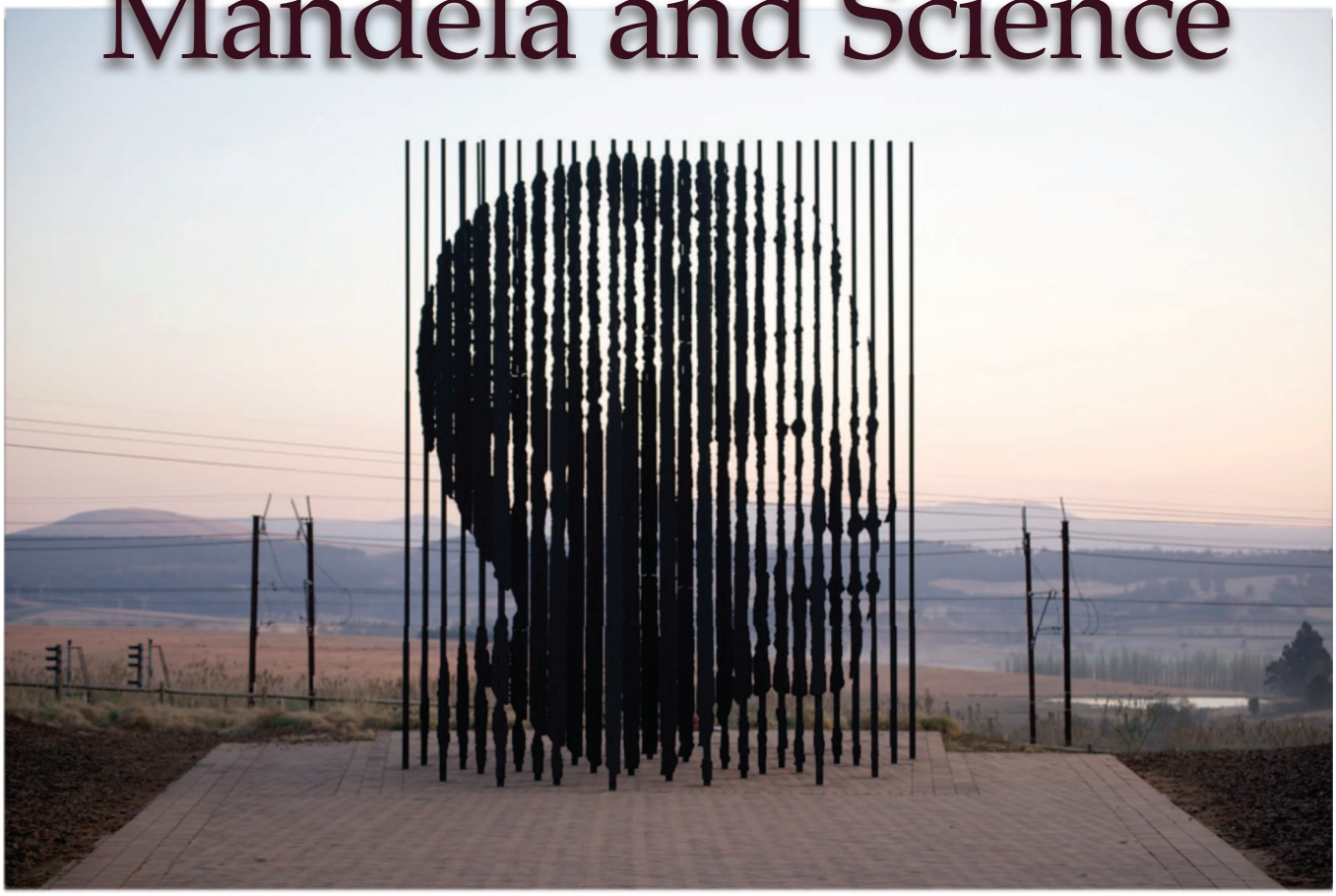
Vol 5, Issue 4, December 2013 Webpage Email

Physics Comment

A Southern African Physics Magazine

Mandela and Science



A Quarterly Newsletter Issue No 4- Summer 2013

Vision and dedication
We take a look back at Simon Connell's term as president of the SAIP.
Page 10

PC welcomes A.D.M. Walker
The autobiography of the new member of the editorial board, leads us back to the early days of IT in Phyiscs. **Page 15**

Surprise at Hard Probes Conference in SA

At the meeting, 190 scientists from 24 countries came closer to understanding the Little Bang, the artificial brother of the the Big Bang. **Page 17**

World Space Week at SANSA
The South African space agency celebrates World Space Week with a new satellite tracking antenna and the announcement of a third SA earth observation satellite . **Page 21**

Contents

Editor‘s Note

The news of the passing of the father of the nation, Nelson Mandela, spread with the speed of light around the globe and lead to a communal mourning all over the world. In my opinion, the fact that Mandela is a univocally recognised hero of freedom and democracy demonstrates how far the global community has converged in their humane and even political values. This goes together with the decline of ideologies - a development which in particular we scientists profit from - because it allows us to work together on the means for the progress and welfare of all. In this issue of *Physics Comment* Prof Simon Connell analyses the influence of Mandela on science in South Africa (p. 10).

While writing this note the first moon landing takes place since the Soviet mission Luna 24 in 1976. The Chinese probe Chang’e is putting a robot with the poetic name Yutu (jade rabbit) on the moon surface in order to spectrally analyse the chemical compounds of rocks and the structure of the satellite’s crust. This mission is related to ambitious long term goals: to eventually exploit the abundant lunar rescources of Helium-3, which is rare on earth and might be used in future to generate energy from controlled nuclear fusion. Moreover, China plans a lunar space station which could be used as basis for manned space flights to other planets. Although difficult to realize, such visions combined with international collaboration might contribute to find ways for the future prosperity of human kind. Mrs Catherine Webster describes some of the efforts of the South African National Space Agency to explore space in the context of the World Space Week (p.21).

Back to the reality of writing this note, I very gladly announce that Prof Dave Walker from UKZN has kindly agreed to join the editorial board of *Physics Comment* with this issue. Being the expert in many aspects of science that he is (cf., p.14) I see a prosperous future for *PC* as well.

With best wishes for the festive season
Prof Thomas Konrad

Caption of picture on cover page: Nelson Mandela Monument near Howick in the Natal Midlands created by Jo’burg artist Marco Cianfanelli. A brief description can be found on p.6.

Physics Comment is a journal published by the South African Institute of Physics (SAIP) and appears quarterly . The vision of the SAIP is to be the voice of Physics in South Africa.

News from South Africa

Nelson Rolihlahla Mandela 1918-2013: the Spirit of Unity

by Igle Gledhill (CSIR), Simon Connell (UJ), Mmantsae Diale (UP) and Thulani Jili (UNIZULU)

"Unless a man undertakes more than he possibly can do, he will never do all he can do." (*Henry Drummond)*

The passing of Tata Nelson Rolihlahla Mandela is deeply mourned. He has been a true South African of global stature. His spirit will be one in which we take up our challenges: we have to tackle the most difficult of problems, keep going when things are tougher than tough, and unify our communities.

President Nelson Mandela inaugurated a democracy in South Africa that has built science into its structure, and provided a voice for scientists. The spending on science increased, and the administration of that spending has been visionary, inclusive and transparent. The Science System is now transformed and open to all South Africans. Some of the fruits have been the SKA Award, participation in Global Science Infrastructure, and improved local infrastructure. Who could have imagined, thirty years ago, the agenda in science that we have now?

It may be tempting to relate President Mandela's personal experience of the field to his partnership in law with Oliver Tambo, who held a BSc in Maths and Physics from Fort Hare, and had personally and painfully encountered a government system that limited academic freedom and access to science. However, we believe the links are deeper.

Dr Mandela preceded his actions with thorough, and critical, thinking. He opened, in fact, a way of thinking about the cornucopia of our national problems which we confront as a nation with a unique balance of courage, intellectual engagement, patience, and compassion. As a community of practice, we might do well to apply our powers of critical thinking and objectivity as clearly and conscientiously.

"We grew up during those dark days of apartheid but he was always, although incarcerated, a symbol of hope not only to blacks but to all South Africans." Dr Mandela's words at his Rivonia trial, "…. I have fought against white domination, I have fought against black domination. I have cherished the idea of a democratic and free society…" should be remembered as a directing path also for South African progress in science and technology. He joyously embraced education, the arts, and sports from soccer and rugby to cricket. A parallel challenge for us may be to draw disciplines and departments together, encouraging the very best we have to offer in global science. The common ground, for us, is the love of the field, the abundant benefits that physics offers for humanity and the human endeavour, and the road to universal participation in science and universal access to science.

South Africa is very blessed to have been the home of this unique man. He conducted himself with integrity and was a consummate statesman – with a smile, an authentic and unforgettable smile. He was great enough to embrace the political heads of the world and small sticky children as equals. Here was a man who did not hesitate to ask the captains of industry – always besieged by competitive worries – to give a hand to those impoverished by lack of opportunities. As an Institute we should rededicate our efforts towards the education of all of his people. It is indeed a goal worth pursuing and a fitting tribute to his great heart.

When one of us heard the news on Friday morning, she listened to a recording of Johnny Clegg, at one of his concerts, handing the microphone to President Mandela, who said (approximately): "It is music, and dance, that restore my peace with the world, and with myself. There are people here at the front who are dancing, but not there at the back. Let's play it again."

The spirit of the physics community is not to back off the hard problems, but to seek solutions. And, as the authors think, to dance as well.

The Institute takes up his challenge of living in a way that respects and enhances the freedom of others.

Open Letter

from Jim Gates, University of Maryland, USA.

To all my friends in South Africa,

I send you my deepest condolences.

Before I visited Robben Island, I had always assumed that Nelson Mandela was the South African version of George Washington. After my visit, I came to the belief that George Washington was the United States version of Nelson Mandela.

His story (which I learned in far greater detail while in S.A.) was of a life that was extremely thoughtful and elegantly well lived. He was as human as any of us. But he had an almost inhuman amount of courage and humanity.

Your country and our world has lost a singularly important individual from our corporeal existence. But from hearts and minds, Nelson will never be lost. For he has given your country a chance to avoid a holocaust. He has given your country a chance to truly become a non-racial place unlike any other including my own.

Of course, the struggle has not ended and there remains much to be done (everywhere), Madiba gave S.A. an opportunity to shine as an example before all nations and show that a country can peacefully move past one of our species' most deeply engrained evils ... the evil of belief in the racial superiority of one group over another.

Perhaps, S.A. will become the nation in the world to demonstrate this on a scale and with a fidelity that exceeds all others.

Your Friend,

Jim Gates

Prof Gates is a renowned expert in supersymmetry, supergravity and string theory. He is currently based at the University of Maryland. He has been one of the earliest contributors to this field following his doctoral thesis, the first on supersymmetry at MIT. He also co-authored the first comprehensive book on the subject "superspace" in 1984. He has been named to the USA President's Council of Advisors on Science and Technology. President Obama recently bestowed on him the National Medal of Science, the premier award for scientific achievement given by the U.S. government.

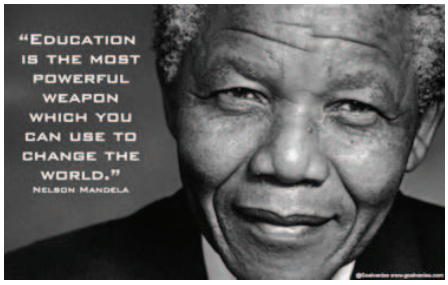
What Mandela meant for Science in South Africa

By Simon Connell, University of Johannesburg, Former SAIP President

As the tributes to Nelson Mandela pour in … we can reflect on his contribution to Science in South Africa.

We realize, that South Africa would not now be participating so strongly in the process of science if democracy and reconciliation had not been ushered in by peaceful negotiations, culminating in the elections of 1994. Before this time, apartheid South Africa, had become increasingly characterized by violent repression, economic and political isolation, and also isolation from global scientific participation. Quality education was reserved for a minority of the population so that the majority was essentially excluded from the process of science, learning and research. The science system itself was non-transparent and geared to the survival of a militarised nation under siege.

This has all changed very spectacularly. As Mandela said "Education is not a privilege, but a right – the doors of learning must be opened for all". Indeed, South Africa now has a vigorous, healthy and growing scientific research system, open to all, and with an excellent global profile. Most obviously, South Africa successfully won the bid to bring the major part of the global Square Kilometer Array (SKA) project to Africa. The SKA will soon become the world's largest radio astronomy telescope, capable of seeing back in time to the afterglow of the big bang, and capable of searching for dark matter, amongst many other fascinating and very impactful topics. This successful bid was well supported by two decades of wise investment in major astronomy infrastructure development and capacity building within the country. This followed the recognition up to cabinet level during Mandela's presidency that Southern Africa had a niche geographical advantage for astronomical observation. South Africa is now strongly supporting the Namibian bid to host the southern hemisphere portion



of the Cherenkov Telescope Array (CTA). This will be the world's largest gamma ray telescope. This renewed entry to global science by the development of major locally based international research infrastructure is matched by improved access to other major international research infrastructure abroad. In May this year, South Africa signed an agreement with the European Synchrotron Research Facility (ESRF), where it became the first African country to be associated with this premier inter-national light source. This reflected the significant level of participation developed over the last two decades by South African scientists from a wide range of disciplines in synchrotron-based research at about ten synchrotrons spread over four continents. Several years earlier, South Africa signed a government level agreement with the Joint Institute of Nuclear Research (JINR) in Dubna, leading to improved collaboration there. Of the very many impactful local national-scale research infrastructure developments, one can single out the establishment of the National Institute for Theoretical Physics (NITheP). It is significant because it is a visionary step even for a developed country. This has promoted international exchange within this field, and lead to a strong growth in the national footprint of high caliber theoretical physics. The inclusion of strong support for science at its most abstract level, evidences the long range vision of the new democratic policy-makers and excellent rapport between them and the new local and international physics community. Indeed, the first new Science and Technology Policy was adopted during Mandela's presidency. There are many other examples of new investment in significant local major research infrastructures, as well as in University-based laboratories. The access to research and learning is, of course, now available to all, and in the last two decades, the representation matches the demography of the country. At tertiary level, a mood of optimism has swept through the research community.

One premier international research infrastructure has made headlines many times over the last two years, capturing the scientific imagination of the world. A Higgs boson was discovered at a global science facility, CERN's Large Hadron Collider (LHC), in July 2012. In October 2013, the Nobel Prize for Physics was awarded to two of the theorists who predicted the existence of the Higgs Boson. The award citation made specific mention of the discovery at the LHC. South Africa was involved in this global scientific campaign based at the LHC. This gigantic machine will continue to uncover new physics, and amongst others, we expect it to find the particulate content of dark matter, and emphasise the strong connection to the major new astronomy facilities in Southern Africa. Scientists believe a new golden age of discovery has dawned, in several fields, and happily, because of the transition to democracy, South Africa is now involved. South African participation at CERN was first recognised at government level with the signing of a Collaboration Agreement on the 4th of July, 1992. This was in fact once South Africa set out on the road to democracy. In those earlier days, South Africa participated in the NA43, NA59 and

NA63 experiments and in the use of the ISOLDE Facility. South Africa formerly joined the ALICE experiment in 2001 and the ATLAS experiment in 2010. These are major global collaborations at the LHC. Theoretical physics interaction connected to CERN has also developed. Spin-offs for South Africa which have manifested or are in development include IT technology (big data, high throughput data), accelerator technology (research), nuclear energy technology (modeling) and mining technology (ore sorting).

The connection between the appropriate political climate and the opportunity to participate in global science is very clear from the South African example. The growth of science in South Africa, with many specific examples, such as the direct participation of South Africa in the global science drive to discover the Higgs Boson, owes much to Mandela. However, Tata Madiba, as he is affectionately known in South Africa, would be the first to maintain "What we have achieved is the collective effort of every South African."

Apart from creating a general political climate favourable to research, Mandela was known to intervene directly when

science became politicized. An example was the contentious politics surrounding health issues in South Africa. He appealed, "In the face of the grave threat posed by HIV/AIDS, we have to rise above our differences and combine our efforts to save our people. History will judge us harshly if we fail to do so now, and right now."

Mandela realised that Africa needed new premier scientific institutions, and he championed the formation of the Nelson Mandela African Institute of Science and Technology (NM-AIST), which now has a network of schools spread across Africa. The NM-AIST vision is to become a world-class institution of higher learning dedicated to the pursuit and promotion of excellence in science and engineering, and their applications for economic growth and sustainable development in Africa.

Barack Obama said that many years ago, while he was still a student, Mandela stirred something within himself. "It woke me up to my responsibilities to others and to myself, and it set me on an improbable journey that finds me here today". He was speaking at Mandela's Memorial Service as President of the USA. The inspiration of Mandela is therefore felt by all. The blossoming of new opportunities for global partnerships in an optimistic vision for South Africa are so tangible that they are sometimes termed "Madiba magic" in the media, or by scientists, the "Mandela effect". In many cases, as in the previous paragraph, they embody a Pan-African vision. The "Mandela effect" has given impetus to both improved and new major scientific collaborations world-wide. These are of course too numerous too mention more than a few. This year the SA-Germany - Year of Science was celebrated, recognizing deep joint contributions to research and capacity building partnerships. A particularly important contribution by the international

community has been participating in specialist missions to develop science policy and assess science performance in South Africa. An excellent example is the 2004 "Shaping the Future of Physics" exercise, which set the stage for the tremendous growth in the health of that discipline. One of the International participants, Jim Gates, was later to write that his experience in South Africa on this project "began the preparation for me for my service as a policy advisor for both the Governor of Maryland and for President Barack Obama". A special relationship has emerged between the South African Institute of Physics and the National Society of Black Physicists (NSBP) in the USA. Although all people in the world have their roots in Africa, with these colleagues, those roots are more recent. A host of joint projects with a Pan-African vision have arisen. Lawrence Norris of the NSBP has mused that "from South Africa a wave of democracy, openness and cooperation will sweep the globe."

Mandela's direct involvement in science may be seen as linked to his firm belief about the power of education in building democracy and development. He said, "Education is the most powerful weapon which you can use to change the world".

It is on this topic of education that I want to end this article. Democracy, seen as one of the "Legacies of Mandela", ushered in a new era for science in South Africa. Sadly, basic education provision has failed to match this. Seen on a general national basis, it is evidently in a state of near collapse, and severely prejudices the sustainability of the magnificent scientific advances. Mandela's focus on children, and his identification of the importance of education, has in fact not been sufficiently respected.

The contribution of Mandela to democracy in South Africa has therefore paved the way for the South Africa's scientific renaissance. This has been at the research level. It is imperative, as supported by Mandela's clear injunction, that the basic education system experience a similar renaissance.

Contact: Prof Simon Connell
University of Johannesburg
Phone: 082 954-7508
shconnell@uj.ac.za

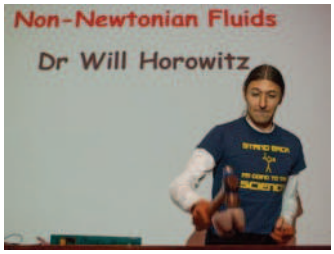
Pictures of Nelson Mandela Monument Howick

Some of the pictures on pages 4 - 6 show the Nelson Mandela monument near Howick at the place where Mandela was captured and subsequently sent to prison for 27 years. The sculpture was created out of 50 steel columns by Johannesburg artist Marco Cianfanelli in 2012 . The artist commented in his press release: "The 50 columns represent the 50 years since his capture, but they also suggest the idea of many making the whole; of solidarity." (The Editor)

UCT's Phenomenal Physics 2013 Goes Off with a Bang!

by Gregor Leigh, UCT, Cape Town.

Phenomenal Physics – the University of Cape Town Physics Department's annual flagship schools outreach event – went off with a bang (literally) in Lecture Theatre A, in the RW James Building on Upper Campus, on Thursday 17 October. Thanks to the leadership of Dr Spencer Wheaton, the PR and organisational skills of the Science Faculty's Student Recruitment Officer, Mrs Shanaaz Smith, and the performing skills of a knowledgeable team of physics lecturers,



Dr Will Horowitz hammers home the message about the rigidity of non-Newtonian fluids.

several hundred Grade 11 pupils from all over the Western Cape were kept entertained for a whole afternoon by a series of fast-moving, thought-provoking (and fun!) demonstrations of a variety of physical phenomena.

Besides being highly entertaining, with much pupil participation, the annual show aims to whet the appetite of curious young people and encourage them to continue studying science at tertiary level.

After an exhausting afternoon's work, Gregor Leigh cools off in a shower of liquid nitrogen.

Items ranged from the low-tech (a P-rated scientist making himself "comfortable" on a bed of nails) to high-tech analyses of line emission spectra and musical wave forms using both sophisticated computer equipment and simple hand-held diffraction gratings; from low temperatures (liquid nitrogen) to the fierce heat of an arc-welding electromagnetic device; and from things that went round slowly, to a water

A young volunteer demonstrates the principles of angular momentum on the rotating stool.

rocket that went bang and travelled alarmingly fast. Careful thought went into each presentation, and the learners were continually encouraged to apply their

Jeff Fearon sheds light on standing waves. (Or is it vice versa?!)

minds by predicting outcomes and explaining unexpected results.

Teachers, many of whom return year after year with fresh crops of Grade 11s, reported afterwards that transport returning to school was abuzz with excited discussions about what pupils had seen – or thought they had seen – and firm intentions of studying physics at UCT in the near future.

Dr Andrew Hamilton, recent recipient of a College of Fellows Young Researcher Award, seems less certain about lowering himself onto a bed of sharp nails than he is about the Higgs boson he helped to discover this year.

Author Biography: Gregor Leigh lectures physics to first year engineering students at University of Cape Town. Email contact: *gregor.leigh@uct.ac.za*

IAU Teaching Astronomy to Undergrads

The IAU Office of Astronomy for Development "Teaching astronomy to undergraduates" workshop at the University of Zululand

Dr. Jean-Christophe Mauduit (IAU-OAD) & Laure Catala (SAAO/UCT)

1) The IAU Office of Astronomy for Development and the AstroVARSITY project

As part of its global mandate, the International Astronomical Union1 (IAU) Office of Astronomy for Development2 (OAD), hosted at the South African Astronomical Observatory3 (SAAO) in Cape Town, implements special projects throughout South Africa. These often serve as learning experiences for similar projects in other parts of the world. In the context of the emergence of South Africa as a world leader in astronomy research (Southern African Large Telescope, Square Kilometer Array), the IAU-OAD has started a project aimed at using Astronomy to enhance Physics education at university level, starting with the so-called "Historically Black Universities".

The AstroVARSITY project4, led and developed by OAD intern and SAAO/UCT Astronomy PhD student Laure Catala, consists of workshops that offer hands-on astronomy activities and exercises based on a small telescope. The courses and practicals provided can be used by Mathematics and Physics lecturers in order to enhance their teaching. Astronomical databases and general data analysis tools are also introduced in the context of Virtual Observatories as well as the opportunities they represent for research, education and outreach purposes.

As a proof of concept, a first workshop (AsTROW5) was organized at the OAD in Cape Town in October 2012, gathering lecturers from several universities across South Africa. A second workshop subsequently took place at the University of Zululand on 15th – 17th July 2013, immediately after the SAIP 2013 conference. The ultimate goal of the project is to implement an official teaching framework within participating universities (e.g. using the telescope/virtual observatory as part of Physics practicals) and to provide a package containing teaching material and off-the-shelf instrumentation to Physics and Mathematics departments worldwide.

2) "Teaching Astronomy to undergraduates" workshop at the University of Zululand

As a follow-up to the AsTROW workshop held in October 2012, the workshop at the University of Zululand was aimed at presenting the practical part of the AstroVARSITY project to lecturers and tutors as well as discussing ways of implementing it into the curriculum.

The workshop participants were taught the basic working principles of a small telescope and how to operate it. Stargazing sessions were organised where the participants set up and observed objects of astronomical interest (planets, stars, clusters, etc.) on their own. Presentations introduced potential tutorials that could be built into the Physics curriculum as well as Virtual Observatories opportunities in terms of research, education and outreach projects.

Figure 1 - Poster of the IAU-OAD Unizulu workshop

By the end of the three day workshop, the participants had gained significant knowledge in Astronomy. They became familiar with the telescope, the night sky and the changes in its appearance with time and position on Earth; they were able to use astronomical software such as Stellarium to plan observations as well as online astronomy tools for basic conversions and image analysis (NED, Aladdin etc.). In the process, links between major Physics concepts and Astronomy (e.g. Newton's law of gravitation, optics, blackbody radiation, etc.) were reinforced.

Figure 2 – Some of the workshop participants pose around the IAU-OAD telescope in front of the

Beyond the gain in general astronomical knowledge, the workshop participants were exposed to topics such as:

- the wide range of research and teaching opportunities offered by the field of astronomy,
- how to use astronomy to attract and vector students towards the sciences,
- the multiple use of the package (telescope & photometer) in teaching, research and outreach,
- the cost-effectiveness of basic astronomy research projects (affordability of instruments, free access to online databases, VOs and associated astronomy programmes).

3) The way forward: a global reach throughout South Africa and worldwide

This first on-site workshop held at the University of Zululand proved to be very successful. Highly motivated Physics lecturers and graduate students were identified to lead efforts in order to introduce Astronomy within the University of Zululand. Hence the OAD is currently following up with the lecturers and helping them in acquiring a small telescope through the university channels and in building an astronomy club in order to start the impetus at the university. In addition, partnerships with nearby universities are being explored to further develop the human capacity building effort in Astronomy at the University of Zululand. A second workshop is also being planned to reinforce previously introduced concepts and handing over the necessary material to start an optional "introduction to astronomy and photometry" course.

On a more global scale, the course material is being consolidated and will be freely available for download on the IAU-OAD website. Efforts will also be made to get PhD & Master's students around South Africa to get acquainted with the training package developed and to volunteer their time to deliver such workshops to other Historically Black Universities, in the hope of narrowing the gap in Astronomy knowledge and opportunities across South Africa. In the long run, the OAD hopes that similar workshops could be held in other universities on the African continent, and beyond.

References

http://www.iau.org

http://www.astro4dev.org

http://www.saao.ac.za

http://www.astro4dev.org/activities/astrovarsity

http://www.astro4dev.org/activities/astrovarsity/astrow

Author Biographies:

Dr. Jean-Christophe Mauduit was appointed as OAD Project Officer on February 11th, 2013. He holds a PhD in astrophysics from the Paris Observatory and participated in large ESA and NASA satellite missions as a postdoctoral researcher at the Côte d'Azur observatory and the California Institute of Technology. He has been involved in many international education and outreach programs (Hands on Universe, Universe Awareness, Caltech&Spitzer outreach) as well as various science development projects around the world.

Ms Laure Catala is a second year PhD student from France, working on optical instrumentation for the Southern African Large Telescope, affiliated to both the University of Cape Town and the South African Astronomical Observatory.

Free SAIP Membership for 3rd Year and Honours Physics Students

by Brian Masara (SAIP Office)

The SAIP Council passed a resolution to extend free membership all 3rd Year Physics students and all Honours Physics Students. In order for 3rd year and honours students to be given free SAIP membership they must do the following.

- Approach their supervisor or physics head of department and ask them to send a request to SAIP
- The HoDs / Supervisors can choose to make their students free SAIP members
- The supervisor or HOD can send an email with the students' names and email address to SAIP on info@saip.org.za
- The 3rd year and honours students will have the following benefits
- Receive all SAIP electronic communication such as the Physics
- Comment magazine and adverts for scholarships, conferences and jobs.
- Attend the SAIP annual conference as student membership rates

This subscription will be valid for 1 year from January to December only hence for honours students they can ask their supervisor/HoD to renew it every year in January.Physics in South Africa

Join SAIP Membership

By Brian Masara (SAIP office, Pretoria)

Physics is a basic science that is a basis for all science and technology disciplines. This results in physics graduates working in every sector imaginable. Therefore SAIP caters for a wide range of industries and economic sectors.

SAIP membership includes any physicists who graduated with at least physics related degree working in either; industry, commerce, government, academia, research, theoretical physics, experimental physics, and uses physics skills and thought processes in their job/career.

Why Professional Membership is Important

Academic qualifications are only the beginning of a career in physics and its applications. The need for continuing professional development is widely recognised to be the mechanism by which professionals maintain their knowledge after the formal education process has been completed. By becoming a member of a professional society one demonstrates their commitment to maintaining competence in their field through continuing your professional development from activities such as conferences, schools and workshops and abiding by an acceptable code of conduct. Membership of a professional society is an important addition to a physicist's personal credentials for example when competing for a job membership of

professional society will distinguish one from other applicants with similar qualifications but no professional affiliation.

What members say about SAIP membership

Dr Igle Gledhill - It's useful to have a profess-ional home that is not an employer or an alma mater. I came back from four years in the USA and switched fields at the same time. Funnily enough, SAIP is home – the banquet is a hoot, the conferences keep me up to date, the Institute is serious about science in South Africa and gets things done, and my colleagues keep me on my toes.

Dr Daniel Moeketsi - SAIP provide a platform to showcase physics research progress and direction in the country and expose students to many career opportunities both in public and private sector. I encourage postgraduate students to subscribe for SAIP membership and actively participate in the organisation's annual activities.

Membership benefits

I. Stay informed - News flashes and alerts to are sent directly to your email. A quarterly magazine, Physics Comment, will keep you briefed on physics news, government policy and jobs in industry and academia.

II. Specialist Groups and Networking - Through the various activities of SAIP, networks have been established with the African and International Physics communities, to benefit all our members. You'll make important new contacts and forge lifelong professional relationships by getting involved in a specialist group.

III. Save Money - You'll receive discounted rates for SIAP conferences, and have the benefit of paying affiliate membership fees for IOP membership.

IV. Employment opportunity information - Job advertisements will be displayed on our new website and mailed to members from time to time.

V. Access to current information on sources of funding grants and scholarships - Exclusive service provided to our members via a direct email system.

VI. Scientific meetings - The annual conferences and workshops provide learning opportunities for different specialisation areas and varying degrees of experience.

VII. Especially for the global physics community - You'll have the opportunity to be partake in events organised by the SAIP for the Physics community in South Africa as well as Africa: developmental workshops, schools and conferences.

VIII. Additional resources - Your membership privileges also include information and guidance when applying for and acquiring visas to study, participate in scientific meeting and research opportunities in South Africa and abroad. There is also an exclusive member-only area on our website.

IX. Career guidance and resources- Career assistance is provided to all members to find their career path in industry or academia.

X. Opportunities to win awards for excellence - SAIP recognises contributions to physics in SA by awarding two different medals and various student prizes at the annual conference.

XI. Teaching and Learning Resources for schools - As part of our growing outreach programme we provide teachers and learners with the tools and opportunities to allow and motivate more learners to follow careers with physics as a background.

JOIN SAIP TODAY CLICK THE LINK BELOW FOR MORE INFORMATION ON HOW TO APPLY

http://www.saip.org.za/index.php/members/membership-info

SA Physics Graduates Database

By Brian Masara (SAIP office, Pretoria)

If you have a degree in physics and you are currently working, studying or unemployed and resident in South Africa, or have studied physics in South Africa we kindly request you to sign up and give us your personal statistics. We need you! The statistics we collect, with your help, will be used to influence legislation, decision-making and all matters related to physics funding required for training more physicists.

Read more details here on confidentiality and great benefits of signing up and updating your details

To register click here .For enquiries contact SAIP Office at info@saip.org.za

Vision and Dedication: Looking Back at Simon Connell's Term as President of SAIP

By Igle Gledhill, SAIP President

Simon Connell's term as SAIP President, 2011-2013, has been characterised by dedicated hard work backing up clear-sighted vision for the development of physics in South Africa and Africa.

President Connell in 2012 at the 57th Annual SAIP Conference.

Way back in 2011, Simon attended the launch by the Minister of Higher Education and Training, Dr Blade Nzimande, on the registration of skilled professionals across South Africa. It was Simon who saw the opportunity for physicists to lead the way for scientists in becoming a Professional Body, and he has guided the initiative from the earliest proposal, through the pilot project, past the update of the SAIP Constitution to comply with the new regulations, to the present status where registration with the SA Qualifications Authority is nearly complete. The Professional Physicist designation, which is designed to be compatible with SACNASP registration as a Professional Natural Scientist, has the advantages of offering an additional level of professional credentials in the competitive world of industry and in the recruitment of physicists, as well as continuous professional development. In addition, the public is protected by adherence of physicists to an ethical code of conduct. It is hoped that the development will lead to the unlocking of the Sector Training and Education funding for physics. Simon has presided over the development of many of the documents and the ideas contained therein – a mammoth task over the years.

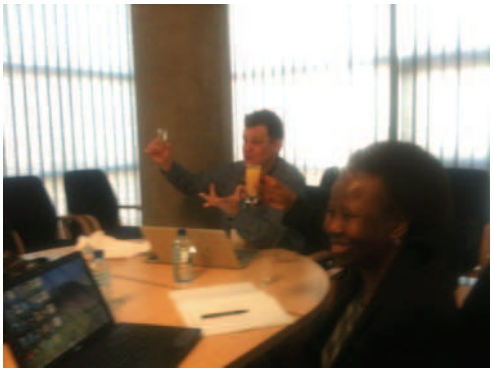
Many physicists don't realise the level of engagement with government that is necessary to keep the wheels of science turning. This has been a forte of Simon's: he has obtained meetings for the SAIP Executive Office (EO) with Science and Technology Minister Derek Hanekom and has driven continuous engagement with DST. Simon has an instinctive understanding of the necessity for keeping government well-informed about the achievements of the physics community, and of setting up a mechanism for quick response to DST requests through the Executive Office to strengthen the science and technology information structure. The links are working very well, and requests for information run through the EO every few days at present.

Simon's talent for international communications has led to the signing of a Memorandum of Understanding with the US National Society of Black Physicists, the NSBP, by Science and Technology Minister Naledi Pandor in 2012. The NSBP link has been extraordinarily fruitful for South Africa and to Africa, and projects ranging from SKA, through gravitational wave astronomy, HESS, CERN, synchrotron science, telescope and astronomy projects across Africa, the Cerenkov Array Telescope and Namibian collaboration are under continuous discussion. The newsletter Waves and Packets is an NSBP-SAIP-African Physical Society-African Astronomical Society collaboration, and owes a great deal to Simon's motivation. Simon continues to serve, with Azwinndini Muronga, in the International Liaison Portfolio of SAIP Council. In 2012, Simon signed an MOU with the Institute of Physics in London, which has already proved invaluable. The Entrepreneurship for Physicists course flourished in the 2011-2013 term, and is a continuing feature of the SAIP calendar. This course runs through the Institute of Physics collaboration, with links to the Third world Academy of Science, and the International Centre for Theoretical Physics.

An upheaval in the astronomy community was experienced in 2011 and 2012. Simon was part of the outspoken SAIP Task Team that interacted with the NRF and DST and motivated strongly for mechanisms to hear and understand the community through the Astro Desk, which was indeed put in place and has been ably held by Manfred Hellberg and Nithaya Chetty. Subsequently, SAIP helped the NRF organise the Astronomy Town meeting just before the Annual Conference. This meeting was about Astronomers talking amongst each other and with the NRF on topics ranging from the management of science to collaborations, new initiatives and new proposals. Simon was one of the drivers in opening the dialog between scientists and

engineers working in the field of Astronomy. Themes in the community have been the building of a multi-wavelength community, and construction of the Decadal Plan for Astronomy in South Africa.

However, Simon's passion has been to see the Educational Pipeline project develop and grow. One aspect is the most basic: education at schools. Among the recommendations of the International Panel on Shaping the Future of Physics in South Africa, the main item that remains outstanding on the list of 14 Recommendations is number 1: *In many countries, elementary and secondary school teaching of mathematics and science is a considerable worry. In South Africa this situation is exacerbated in the historically black schools […] we must flag this very serious situation. We acknowledge that steps are being taken to address this matter, but urge the relevant authorities to pursue it with even more vigour, as it is a crisis situation. Individuals in the physics community are to be commended for their activity in this regard, but more involvement is needed, particularly at the structural level.* SAIP has addressed education in schools in vigorous ways over the intervening years. However, one of the most significant has been the development and pioneering of Teacher Training workshops, with David Wolfe of the Institute of Physics. The pilot series has been welcomed enthusiastically by the teachers involved, and the series will be taken to the next level in 2014.



Prof Connell and Council Member Dr Mmantsae Diale at the 200th SAIP Council meeting.

The second element of the Education Pipeline project that Simon has championed has been the Review of Undergraduate Physics. He worked with Edmund Zingu to move the Benchmark Curriculum statement forward, and the physics community is now in the remarkable position of having agreement between universities on an outline of curriculum fundamentals. The nature of the crisis in undergrad education was indeed brought to the fore by Simon himself: while the problems reported in the Review are not unusual across the world at present, the scale of the challenges in South Africa stands out in international terms. In early 2013 Phase 2 of the Undergraduate Review opened: the implementation phase. The loss of Ed Zingu has hit the community hard, but the unity that he managed to achieve provides a foundation for going forward.

Simon has, unlike many leaders in other spheres, provided continuity in driving forward the initiatives of his predecessors. The Physics 500 project continues to provide access to physicists in industry. The Physics Graduate Database is growing. Outreach projects are under way, and Women in Physics in South Africa, having held the IUPAP conference on the subject in 2011, continued to be supported. The Biophysics project is gathering momentum. *Physics Comment* circulates regularly.

For members, one of the most significant activities is the Annual Conference. The two very successful conferences in Simon's term were hosted by the University of Pretoria in 2012 and the University of Zululand – the latter being the first warm conference for several decades. These conferences have pushed SAIP's value to members forward as the concept of recognised proceedings for the conference was crystallised. SAIP holds a national conference at which the fraction of students is 60% and rising; many students are giving their first paper, and being welcomed into the professional community for the first time. The reviews must meet Department of Higher Education standards in order to be useful to the authors, and the major challenge is that the reviewers – who must hold PhD's – have a significant load of papers on which their response is awaited. The value to the membership is potentially excellent, and Simon's unwavering championing of the Proceedings has led Council to consider the appointment of an Editorial committee and a permanent Editor.

Not least among the accomplishments of Simon's term is the completion of the history of physics project in the form of the publication of the book "Physics in South Africa", which places on record the stories of the departments and institutes through the 20th century and into the 21st.

Simon has taken case to expand the benefits to members, and encouraged the opening of membership to undergraduates. The underpinning factors that allow all these actions to be taken are the provision of growth and financial sustainability, and the excellent functioning of the Executive Office. Simon has ensured that proposals for the first reach the Minister himself, and the Minister has smiled on them. The governance demand on the Executive Office has grown by leaps and bounds, and it was Simon, with his head for business, who made sure that the basic investigations on tax status and Non-Profit Organisation (NPO) status were carried out thoroughly and soundly. As a result SAIP is registered for VAT and is up to date, and it registered as an NPO. That allows Brian Masara, heading the EO, to work his magic, and Linette White to support operations; and the Executive Office has, in the last two years, moved into generating income through writing proposals, as well as conference organisation and the SAIP gift shop.
On behalf of the Council and the members, I'd like to thank Simon, the strategic thinker, for his unremitting dedication to the cause of physics, and wish him well as he joins the hard-working group of Past Presidents!

Former SAIP President Simon Connell passes the baton after his important term to SAIP President Igle Gledhill.

Obituary: Prof M W J Scourfield

by A D M Walker, UKZN

Malcolm Scourfield, Professor Emeritus in Physics, in the School of Chemistry and Physics at the University of KwaZulu-Natal, died at the age of 81 on Friday 8th November after a long illness.

He was late starter in the academic world. Brought up and schooled in Wales, he did two years of National Service in the Royal Air Force and an honours degree in Physics at the University of Keele. Thereafter he became a school master, teaching in Jamaica for a number of years. It was some time before it became possible for him to pursue his real ambition – research in physics. When already in his thirties he entered the research programme in the University of Calgary in Canada. There he did an MSc and a PhD in the subject which he made his own – the study of the aurora on fast time scales using low light level TV, then a new and ground breaking technology.

In 1972, he joined the Department of Physics at the then University of Natal in Durban as Senior Lecturer. He rapidly made his mark in the Department, both in teaching and research. Naturally gregarious, he enjoyed collaboration. He participated in the work on very low frequency radio noise that was in progress in the department so that it could augment and illuminate the auroral work which he instituted at Sanae Antarctica. He was a driving force in the substorm workshops which brought scientists together from all over South Africa. He started a whole new field nationally when he was the major driver in instituting the National Ozone Programme. He was a prominent participant in the National Antarctic programme. He has published prolifically in important international journals. Above all he was a supervisor par excellence. His many MSc and PhD students have gone out into the world and competed both nationally and internationally at the highest level.

He served the Faculty of Science and the University in many ways. It is noteworthy that most of the things he did were achieved by the hardworking committees with a job of work to do rather than the high-profile committees which sometimes contribute more hot air to global warming than illumination to University affairs. In administration he was a rock that could be relied upon. He uncomplainingly kept things going, made major contributions to planning and policy and kept firm sight of both the wood and the trees – a rare ability.

His first wife, Stella died after a short illness a few years after they had arrived in South Africa, leaving him with a young family, Victoria, Louisa and Jeremy. Some time later he married his second wife Brenda who brought a near-doubling of the family with her children Abigail and Mungo.

He leaves his wife Brenda, their children and grandchildren. He will be mourned by a very wide circle of friends and colleagues in South Africa and abroad.

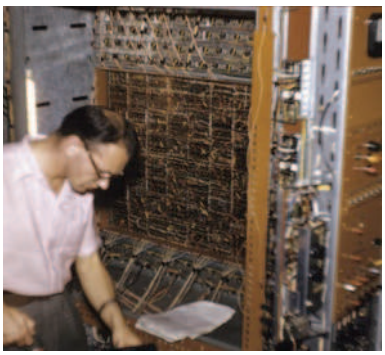
Biographies of South African Physicists

Professor A D M Walker

Autobiography

Prof A. D. M. Walker, always known by his second name David, is Professor Emeritus and Senior Research Associate in Physics at the University of KwaZulu-Natal. He was born in Port Shepstone, Natal, in 1937 and his schooling was in Umtata (now Mthatha) in the Transkei. At the beginning of 1955 he arrived at Rhodes University as a very youthful and insignificant "ink" or first year student in order to start a BSc degree. He majored in Mathematics, Applied Mathematics and Physics and obtained his BSc (Hons) in Physics in 1958. He then began an MSc degree supervised by the late Prof Jack Gledhill in 1959. It was a theoretical study of the effects of a solar eclipse on the ionosphere, based on Gledhill's ionosonde data. The tools at his disposal included ruler, protractor, a slide rule and a map representing contours of constant electron density as a function of time. This had been painstakingly produced by Gledhill for an earlier publication. It was drawn by hand in indian ink on a roll of graph paper about 7 or 8 metres long by 50cm wide and was the result of hand-calculated analysis of the ionograms throughout the day. Later a Marchant electro-mechanical calculator became available, and ultimately access to one of the first two electronic computers in South Africa, a Stantec Zebra at the CSIR (the other was at the Old Mutual). This had roughly the functionality of a programmable hand calculator of the late nineteen sixties, but occupied a very large room, used punched paper tape input and output, and a teletype machine for printing results from the tape at a few characters a second. This fantastic advance in technology allowed the completion of an MSc degree with distinction at the end of 1961. Shortly afterwards he was awarded a Shell postgraduate scholarship and departed for St John's College, Cambridge, where he spent three years on a theoretical study of ionospheric radio propagation under the supervision of the late Dr K. G. Budden in Sir Martin Ryle's radio astronomy group. There he honed his computer skills on EDSAC 2, the pioneering computer developed by Maurice Wilkes and his team. A huge electron tube driven monster occupying two floors of the building, it had just 1024 40-bit words of "immediate access store" (i.e. RAM) made up of small doughnut shaped magnetic cores about *1* cm across. It churned out punched paper tape at a frightening speed of 600 characters a second.

Control Console of the transistor-based version of the Stantec Zebra. © Copyright 1994 - 2006 A.J. Flavell & Glasgow University. A brochure with the specifications of Stantec Zebra can be found here.



On the left: researchers at Cambridge queuing to use the EDSAC 2. On top: paper tape of the type to be used for EDSAC. On the right: maintenance work on the EDSAC 2. All pictures from article on history of computation, credit: University of Cambridge

Returning to South Africa at the beginning of 1966 with a newly minted PhD, Walker was appointed Lecturer in Gledhill's Department at Rhodes. He served there as Lecturer and Senior Lecturer until 1972 when, at the young age of 34 he was appointed Professor of Theoretical Physics in Prof N D Clarence's Physics Department at the University of Natal, Durban (UND). In 1975 he was appointed Head of Department when Clarence became Vice-Principal and Deputy Vice Chancellor and served in that position until 1991 when he relinquished the Headship to take up a four year appointment as Dean of Science. During his career he served on the University Council for a number of years, acted as University Vice-Principal on several occasions, and served on numerous university bodies. He retired at the end of 2002 and was elected Professor Emeritus. After his retirement he worked in the research Office of the University for several years on contract while the merger of UND and the university of Durban-Westville was under way. He was responsible for overseeing the merging of the University Libraries (3 independent libraries at Howard College, Pietermaritzburg and Westville, and 16 branch libraries).

Walker's research field changed somewhat from radio propagation theory when, as a Humboldt Fellow, he spent a year with his wife and family at the Max Planck Institut für Aeronomie in West Germany (as it then was) in 1977 and 1978. The Institute was in the small village of Katlenburg-Lindau in Lower Saxony, near the East German border not far from Göttingen. There results from a new auroral radar experiment designed by Ray Greenwald were just coming in and providing a new way of observing ionospheric convection. Serendipitously Walker's theoretical background allowed the data to be used to provide complete understanding of the nature of one type of long period pulsations of the magnetosphere. He describes the few months of initial work as the most exciting of his scientific career. Again the technology of the time was interesting. The radar data analysis was carried out by a Nova minicomputer – a new technology. The software suite had been written in assembly language. There was no higher level language available. The standard data analysis was presented in graphical form on the screen of a Tektronix storage oscilloscope (a considerable achievement by Greenwald at the time). However it was inflexible. After a number of days measuring the length of vectors on the screen and transferring the results to squared paper with coloured pencils it was agreed that it would be necessary to implement Fortran on the machine. There was no hard disc drive, only two seven inch floppy drives. Ultimately analysis programs in Fortran had to be run by inserting the Fortran disk into one drive and the program disk into the other. The compiled routines were copied to the second floppy. The Fortran disk was then removed and a Linker disk inserted. This produced an executable program which could be run. Output went either to a teletype printer or the storage oscilloscope. Magnetometer data arrived from Scotland in an envelope on chart paper. The results, announced in a Nature letter followed by a longer complete paper in J. Geophys. Res., aroused considerable interest and the latter

On the left: Walker in front of the first HF radar antenna array that had just been installed at Sanae, Antarctica (1997).

In the middle: David Walker and Ray Greenwald in the control hut at Goose Bay, Labrador (1991). The beer was very cold.

On the right: Walker at the Goose Bay antenna array (1991).

paper has been cited more than 200 times. On his return to South Africa he continued research in geomagnetic pulsation theory and associated magnetohydrodynamic wave theory.

The space physics research group that he headed at UND carried out most of its experimental investigations in Antarctica and Walker became closely associated with the South African Antarctic programme. He maintained contact with Greenwald who had returned to the United States and spent several extended periods at the Johns Hopkins University Applied Physics Laboratory (APL) working on auroral radar data. At this time Greenwald was developing the HF radar at Goose Bay Labrador that became the basis for the international SuperDARN network of radars. In the late apartheid era of the nineteen eighties formal links between South Africa and other countries were impossible so no South African radar was possible. All changed in 1992 when Mandela was released from prison and apartheid began to unravel. Walker was approached by Dr John Dudeney of the British Antarctic Survey (then Divisional Head of Upper Atmosphere Services at BAS) and Dr Kile Baker of APL with a view to constructing a South African radar at Sanae, Antarctica to pair with the BAS radar at Halley and at the magnetic conjugate point of the APL radar at Goose Bay. As a consequence Dudeney and Baker flew out to South Africa in 1993 and a joint agreement for the Southern Hemisphere Auroral Radar Experiment (SHARE) was signed by Walker, Dudeney, and Baker at a ceremony hosted by the Deputy Minister of Environment Affairs. The costs were equally shared between Department of Environment Affairs, BAS and the National Science Foundation of the USA (NSF). The radar was constructed at Potchefstroom University (now part of North West University) and responsibility for program of scientific data management and analysis was undertaken by UND. It was installed at Sanae at the 1997/8 takeover, and, apart from downtimes due to major storm damage on three occasions, has operated since then. Walker was the Principal Investigator of the South African Radar from 1993 until 2002 when he retired. The radar has now become a major flagship experiment of SANSA Space Science (formerly the Hermanus Magnetic Observatory, now part of the South African National Space Agency). They are installing a completely new digital version of the radar at Sanae during the current 2013/14 takeover.

Signing of the Principal Investigators' agreement, bringing the Japanese into the SHARE programme, at the Rome meeting of SCAR in 1994. Left to right: Prof Natsuo Sato, Polar Inst. Japan; Dr John Dudeney, British Antarctic Survey; David Walker.

Walker's involvement in Antarctica led to his being appointed in 1996 as South African National Delegate to the Scientific Committee for Antarctic Research (SCAR), an ICSU (International Council for Science) scientific committee responsible for coordinating international research in Antarctica and advising the Antarctic Treaty Organization on Scientific matters. He served SCAR as Chair of the Working Group on Solar Terrestrial and Atmospheric Research and was then elected as SCAR Vice President and served in that capacity from 1998 to 2002.

He is a Fellow of the SAIP, a Fellow of the Royal Society of South Africa and a Fellow of UKZN. His awards include the de Beers Gold Medal of SAIP, a NASA Group Achievement award, and an Editor's award from Journal of Geophysical Research (USA). He has served terms as Associate Editor of J. Geophys. Res. (USA) and on the Editorial Board of Planetary and Space Science (UK).

Since his retirement he has developed an interest in history and has recently published *Pawns in a Larger Game* a history of the Eastern Cape Frontier in the nineteenth century. His author page on amazon.com now includes two books on plasma and magnetohydrodynamic waves and one on history.

He and his wife Carol live in Westville and frequently travel to visit their children and grandchildren in New York, Cape Town and Glasgow.

Articles

Hard Probes 2013

South Africa Hosts the 6th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions

By W. A. Horowitz, UCT

From Nov 4 – 8, 2013, South Africa had the honour of hosting the 6th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions (Hard Probes 2013). At the meeting, 190 scientists from 24 countries came closer to understanding the Little Bang, the miniature Big Bangs scientists create thousands of times a second in particle accelerators such as the Large Hadron Collider (LHC) at CERN.

More often associated with the Higgs physics investigated by means of colliding protons, the LHC (as well as the Relativistic Heavy Ion Collider, or RHIC, at Brookhaven National Laboratory in the US) also smashes together large nuclei such as lead at near the speed of light. In less than 10^{-23} seconds, the enormous energy released when these nuclei crash into each other creates thousands of particles that thermalize into a plasma at temperatures in excess of a trillion degrees—100,000 times hotter than the centre of the sun. In these violent conditions atoms and nuclei, the usual building blocks of the universe, can no longer exist; rather scientists create a state of matter not seen since a microsecond after the Big Bang: the quark-gluon plasma (QGP). In a QGP quarks and gluons, the most basic components of protons and neutrons, fundamentally rearrange themselves. The goal of the field of high-energy nuclear physics is to learn qualitatively how the quarks and gluons rearrange themselves and to quantitatively determine the properties of this novel form of matter.

The Hard Probes conference series focuses on the information scientists can learn about quark-gluon plasma by using what are known as "hard probes," extremely energetic particles created in the earliest stages of a heavy ion collision. Some of these hard probes particles provide a unique femtoscope a billion times more powerful than a microscope to allow physicists to actually watch the forces at work in a QGP. Others melt at various, enormously high temperatures; by observing their absence scientists can actually use them as thermometers of the plasma (see Fig. 1, Left).

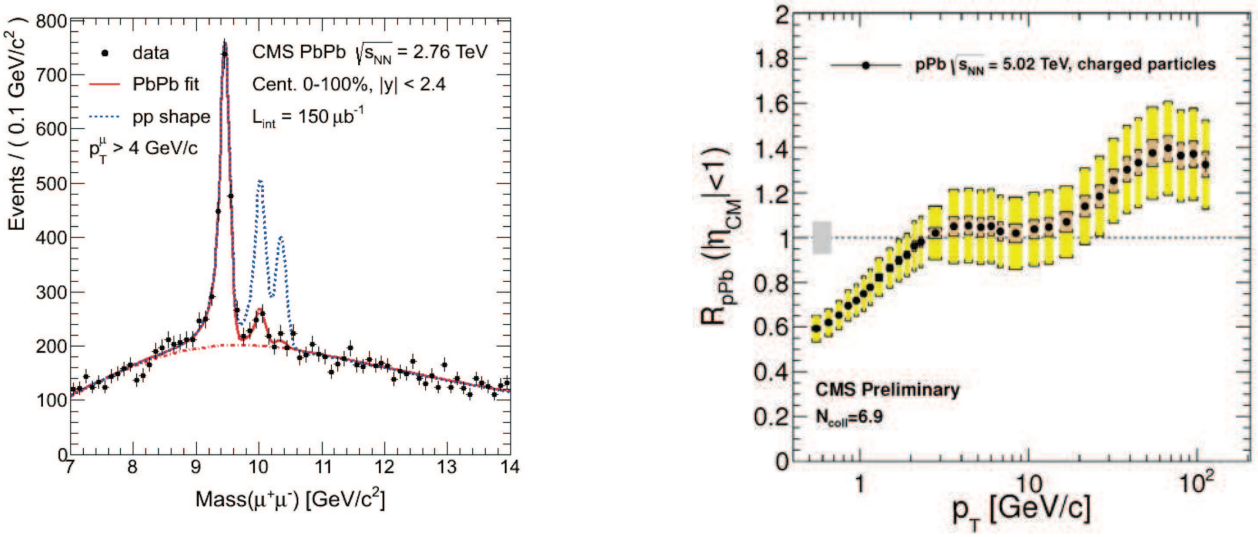


Fig. 1. (Left) Observation of the melting of quarkonia in hot quark-gluon plasma (compare the yield in proton-proton collisions represented by the dotted line to the much reduced yield in Pb-Pb collisions) [1]. (Right) Surprising rise in R_{pPb} at high momenta as a function of momentum; result was expected to be consistent with 1 for momenta greater than a few GeV/c [1].

Previous Hard Probes conferences were held in locations such as the United States, Italy, and Israel; South Africa won the right to hold the 6th conference in the series over competing bids from China and Canada. Opened by Michael Masutha, the Deputy Minister of the Department of Science and Technology, Cape Town's Hard Probes 2013 saw the release of the shocking first results from collisions of protons and lead nuclei at the LHC. Originally thought of as a mere control experiment, this newest and last set of data taken at CERN before the multi-year upgrade shutdown cast into doubt literally all current ideas in high-energy nuclear physics. In Fig. 1, Right, we show the R_{pPb} result from CMS as a function of momentum. In general R_{AB} is defined as

$$R_{AB} \equiv \frac{dN_{AB}/d^2p_T}{N_{bin}\, dN_{pp}/d^2p_T},$$

which is the ratio of an observable in A+B collisions (in this case the number of charged particles) compared to p+p collisions scaled by N_{bin}, the expected number of p+p like collisions in an A+B collision. If the fireball created in a heavy ion collision does not affect the produced particles (like for electroweak probes), then $R_{AB} = 1$. Everyone predicted R_{pPb} to be consistent with 1 at high momenta as one expects there to be no QGP created in the collision of a proton with a lead nucleus. If anything, the astonishing near-perfect relativistic fluid flow observed in p+Pb collisions would suggest $R_{pPb} < 1$. It is clear that the results shown in Cape Town will dominate the discourse in the field for years to come. Those interested in exploring heavy ion physics further might find [2-5] and references therein worthwhile reading material.

Prior to the conference, UCT hosted a 5-day summer school attended by over 50 local and international students and postdoctoral researchers. The summer school was opened by Andy Buffler, Head of the Physics Department; Anton le Roex, Dean of the Faculty of Science; and Danie Visser, Deputy Vice Chancellor for Research. The South African contingent included students and researchers from UCT as well as the Universities of Fort Hare, Limpopo, and Venda; lecturers for the school were world-leading physicists from France, Finland, the United States, and South Africa.

Group photo for the Hard Probes 2013 conference.

In the words of Prof. Will Brooks of USM Valparaíso, Hard Probes 2013 was "obviously a momentous occasion on the unveiling of the first p+Pb results, which will be imprinted on the memories of the attendees forever associated with this beautiful spot."

References

1. J Velkovska for the CMS Collaboration, "What Have Hard Probes Taught Us about the QGP?," Hard Probes 2013
2. C Johnson and P Steinberg, "What black holes teach about strongly coupled particles," Phys. Today **63**, 5 (2010) 29-33
3. B Jacak and P Steinberg, "Creating the perfect liquid in heavy-ion collisions," Phys. Today **63**, 5 (2010) 39-43
4. M Riordan and B Zajc, "The First Few Microseconds," Sci.Am. **294N5** (2006) 24-31
5. M Gyulassy and L McLerran, "New forms of QCD matter discovered at RHIC," Nucl.Phys. **A750** (2005) 30-63

Author Biography: Dr. W. A. Horowitz is a Lecturer in Physics at the University of Cape Town and is the Chair of the Local Organizing Committee for Hard Probes 2013. The meeting would not have succeeded without the help of the full LOC: Heribert Weigert (UCT; co-chair), Zinhle Buthelezi (iThemba LABS), Jean Cleymans (UCT), Tom Dietel (UCT), Siegfried Förtsch (iThemba LABS), Andrew Hamilton (UCT), Naomi Haasbroek (iThemba LABS, secretary), Azwinndini Muronga (UJ), Andre Peshier (UCT), Peter Steinberg (Brookhaven National Laboratory, USA), Zeblon Vilakazi (iThemba LABS)

Depth Profiling of Thin Solid Films by Heavy Ion ERDA

Compositional depth profiling of thin solid films by Heavy Ion ERDA at iThemba LABS Gauteng

By Mandla Msimanga, iThemba Labs, Gauteng

Introduction

Thin film materials find use in a multitude of applications ranging from absorptive coatings in optical and solar energy devices to protective coatings for biomaterials, and a host of other device applications in the semiconductor industry [1–3]. The optical, mechanical, and electrical properties of thin film structures depend a lot on film composition and thickness, interfacial topography and depth profile of the layer stack. Of the vast number of surface and sub-surface analytical techniques available to materials scientists, nuclear techniques can readily offer quantitative and standard-free analysis with high resolution depth profiling not easily attainable by non-nuclear spectrometries [4, 5]. Heavy Ion Elastic Recoil Detection Analysis (Heavy Ion ERDA) is one of the latest nuclear analytical techniques whose development has been spurred on mostly by the need for simultaneous analysis of light elements in heavy element matrices. When built with a mass dispersive recoil detector system, it is possible to obtain depth profiles of all target elements present in a layer structure in a single measurement. Not yet available commercially, the technique is generally developed in-house in most ion beam materials analysis labs. This article serves to introduce to the solid state and materials research community in South Africa the Heavy Ion ERDA facility recently developed and implemented at iThemba LABS [6].

Heavy Ion ERDA basics

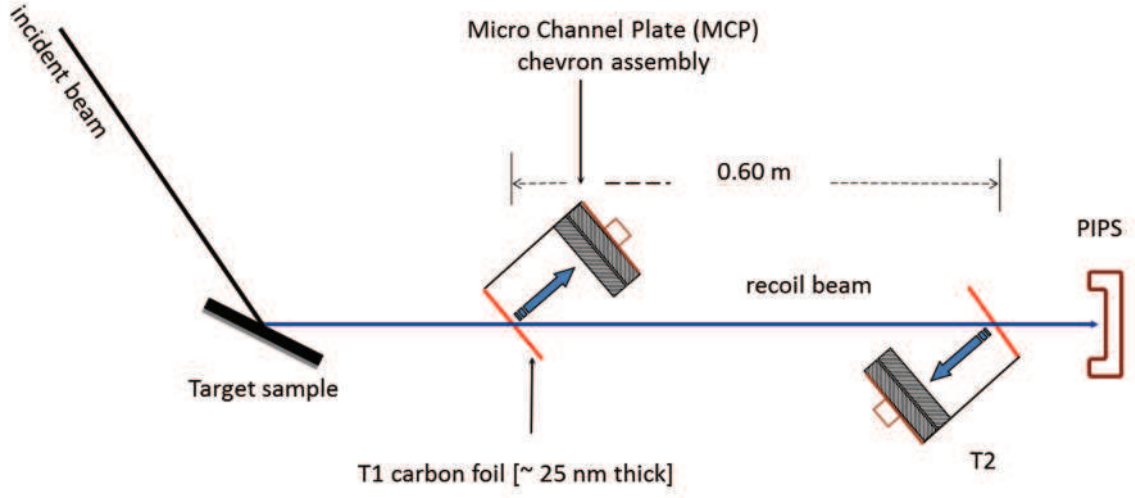


Figure 1Basic set up of the iThemba LABS Heavy Ion ERDA detector system

The ERDA technique consists in the detection of recoil ions knocked off the surface region of a target sample by a projectile beam coming in at 15^{o}-20^{o} grazing incidence angle to the sample surface. The detector system installed at iThemba LABS Gauteng is a Time of Flight – Energy (ToF-E) spectrometer, mounted 30^{o} to the

incident beam direction. It consists of two carbon foil based Microchannel Plate (MCP) timing detectors, 0.60 m apart, and a silicon PIPS® (Passivated Implanted Planar Silicon) detector for measuring the ToF and Energy of the recoil ions in coincidence. This coincidence measurement leads to separation of recoil particles according to their atomic mass. A schematic of the detector set up is shown in Figure 1.
The mass perception of the detector system for the detected recoils derives from the kinematics of the collision between the incident projectile beam and the target sample atoms;

$$E_r = \frac{4m_p m_r}{\left(m_p + m_r\right)^2}\cos^2\theta \cdot E_p \quad (1),$$

where E_p and E_r are the energy of the projectile and recoil ions of atomic mass m_p and m_r respectively, and θ is the angle between the incident and the recoil beam directions. Similarly the depth information of the technique results from the concept of effective stopping force S_{eff} [7], the energy loss per unit depth of both the projectile and the recoil ions as they traverse the film;

$$x_i = \int_{E_r}^{E_i} \frac{dE}{S_{eff}(E)} \quad (2),$$

where E_i is the energy of a recoil ion originating from a depth x_i below the surface, and E_r is the surface energy. Analytical depths range up to about 1μm for installations at large accelerator labs.

Selected analysis example

The analysis example described here is of a TiB_2/Si film produced by RF magnetron sputtering,that was analysed for stoichiometry and depth profile. This was one in a batch of films produced for an investigative study of hard refractory coatings [8]. The incident projectile beam was a 26 MeV Cu^{7+} beam produced in an 860C sputter ion source, and accelerated through the 6MV tandem accelerator of iThemba LABS Gauteng. Figure 2 depicts the 2-dimensional ToF-Energy scatter plot, showing all the elemental species present in the sample, as well as the forward scattered incident beam. It is interesting to note that the B-10 and B-11 isotopes are well separated, indicating a mass resolution of <1u for the light elements. Also detected were C, O and N impurities, possibly incorporated into the film during the deposition process. The depth profile of the film, calculated using an energy-to-depth conversion algorithm from the measured elemental energy spectra [9], is also shown in Fig. 2.
The depth profile shows that the atomic ratios are practically constant with depth up to 120 nm, the film

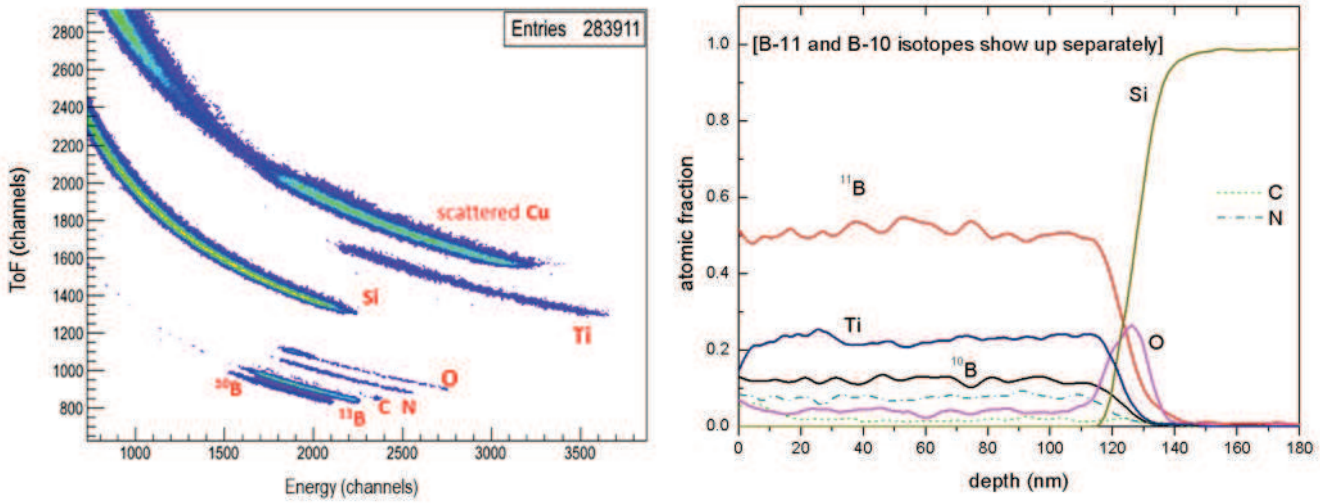


Figure 2: Two dimensional ToF-Energy scatter plot of recoil ions from the TiB2/Si thin film (left) and calculated compositional depth profiles extracted from the energy spectra of detected recoil ion species (right).

thickness. The uncertainty in the film thickness, a measure of the depth resolution, can be considered to be half the width of the B-11 profile edge for example, which works out to be about 4.0 nm at that depth. The depth resolution at the surface is much less than this due to absence of energy broadening due to beam energy loss

straggling and multiple scattering effects. One also notes an oxygen peak at the film-substrate interface which could be due to native oxide on the Si substrate.

Conclusion

This brief article describes the Heavy Ion ERDA installation at iThemba LABS developed for thin film compositional depth profiling. The analysis example described demonstrates the efficacy of the ERDA set up in thin film depth profiling, with the hope that this will create awareness within the materials research community in South Africa of the availability of this new high depth resolution analysis facility.

References

1. D. Xinkang, W. Cong, W. Tianmin, Z. Long, C. Buliang, R. Ning, *Microstructure and spectral selectivity of Mo–Al_2O_3 solar selective absorbing coatings after annealing*, Thin Solid Films 516 (2008) 3971–3977.
2. A. Gutiérrez, C. Munuera, M.F. Lopez, J.A. Jiménez, C. Morant, T. Matzelle, N. Kruse, C. Ocal, *Surface microstructure of the oxide protective layers grown on vanadium-free Ti alloys for use in biomedical applications*, Surf. Sci. 600 (2006) 3780–3784.
3. W. Mönch, *Electronic properties of semiconductor interfaces*, Springer Ser.Surf. Sci. 43 (2004).
4. M. Döbeli, *Characterization of oxide films by MeV ion beam techniques*, J.Phys.:Condens. Matter 20 (2008) 264010.
5. T. Sajavaraa, K. Arstila, *Thin film characterisation using MeV ion beams*, in: R.Hellborg, H.J. Whitlow, Y. Zhang (Eds.), Ion Beams in NanoscienceandTechnology, Springer, 2010. pp. 171–184.
6. M. Msimanga et. al, *The new Heavy Ion ERDA set up at iThemba LABS Gauteng: Multilayer thin film depth profiling using direct calculation and Monte Carlo simulation codes,*Nucl. Instr. Meth B 296 (2013) 54-60.
7. J. Tirira, Y. Serruys and P. Trocellier, Forward Recoil Spectrometry - Applications to hydrogen determination in solids, (1996) Plenum Press, New York.
8. D. Wamwangi, Physics Department, WITS University, Private communication.
9. A. Bergamier, G. Dollinger, C.M. Frey, T. Faestermann, *Quantitative elastic recoil detection (ERD)*, Fresenius. J. Anal. Chem. 353 (1995) 582–584.

Author Biography: Dr. Mandla Msimanga (mandla@tlabs.ac.za) is a Research Scientist at iThemba LABS Gauteng where he is also the instrument scientist in charge of the Heavy Ion ERDA facility. His research interests are in ion beam effects in solid thin films and ion beam materials analysis and modification.

SA Space Agency Celebrates World Space Week

By Catherine Webster | Communications Officer SANSA Space Science

The United Nations commemoration of World Space Week (4-10 October) is in its fourteenth year and is a global celebration of space. This initiative aims at educating people about the benefits received from investment in space science and technology, and promotes the greater use of space for sustainable socio-economic development.

It also encourages public support for space programmes, gets children excited about space, raises awareness of institutions around the world that are involved in space, and fosters international cooperation in space outreach and education.

Space may seem a distant reality, but we only have to look around us to see the benefits it has brought to our daily lives. Images from space are now commonly used in plenty of sectors such as weather forecast,

agriculture (smart farming), urban planning, monitoring de-forestation or supporting crisis management in case of flooding or large forest fires.
Space also creates unique opportunities to boost the economic performance of our continent. For one, it drives innovation. We can transfer technology from the space sector and create smart technologies and smart production. Spin-offs create further commercial uses which contribute to industrial growth.
The South African National Space Agency (SANSA) in partnership with the Department of Science and Technology (DST) hosted various World Space Week events across the country. The official opening of World Space Week took place at the SANSA facility in Hartebeesthoek with the inauguration of a new In Orbit Test (IOT) antenna. Another event was held in Pretoria at the National Botanical Gardens to launch a new educational resource for high school learners utilising satellite data from SANSA. The Agency also hosted a ceremony to unveil a new high frequency digital radar built by a team of SANSA engineers in Hermanus, Western Cape.
Let's take a closer look at each of these new developments shaping the South African space industry.

SANSA's new Ku-band In-Orbit Testing (IOT) limited-motion

New Satellite Tracking Antenna for South Africa

The ever-increasing need for information generated from space requires a number of satellites to orbit the earth, which require more antennas all over the world to track and monitor their orbits and functions. This provides a great opportunity for South Africa to invest in and develop space programmes and projects.
SANSA's new Ku-band In-Orbit Test (IOT) limited-motion antenna is an important addition to its growing number of technologically advanced antennae at its Space Operations facility, in Hartebeesthoek, near Brits.
The new R17-million facility, internally funded by SANSA, comprises of a 10 m Ku-direct broadcast satellite band antenna and an equipment room fitted with IOT equipment and infrastructure to assist clients to successfully commission new satellites. SANSA has years of experience and knowledge in the operation of IOT's. The facility will have a useful life stretching beyond the next decade and will be upgraded continuously to ensure the best possible service to both the national and international space industry.

Dr Sandile Malinga SANSA CEO, Dr Phil Mjwara Director General DST, Dr Woodrow Whitlow NASA and Raoul Hodges SANSA Space Operations MD during the inauguration of the new Antenna.

"The new antenna was built in response to the growing demand by satellite owners for ground facilities that are essential to test the in-orbit communications performance of new geostationary satellites," says SANSA chief engineer Eugene Avenant. Speaking at the World Space Week inauguration event, Department of Science and Technology (DST) Director General Dr Phil Mjwara said "Nowhere do you see how exciting the interaction of science and technology can be than in space. Often our scientists set challenges which drive extraordinary engineering achievements. Being part of another South African achievement as SANSA inaugurates another successfully completed antenna is humbling and shows why SANSA continues to excel in this industry."

He also expressed his pleasure in the progress the Agency has made since its formation in 2010 saying that it is great that space exploration is becoming part of a national mission. He further pointed out that government can do more and will push our space industry activity to a new level.

Launch of Fundisa resources for schools by SANSA Earth Observation

SANSA launched the latest resource to aid school learners to understand and utilise satellite data and tools in their Geography curriculum. The Fundisa School Education and Fundisa Disk are set to help increase understanding of Earth observations among Grade 10-12 learners. These resources, which include a portal for students, will also help raise awareness about the value satellite imagery adds to Geographic Information Systems (GIS) analysis. These tools are aligned to SANSA's goal of building intellectual capital through cutting-edge research, development, innovation, technology and applications in the country.

The disk contains numerous Earth observation satellite images over South Africa from different satellites as well as tools and applications for the learners to practically gain experience in utilising such data in their school projects.

Many schools do not have computers and computer-based GIS software, the Fundisa resources will provide scenes relating to the schools areas of interest and surrounding communities. SANSA will complement the data with material customised for FET and as much as possible align to the curriculum. By the time the learners graduate in Grade 12 they will have a greater understanding of Earth observation and can proceed to more focused studies at tertiary level.

Dr Jane Olwoch, SANSA Earth Observation MD, handing over a satellite image to Mr Mudau, Chief Director of the DST.

The Fundisa resources aim to help increase understanding of Earth observation among Grade 10-12 learners.

Check out the Fundisa Student Portal at http://fundisa.sansa.org.za/

The Fundisa Student Portal was created to assist research and learning by providing useful information, links and course material in earth observation; enable communication between students and the earth observation team at SANSA through a community web and inspire, excite and leverage research and learning through web mapping applications and other technologies.

South Africa's Next Satellite

The Agency is also undertaking the construction of South Africa's third Earth observation satellite.

The construction of the satellite, which will be launched in about four years' time, is being funded by the Department of Science and Technology. The design and development will involve contributions from the South African industry and scientific communities, thus enabling the development of a local space industry and the necessary skills and knowledge needed for an impactful space programme. The satellite will be different from the previous two South African satellites which were technology demonstrators. The new satellite will have a clear primary mission, secondary missions and ancillary missions similar to international Earth observation satellites.
"The new satellite will be used to take pictures of the African continent that are vital to food security, land use and disaster recovery. A dedicated satellite is important as it makes the African continent less dependent on the rest of the world with regard to procuring this information", says SANSA Acting Space Programme Manager Shravan Singh.

Space brings us many benefits and SANSA is committed to keep up with the latest developments in the industry in order to secure a place on the podium as Africa's leading space-faring nation.

Comment by the Editor: *In its original form this article included an account of the World Space Week events at SANSA Space Science in Hermanus. This focused mainly on the unveiling of the new digital SuperDARN radar that has been constructed there. Since this radar is currently on board the S A Agulhas en route to Antarctica where it will be installed during the current takeover, we have invited the author to provide an expanded version of the this part of the article to include details of its installation and initial operations. We hope to publish this in the March issue.*

Opportunities

MSc and PhD Opportunities with UKZN

The University of KwaZulu-Natal has positions for MSc studies in the High Energy Physics on the ATLAS Experiment For more information please contact Dr. Sahal Yacoob Yacoob@ukzn.ac.za

The University of KwaZulu-Natal has positions for MSc, PhD, and Post-doctoral studies available. More information may be found here: http://caes.ukzn.ac.za/Bursaries.aspx

The research group of Prof T. Konrad at UKZN offers MSc and PhD positions in Quantum Computing and Quantum Communication with photons as well as in Quantum Measurement and Control with ions. Contact Prof Konrad: konradt@ukzn.ac.za

Opportunities for Post-Graduate Studies at Wits University

Postgraduate studentships in Theoretical High Energy Physics at Wits are available. Research areas include non-perturbative methods in quantum field theories, strings, AdS-CFT and gravitation.

For further details please contact Prof. JAP Rodrigues (Joao.Rodrigues@wits.ac.za)

Perimeter Institute Opportunity

Canada's Perimeter Institute for Theoretical Physics (PI), in partnership with the University of Waterloo, welcomes applications to the Master's level course, Perimeter Scholars International (PSI). Exceptional students with an undergraduate honours degree in Physics and/or Mathematics are encouraged to apply. Students must have a minimum of 3 advanced undergraduate or graduate courses in physics. PSI recruits a diverse group of students and especially encourages applications from qualified women candidates. The due date for applications to PSI is February 1st, 2014. Complete details are available at www.perimeterscholars.org

Perimeter Scholars International (PSI) is a 10-month intensive Master's level course held at Perimeter Institute for Theoretical Physics, a leading international research centre in Waterloo, Ontario, Canada. PSI is designed to prepare outstanding students from around the world for cutting edge research. Graduates receive a Master's Degree in Physics from the University of Waterloo and a Perimeter Scholars International Certificate from Perimeter Institute. Students completing PSI are prepared to pursue PhD studies in theoretical physics. Many stay at Perimeter Institute and do their PhD with Perimeter faculty. A list of Perimeter research areas and faculty can be found here. Others go on to PhD programs at other universities.

Upcoming Conferences & Workshops

SAIP 2014 Annual Conference

The South African Institute of Physics Annual Conference for 2014 (SAIP 2014) will be held at the University of Johannesburg 7 to 11 July 2014.

IMPORTANT DATES:

03 Feb 2014 - Abstracts Submission and Registration Opens

11 April 2014 - Abstract Submission Closes

09 May 2014 - Acceptance Notifications

06 June 2014 - Registration Closes

20 June 2014 - Payment Closes

27 June 2014 - Paper Submission Deadline for Proceedings

19 Sept 2014 - Deadline for Reviewed Papers Corrections

Details will be made available in due course on the SAIP2014 site:

http://indico.saip.org.za/event/saip2014

Third Biennial African School of Fundamental Physics and its Applications

We would like to inform you about the third biennial school in Africa, on fundamental nuclear and particle physics and their applications (ASP). Support for ASP comes from institutes in Africa, Europe, USA and Asia with lecturers from LHC experiments and the theory community. Full support for selected African students. Details can be found at:

https://cds.cern.ch/record/1632255

The school (ASP2014) will be held on 3-23 August 2014 at the Cheikh Anta Diop University (UCAD) in Dakar, Senegal. Applications will open on December 16 2013 until March 31 2014.

Regards,

Ketevi Adikle Assamagan

For The International Organizing Committee

All mailing list: all@sa-cern.ac.za

http://silence.tlabs.ac.za/mailman/listinfo/all

Physics Comment Editorial Policy

Deadline for submissions for the March 2014 issue of Physics Comment is 28. February 2014

Physics Comment is an electronic magazine for the Physics community of South Africa, providing objective coverage of the activities of people and associations active in the physics arena. It also covers physics-related ideas, issues, developments and controversies, serving as a forum for discussion. It is not a peer review journal.
Physics Comment publishes innovative reports, features, news, reviews, and other material, which explore and promote the many facets of physics. Physics Comment endeavours to:
support and inform the physics community
promote membership of the South African Institute of Physics
promote the understanding of physics to interested parties and the general public
represent the readers' point of view
focus on issues and topics of importance and of interest to the physics community
We accept submissions on any physics-related subject, which endeavours to inform readers and to encourage writers in their own researches. We aim to be politically, socially and geographically inclusive in the articles, which we commission and receive. Therefore we shall not discriminate according to political or religious views. Physics Comment does not support or endorse any individual politician or political party. However, contributions, which are being published, may contain personal opinions of the authors.
It is our desire to present unfettered the opinions and research of our readers and contributors. All articles submitted for publication are subject to editorial revision. Such revisions, if necessary, will be made in cooperation with the author.
The views expressed in published articles are those of the authors and are not attributed to the Editorial
The Editor will make the final determination of the suitability of the articles for publication.

Declaration by Author

When an author submits material for publication, this means:
The author(s) assures the material is original, his/her own work and is not under any legal restriction for publication online (e.g., previous copyright ownership).
The author allows PC to edit the work for clarity, presentation, including making appropriate hypermedia links within the work.
The author gives PC permission to publish the work and make it accessible in the Magazine's archives indefinitely after publication. The author may retain all other rights by requesting a copyright statement be placed on the work.
Authors should respect intellectual integrity by accrediting the author of any published work, which is being quoted.

Publication Deadlines

Physics Comment is published four times a year.

Issue	Closing Date	Publication Date
Issue 1	28 February	15 March
Issue 2	31 May	15 June
Issue 3	31 August	15 September
Issue 4	30 November	15 December

Specification and Submission of Content

Editorial Tone. As the voice of the physics community, the magazine will create a provocative, stimulating, and thoughtful dialogue with the readers; and provide a variety of perspectives that reflects the dynamism of the physics community.
Article types. The magazine is devoted to articles, reports, interesting facts, announcements and recent developments in several areas related to physics:
Manuscripts. Solicited manuscripts will be judged first for reader interest, accuracy and writing quality. The editor reserves the right to request rewrite, reject, and/or edit for length, organization, sense, grammar, and punctuation.
Re-use. The publisher reserves the right to reuse the printed piece in full or in part in other publications.
Submission and Format. Manuscripts must be submitted to the editor on or before the designated due date Manuscripts must be submitted electronically, on the prescribed Microsoft Word template available for download from http://www.saip.org.za/PhysicsComment/. Manuscripts are to be submitted directly to the editor:
PhysicsComment@saip.org.za.
Style. AP style is followed for punctuation, capitalization, italics and quotations.
Photography and Illustration. All solicited photography and illustration should be part of an article and will be judged first for technical quality and editorial appropriateness. The editor and art director reserve the right to request revision or reject any material that does not meet their criteria. The publisher reserves full rights to all solicited photography and illustration, including the right to reprint or reuse graphic material in other publications.

Categories of Content Contributions

Technical articles and reports: These are generic articles of about 1 500 words plus diagrams and pictures. A technical article covers a relevant feature topic. Articles are authored by the writer and publishing a 40-word resume of the author could enhance its credibility. By submitting an article that has been previously published the author confirms that he/she has the right to do so, and that all the necessary permissions have been received. Acknowledgement must be made within the article.
News: These are short editorial items usually not more than 250 words. Full colour pictures must be clearly referenced on the editorial submission and on the picture or picture file.
Advertorials: Advertorials could be published when supplied by the client. We recommend a maximum of 500 words plus one or two pictures for maximum impact. A PDF file of the laid out advertorial should be emailed by the client along with an MS Word file of the text and separate image files of the pictures. It is the client's responsibility to ensure that the advertorial is correct as it is in fact a paid for advert page.
Letters to the Editor: Letters to the Editor are encouraged. The Editor reserves the right to edit for length and format. The Editor will not change the political position of the initial letter. Physics Comment does not publish anonymous letters.
Advertising Policy: The Editorial Board will determine advertising prices for Physics Comment, subject to approval by SAIP Council. The objective will be to obtain revenue to maintain and develop the magazine. Physics Comment offers classified advertising to subscribers of the magazine for free. The advertisements must be a maximum of 60 words including the telephone number, and there is a limit of three free classifieds per subscriber, per issue. Advertisements may include a photo, which may be reduced in size or resolution by the editor to optimize loading time. All items or opportunities, which are being advertised for free, should be physics-related. The Editor reserves the right to refuse any advertising, which does not conform to the objectives of the magazine.

Submission of Articles

All articles must be submitted on the prescribed template available for download from http://www.saip.org.za/PhysicsComment/