symmetry points and lines throughout the fundamental domain in the Brillouin zone. These irreducible representations and co-representations are the starting point in calculations of the coupling coefficients. They are also needed for structure elucidation in X-ray, electron and neutron diffraction experiments. The coupling coefficients are used in the calculation of material tensors, like Raman scattering tensors, Brillouin scattering, morphic effects in crystals, as well as non-linear magneto-optical properties. The selection rules and wave vector selection rules for these space groups are given.

562 - Analysis of similarities and differences between a circular current's and a simple electric dipole's Cartesian torques

Poster2 - Wednesday 10 July 2013 17:40

Authors: *CHIRWA, Max (Walter Sisulu University)*

After the realization of the circular current's model of two merged distributions of distinct Cartesian x- and y-component line current elements as respective Cartesian line magnetic dipoles, we analytically compare its two Cartesian dipolar torque components to those of a z-axis symmetric electric dipolar distribution. Starting with the indisputable concept of torques as moments of respective forces, individual elemental Cartesian dipolar torque components are constructed under identical field directions, then integrated and recombined into the overall magnetic or electric dipolar torque. Only magnetic dipolar torque on the x component magnetic dipoles is in the negative x-direction and is due to a z-force component created by the y-component magnetic field, whereas only the magnetic torque on the y-component magnetic dipoles is in the positive y-direction and is due to a z-force component created by the x-component magnetic field. For the z-axis electric dipolar distribution, only its x-component electric dipolar torque is due to the y-component electric force created by the y-component electric field, while it is vice versa for its y-component electric dipolar torque. In spite of the diverse origins of these Cartesian torque components, two reasons permit their ultimate recombination into a triple or duo vector cross product involving a dipolar orientation vector, a magnetic vector or electric scalar charge and all three Cartesian field components. The Cartesian force on each dipole due to the z-component magnetic or electric field is parallel to its dipolar orientation vector, so that its related magnetic or electric Cartesian torque component vanishes. The integrated magnetic dipolar moments of the circular current's two distinct Cartesian magnetic dipoles are equal, but it is their sum which constitutes the magnetic dipolar moment of the whole circular current. The z-axis electric dipole's two Cartesian torque components involve only one electric dipole moment. It is thus illustrates that the traditional ad hoc definition of a circular current's magnetic dipole moment errs by a factor of 2 for failing to note that equality of any two moments does not necessarily mean equality of the two physical quantities generating them. This is also assisted by similar inequalities characterizing magnetic and electric Cartesian dipolar torque components.

563 - The development of a converter target for the production of radioactive beams at iThemba LABS

Poster2 - Wednesday 10 July 2013 17:40

Authors: *NGCOBO, Zipho (iThemba Labs)*

iThemba LABS proposes a new proton accelerator for the production of radioactive beams and for simultaneous production of medical isotopes. Neutron-rich radioactive beams can be produced using the Isotope Separation Online (ISOL) method by the fission of uranium. One of the figures of merits for a radioactive beam facility is the intensity of beams as well as purity: being free of unwanted elements.High intense beams require the fission rate to be optimised in the uranium target. Neutron induced fission results in enhanced (much pure) production of neutron-rich fission fragments. It is therefore necessary for neutrons to be created from a high current thus high proton beam power.This project then will characterise the (p, xn) reactions on selected targets between the energies of 20MeV to 70MeV, so as to understand the actual energy and angular distributions of the emitted neutrons. The system being considered will consist of a primary neutron converter and a secondary uranium target. The advantage of a primary neutron converter over a system in which protons hit directly the uranium is that more beam power can be deposited in the converter target without uranium target reaching unbearable temperatures. At GANIL, Ridikas and Mittig found that when bombarding target nuclei with protons, the neutron yields are similar for most nuclei but more favourable for very light (lithium or beryllium) and very heavy (thorium or uranium) nuclei. The experiment taking place at iThemba LABS in September 2013 will measure neutron cross sections of beryllium; oxygen-18 and Tantalum. At the moment predictions are being conducted using MCNPX code. Once the parameters of the converter are optimised then criticality calculations on the uranium target must reveal the extent to which these produced neutrons from the primary target contribute to the fission fragment yields.

564 - Electronic and Optical properties of Si_3Al(P, As)

DCMPM1 - Friday 12 July 2013 09:40

Authors: *AZEMTSA DONFACK, Hermann (University of South Africa)*

A method based on the TB-LMTO-ASA and the Quasi Self consistent-GW (QSGW) approximation is used to investigate the electronic and optical properties of the newly synthesized silicon-like Si_3Al(P, As). These are crystalline materials made of Si, AlAs and AlP, all retaining their tetrahedral bonds. We compared the optical properties of these new IV/III-V semiconductors to those of bulk Si.

565 - Analysis of the Tsallis distribution and it's applicability to high energy physics

Poster2 - Wednesday 10 July 2013 17:40

Authors: *WHITEHEAD, Andile (University of Cape Town)*

The region of soft collisions in nucleon-nucleon interactions occurs in the region of non-perturbative QCD. As such, there are numerous phenomological models present which attempt to describe various aspects of these collisions. The transverse momenta, distributions for charged particles at $\sqrt{s}=900$GeV, and K and ϕ particles at $\sqrt{s}=7$TeV, for p-p collisions obtained from the ALICE experiment at the LHC were fitted using the Tsallis distribution using three parameters, namely T, q and R. The fits performed to these sets of data were found to be extremely satisfactory. However for Pb-Pb collisions the Tsallis distribution did not perform as well due to the neccesity to incorporate hydrodynamical considerations related to heavy-ion collisions, which are not incorporated in the distribution.

567 - The challenges of tutor training for high school learners

Education - Friday 12 July 2013 09:20

Authors: *MURONGA, Azwinndini (University of Johannesburg)*

With an increased emphasis on high school education, the design of an effective tutor training, for high school tutoring, must consider the interaction of many dimensions that affect tutors' performance. Issues to be considered include who should provide training, program requirements and curricula, length of the program, follow-up activities, preparation for international tutors, greater learner diversity, etc.

568 - Nuclear Matter Equation of State and the Neutron Stars

Theoretical - Wednesday 10 July 2013 14:50

Authors: *MURONGA, Azwinndini (University of Johannesburg)*

Neutron stars are powerful laboratories for constraining the equation of state of dense nuclear matter. Many aspects of neutron star structure depend on specific equation of state parameters.Because many aspects of equation of state includingsymmetry and thermal properties are uncertain and not well constrained by experiments, it is important to develop an equation of state with easily adjustable parameters.The purpose of this presentation is to discuss the development of the nuclear matter equation of state for dense nuclear matter.

569 - NON-SPECIALIST: Skills development and training

Education - Wednesday 10 July 2013 13:50

Authors: *SPARROW, RAYMOND WALTER (CSIR - SYNTHETIC BIOLOGY ERA (BIOSCIENCES))*

With the increasing advancements in science and technology the artificial divisions between the various disciplines is increasingly becoming less distinct. More and more there is a need to undertake multi-disciplinary research and development. Therefore the scientists and technology developers now and in the future will need to acquire skills and techniques in more than one area. These developments have been undergoing in Europe, America and Asia for the past 20 years. Africa has only just started to appreciate the benefits of such a direction. Unfortunately the education and training programmes are 10 – 20 years behind the rest of the developed world.This talk will be around the model vocational training programme that was being developed in a unique collaboration between the CSIR Biosciences and UNISA. The talk will describe the principles behind the vocational learning programme and the mechanism as to how the programme would operate. This will include a case study example of how the programme is being implemented within CSIR Biosciences. The final part of the presentation will be on future plans and developments.

570 - Electrical characterization of 5.4 MeV alpha-particle irradiated 4H-SiC with low doping density

Poster1 - Tuesday 09 July 2013 17:40

Authors: *PARADZAH, Alexander (University of Pretoria)*

Nickel Schottky diodes were fabricated on 4H-SiC. The diodes had excellent rectification with twelve orders of magnitude between -2V and +2V. The ideality factor was obtained as1.05 which signifies the dominance of the thermionic emission process in charge transport across the barrier. Deep Level Transient Spectroscopy (DLTS) revealed the presence of four deep level defects in the 30 – 350 K temperature range. The diodes were then irradiated with 5.4 MeV alpha particles up to a fluence of 2.6 × 1010 cm-2. Current Voltage (I-V) and Capacitance Voltage (C-V) measurements revealed degraded diode characteristics after irradiation. DLTS revealed the presence of two more energy levels with activation enthalpies of 0.42 eV and 0.76 eV below the conduction band. These levels were however only realized after annealing the irradiated sample at 200 ■C and they annealed out at 400 ■C.

571 - Effect of the alpha particle charge state and energy on irradiation induced deep level defects in ZnO

Poster1 - Tuesday 09 July 2013 17:40

Primary authors: *MTANGI, Wilbert (University of Pretoria)*
Co-authors: *AURET, FD (University of Pretoria)*

A systematic investigation of the effects of varying alpha-particle energy and ionization state has been performed on alpha-particle irradiated Pd/ZnO Schottky contacts. Deep level transient spectroscopy performed on these contacts reveals three prominent deep level defects, E1, E2, and E3, in the as-deposited samples. For contacts irradiated with 600 keV He+ ions, the three prominent levels have been observed and two new levels have been induced, T2 and Eα1, with activation enthalpies of 0.30 eV and 0.46 eV, respectively. Eα1 with an activation enthalpy of 0.47 eV together with the three prominent levels E1, E2 and E3 have also been observed in contacts irradiated with 1.2 MeV He+. For contacts irradiated with 1.2 MeV He2+, the three prominent levels have also been observed and two new defects Eα1 and Eα2 with activation enthalpies of 0.46 eV and 0.77eV, respectively as determined from standard Arrhenius analysis, have been induced. Preliminary results indicate that particle energy has a strong impact on the formation of the Eα1 level and the formation of T2. Introduction of Eα2 has a strong dependence on the alpha-particle ionization state.

572 - A Novel Mode of Current Switching Dependent on Activated Charge Transport

Applied - Tuesday 09 July 2013 16:20

Primary authors: *WALTON, Stanley (University of Cape Town)*
Co-authors: *BRITTON, David (University of Cape Town); HARTING, Margit (University of Cape Town); JONAH, Emmanuel (University of Cape Town); MAGUNJE, Batsirai (University of Cape Town); ZAMBOU, Serges (University of Cape Town)*

We demonstrate a fully printed transistor with a planar triode geometry, using nanoparticulate silicon as the semiconductor material, which has a unique mode of operation as an electrically controlled two-way (double throw) switch. A signal applied to the base changes the direction of the current from between the collector and base to between the base and emitter. We further show that the switching characteristic results from the activated charge transport in the semiconductor material, and that it is independent of the dominant carrier type in the semiconductor and the nature of the junction between the semiconductor and the three contacts. The same equivalent circuit, and hence similar device characteristics, can be produced using any other material combination with non-linear current-voltage characteristics, such as a suitable combination of semiconducting and conducting materials, such that a Schottky junction is present at all three contacts.We present performance results for two design variants of the printed transistor and confirm our interpretation of the device's operation by constructing a model circuit using individual varistors.

573 - The mechanism of the amidases: Mutating the glutamate adjacent to the catalytic triad inactivates the enzyme

Applied - Tuesday 09 July 2013 14:10

Primary authors: *SEWELL, Bryan Trevor (University of Cape Town)*
Co-authors: *WEBER, Brandon William (University of Cape Town); KIMANI, Serah Wangari (University of Cape Town); VENTER, Gerhard (University of Cape Town)*

All known nitrilase superfamily amidase and carbamoylase structures have a second glutamate, in addition to the Glu, Lys, Cys “catalytic triad”, that is hydrogen bonded to the catalytic lysine. Mutating this glutamate (E142) to a leucine or aspartate in the amidase from Geobacillus pallidus renders the enzyme inactive. X-ray crystal structure determination shows that the structural integrity of the enzyme is maintained in spite of the mutation, with the catalytic cysteine (C166), lysine (K134) and glutamate (E59) in identical positions to those of the wild-type enzyme. The structural integrity is maintained in the case of the E142L mutant by a chloride ion that is located in the position occupied by E142 Oε1 in the wild-type enzyme and thus interacts with the active site lysine. This site is occupied by D142 Oδ1 in the case of the E142D mutant. The active site cysteine of the E142L mutant was found to form a Michael adduct with acrylamide, which is a substrate of the wild-type enzyme. The crystal structure of the adduct and quantum mechanical modelling show that the amide moiety interacts with the active site in a different manner than it does in the wild-type enzyme. The result is that the double bond of the acrylamide rather than the amide carbonyl carbon is adjacent to the active site cysteine. In the case of the E142D mutant no reactions occur and an acetate is found in the active site pocket. The D142 Oδ2 atom is located in two alternative locations that are respectively 2.1 Å and 4.3 Å from the location of E142 Oε2 in the wild-type enzyme. This demonstrates the role of the hydrogen bond between E142 Oε2 and the substrate amino group in positioning the substrate with the correct stereoelectronic alignment to enable the nucleophilic attack of the carbonyl carbon by the catalytic cysteine.

575 - Luminescence properties of blue-red emitting SrAlxOy:1 percent Eu2+,x percent Cr3+ phosphors prepared using sol-gel method

Poster1 - Tuesday 09 July 2013 17:40

Authors: *TEBELE, Angelina Seithati (Student)*

AS Tebele*1, SV Motloung1, FB Dejene11Department of Physics, University of the Free State (Qwaqwa Campus), Private Bag X13, Phuthaditjhaba, 9866, South Africa*Corresponding author e-mail address:tebeleas@qwa.ufs.ac.zaAbstractSrAlxOy:1%Eu2+,x%Cr3+ powders were synthesized by sol-gel method at a low temperature below (~80 0C). Metal nitrates were used as the source of metal ions and citric acid as a chelating agent. Concentrations of Cr3+ ions were varied in the precursor during synthesis. The annealed samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and photoluminescence (PL) spectroscopy. The XRD revealed that the annealed samples consist of mixture of orthorhombic, unknown, cubic and hexagonal phases. Varying the Cr3+ concentrations do not affect the crystal structure of the phosphor. Morphology of the phosphor was influenced by varying the Cr3+ concentrations in the precursors. The PL results showed strong luminescence in the blue to red regions of the spectrum. The highest emission peak is at 702 nm, which is attributed to the typical 4T2(4F) – 4A2(4F) cromophore (Cr3+) ion transition. It was observed from the PL spectra that Eu2+ ions emissions were being suppressed relative to those of Cr3+ possibly due to energy transfer from Eu3+ ions to Cr3+ ions. Keywords: Sol-gel, SrAlxOy:1%Eu2+,x%Cr3+, luminescent, energy transfer

577 - Anomalous Higgs Couplings

Poster2 - Wednesday 10 July 2013 17:40

Authors: *AMAR, Gilad (University of the Witwatersrand)*

With the discovery of a Higgs boson at the LHC a new era in particle physics opens up. The Vector Boson Fusion (VBF) production mechanism provides an invaluable opportunity to explore the spin-CP of the Higgs boson. It has been recently pointed out (A. Djouadi, R.M. Godbole, B. Mellado, K. Mohan http://arxiv.org/abs/arXiv:1301.4965) that new physics in the HVV vertex implies strong variations in the acceptance of the Higgs boson observation with the VBF production mechanism. Phenomenology results for ep and pp collisions will be shown.

SPEAKER LIST

SPEAKER LIST

SPEAKER LIST

ABBREVIATIONS

CERN - European Organization for Nuclear Research
CSIR – Council for Scientific and Industrial Research
DUT – Durban University of Technology
FHIT – Fort Hare Institute of Technology
HartRAO – Hartebeesthoek Radio Astronomy Observatory
HMO – Hermanus Magnetic Observatory
LRC – Laser Research Centre
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 Fort Hare
UFS – 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 the Western Cape
UNIZULU – University of Zululand
WiPiSA – Women in Physics in South Africa
Wits – University of the Witwatersrand
WSU – Walter Sisulu University

NITheP
National Institute for Theoretical Physics

ADVANCING RESEARCH AND TRAINING IN **THEORETICAL PHYSICS**

The National Institute for Theoretical Physics (NITheP) promotes research programmes and educational opportunities in the field of theoretical physics in South Africa and Africa.

We offer several attractive programmes for researchers and students to drive our research and capacity-building goals:

Students:

- Bursaries
- Travel grants
- Internships
- Schools

Associate programmes:

- Visitor
- Workshop
- Short research
- Mobility

Visit our website at www.nithep.ac.za for more information.

The National Institute for Theoretical Physics has facilities at the Universities of Stellenbosch, KwaZulu-Natal and Witwatersrand.