Vol 6, Issue 4,December 2014 Webpage Email

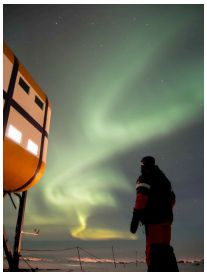
Physics Comment

A Southern African Physics Magazine

A Quarterly Newsletter Issue No 4 - Summer 2014

Active Women in Physics

The WiPiSA lunches and success story continue (p.5)

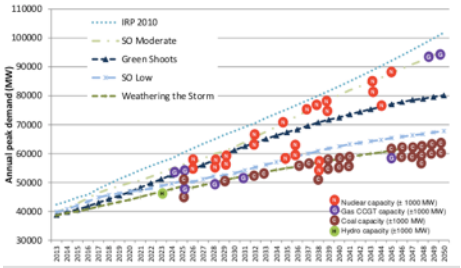


Living on 'the ice'

What is it like to live at the South Pole and experience the Aurora Australis ? (p.8)

Updated energy demand and costs

An updated Integrated Resource Plan makes new predictions of how many nuclear power stations are needed, p.14



Editorial board: T. Konrad and A.D.M. Walker

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Editor‘s Note

In the last issue of *Physics Comment* we reported briefly on potential plans by the SA Government to purchase eight nuclear power stations from a Russian company for $ 55.7 billion US and asked you, the readers of PC, for comments. Within a few days we obtained an answer, which has evolved from a *letter to the editor* into a full-blown article. The author, Dr Hans C. Eggers from the University of Stellenbosch, unravels a captivating story which concludes that South Africa might only have demand for one or two new nuclear power plants instead of eight. Because of the high costs involved, the question of whether the planned purchase is reasonable, must be addressed. With the current exchange rate, $ 55.7 billion US correspond to R 651 billion. The costs might in realitas surpass the R 1 trillion mark when interest rates and inflation are taken into account. Please find Dr Eggers' article on page 14 and an editorial introduction below.

In September of this year news broke that, during a visit to Russia, President Zuma had signed a multi-billion Rand nuclear deal with Russia for the supply of nuclear power stations. This was rapidly denied by the Department of Energy, which stated that it was “only a framework agreement” with a potential vendor and that other similar agreements were to be signed with other vendors. Nevertheless it became apparent that current Government actions could potentially lead to the acquisition of up to 8 nuclear power stations providing 9600 MW of power by 2023.

The current spate of load shedding has brought home to the public the parlous state of the country's energy supply.

The Government's actions are informed by the Department of Energy's Integrated Resource Plan (IRP)[1] drawn up in 2010. To allow for changes in circumstances an updated version[2] was drawn up in 2013 and made available for public comment in February this year. According to a report in Business Day Live[3] published in September:

“There are substantial differences between the IRP 2010 and the update, especially with regard to nuclear power. However, the updated version has not yet been made final by the Cabinet so the 2010 IRP still stands. It had been expected that Energy Minister Tina Joematt-Pettersson would submit a finalised version of the update to the Cabinet.

“Whether this will happen is now uncertain. Questions addressed to the department on this matter went unanswered.”

The response to the 2013 update of the Nuclear Industry Association of South Africa (NIASA)[4] (clearly an interested party) seriously questions the validity of the assumptions on which it is based.

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1 Dept of Energy: Integrated Resource Plan for Electricity 2010-2030 (IRP 2010-2030). Revision 2, Final report, 25 March 2011.

2 Dept of Energy: *Integrated resource plan for electricity (IRP): 2010-2030: Update Report 2013*, http://www.doe-irp.co.za/, www.niasa.co.za/, 21 Nov. 2013

3 Paton, C: Eskom not taking part in Nuclear acquisition, *Business Day Live*, www.bdlive.co.za/business/energy/2014/09/15/eskom-not-taking-part-in-nuclear-acquisition, 15 Sep. 2014

4 Serfontein, D *E: Review of Integrated Resource Plan forElectricity (IRP) 2010—2030: Update report 2013*, Review commissioned by: Nuclear Industry Association of South Africa, www.niasa.co.za/, , 12 Feb. 2014

They maintain that the cost of the nuclear option has been seriously overestimated.

The article by Dr H. C. Eggers in this issue of *Physics Comment* uses the data from the updated 2013 version of the IRP as well as other data to deduce a number of future scenarios. It makes it clear that, on the basis of the figures of the DoE's own advisors, it is quite likely that the need for additional nuclear power by 2026 may be substantially less than the 9600 MW currently being considered. The figure of 9600 MW is based on a compound GDP growth of 5.4% for the 20 year period 2010 – 2030, a rate projected in the outdated 2010 IRP.

There is a very wide divergence in the different scenarios that demand serious consideration. The country cannot afford the risk of allowing political considerations to outweigh the best technical advice. We hope that the article by Eggers will provoke the South African nuclear physics community to become engaged in the debate.

Physicists are hired world-wide as advisers in different areas, from economic to political, because of their reputation in analysing matters soberly and solving problems efficiently. Would it not be great if the comments of physicists could be heard and used more often to solve problems of national importance? In what better place than *Physics Comment*? We are looking forward to your feedback!

With best wishes for the festive season
Prof. Dave Walker and Prof Thomas Konrad

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Caption of picture on frontpage: Koeberg Nuclear Power Plant 2010.
From: http://commons.wikimedia.org/wiki/File:Koeberg_Nuclear_Power_Plant_2010-1.jpg?uselang=en-gb
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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.

SAIP Council: Dr. I.M.A. Gledhill (President CSIR, Dr. M. Tibane (Honorary Secretary- UNISA), Dr A. Matthews (Treasurer - UKZN.), Prof I. Basson (UNISA), Prof. S.H. Connell (U. Johannesburg), Prof. M.M. Diale (U.Pretoria), Prof. T. Konrad (UKZN), Prof. K.K. Muller-Nedebock (U.Stellenbosch), Prof A. Muongo (U. Johannesburg), Z. Ngcobo (U.Zululand) , Dr.S.Ramaila (U.Johannesburg), Prof. F. Scholtz (NITheP), Prof. P. Woudt (UCT)

News from Africa

Africa participates at 28th IUPAP GA

Mr Brian Masara, SAIP Office, Pretoria.

At the 28th International Union of Pure and Applied Physics (IUPAP) General Assembly (GA) in Singapore, the African representatives took time out to meet together.

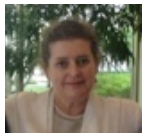
Above, from left to right: Prof Azwinndini Muronga, South Africa; Prof Najeh Thabet Mliki, Tunisia; Prof Akintayo Adedoyin, Botswana; Prof Moses JojoEghan, Ghana; Dr Igle Gledhill, South Africa; Prof AhmaduWague, Senegal; Prof Francis Allotey, Ghana ; Prof Sergei Zekeng, Cameroon.

"Let's keep Africa shining..."

Also at the GA was the IUPAP Associate Secretary General, Dr Rudzani Nemutudi, who was deep in discussion at the time of the photograph in the left lower corner. "Let's keep Africa shining in every way we can, and always have the can-do spirit."

5th December 2014: The Thinker

Dr Igle Gledhill, President SAIP, Pretoria



I've just visited 14 departments of physics with Prof David Wolfe of the Institute of Physics, London, and Brian Masara, SAIP. There is consensus across all of these groups of physicists that students need to be thinking by the time they graduate, and that not all of them have learned thinking skills before they enter university. There's consensus, too, that thinking can be learned.

Dr Nelson Mandela was a thinker and a statesman: a thinker in action.

Our physics education specialists know how to write this down in terms of curriculum design, and they explore in their research how thinking can be learned and taught.

On each departmental visit, actively using the findings of education research in undergrad teaching and learning has been a good and fruitful topic of conversation.

So on this significant anniversary, my aim is, through the physics departments, to encourage at least 5 more students in each first year physics class to become great thinkers, and to take action based on deep, well-educated thought. That's about one hundred forward thinkers. We're going to need them if we succeed in raising the ratio of R&D to GDP from the present dismal 0.76% to 1.5% by 2019.

WiPiSA Lunch: University of Limpopo

Mrs Hellen Chuma, WiPiSA student representative, University of Limpopo

The Physics Department of the University of Limpopo hosted the WiPiSA lunch on the 17 October 2014. The event was organised by Ms Hellen Chuma (WiPiSA student representative) and Ms Sylvia Ledwaba. The invited Physics female students included 2nd and 3rd year undergraduate students, as well as Honours, MSc and PhD postgraduate students, together with academic staff members. The event was a success: an overwhelming turnout of over 50 ladies attended. The lunch was organised with the aim to encourage and stimulate more interest in students to pursue their studies in physics.

The WiPiSA lunch was full of exciting speakers and topics. One of the items was a general overview of WiPiSA, rendered by Ms Chuma. Some of the senior physics students, Ms Jane Ntuli (MSc) and Ms Khomotso Maenetja (PhD), gave motivational talks, and shared stories and experiences of their journey as female physics students. Activities and discussions which took place during the lunch. Attendants divided themselves into smaller groups, and discussed obstacles or barriers that cause the decline in the number of women in physics at both undergraduate and postgraduate level, as well as addressing some of the challenges women are facing as aspiring physicists.

The keynote address was given by Prof. Regina Maphanga, who encouraged students to consider choosing physics as a career. The core of her presentation was to advise students to further their studies in physics and attain higher degrees, particularly a PhD. In addition, she advised students to embrace their feminity.

A special mention was given to the research activities in the Physics Department at the Uni-

Below: delegates to IUPAP GA 2014

Participants of WiPiSA launch in Limpopo Oct 2014

versity of Limpopo and the opportunities for postgraduate degrees.

All students were excited about being exposed to WiPiSA, and some suggested that more similar events should be held frequently to give women in physics an opportunity to network, talk about challenges encountered and also finding ways to overcome various difficulties.

WiPiSA Departmental Lunches Funding Opportunity

Prof Aletta Prinsloo, alettap@uj.ac.za,

Two of the main objectives of WiPiSA are

- to encourage and stimulate an interest in girls and women to study physics
- to support girls and women to work in physics-related careers and assist in removing/overcoming obstacles and barriers for girls and women in their studies and at workplace.

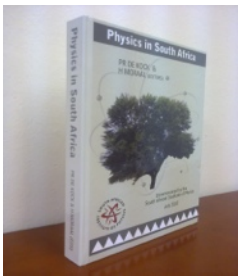
To meet this objectives we initiated an idea to have departmental lunches across universities within South Africa. The lunch activity is expected to bring women in physics together; academics, those in leadership roles and students (both undergraduates and postgraduates) to enjoy a meal together while encouraging and stimulating interests in others to study physics, networking and talking about some challenges they are facing as women in physics.

WiPiSA will provide a funding of R3000-00 only for your institution to organize the lunch. We therefore request you to help us accomplish this goal, or forward the name and contact information of the representative from your department to facilitate this activity. We would appreciate if the lunch event can be held before the end of November 2014 as this will help us to compile a report. WIPiSA expects you to send us:

- A short report about the event (venue, number of attendees, activities, etc).
- The outcomes of the event (students were motivated, links established, etc).
- Few event pictures.

Please do not hesitate to contact me at *tibanmm@unisa.ac.za* for further enquiries.

Purchase the book Physics in South Africa



Order from SAIP Office.

The book is currently available from the SAIP Office in Pretoria in hard copy and currently priced as

a) Hard covered Copy R500 per copy

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To order your copy please Email or Phone +27 12 841 2655/2627.

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 professional 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.

Above:Teachers who attended the workshop. Below: Teachers during the interactive sessions

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

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

Free SAIP Membership for 3rdYear and Honours Physics Students

Mr Brian Masara, EO of SAIP, Pretoria

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

1. Approach their supervisor or physics head of department and ask them to send a request to SAIP
2. The HoDs / Supervisors can choose to make their students free SAIP members
3. 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.

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.

Director of Johannesburg Central District, Ms Tshepo Seate, with Prof Azwinndini Muronga (Director of UJ Soweto Science Centre) and Dr Igle Gledhill (SAIP President) during the workshop

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

Articles

Living on 'the Ice'

by Mrs Catherine Webster, SANSA Space Science communication officer

The land of ice and snow, the coldest, windiest, driest, least populated and most remote corner of the world, is not a place for the faint hearted. Those brave enough to embark on a journey to Antarctica will forever have a deep connection to this icy land.

The 4500 km journey to Antarctica begins at the Cape Town Harbour aboard the SA Agulhas II, a research and supply vessel. For the next three weeks rough seas, delays and seasickness are often a challenge, but it's all worthwhile when you catch a glimpse of some of the most spectacular sights you could ever imagine. Breath-taking views of icebergs and ice floats, sunrises and sunsets, not to mention the various local habitants such as penguins, whales and seals frolicking in the icy water as you approach the Ice shelf.

Once the ship reaches the shelf the next series of challenges begin and one must be fit and able to carry out hard manual labour under extreme weather conditions. No one escapes the gruelling task of unloading the supplies and gear from the ship onto the Ice shelf and from there hauling the load across 300 km of snow and ice to SANAE IV, the South African National Antarctic Expedition base. There are no shops on the Antarctic continent so all the supplies needed to work and live at the base must be planned right down to the last tea bag.

South Africa maintains a permanent presence at the SANAE IV base in order to carry out various re-

search programmes. Part of the South African National Antarctic Programme (SANAP) involves studying and monitoring the near earth-space environment. SANSA, based in Hermanus, has a dedicated team of researchers, engineers and postgraduate students who facilitate space science research and monitor space weather from the base throughout the year.

Antarctica is often referred to as a "Window into Geospace" as the earth's magnetic field lines converge at the poles and act as a funnel for space plasma to travel into the earth's atmosphere; making it an ideal location for space science research. This research provides data on how space weather may affect communication satellites which play a vital role in our everyday life such as GPS navigation and cellular communications.

Every year SANSA, with the support of the Department of Environmental Affairs, sends two teams to Antarctica - an overwintering team and a takeover team.

The overwintering team live at the base for 14 months while the takeover team only stays for 3 months to assist the new team take over from the departing team.

Antarctica holds a fascination for many people and has done for centuries. It's not just a hostile environment for countries to send research teams to study obscure phenomena - it's also seen as a "barometer" against which the rate and effects of climate change and global warming can be measured. This is one of the reasons why most developed and some developing countries have bases in Antarctica and why it's vital for the research and support teams to continue carrying out such important research.

Despite being covered in ice sheets up to 4 km thick, there is low snowfall and most of the continent is technically a desert. The amazing thing is that this desert holds about 70 percent of the world's fresh water. Even stranger is that the rarest commodity while living on "The Ice" is fresh water.

Water is produced by melting the snow and ice in a snow smelter, known by most as the "smelly". The water is then pumped up to the base for use. Shovelling snow into the "smelly" is a tough job and becomes very tiring but it has to be done in order to have water for everyday use. When bad weather strikes, such as blizzards, it becomes too dangerous to go outside and no one can be out on "smelly duty" which leads to water shortages. When this happens the South Afri-

can team has to be even more cautious of their water consumption. Showers and laundry are the first to be put on hold.

It is said that the most important thing about living at the base is the social environment. The best way to enjoy yourself is to work closely with your colleagues and support everyone through the ups and downs. Being in such close proximity with the same people for an extended period of time is not easy, but it is an opportunity to create lifelong friendships. Taking part in the social activities like playing soccer on the ice, celebrating birthdays and special holidays, visiting other stations or even having a good old South African braai is what makes life fun while living on "The Ice". One of the greatest treats is experiencing the natural phenomenon of beautiful coloured light displays in the sky known as the Aurora Australis or the Southern Lights.

Antarctica is a continent of many hidden treasures awaiting those brave enough to take the risk and journey to the land of ice and snow.

Meet this year's team who embarked on their journey to Antarctica on 5 December 2014.

Back row from left to right: Henk Potgieter, Dr Gert Lamprecht (not on the voyage but manages the project from SANSA in Hermanus), Daleel Lilla. Front row from left to right: Vereesè van Tonder, Jonathan Ward, Ani Vermeulen and Ruhann Steyn.

SANSA Scientist first African to receive International Space Science Award

by Mrs Catherine Webster, SANSA Space Science communication officer

SANSA Researcher, Dr John Bosco Habarulema, based in Hermanus, is the first African to receive the Sunanda & Santimay Basu Early Career Award.

The award is presented by the Space Physics & Aeronomy (SPA) Section of the American Geophysical Union (AGU) to researchers, in their early stage of their careers, have already made outstanding contributions to research in Sun-Earth Systems Science.

Scientists who currently live and work in developing nations and have obtained their Ph.D. degree (or highest equivalent degree) during the seven-year period prior to the award presentation year are eligible for this award. Ugandian born Dr Hagarulema, studied as a participant of the National Astrophysics and Space Science Programme (NASSP) at the University of Cape Town and is an example of the benefit of NASSP in bringing outstanding scientists to South Africa.

Awardee Dr John Bosco Haburulema

For Dr Habarulema's work to be considered for this award, it also had to meet the criteria of advancing the understanding of both plasma physical processes and their applications for the benefit of society. His PhD thesis, for example, dealt with modelling the Earth's ionosphere to determine the effect of space weather such as solar flares on the Global Positioning System.

Managing Director at SANSA Space Science, Dr Lee-Anne McKinnell said "SANSA is extremely proud of Dr Habarulema and his dedication to the field of Space Science research. Africa needs more young researchers of his calibre working on understanding our near-earth space environment"

A number of important reasons led the AGU in selecting Dr Habarulema for the 2014 International Basu Award. These include an impressive research record, his contributions to the areas of ionosperic physics and space weather and Dr Habarulema's efforts to overcome intrinsic challenges not only to obtain his education and success in his career, but also to develop the field of space sciences in Africa.

"I am very excited to have received this award so early in my career" Dr Habarulema said. "I hope that this inspires other young African scientists to believe in themselves and to never give up on their goals. The best way to succeed is to accept that you don't know it all. Learn from your failures and grab every opportunity to advance your career."

Dr Habarulema has been invited by the SPA Section to present a paper on his current research at the 2014 AGU Fall Meeting to be held in San Francisco, California from 15 to 19 December 2014, where he will be presented with this prestigious award. With nearly 24 000 attendees, the AGU Fall Meeting is the largest Earth and space science meeting in the world and is the best place for researchers to present their work and hear about the latest discoveries, trends and challenges in the field.

"Not only is Dr Habarulema a world class researcher he is a dedicated mentor to a number of high school and university students in the local community. He is a role model for young African scientist and has a bright career ahead of him" McKinnell said.

Some Comments on Nuclear Power Generation: Scenarios, Risks, Consequences

Dr H.C. Eggers, Department of Physics, Stellenbosch University

South African energy policy is currently under intense scrutiny following two major developments this year. Current load shedding threatens to escalate into chronic instability as construction of new coal power stations is behind schedule and existing ones perform under specification. The country was also startled by announcements in September 2014 that contracts for the construction by foreign vendors of up to eight nuclear power stations for a total of 9600 MW are to be signed.

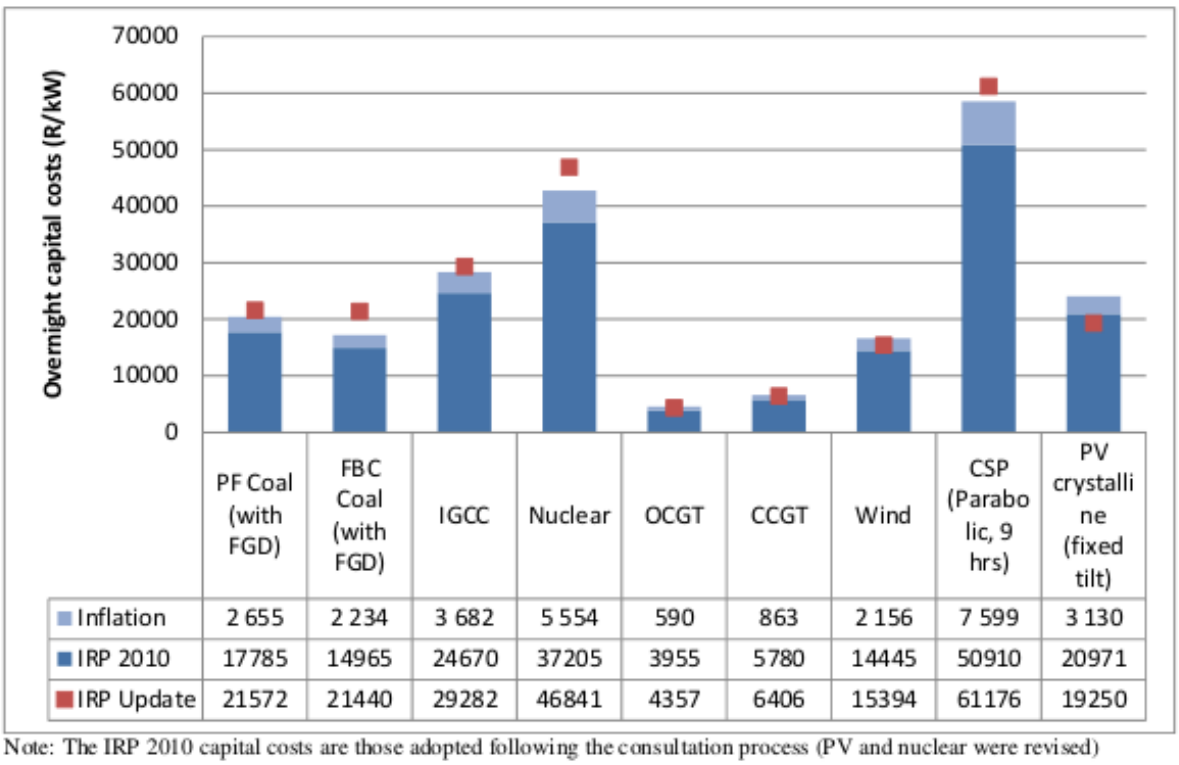
Constructing additional power generating units will be one of the largest costs facing South Africa in the coming decades and will likely exceed the country's annual budget revenues many times over. These costs therefore represent a risk to the state and society as a whole; conversely, proper calculation of risks, costs and wise allocation of investment to the various power generation options will greatly enhance the development trajectory.

In 2010, the Department of Energy promulgated the Integrated Resource Plan (IRP) as the government's framework for resource planning, including electric power generation. An "IRP Update" of November 2013 (termed "IRP" below), is, in its own words, supposed to inform decisions required the lead-up to a new iteration of the IRP. An immediate commitment by the government to 9600 MW of nuclear power appears to be in conflict with data and recommendations of the IRP Update.

Risk of costs

Costs are hard to quantify, but we can try. The following facts and figures are taken from the IRP, which is available at www.doe-irp.co.za. Figure 3 shows the updated IRP estimates on overnight capital costs, the cost if the plant were to be built overnight, neglecting interest payable during construction. Abbreviations are: PF, FBC, IGCC = new coal technology, OCGT = Open-Cycle Gas Turbine, CCGT = Combined-Cycle Gas Turbine, CSP = Concentrated Solar Power, PV = Photovoltaics.

Figure 3 – Comparison of overnight capital costs between IRP 2010 and the Update



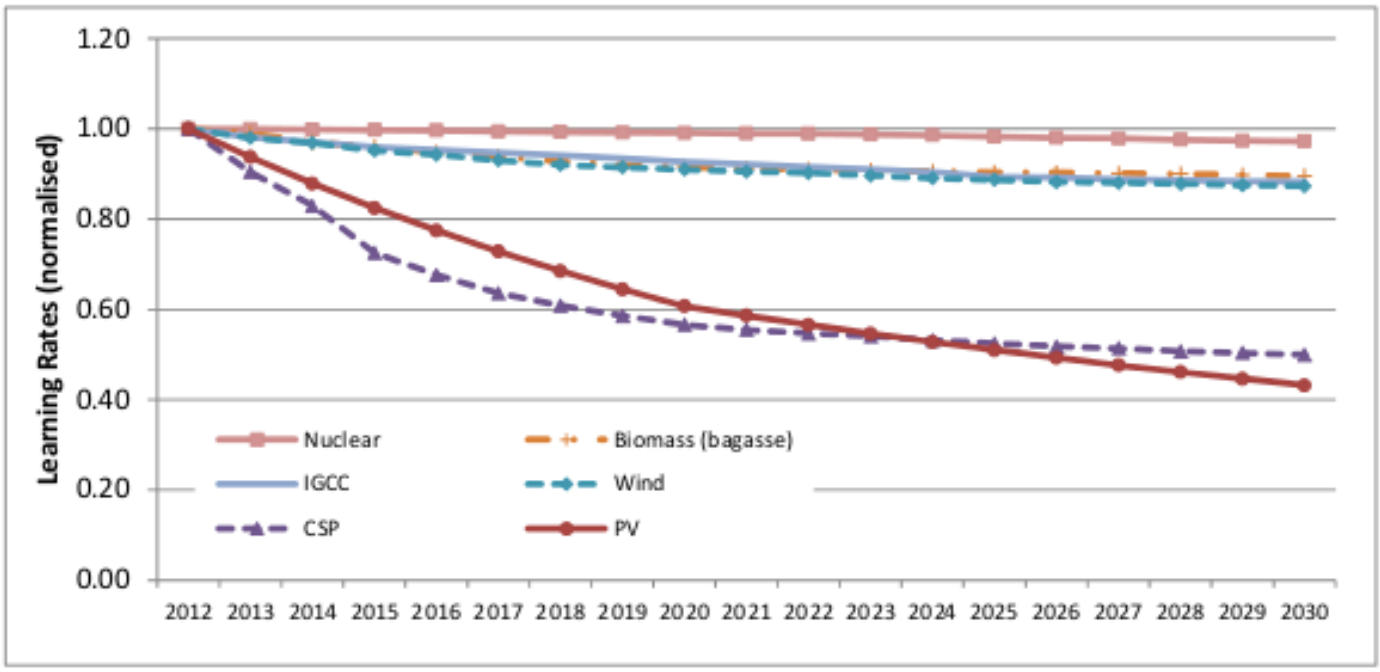
	PF Coal (with FGD)	FBC Coal (with FGD)	IGCC	Nuclear	OCGT	CCGT	Wind	CSP (Parabolic, 9 hrs)	PV crystalline (fixed tilt)
Inflation	2 655	2 234	3 682	5 554	590	863	2 156	7 599	3 130
IRP 2010	17785	14965	24670	37205	3955	5780	14445	50910	20971
IRP Update	21572	21440	29282	46841	4357	6406	15394	61176	19250

Note: The IRP 2010 capital costs are those adopted following the consultation process (PV and nuclear were revised)

From Figure 3, it is clear that nuclear power is already more expensive than some renewables (wind and PV), much more expensive than gas, and that costs for nuclear have increased faster in 2010–2013 than those for other options with the exception of CSP.

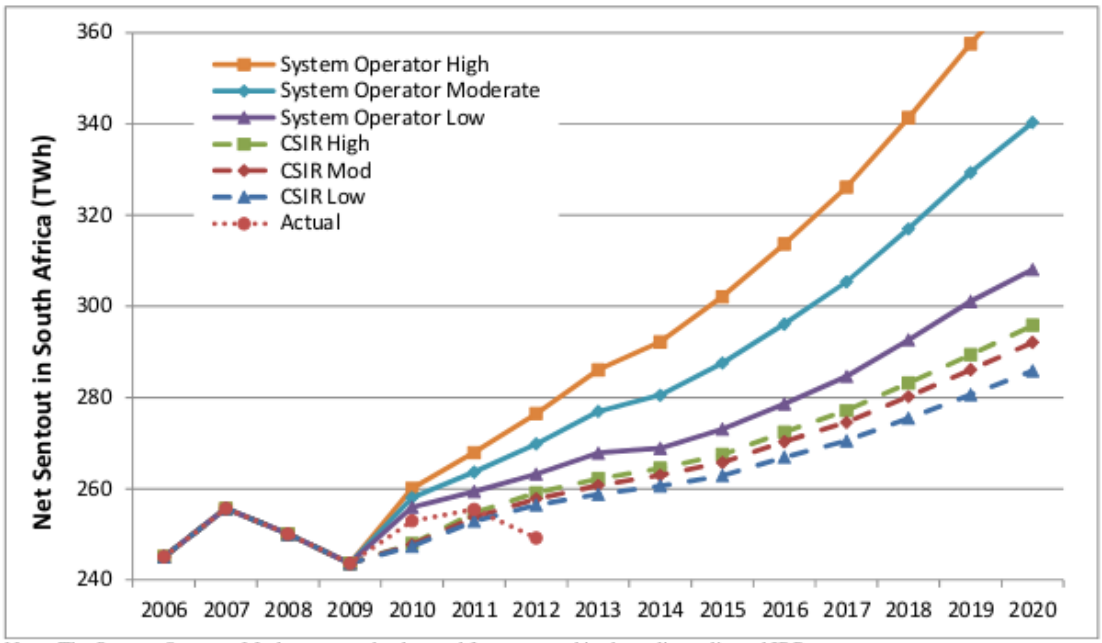
Learning rates in Figure 4 represent the estimated normalised cost reduction over time. Costs for renewables CSP and PV are expected to come down significantly in the coming decade, while nuclear power is seen as a mature technology with little expectation of cost reduction in the future.

Figure 4 – Technology cost paths applied in Update Base Case



How much would 9600 MW in nuclear power cost? The IRP states that Based on a number of expert studies and reported project costs for new nuclear investment, generic nuclear capital costs were possible in the $3800/kW to $ 7000/kW range. ...Costs for new nuclear capacity ...of $ 5800/kW overnight cost in 2012 dollars are taken as the generic cost for purposes of this update.

Figure 5 – Expected RSA sent-out from IRP 2010 vs actual



Note: The System Operator Moderate was the demand forecast used in the policy-adjusted IRP
Sources: StatsSA (for actual), IRP 2010 (forecasts)

From this, we can estimate an overnight cost for 9600 MW to be $ 55.7 billion which at an exchange rate of R11 to the dollar translates into R612 billion. To this one would have to add the costs of paying o↵ vendor loans over thirty years and, of course, any overruns and delays. Since vendor loans would be denominated in dollars, the Rand cost would be highly vulnerable to exchange rate fluctuations.

Demand projections

Figure 5 shows projections of electricity demand for various scenarios; the System Operator Moderate case was used as the base case in the 2010 IRP version. Actual demand during the years 2011–2012, shown by the dotted line, fell short of even the most conservative 2010 projection. Reasons given for the decrease include a buyback programme, supply constraints and behavioural changes brought about by price increases, relocation by big customers and improved energy efficiency. During this period, the GDP Q/Q [quarter over quarter, the ed.] growth rate came down from 4.8% to 1.2%. Demand is clearly correlated to GDP growth.

Based on the reduction in demand in 2010–2012, the IRP revised downwards the required megawatts projected for 2030 as set out in Table 2. The IRP envisages an updated Base Case 2030 need for nuclear power not of 9600 MW, as averred in recent government statements, but only 6660 MW, including 1800 MW already installed at Koeberg.

Even the updated Base Case has so far turned out to be too optimistic. The current GDP real growth rate falls below the worst scenario considered in the IRP, called Weathering the Storm, which assumes a worst-case GDP growth rate of 2.9%. Under the Weathering the Storm scenario, the IRP in Table 3 foresees a need of only 1860 MW nuclear power in 2030, including Koeberg, stating that The nuclear requirement is entirely dependent on the demand projection as there is no nuclear build in either the SO Low or the Weathering the Storm scenarios. In other words, if the economy continues to develop at its current sluggish pace, there will, according to the IRP, be no need for additional nuclear power at all.

Table 2 – Technology options arising from IRP 2010 and the Update Base Case in 2030

Technology option	IRP 2010 (MW)	Base Case (MW)
Existing Coal	34746	36230
New Coal	6250	2450
CCGT	2370	3550
OCGT / Gas Engines	7330	7680
Hydro Imports	4109	3000
Hydro Domestic	700	690
PS (incl Imports)	2912	2900
Nuclear	11400	6660
PV	8400	9770
CSP	1200	3300
Wind[3]	9200	4360
Other	915	640
TOTAL	**89532**	**81350**

Notes:
(1) Demand Response options added to IRP 2010 to ensure comparability (previously not considered in IRP)
(2) "Existing" coal includes Medupi and Kusile

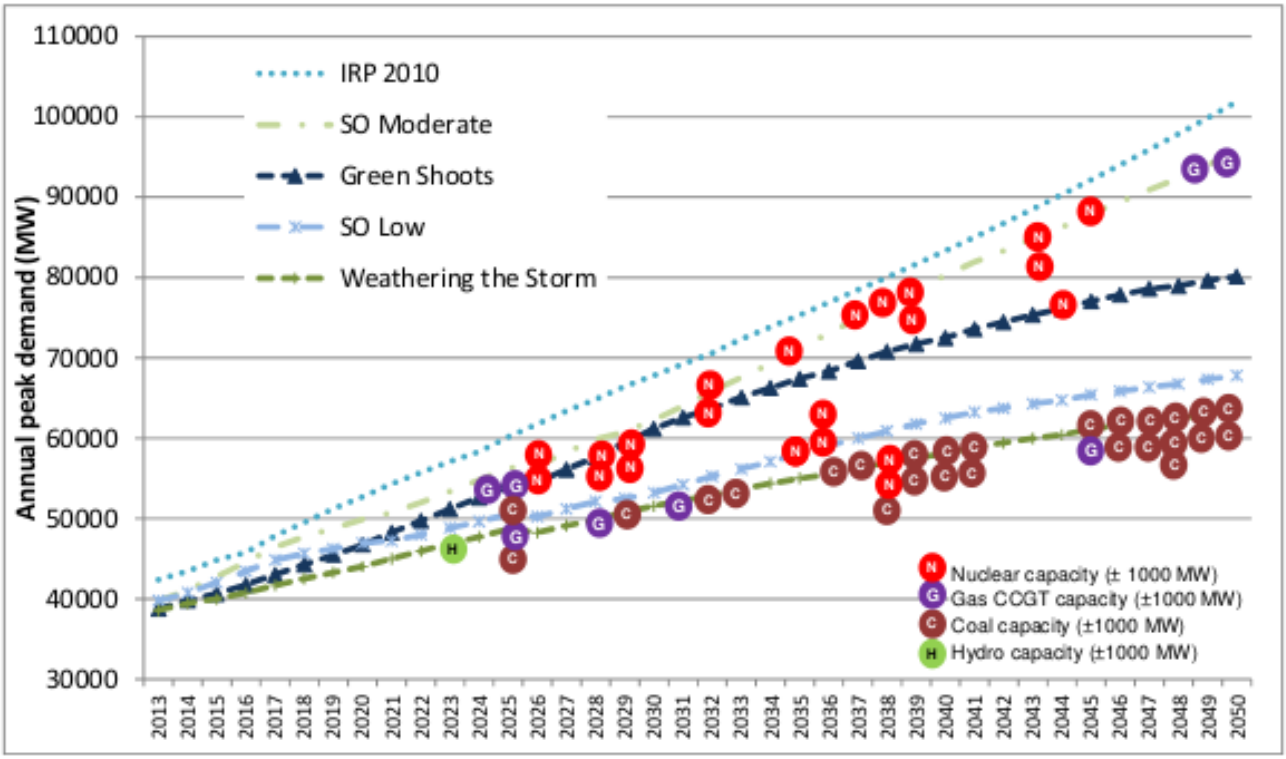
Table 3 – Technology options arising from the four demand trajectories in 2030

Technology option	SO Moderate (MW)	Green Shoots (MW)	SO Low (MW)	Weathering the Storm (MW)	Scenario-wise decom-position (MW)
Existing Coal	36230	36230	36230	36700	36047
New Coal	2700	2450	2450	2450	2355
CCGT	2840	3550	2840	1420	3760
OCGT / Gas Engines	8280	7680	6960	6720	7731
Hydro Imports	3000	3000	3000	3000	3000
Hydro Domestic	690	690	690	690	690
PS (incl Imports)	2900	2900	2900	2900	2900
Nuclear	8260	6660	1860	1860	6717
PV	10050	9770	8860	7400	9770
CSP	2900	3300	300	300	3166
Wind	4090	4360	3240	2260	4402
Other	640	640	640	640	640
TOTAL	**82580**	**81350**	**69970**	**66340**	**81179**

Notes:
(1) "Existing" coal includes Medupi and Kusile
(2) The scenario-wise decomposition scenario is not based on mixed integer optimisation (i.e. optimised output allows for partial construction of units) whereas all other scenarios are mixed integer (i.e. capacity reflects whole units with no partial construction allowed)

In Figure 40 of the IRP, the timeline for construction of various major power projects is set out for the different scenarios considered. The 2010 and updated Base Cases, viz. SO Moderate and Green Shoots both assume a compound GDP growth rate of 5.4% for the next 20 years. By comparison, the actual 2014 Q3 figure as published by StatsSA is 1.4%. Based on current experience, the SO Low and Weathering the Storm scenarios appear more realistic.

Figure 40 – Peak demand paths indicating incremental large investment requirements



Even under the optimistic SO Moderate and Green Shoots scenarios, South Africa would have no need to start constructing eight nuclear power stations in the near future: as shown in Table 3 and Fig 40, a total of 2000MW nuclear completed in 2026 would be sufficient, followed later by more units. The IRP comes to the conclusion that the nuclear decision can possibly be delayed. The revised demand projections suggest that no new nuclear base-load capacity is required until after 2025 (and for lower demand not until at earliest 2035) and that there are alternative options, such as regional hydro, that can fulfil the requirement and allow further exploration of the shale gas potential before prematurely committing to a technology that may be redundant if the electricity demand expectations do not materialise.

The IRP further states that if nuclear power station vendors cannot commit to a price below $6500/kW, then the nuclear option should be abandoned, as other technologies would be cheaper.

Risk and flexibility

Projecting electric power demand 30 years into the future is hard, and given the magnitude of the investment, getting it wrong can become very expensive for the country. Flexibility and adaptability to changing conditions are hence seen as the guiding principle in the IRP:

Flexibility in decisions should be the priority to favour decisions of least regret. This would suggest that commitments to long range large-scale investment decisions should be avoided.

while in Section 5.5 we read

Building for the higher demand may result in over-capacity and stranded investment but building for the low could constraint the development path. The dynamics of the decision should be to allow maximum flexibility to build for the low as a minimum, but provide options for faster, more flexible development to meet the aspirations of the country.

Broadly speaking, nuclear power is inflexible due to the large size and long construction times, while renewables are more flexible in size and construction times.

A second consideration is, however, to maintain diversity of power generation modes, suggesting that the optimal route lies neither in exclusive commitment to nuclear power, to the detriment of all other modes, nor in complete abandonment of the nuclear option.

According to Fig 40, South Africa would need only 2000 MW of additional nuclear power, only in 2026, and only if the Base Cases materialise. The principle of flexibility suggests that South Africa waits as long as possible before committing contractually to specific plants. To achieve flexibility in power generation mode, on the other hand, and because nuclear power plant construction are frequently plagued by delays, it may be wise to commit in the near future to a single additional nuclear power unit, or two at a stretch.

Conclusions

While I am clearly not a qualified expert in the field and the views expressed here are those of an outsider, the views of the IRP should presumably be taken seriously.

1. South Africa clearly needs nuclear power, now and in future.

    (a) Coal has to be phased out as soon as possible to lower South Africa's carbon footprint and reduce pollution. Nuclear energy must be part of the mix of generation modes gradually replacing coal.

    (b) While renewables are progressing quickly, they have some way to go to provide the baseload capabilities for which nuclear power is ideal.

    (c) South Africa has proven expertise in nuclear physics and nuclear engineering.

2. Nuclear power presents significant risks in terms of safety and waste storage, but these challenges pale against the high financial risk associated with the construction of eight nuclear power stations. Since Eskom is already struggling to find financing for current projects, all eight would have to be bought on vendor finance, which costs would have to be borne by the customer over decades by large increases in the price of electricity.

3. Large electricity price increases will make alternatives to nuclear power more competitive, and customers will learn to adapt by becoming more energy-efficient. The o↲take of eight nuclear power stations is therefore not guaranteed even under optimistic scenarios of high GDP growth rate. In worst-case scenarios, the output of eight nuclear power stations will far exceed demand even as vendor loans have to be serviced in full, thereby further depressing the economy.

4. Renewables technology is progressing rapidly. For example, a major reason why renewables have traditionally been considered uncompetitive is the lack of storage capacity. That appears to be changing rapidly, to the extent that photovoltaic-battery combinations, now readily available for household use, are even seen as a threat to traditional large power utilities; see e.g. www.bloomberg.com/news/2014-12-05/musk-battery-works-fill-utilities-with-fear- and-promise.html

5. Flexibility both in timeframes and diversity in power generation modes should be the prime criterion. Financial risks should be spread rather than putting all available funds into one option.

6. Capacity building in South African nuclear physics and South African nuclear engineering should continue unabated and indeed be ramped up. It would be absurd to have to rely exclusively on foreign technical experts and advice to maintain nuclear power plants.

7. The choice of foreign vendor is important but not the primary issue. The four candidate vendor countries Russia, China, France and the USA are all acting in their own interests, and all would happily promote South African technical and financial dependency if allowed to do so by unwise decisions.

8. Local capacity in, and funding of, the physics and manufacturing of renewables should be in- creased significantly. Renewables are more suited for job generation due to the small scale and diversity of technologies involved.

9. The debate over nuclear power should not paralyse the energy sector as a whole. The government should finalise bids within the third window of the Independent Power Producers initiative, given the success of the first two windows.

In summary, cabinet should approve the IRP update and act according to its recommendations. South Africa may need one or two new nuclear plants, but certainly not eight, and needs to promote other options vigorously in any case.

Opportunities

Projects Officer SAIP

Vacancy: Projects Officer (full-time position)

Salary: R300 000 pa (Total Cost to Company)

The South African Institute of Physics (SAIP) would like to appoint a Projects Officer who will be responsible for the coordination of all SAIP projects and will provide implementation support to the teams working on SAIP-supported projects. The Projects Officer will report to the Executive Officer.

Main Duties

1. Develop project proposals, tender documents, project budgets, implementation plans and monitoring and evaluation methods
2. Assist with finding partners and sources of funding for projects
3. Assist with communication and collaboration with donors and partners
4. Coordinate volunteers working on SAIP projects
5. Ensure and monitor timely and correct implementation of projects
6. Prepare project reports
7. Maintain project files and related documentation
8. Prepare meeting agendas and minutes for external meetings with partners and donors
9. Participate in the organization of SAIP events such as meetings, workshops, conferences, winter-schools, and training
10. Play a leading role in communication of SAIP projects to stakeholders

Qualifications

- A three-year tertiary qualification in physics, natural sciences, community development, project management, or similar relevant field.

Skills

- Good proposal and report writing skills
- Proficient in basic computer packages including Word, Excel, and Powerpoint
- Strong planning and organizational skills
- Excellent communication and interpersonal skills
- Self-motivated, reliable, can work with minimal supervision

Advantages

- Interest in science education or public outreach in the physical sciences
- Experience in program and projects development and management in an NGO, educational, government, or business organisation

Application: Please email application and CV to brian.masara@saip.org.za

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 of ions. Contact Prof Konrad: konradt@ukzn.ac.za

Quantum Information Processing and Communication

A few Masters and PhD positions are available for 2015 at the SA Research Chair in Quantum Information Processing and Communication at the University of KwaZulu-Natal in Durban. Next to the more traditional research opportunities such as in the theory of open quantum systems and decoherence, we are offering some very interesting projects in the vibrant fields of quantum biology and quantum machine learning.

More information can be found on the Group's website (http://quantum.ukzn.ac.za). If interested please please contact Prof F Petruccione (petruccione@ukzn.ac.za)

Upcoming Conferences & Workshops

Bring International Physics Conferences to South Africa

The SAIP Office would like to help South African physics community to bring international conferences and workshops to South Africa. The SAIP can help with hosting these conferences as well as preparing bidding documents, budgeting and fundraising.

The SAIP office has helped in hosting very successful international physics conferences and workshops.

Please email the conferences you want us to help bring to South Africa to info@saip.org.za

SAIP2015

The SAIP2015 Annual Conference will be held in Port Elizaberth from 29 June to 3 July 2015

for more details visit www.saipconference.co.za

Postgraduate opportunities within South Africa - ALICE (SA-ALICE)

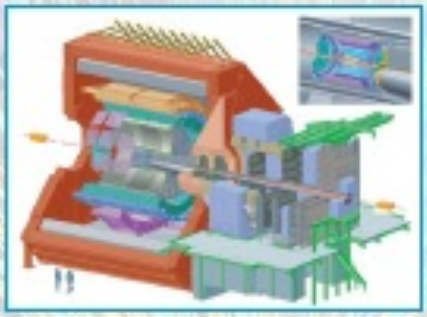
⇒ Take a "journey to the early Universe"

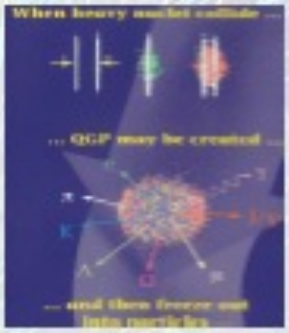
What happens to matter when it is heated to 100 000 times the temperature at the centre of the Sun?

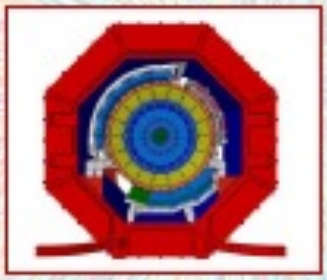
Why do protons and neutrons weigh 100 times more than the quarks they are made of?

Can the quarks inside the protons and neutrons be free?

The Large Hadron Collider (LHC), situated at CERN 100m underground between Switzerland and France, and ALICE - A Large Ion Collider Experiment are the extraordinary tools to search for answers to these fundamental questions. SA-ALICE is participating in the ALICE Collaboration with a focus on muon and photon measurements in heavy-ion collisions at the LHC and online & offline computing upgrades of ALICE.







Student Opportunities:

SA-ALICE operates under the auspices of the South Africa - CERN (SA-CERN) program. We offer various

- *BSc Honours, MSc and PhD projects to students interested in the field of High Energy, Particle and Nuclear Physics & in Computing. Interested students will be able to travel to CERN (Geneva, Switzerland) to participate in experiments!*
- *Local ALICE Masterclasses to introduce 3rd year and Honours students to ALICE measurements.*
- *Outreach programs, e.g. annual International Particle Physics Masterclasses geared for high school pupils (http://www.tlabs.ac.za/physics-masterclass).*

For further information see http://sa-cern.tlabs.ac.za/alice or contact:

Dr T Dietel (tom.dietel@cern.ch) at UCT,

Drs Z Buthelezi (zinhle@tlabs.ac.za) and SV Förtsch (fortsch@tlabs.ac.za) at iThemba LABS.

Quantum Physics: Foundations and Applications

From 03-13 Feb 2015

Research in quantum mechanics in the recent past has been strongly influenced by two trends:
(1) The role of edge states in quantum systems formulated on manifolds with boundaries, which requires a careful analysis of elliptic operators and their domains of self-adjointness.

(2) The role that quantum information theory plays in the foundations of quantum physics and specifically the study of non-separable and open quantum systems.

The proposed workshop aims to bring together experts in the above fields who can expose research workers and students to the physical and mathematical ideas underlying these developments, and to promote fruitful interaction among the more senior physicists.

For more information please visit: http://www.nithep.ac.za/4mb.htm

14th International Conference on Particle Induced X-ray Emission

The 14th International Conference on Particle Induced X-ray Emission will be held at the Lord Charles Hotel in Somerset West, 26 Feb – 3 Mar 2015.

For more information visit: http://www.pixe2015.tlabs.ac.za

6th South African Conference on Photonic Materials

4 – 8 May 2015 Mabula Game Lodge, South Africa

Announcement and call for abstracts
The purpose of the conference is to bring together scientists from Africa and abroad, who are working on various issues related to photonic materials. Following the success of the previous 5 conferences, Mabula 2015 will follow the same general format.

IMPORTANT DEADLINES:

- Abstract submission: 1 February 2015
- Notice of acceptance: 21 February 2015
- Registration deadline: 14 March 2015
- Early bird payment: 31 March 2015
- Final payment: 21 April 2015
- Manuscript submission: 18 April 2015
- Conference Commences: 4 May 2015
- Reviewing of manuscripts deadline: Last day of the conference

More information on conference fees, programme, and abstract and manuscript preparation is available at the conference website: http://events.saip.org.za/event/sacpm2015. Requests for official Letters of Invitation (to help secure funding or facilitate entry into South Africa for participants) and any other information on the conference should be addressed to Dr Jackie Nel at +27-12-420-3580 or Jackie.nel@up.ac.za

SAAPMB 2015 Cancer Imaging

The 53rd National Congress of the South African Association of Physicists in Medicine and Biology (SAAPMB) will be held from 23 – 27 September 2015 under the theme Cancer Imaging in the friendly city of Bloemfontein, South Africa.

Do not miss out on this outstanding Spring event with a hands-on training workshop, congress contributions from local and international speakers and an overseas expert panel on the topics of Medical Physics, Radiotherapy and Diagnostic Imaging. With our common goal of fighting cancer in a rapidly developing information and technology driven era, we would be delighted to have you present at the congress. Use this opportunity to be inspired, motivated and to network with your peers and other experts in your profession. As always in the centre of the hearty Free State province, the social programme will be especially enjoyable.

For more information and registration visit http://www.saapmb2015.co.za/

Physics Comment Editorial Policy

Deadline for submissions for the March 2014 issue of Physics Comment is 28. Feb 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
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The views expressed in published articles are those of the authors and are not attributed to the Editorial
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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

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Article types. The magazine is devoted to articles, reports, interesting facts, announcements and recent developments in several areas related to physics:
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