Physics Comment

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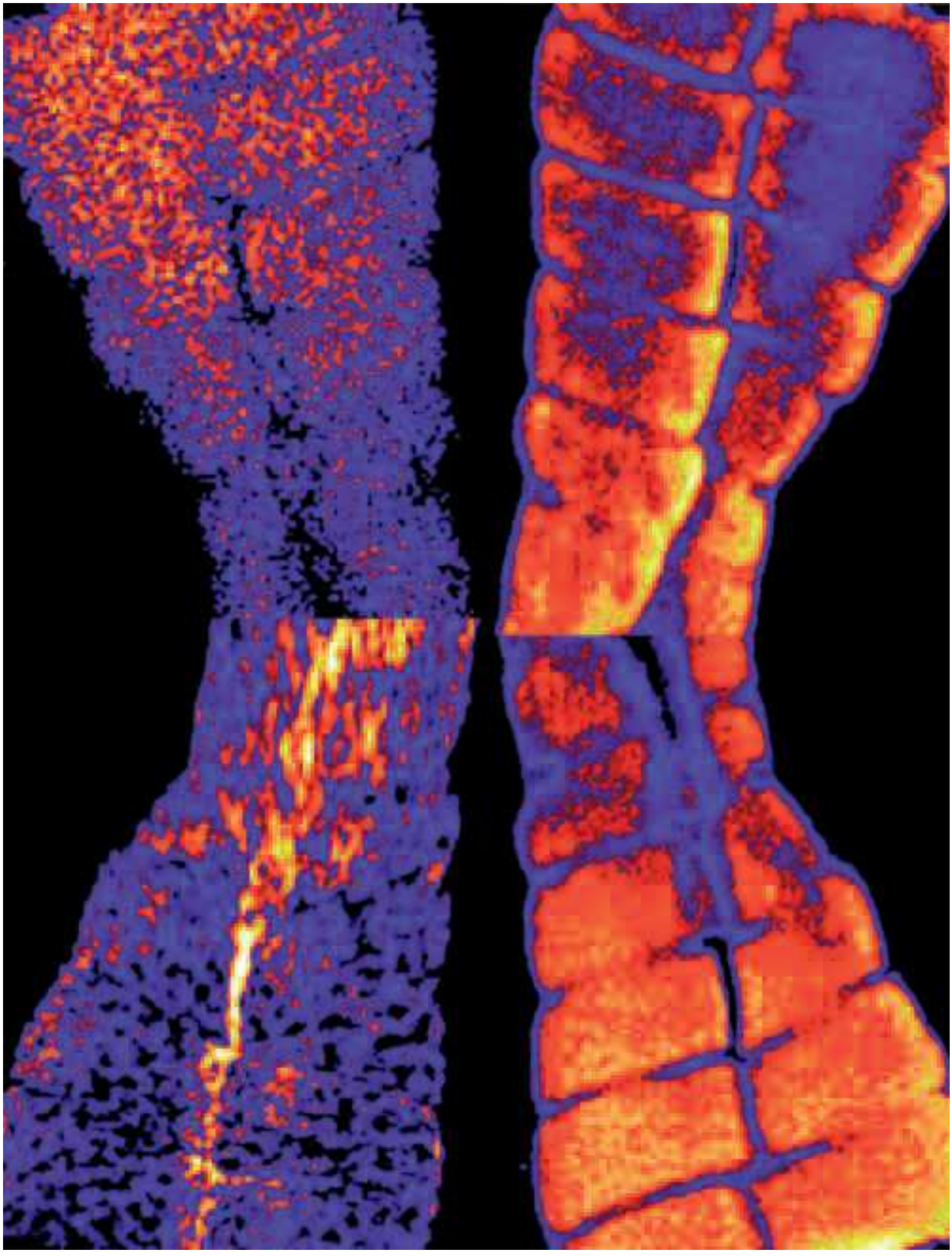

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Cover Picture: Physics meets ecophysiology

Photograph courtesy of Dr Monika Tarnawska and Dr Wojciech Przybylowicz.

PIXE (Particle Induced X-ray Emission) maps of metal distribution (clockwise from bottom left: zinc, nickel, potassium, calcium) in the hepatopancreas of the woodlouse *Porcellio scaber*. Maps were obtained using the nuclear microprobe at the Materials Research Department of iThemba LABS. This study is focused on how the functional role of the hepatopancreas, the main metal storage organ in woodlice, is affected by excess nickel, an element that is toxic to soil invertebrates. The study is part of the bilateral collaboration between the Department of Animal Physiology & Ecotoxicology, University of Silesia, Katowice in Poland and iThemba LABS (project leaders: Prof. P. Migula and Dr J. Mesjasz-Przybylowicz).

Editorial

Jaynie Padayachee

This 2nd issue of Physics Comment contains two articles which bring to light what all of us know: a poor high-school Mathematics foundation adversely affects Physics at university. However, the levels of "poor" are now probably worse than they have ever been. The recent *International Review of Mathematical Sciences Research at South African Higher Education Institutions* [1] states that "…the number of students qualified to undertake mathematical studies at university is low. Improving the size of this pool is a critical factor if research is to be enhanced in the long-term." Without Mathematics, Physics is nothing. Perhaps it is time for Physicists and Mathematicians to pool their limited outreach and teacher training resources to maximise impact.

[1] http://www.saip.org.za/documents/review_msr_report.pdf

2008/2009 NSTF Award Winners

The 11th NSTF Awards gala dinner was held at Emperor's Palace, Kempton Park in Gauteng on 26 May 2009. Congratulations to the three SAIP members who were recognised for their contributions to science, engineering, technology and innovation.

Hendrik Swart, Head of Department of Physics, University of the Free State was awarded the Eskom Award for Research Capacity Development over the last 5-10 years (Male) for his significant contribution to the development of students in a niche area of nanophysics.

Martin Ntwaeaborwa, Senior Lecturer, Department of Physics, University of the Free State was awarded the NRF TW Kambule Award for a Distinguished Young Black Researcher over the last 5-10 years for his contribution to the understanding and harnessing of light emitting nanomaterials for practical applications.

Case Rijsdijk was given a special award, recognising an outstanding contribution to Science, Engineering, Technology and Innovation - for enthusiastic communication of physics and astronomy to learners over a lifetime.

The first OBE cohort in Physics 1 – set up for failure?

Hartmut Winkler

Introduction

The phasing in of the outcomes based education (OBE) model of tuition in South African schools aimed to eradicate past inequalities and improve school leaver competitiveness, and was a cornerstone of the government plan to massively increase a pool of scientifically capable school leavers that would move through university and eventually alleviate the country's technological skills shortage.

The 2008 grade 12 class was the first to have been reared in the new system. Unlike their predecessors, these learners did not go through a two-stream (higher and standard grade) scheme, which led to widespread fears amongst educators that academic standards would now be compromised. These worries grew when it became clear that Mathematics learners would henceforth have the option to only write two of three examinations, and leave out the paper on geometry and other fields critical to future scientists.

To top it off, several commentators felt that the 2008 Mathematics grade 12 examination papers had been exceptionally easy. For example, a group of teachers calling themselves the Concerned Mathematics Educators heavily criticized the quality of these papers. Its spokesperson, Aslam Mukadam, described the examination as "watered down", and predicted that "if this standard is going to be used as a benchmark in future examinations, it will not adequately prepare young students to study Mathematics-related courses at university level"[1].

Speaking at the 3rd Annual Education Conference in South Africa on 3 March, Jonathan Jansen was in '… no doubt that come June there would be a massive failure rate in first years at university. "Why? Because there are thousands more students in university based on fake marks. …"'[2].

Reports from tertiary institutions across the country soon substantiated these forecasts. For example, Die Beeld reported a 17% pass rate for the 2009 first Chemistry 1 semester test at the University of Pretoria (as opposed to a 47% pass rate in the corresponding test in 2008)[3].

Experiences at the University of Johannesburg

What follows is a brief analysis of the performance of the students of the University of Johannesburg (UJ) 2009 Physics 1 (major) class. In particular, the analysis assesses the ability to cope with the demands of university-level physics of the group of students who completed grade 12 last year.

The Physics 1 (major) first semester course, PHY1A01 (= Mechanics, Waves and Heat), has a minimum entrance requirement of 60% for both grade 12 Mathematics and Physical Science. While prospective Physics major students take this course, the vast majority of the class come from the Engineering faculty (for whom the course is compulsory). The course has been running in its current form (with minor annual modifications and improvements) for several years, and in particular the author has taught the course for the past three years. It would thus under normal circumstances have been expected that the marks averages in this course should have shown no significant variations over these three years.

The first sign of unusual circumstances became evident at the 2009 registration, when a huge number of 512 students were enrolled for PHY1A01 (up from ~375 in 2008). This failure to cap the numbers at a more manageable figure was in part due to a higher than usual percentage of successful applicants to university study actually registering this year (probably because other institutions had also filled up, leaving these students no option but to register

at UJ). The 512 students all satisfied the entrance requirement, and were hence accepted into PHY1A01.

In order to investigate the performance of the students, they are here classified into four categories: (a) PHY1A01 *repeaters*, (b) *older new* students in PHY1A01 for the first time, but who are known not to have been at school in 2008, (c) students that are known to have been at school in *Gauteng* in 2008, and (d) *other* students *new* to UJ, whose schooling status was unknown (some were at school, while some joined UJ from other institutions).

The 2009 semester test averages for students from each of the above categories is listed below.

	(a) repeaters	(b) older new	(c) Gauteng	(d) other new
Test 1	53.0%	46.5%	30.0%	29.5%
Test 2	51.0%	41.7%	31.3%	34.2%
Test 3	43.4%	40.5%	29.6%	33.8%

These figures may be compared with the corresponding table for 2008. Note that here insufficient information was available to determine a separate "Gauteng" fresh matriculants sample. Such students here fall under category (d). Note that the 2008 Test 2 corresponds to the 2009 Test 3.

	(a) repeaters	(b) older new	(d) other new
Test 1	49.4%	45.9%	42.4%
Test 2	38.2%	35.6%	36.5%

In 2008, new students on average did 7% worse than repeaters in the first test, while this gap had shrunk to 1.7% by the end of the semester. In 2009, however, new students were initially a full 23.5% worse than their repeating counterparts, with the gap decreasing to 9.6% at the end of the term. The entirely OBE-raised Gauteng sample started the term 23% behind the repeaters, and was still trailing these by 13.8% at the end.

There is every reason to believe that the repeaters constitute a valid control sample – they are a group of students who obtained just below 50% in the prior year, and, as mentioned, the course in 2008 was on the same level of difficulty as in 2007. The conclusion one can therefore draw is that the first year students entering the system from grade 12 in 2008 are scoring at best 8%, and at worst 12% lower marks than their counterparts did in the previous year. This obviously has very serious consequences for the Physics pass rates, not only at UJ, but also in other institutions, where similar circumstances are expected to prevail.

The future?

Tighter entrance requirements and selection criteria for applicants to Science and Technology programmes are being considered, and are likely to be implemented at UJ and probably most other institutions. This will however have the effect of seriously depleting student numbers in these fields, and will do nothing to alleviate the chronic national skills shortage in engineering and technological fields.

The new OBE schooling system has not been able to adapt school leavers better to the demands of university. A larger number of students were enrolled this year, but the total number of students passing is expected to at best stay at the previous year's level. Drastic improvement measures in the secondary education tier are therefore now as necessary as ever.

Instead of the current tendency to refer the 'catch up' task to tertiary institutions in the form of extended programmes, serious consideration should be given to introducing a 13th school year, where talented learners from around the country can be assembled at a few well resourced schools with top-class Science teachers for an additional school year, akin to the British A-levels. If instead badly prepared students continue to be released into a usually alienating university environment, bad results and high dropout rates will continue to be a regular feature for years to come.

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3. Die Beeld, 8 April 2009

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A personal reflection on educational change: adjusting with the times

Gillian J Arendse

Most academic staff at tertiary institutions have been confronted with the reality that the typical 1st year student has changed dramatically over the past few years. Colleagues at various tertiary institutions have commented on the under-preparedness of the students. This not only

refers to their inability to come to grips with the content, but also their attitude towards learning in general. A recent article in one of the local newspapers[1] highlighted an analysis performed by a university professor on the performance of first year students in a mathematics class test. It turned out that only 27% of all the students who obtained a pass of 70% and higher for mathematics in matric (2008) were able to pass the test. A 4th-year BSc student who plans on becoming a teacher echoes this sentiment in a statement: "Prof, the 1st year students seem to know less and less every year". An interaction between a lecturer and a student at the end of a test revealed the following: "How did it go? Not so well, but it is not the Physics. It is the Mathematics that is required".

Various studies have reported on the insufficient content knowledge of school educators. However, we have to be "careful" when pointing the finger at the schooling system, as we ourselves are the input to this loop. Tertiary institutions are responsible for the development and training of the educators who we claim are struggling to get the job done. In addition to tertiary institutions, science centres and national research facilities have, through their various outreach activities, attempted to address the needs of educators as well. There are also cases where science is being taught without any formal qualification or experience. In addition to this, many educators are struggling to come to grips with the "new" content that has been added. The question therefore: "are we adding value; are we empowering; are we developing our students (educators) through what we offer?"

Arnold B Arons in his textbook *Teaching Introductory Physics*, makes the following statement: "The principal function of education – higher education in particular – must be to help individuals to their own intellectual feet: To give them conceptual starting points and an awareness of what it means to learn and understand something so that they can continue to read, study, and learn as need and opportunity arise, without perpetual formal instruction."

Should institutions therefore not reflect on what they are doing with their students to improve their learning? A lot of time is spent discussing what will be taught in undergraduate courses, but how much time is spent on what and how they (the students) will be learning? Most universities have adopted a student-centred approach to teaching and learning, but what does this mean in reality?

"Stroll down the corridors of a typical college, and glance in some of the classrooms where freshman courses in physics are being taught. Chances are you will see something like the following: Instructors in front of their captive – but rarely captivated – audience extolling, with various degrees of enthusiasm, the virtues of physics and solving problems of the week. Seated obediently in uniform rows facing their leader are the students, vigorously scribbling in attempts to transcribe each utterance and every blackboard marking …"[2]. This statement was made by Gautreau in 1997, but could this still be true today? Have we changed the way in which we interact with our students? Sadly, I have to report – no! Or at least that was my experience when I attended a couple of 1st year lectures. Sure, we have moved away from talk and chalk, but what did we end up with … talk and PowerPoint! It seems as if a lot of time is spent to ensure that the interaction is "as painless" as possible. Questions posed during lectures can in most cases be answered by a simple yes or no. There is no need for the students to take any notes or bring a textbook along, as everything is "available".

It seems as if most of what we are doing is focused on the "weaker students" – we tend to repeat statements a number of times – there might be somebody who did not get it the first time. We introduce supplementary tuition, our practicals start off with a show-and-tell, and we introduce weekly tests to get them to work. Don't get me wrong, I am not saying we should not be doing these things, but they need to be done for the right reasons. Our interventions should be aimed at getting the students to their "own intellectual feet". If this is not the case, our tertiary institutions will become "glorified high schools" where we follow the same practices that we are protesting about.

For decades introductory science courses have relied largely on lectures and tests that reward memorization of facts and formulas, an approach that has driven away many talented students. While many science instructors have prided themselves on using the introductory courses to "wash out" students who are lazy or lack aptitude, in reality many students who drop their science majors are academically well prepared and motivated. Other students stick it out despite bad teaching[3]. Teaching should be about creating opportunities for learning to take place and should therefore seek to engage the student in all aspects of the learning process. This clearly suggests the need to move away from producing passive learners; rather the aim should be to produce life-long learners; learners who are actively engaged; learners who are standing on their own intellectual feet.

While new teaching methodologies like active engagement, problem-based learning, peer-instruction and experiential learning, have shown success in engaging and retaining undergraduates, they have yet to be widely adopted in academia, especially within South African tertiary institutions.

Physics departments have (or will have in the

near future) a number of young academics that have good ideas as to how the current teaching practices can be altered to ensure better graduates in both our service modules and the mainstream. We should never loose sight of the fact that even though the students enrolled in our service modules will never become Physics majors, that they might end up being the first (and in many cases also the last) science teacher of our prospective students. It is therefore important that these individuals be given the opportunity, encouragement and support to experiment with new teaching/learning methodologies.

"If you are passionate about the teaching of science there could be no better place or time to be located than in South Africa at the start of the 21st century." [Case, Marshall – 2006]

Aluta Continua – The struggle continues

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Physics for Economic Development –Entrepreneurship & The Stage-Gate™ process

Part 2 in our series

Brian Masara

This is the second in a series of articles written on physics for sustainable development and entrepreneurship. The critical role that scientists play in our economy is compromised because faculty, graduate students and postdoctoral researchers do not have a base level understanding of commercialisation and the skills needed. As soon as they finish studying they look for a job. We need to realise that when entrepreneurship thinking and skills are combined with breakthroughs and advances in science and technology we create an enabling environment to solve the big challenges Africa faces today as well as attain the millennium development goals.

Contribution of science and technology is mainly emphasised in terms of innovation but innovation alone does not lead to implementation and diffusion of the innovative ideas for sustainable socio-economic development. In order to bridge innovation to implementation gape we need to inculcate the culture and skills of entrepreneurship among physicists. Innovation might only create new products, services or processes whereas entrepreneurs will gather resources, organize talent and provide leadership to develop viable ventures using these innovations. One tool that scientists and successful technology based companies have used to drive products from R&D to commercialisation is the STAGE – GATE process which I introduced in my first article.

The Stage Gate™

In the first article of this series, the stage gate process was introduced. This is a new product management process that is used to develop new products from ideation to commercialisation. It is termed State Gate because it has gates and stages. Gates assess project quality; they are our quality control checkpoints. A project cannot move to the next stage before it satisfies the criteria of the current gate. The following decisions can be made at each gate either to proceed, hold the project or go back to the previous stage. A gate must cover three aspects:

1. Quality of execution – identify and check if previous steps were well executed?
2. Business rationale – is the project/idea still an attractive business investment? For example is there a need or a market for the product? Are you not infringing on someone patent etc?
3. Quality of action plan – are the next steps well planned and reasonable? Obviously before proceeding with a project from one stage to the next we need to check if we have a solid plan of action and if resources are available before we proceed.

Several activities are undertaken during each stage. Stages are cross-functional in nature. The stage gate process encourages teamwork. At each stage several people must be working together for a project to be successful. For example if you are an electronics richer who has an idea to develop a state of the art electronic device obviously you may require a marketing person to help with marketing issues, a mechanical engineer to design the electronics housing, a graphic designer to do some artwork, a patent attorney to file your patent, a process engineer to help with production process layout, an accountant or cost engineer to help with product costing, a business development expert to help raise funds a etc. Successful projects are always a result of teamwork. Hence the starting point for any successful project is the identification of a winning team.

Gate 1 and Stage 1

To put this discussion into context I will introduce gate 1 and stage 1 of the stage gate process.

Gate 1 – Initial Screen

As physicists and scientists in general we are trained to be analytical in everyday life. Hence as we work in our research, teaching and professional areas many new ideas cross our minds from time to time. These can be ideas on how we can do something new, ideas on how we can improve existing processes and sometimes these ideas come as pure accidents or discoveries as we work. It is important to note that because of time and resource constrains we cannot pursue all these ideas that come into minds. Hence the role of gate 1 of the stage gate process is to identify right at the ideation stage which of these ideas are worth pursuing and which is not.

Gate 1 screens ideas from variety of sources already mentioned above. This is where one makes the first decision to commit resources to the idea. Resources at this stage maybe just time and man-hours spent on the project and very limited financial resources if any. The factors that one considers at gate 1 include the following the following question

1. Strategic alignment – for example is the idea aligned with your broad strategic goals? Will it contribute to the attainment of your overall objectives?
2. Technical feasibility – is the project/idea technically feasible both from a scientific point of view and from the resources (both personnel skills and equipment) point of view?
3. Competitive advantage – Is this a unique idea or a ME-TOO product? Do you think you will have a market

Stage 1 – Preliminary Investigation

If one decides to go ahead then there is a need to do a preliminary investigation. This sometime referred to as the quick and dirty analysis. Stage one will include a through check of the following

1. Patent searches – check if there is no patent already filed that can affect your project
2. Quick and dirty market survey e.g. what products currently satisfy the needs your product will fulfil, what is the threat of new products and substitutes for your product? What market share do you think you will get?
3. Technical appraisal of your equipment and resources capability in developing the product?
4. What are the legal implications on the product you wish to develop?
5. Where will you get resources for development of the idea? Both financial and non-financial resources?

In the next article we will look at the next gates and stages.

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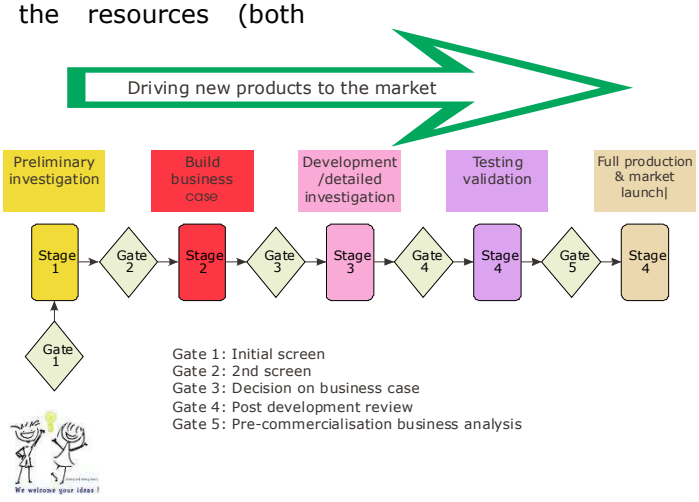

Rethinking Physics: Newton's *f*Laws of Gravity

OO Nubi

Beginnings

"*Physics' greatest endeavour has ground to a halt. We are in a period of utter confusion.*" - Nobel laureate David Gross, New Scientist[7]

Science is essentially the way we relate to existence and our attempts to understand and comprehend it. But it so happens that the more closely we observed the universe the more complex it grows.

Since ancient Greek times, philosophers have

speculated that the apparent diversity of observations of various phenomena conceals an underlying unity, thus prompting the search for the *Theory of Everything* (or the *grand unified theory*, as it is called today).

The *Principia*, a three-volume work by Isaac Newton published on 5 July 1687, is widely regarded as one of the most important scientific works ever written. It provided the first dramatic empirical evidence for the unification of two apparently distinct phenomena: *terrestrial* gravity (that holds and pulls objects to the Earth's surface) and *celestial* gravity (that keeps bodies in orbit around other bodies).

A presumably better explanation of gravity is Albert Einstein's 1916 *General Relativity Theory*, in which he proposed a 4-dimensional warped space-time concept. Strangely enough, this theory is rarely taught in university science and hardly used in engineering or space programs, as opposed to Newton's laws.

In the 21st century, real and "thought" experiments are revealing increasingly anomalous behaviours1,2, thus persuading scientists to invoke a host of concepts (dark matter, dark energies, multi-dimensional strings and mysterious quantum effects) that only a handful of super-scientists can fully comprehend. Today, we are in search of *graviton particles* and *gravity waves* in order to support theories such as *quantum gravity* and *superstrings*. Our universe has never been so bizarre!

Slips, Flaws & Inconsistencies:

> "*We don't know anything. Everything about gravity is mysterious*." – Michael Martin Nieto, theoretical physicist, Los Alamos National Laboratory, Discover Magazine, October 2003.

A reasonable place to start investigating gravity is the seemingly robust Newton's First Law of Motion, which stipulates that in our universe, linear motion is the norm, and curves require a perturbation (hence a force). To account for this perturbation, Newton had to invent gravity as a force of nature. Experiments and observations however reveal that straight-line motion is rare and objects in the real universe move in natural curves. Objects that move in straight lines do so only relative to observers at particular reference point, and this motion is only sustained by the continuous expenditure of accelerating force to maintain it. For instance, an object moving on the earth's surface follows a curved path; and it actually needs a force to constrain it along a straight path. This equally applies to bodies travelling through space. Therefore, in describing the behaviour of objects in our observable universe, linear motion seems to be an odd first postulate to begin with. Unfortunately, all observed motion is wrapped around this assertion today.

Since it is impossible to empirically demonstrate non-curvilinear motion that did not require a continuous input of energy, curvilinear motion about objects is the natural motion of things unless impressed continuously by a force to cause a straight-line motion.

Putting aside the fact that the premise for declaring gravity as a force is clearly flawed, in order to describe a force that behaves the way gravity does, several other observed physical laws have to be violated. Gravitational force, supposedly responsible for the pair of terrestrial and celestial effects, acts over astronomical distances continuously, millennia after millennia, without diminishing in strength or even depleting a known power source. This obvious inconsistency with the *Principle of Conservation of Energy* is often explained away with the claim that "work done is zero" when no distance is covered. But the work function (*work done* = *force* x *distance*) itself can only be reasonably applied when useful work is being done on an object. For instance, this function becomes useless for determining how much energy is being used up in pushing a heavy object that does not move. It cannot detect energy used up by a force when no distance is moved and cannot therefore account for the seemingly infinite gravitational energy expended in keeping objects held to the Earth's surface or in keeping bodies in orbits.

Gravity also appears to travel faster than light, thereby violating the speed-of-light limit. A quick 'thought experiment' easily demonstrates this: If the Sun were to suddenly vanish, its hold on planets (accounted for by the gravitational law, $F = Gm_1m_2/r^2$) disappears instantly. The Sun however, will still be observable on Earth for about eight more minutes thereafter. It has so far proved problematic to experimentally prove the validity of the inverse square law beyond doubts. There are suggestions for this law to be modified and even considerations of a fifth force of nature in order to explain observations[3+].

In arriving at the much revered *Law of Gravitation* for explaining bodies in orbit, Newton assumed the model of a small mass that is being swung around on a *string*, invoking the centripetal force $F = mv^2/r$ in the process. Obviously when swung faster, the tension in the string will increase as the speed of the mass increases, but the radius remains fixed. On the other hand, an orbiting body moves further out (the radius of the orbit increases) as it moves faster, so that the force of gravity actually decreases. The phenomenon of orbits is thus better described by a mass-on-a-*spring* (not string) model, though it may be inadequate.

A force that accelerates all objects equally irrespective of their masses (thus disregarding inertia) is somewhat unparalleled in our

experience of the universe. Gravitational force claims to do this. Further, while we are able to insulate against all other forces and fields (electricity, electromagnetic fields, etc.) it has been impossible to device a 'gravity shield' for the strange attractive-ever/repulsive-never gravity.

Though Newton's description of gravity provides no insight into *why* this mysterious force behaves as proposed (it only tries to model its behaviour), it has however been successful on several fronts in the advancement of science, most notably in space explorations. Questions are however being raised about why spacecrafts hurtling through the Solar System have been behaving so bizarrely. NASA has published unexpected pull back (towards the Sun) on Pioneers 10 & 11 and Ulysses spacecrafts, exceeding what is predicted by gravity[4]. Apollo landing missions were also reported to have encountered more gravity than previously expected 1/6th*g*, causing them to overshoot their landing site.

Rethinking

> *"The illiterates of the 21st century are not those who cannot read or write but those who cannot learn, relearn and unlearn." - Alvin Toffler.*
>
> *"We often stumble onto the truth but most of us brush ourselves off and pretend it did not happen!" - Winston Churchill.*
>
> *"Physics constitutes a logical system of thought which is in a state of evolution, whose basis cannot be distilled, as it were, from experience by an inductive method, but can only be arrived at by free invention. ... We must always be ready to change these notions - that is to say, the axiomatic basis of physics (Principles) - in order to do justice to perceived facts in the most perfect way logically"* - Einstein, Ideas and Opinions, 1954.

Gravity remains one of the most mysterious entities in our science (even though it is one of the most familiar experiences known to man) and its proclamation as a 'force' may be nothing more than a 'farce'.

In Newton's time, myths, magic mysticism, alchemy and the notion of perpetual-motion machines were rife; so it was not too difficult for the idea of a largely mystifying force to be incorporated into scientific thinking. Because of its compelling nature, the theory of gravity has become so established in our thinking that it is almost inconceivable to divorce it from our everyday experience of gravity; more so when there are no other viable theories to challenge it.

It is worth noting that the equation describing objects undergoing constant acceleration, $d = \frac{1}{2}at^2$, introduced by Galileo Galelei (1564-1642), as well as Kepler's planetary laws (1609), are only geometric in nature. They do not involve mass nor do they suggest that gravity is a force. It should therefore not be too surprising if it is discovered that the effect we call gravity follows purely from geometry.

One such description[5] assumes that atoms (and by extension, all bodies) are constantly expanding. As such, everything appears to be of the same size relatively (since observers are also expanding at the same rate). Objects near the earth's surface will rapidly approach (effectively fall towards) the expanding earth beneath because the Earth's expansion is larger due to its size. While this particular model (which does away with the concept of an attractive force) is yet to be tested in its entirety, it emphasises the point that an observed phenomenon can be explained in a variety of ways.

The Earth was once thought to be flat. In the days of the great astronomer Tyco Brahe, it was considered to be at the centre of the universe, until Kepler, Brahe's pupil, turned the theories upside down. A simple paradigm shift was able to remove previously inexplicable anomalies in the motions of celestial bodies! As long as the widespread notion that physics has essentially figured out the universe remains, we will continue to fail to follow our intuitive belief that our universe is not bizarre place and that there might be simpler models to explain natural phenomena.

From time to time, fresh scientific perspectives that surface6+ are vigorously dismissed by the heavily guarded, unified front of today's scientific community and science media. Most negative critiques of a new approach either produce counter arguments based on the same flawed theories that are being disputed or embark on personal attacks against its author. It is quite possible that a new viable theory may even abandon the current energy-based theories completely and be structured around an entirely new principle yet to be uncovered. Definitely, there is some virtue in being able to think out of the box!

Finally, it is empirically evident that in four hundred years of scientific history, all great discoverers (from Copernicus and Aquinas through Galileo, Newton, Mendel, Mendeleyev, to Einstein) were convinced of the existence of a *supreme mind* (God?) from which they sourced their inspiration. While not advocating for scientists to subscribe to religion, it may well be that only minds that have the mental openness to recognise an ultimate order (as well as the legislator) can ultimately catch a glimpse of universal laws.

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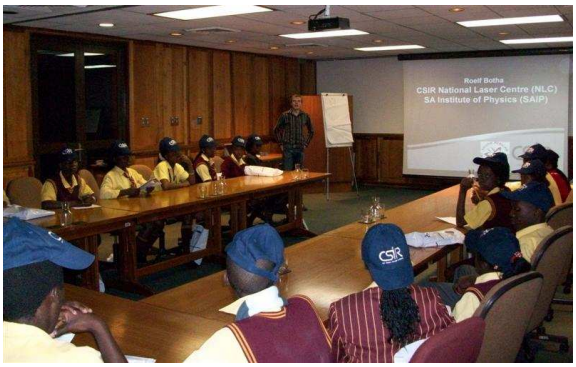
Putting SAIP in the public eye…

Roelf Botha

Outreach is a very important tool for the sciences to be perceived as understandable and accessible by the general public, especially secondary school learners. The same applies for the field of physics, especially since it is perceived by many to be 'that difficult subject' for 'the geniuses'. (These are the kind of statements made by secondary learners…).

The South African Institute of Physics realised that the Marketing of the Institute and Physics Outreach are important aspects to ensure a successful continued existence. Since the beginning of 2009 these aspects were actively pursued. Currently, the main focus is the secondary learners, especially grades 11 – 12. The goal is to realise that physical science is fundamental to all sciences and can also be an excellent career choice.



Learners attending a lecture at the CSIR's National Laser Centre boardroom

The motivation is given to them through the diversity of field types they can be employed in once they have a good background in physics: industry, wealth creation, medicine, energy, transport and education, to name but a few. We also make it clear that research is one of these options, but that not all physicists end up in a lab with messed-up gray hair, glasses and white overcoats.

So, how do we go about reaching secondary learners? We focus on three types of events: exhibitions and workshops at science shows, school visits to the CSIR and visits to schools. A **'Physics Pavilion'** is under development for use at all these events. This pavilion will include brochures and flyers, banners, posters and complimentary gifts/prizes. The most difficult part of outreach, especially at science shows, is to 'grab' learners' attention. Fortunately, due to the collaboration of SAIP Outreach with the CSIR National Laser Centre Outreach program, we have a very good tool i.e. *the laser*.

Presenting a miniature laser show has proven to be extremely effective in attracting learners. It is then relatively easy to engage with them: what can one do with lasers, how do they work, did you know we call that laser physics etc. etc? At this stage, it is then straight-forward to give the learners more information about physics. Examples of all the fields in SA physics are highlighted, with special focus on big and upcoming projects like MeerKAT. The learners find these sessions highly entertaining and informative and it definitely broadens their perception of physics and related fields.

The SAIP's Executive Officer, Brian Masara and the Marketing and Outreach Coordinator, Roelf Botha, at the annual SA PhD Conference 2009

SAIP has been involved in 8 events thus far during 2009:

1. **Science Unlimited:** Held annually at the Tshwane Events Centre. It is a Science, Education and Technology (SET) Education and awareness week, comprising of science shows, workshops, lectures, demonstrations and interactive exhibitions
2. **Scifest Africa:** An annual national science festival held in Grahamstown for the duration of one week. It consists of different programs running parallel: lectures, talkshops, exhibitions, workshops, fringe events etc.
3. **Visit to CSIR**: **Kutama High:** The goal was to spark imaginations within the SET field. 2 CSIR units were visited: the National Laser Centre and Defence, Peace, Safety and Security
4. **SA PhD Conference 2009**: To provide tertiary postgraduate learners with information on doctoral studies as well as opportunities available.
5. **University of Pretoria Open Day**: The goal of this open day is to facilitate potential students of the university in making career choices as well as gather information from various departments and stakeholders.
6. **Visit to CSIR: Litho Senior Secondary**. Learners (grade 8 – 10) from Litho Senior Secondary visited the CSIR National Laser Centre with the goal to spark imaginations within the various Science fields
7. **Visit to CSIR: Hlompanamg Senior Secondary**: As part of the *Take a Girl Child to Work* initiative, this school wanted to participate. Three units were visited: the National Laser Centre, Wind Tunnel, Knowledge Commons and Security
8. **Visit to Maragon Private, Roodepoort**: This was the first visit of 2009 to a Gauteng school and took the form of a presentation on light, lasers and the importance of physics, as well as an interactive workshop.

The overall figures and impact for these events are:

- Impact (persons reached): 3 240
- Specific Individual Contact: 210
- Weighted Impact (time in hours x number of persons): 2 636 person hours

Numerous events are planned for the remainder of 2009 and we hope to make a tangible impact on the number of tertiary learners choosing physics as a main subject.

Author Biography: Roelf Botha is the SAIP Outreach Coordinator and may be contacted at Roelf.Botha@saip.org.za

Techtrack

Energy saving designs must be a feature of current thinking

Kelvin Kemm

If one has studied some physics and has come to grips with the concept of energy then it is reasonably easy to understand how energy changes from one form to another.

One can also understand the concept of conservation of energy, or saving energy, or reducing energy consumption, and some of the other terms that appear in newspapers.

However, for people who do not understand energy at the physics level, it can be really confusing, particularly when one opens any number of popular magazines and reads about ideas like 'spiritual energy' or the 'healing energy' of polished stones, or 'cosmic energy' shaping your life. All this type of mumbo-jumbo energy is nothing but poetic illusion.

Nevertheless real genuine energy is still difficult to understand. Currently in the cricket matches, here in South Africa , the officials are using an infra-red device to see if the ball hit the bat. If the ball hits the bat then a white mark appears on the bat in the replay footage. But the replay footage is in black and white.

So many people have asked we why the pictures are not in colour. The point is that the so-called black and white is actually a thermal picture showing warm and cool. One could code the image pink and blue if you like, showing warm and cool. The point is that the picture is not actually a picture of the batsman as such, but is an image of the heat that the batsman, and his clothes and his bat are giving off.

When the ball hits the bat, even if it is only a small nick, there is a heat energy transfer into the bat from the kinetic motion of the ball. This heat generated in the bat shows up as a white spot for a while, until it cools again, because heat has been coded as white in the image. The third umpire can then 'see' the heat and so determine if there was bat and ball contact.

The whole country is in a frame of mind to save energy. This actually means save electricity, in the public mind.

Currently the 'save' campaign essentially means switch off any device using electricity, when it is not necessary to have it on, such as household lighting or water heating in geysers. It also means using lower energy light bulbs, and other similar moves. That is reasonable for private

houses but what happens about industry, which uses many more different types of electrical devices, such as furnaces, big electric motors, and such like.

In the case of industry it is often more difficult to save electricity because they cannot just switch some motor off. Also, industry frequently monitors its electricity consumption and so it is aware of how much is used, and may well have an energy saving plan in place that has been operating for years. Certainly industry can make many additional savings, by switching off and cutting down, but one can only go so far with such an approach.

For longer term savings there is a new mindset required, and that includes designing energy consumption functions right from the outset to be energy efficient. This challenge is leading to new innovative approaches, which is what one wants to see.

In the case of electric motors they run best, and most efficiently, when they are running at three quarters speed or higher. But many motors never operate this way and so are frequently inefficient. For example, in the case of lifts, a lift may be designed to carry say 15 people, so the designer has to design in a motor capable of lifting 15 people.

To be safe the designer designs in a motor capable of lifting 20 people, but mostly the lift operates with only half a dozen people and maybe only one or two. So the motor is mostly running at way under half its design capability. In this range it runs poorly, wasting electricity.

Something like driving your car around all day long but only in first gear.

A solution has been to use more than one motor on a lift. Even more cunning is that motors are now placed on top of the lift, and not at the top of the lift shaft. So if one wants to add an extra floor to the building, it is easy, you just move the lift cable hooks up one floor, you don't have to move a whole motor housing.

On top of the lift only one motor operates if there are only half a dozen people in the lift, and only when the load increase does the second motor kick in to assist. So far seven South African hospitals have installed this system, largely because hospitals are usually designed to be able to add extra floors at a later date.

It is this type of energy saving design that must become a feature of current and future thinking.

Techtrack appears each week in Engineering News (www.engineeringnews.co.za). It has been reprinted here by permission of K. Kemm. This Techtrack appeared in Engineering News, Vol 29 No 13, 10-16 April 2009).

Kelvin Kemm is a business consultant and can be emailed at stratek@pixie.co.za.

Physics 500

The Physics 500 Project aims to identify and track physicists in Industry.

The purposes of the project are:

- To identify industries in South Africa that employ physicists,
- To identify physicists working in South Africa,
- To use this information to promote physics,
- To promote collaboration between the SAIP and industry.

For more information, visit the project website at: http://www.saip.org.za/physics500/login.php

Jan Roodt, from Pretoria

Qualifications

In 1998, Ph.D., from Process Engineering at US, "The prediction of the emission spectra of solid rocket propellants"

In 1988, M.Sc., from Physics at UFS, "The bulk crystal growth of CMT"

Career

Started 2005 at CSIR in Defence, Peace, Safety and Security Unit as "Contracts R&D Manager"

Started 2001 at CSIR in Defence Electronics Programme as "Programme Manager"

Started 1999 at CSIR in Defence Electronics as "Manager Simulation for Acquisition Support"

Started 1995 at CSIR in Defence Electronics as "Manager Infrared Systems"

Started 1990 at CSIR in Electro Optics as "Infrared Measurement Specialist"

Started 1986 at CSIR in National Physics Research Laboratory as "Researcher – Semi-conductor crystal growth"

Survey

Why did you originally choose to study physics at university?

I liked physics and maths at school and wanted to become a "rocket scientist"

Did you enjoy your university physics? What inspired you about physics?

Yes, it was exciting and stretching, I loved the analysis and modelling part of it, building models to describe physical phenomena, understanding how the universe "worked". I realized we only know a bit, but that bit makes our world a better place.

What did you do after graduating from university with your highest physics degree?

I joined the CSIR as a researcher in the materials group.

What made you choose a career in industry rather than a career in academia?

I felt that I needed to engage with real world problems and solve problems in an applied manner, rather than write papers on topics or a research field alone. I also felt that I was not a real academic at the time (a professor).

When did your industrial career really take off?

In 1995 I started work on a really difficult problem in the military domain that I could see would lead to an innovative product if we could solve the physics and chemistry. I started to work across disciplines.

If you consider yourself no longer a physicist, what made you give up physics to pursue your career?

I am still a physicist at heart, I use the same thinking skills, the same approaches, but my current job expects me to also solve business and people problems. My understanding of systems of systems – a core concept of modern physics – is my competitive advantage. Knowing what to ask and how to ask he important questions – that is a rare skill. Physicists develop that skill at university.

Is there a particular contribution in industry that you are especially proud of and that you attribute to your training in physics?

My PhD work is still an important milestone/departure point for work in the development of new propellants, and I have established a firm modelling and simulation baseline using my background in physics that is earning CSIR substantial income.

How does your physics training help with your career?

The analysis and synthesis approaches and my ability to see the big picture, how things fit together, are valuable life skills. I am a systems thinker because of my physics training.

What advice do you have for physics students thinking of embarking on a similar career?

Do physics and link it with applied maths/numerical methods/computer science and then try and get a first position that will help you work with several disciplines? Work on real-world problems, but also try and keep your links to academia. You want to know what the current theoretical issues are. Read some philosophy texts. Physics, and the research we embark on, is really at the core of the big questions of our time.

What advice would you give to university departments to make their physics teaching and research programmes more useful for industry?

Focus on supporting skills that could help the students think holistically. Consider those subjects in thermodynamics that link to dynamic systems theory, to emergence and chaos, as important aspects at the graduate level. The important questions in industry now relate to the systems-of-systems level, "optimisation" and linking diverse disciplines into good solutions.

What are your perceptions about the importance of physics in present-day society?

As it is with maths, physics is very important. There is no doubt that several fields of physics are now templates for research into human behaviour etc. Above all, physics is about understanding the world we live in, describing it and working with these concepts to make it a better and safer place for all. It is a "universal" discipline. It has all the philosophical bits that make it go beyond just another subject. And above all, it is fun.

TWAS Conference and Book on SA Science

Harm Moraal

The Academy of Science of South Africa (ASSAf) will be hosting the prestigious international Conference of the Academy of Science for the Developing World (TWAS) at the Durban International Convention Centre from 19 to 23 October 2009. The conference will be attended by approximately 400 TWAS fellows, all notable scientists and scholars from the developing world, and will include a number of Nobel laureates.

ASSAf plans to publish a book entitled 'The State of Science in South Africa' and to distribute it during this conference. It is aimed at profiling South African science by focusing on the cutting-edge research that has been accomplished in various disciplinary fields. The book will cover

these fields in 11 chapters, one of which will be on Physics/Astronomy/Space Science.

Each chapter is to be written by a South African scholar and will be peer-reviewed by a panel of experts. It is anticipated that this book will make a noteworthy contribution to the science system in South Africa and that it will form an authoritative text for many years to come. The project is supported and funded by the NRF.

Initially one thousand copies of the book will be printed and disseminated to conference participants, members of the Academy, as well as key national and international stakeholders. Additional print runs are possible if funds become available.

Prof H Moraal has been asked to coordinate/write the 7- to 10-page chapter on Physics/Astronomy/Space Science, and he conducts this task under the auspices of the SAIP as "The Voice of Physics in South Africa", and with contributions from the following SAIP

Specialist Group Chairs:

1. Applied Physics – Prof.T Derry
2. Astrophysics and Space Science – Dr. RR Sefako
3. Condensed Matter and Materials Science – Prof. DT Britton
4. Education – Dr.G Arendse
5. Optics, Lasers and Spectroscopy – Dr. AW Forbes
6. Nuclear, Particle and Radiation Physics – Dr. SM Mullins
7. Theoretical Physics – Prof. HB Geyer

The introduction and summary will highlight the key role of Physics in the sciences and in a scientific/technological society, it will make reference to the 2004 exercise on the "Status and Future of Physics in South Africa", and it ill also assess its outcomes.

This communication is an encouragement for other contributions. The focus should be on national, multi-institutional initiatives and projects, and less on institutional ones. The latter are covered in a parallel, ongoing, project on the (recent) history of Physics in SA. In the spirit of the conference, the emphasis should be on Physics for development.

We eagerly welcome input or suggestions to harm.moraal@nwu.ac.za before 30 June 2009.

Obituary: Wynand Louw Mouton

26 December 1928 – 21 June 2008

Du Toit Mouton

Wynand Mouton received the B.Sc. and M.Sc. degrees (both cum laude) from the University of the Orange Free State in 1948 and 1950, respectively. In 1951 he was appointed as a lecturer in Physics at the University of Natal. He received a Ph.D. in Nuclear Physics from the University of Utrecht in 1962. From 1961 till 1964 he was a senior research officer and assistant director of Nuclear Physics at the University of the Witwatersrand. In 1965 he was appointed as professor of Nuclear Physics at the University of Stellenbosch. In 1972 he became Dean of Science and served as the first vice-rector of the University of Stellenbosch from 1975 to 1976. He was appointed as rector of the University of the Orange Free State in 1976 and held this position until his retirement in 1988.

He was one of the founding members of the South African Institute of Physics and was president of the institute from 1973 to 1975. He served on the boards of a number of organizations and companies, including Volkskas Bank, Armscor, Bloemboard and the South African Council for Education. He was chairman of the board of the SABC from 1980 until 1985 and chairman of the board of the University of the Western Cape from 1976 to 1979. In February 1987 he received the Order for Meritorious Service (Class I Gold) from the state president. He published a number of local and international papers in the area of Nuclear Physics and supervised 12 M.Sc. and 10 Ph.D. students.

He passed away on the 21st of July 2008, less than two months after his beloved wife, Daleen. He is survived by a daughter, two sons and three granddaughters.

Obituary: George Jacob Ritter

18 May 1930 – 5 June 2009

Gorra Heymann

Edward Teller told a South African journalist "I am the father of two children, not of the Hydrogen Bomb!" In that sense George Ritter was the father of four children and not of Optics and Optical Physics in South Africa.

George was born in the Caledon district, but educated mostly in Stellenbosch. He matriculated at the Paul Roos Gymnasium and received his BSc *cum laude* in 1950, and MSc *cum laude* in 1952 from the University of Stellenbosch. As a Rhodes Scholar, working in the Clarendon Laboratory, he obtained a DPhil from Oxford University.

He started his career as lecturer in Physics at the University of Stellenbosch in 1956. After two years he moved to the National Research Council in Ottawa, Canada as a post-doctoral fellow, and worked there for four years as Research Fellow in Dr G Hertzberg's Spectroscopy Laboratory. In 1964 he joined the Optics Division of the National Physics Research Laboratory (NPRL) as Chief Research Officer, from where he advanced, with metronomic regularity, through the ranks to Head of the Division. It was during this period that he, with great endeavour and enthusiasm, applied his knowledge and energy to the establishment of a vital infrastructure for research and development in Optics, and to initiate an optics industry in South Africa. In 1983 he became Assistant Director of the General Physics Group of the NPRL, often acting on behalf of the Director. After the reorganisation of the CSIR in 1989, he was appointed Deputy Director of the Production Technology Division and remained there until he retired.

He became a member of the SAIP in 1957, serving on Council for two terms as Honorary Treasurer. He also acted as Chairman of the Optics and Spectroscopy, as well as the Applied Physics Subgroups of the Institute. He was a Founder Member of the SA Optical Society and an Assessor Member of the SA Akademie vir Wetenskap en Kuns. In 1984 the SA Acoustics Institute rewarded him for exceptional services, and in 1986 the SA Optical Society awarded him the Labotec Prize for Optics.

His many friends and colleagues in and outside the CSIR will fondly remember "dag kollega" George Ritter.

African Journal of Physics

Abebe Kebede (NC A&T State University)

Recently work began on the *African Journal of Physics.* The first issue is out for the purpose of securing an ISNN number from the Library of Congress. The journal was introduced during the *Physics in Africa* session in 2009, in Pittsburgh PA. The African Physical Society and the African Scientific Network will publish the journal jointly.

Call for participation

You are invited to submit full papers (PDF and MS word formats accepted). For more information, visit: http://sirius-c.ncat.edu/asn/afps/

Square Kilometre Array: MSc and PhD Bursaries

The South African Square Kilometre Array Project is calling for applications for postgraduate bursaries for 2010. Visit

http://www.ska.ac.za/studentsupport/mscphd.shtml

for more information and to download the necessary application forms.

South African Physics Graduates Database

One of the main objectives of SAIP is to respond timeously to challenges facing the physics community in South Africa. One such challenge is that "There is a critical skills shortage in physics". However, there is no single body of information tracking the statistics on the extent of the skills shortage in physics. These statistics are required by SAIP in order to effectively:

1. Liase with government and to make an input to relevant legislation and decision-making affecting physics.
2. Advise the NRF and other funding agents on matters related to physics funding required for training more physicists.

Benefits of registering and updating your details:

1. Opportunities for Further Post Graduate Study
2. Consultancy Opportunities
3. Employment Opportunities

Confidentiality

Information on the database will be treated confidentially at all times and will be made available only to selected people. For example, you may choose whether you want your details available for further study, consultancy and employment opportunities.

Registration

To register your personal details please visit http://www.saip.org.za/graduates

Winter Schools

SAIP "Southern Skies" Astronomy Winter School

University of KwaZulu-Natal, 6 July 2009

In celebration of the International Year of Astronomy, an astronomy winter school titled "Southern Skies" will be held on 6 July 2009 at the University of KwaZulu-Natal, prior to the South African Institute of Physics Annual Conference (7-10 July 2009).

Confirmed speakers and topics include:

1. "Lifecycles of quasars and microquasars" - Prof Katherine Blundell, Oxford University

2. "HI in nearby galaxies" - Prof Erwin de Blok, University of Cape Town

3. "Extrasolar planets" - Dr John Menzies, South African Astronomical Observatory

4. "The rotational evolution of cool stars" - Dr Sydney Barnes, Lowell Observatory

5. "Interferometery and the cosmic microwave background" – Dr Jonathan Sievers, Canadian Institute for Theoretical Astrophysics

Further information on the "Southern Skies" winter school is available at

http://www.acru.ukzn.acza/saip/index.php

Parallel Computing Workshop with Applications in Astrophysics and Quantum Information

University of KwaZulu-Natal, 13-17 July 2009

A Parallel Computing Workshop (with Applications in Astrophysics and Quantum Information) will be held at the University of KwaZulu-Natal (UKZN) from 13-17 July 2009 and presented by dynamic lecturers Dr Jon Sievers and Dr Jonathan Dursi from the Canadian Institute of Theoretical Astrophysics and Dr Mervlyn Moodley from UKZN. The workshop is organised by the Astrophysics & Cosmology Research Unit at UKZN and the Centre for Quantum Technology at UKZN supported by the Flagship Programme of the national Centre for High Performance Computing in South Africa.

The aim of the workshop is to train postgraduate students in the methods of high performance computing (HPC), specifically how to tackle their research problems using parallel computing tools. The workshop will run over five days with lectures on parallel computing in the morning, including topics on OpenMP and MPI, and hands-on tutorials in the afternoon. The workshop has a very hands-on component and the lecturers will work closely with the participants. There will also be a feedback session at the end of each day.

There is no registration fee and the workshop organisers will cover all accommodation and meal costs. Participants will have to cover their travel costs to the workshop (including air tickets if you are travelling from outside KwaZulu-Natal).

Honours, masters or doctoral students, who have basic programming skills, and are interested in parallel computing, are eligible to participate in the workshop. Other interested parties can write to us to be considered.

Important: There are a limited number of spaces for the workshop so please **register immediately** if you are interested in attending. This will also give you time to book your flights if you are travelling from outside KwaZulu-Natal. You can register for the workshop (and find out more about the workshop) on the website: http://www.acru.ukzn.ac.za/hpc/index.php

Have your Thesis Abstract published in Physics Comment

In an attempt to highlight current Physics research in South Africa, Physics Comment will publish short abstracts (500 words) of Masters and Doctoral theses in Physics. Please submit abstracts to PhysicsComment@saip.org.za with the subject: *Thesis Abstract*.

Favourite Physics Websites

Share the URLs of your favourite Physics related websites. Please submit URLS to PhysicsComment@saip.org.za with the subject: *My Favourite Physics Websites*.

Physics Comment Editorial Policy

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:

1. 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).
2. The author allows PC to edit the work for clarity, presentation, including making appropriate hypermedia links within the work.
3. 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.
4. Authors should respect intellectual integrity by accrediting the author of any published work which is being quoted.

2009 Publication Deadlines

Physics Comment is published four times a year.

Issue	Closing Date	Publication Date
Issue 1	27 February 2009	16 March 2009
Issue 2	29 May 2009	15 June 2009
Issue 3	28 August 2009	14 September 2009
Issue 4	27 November 2009	14 December 2009

Specification and Submission of Content

1. 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.
2. Article types. The magazine is devoted to articles, reports, interesting facts, announcements and recent developments in several areas related to physics:
3. 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.
4. Re-use. The publisher reserves the right to reuse the printed piece in full or in part in other publications.
5. 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.
6. Style. AP style is followed for punctuation, capitalization, italics and quotations.
7. 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 its credibility could be enhanced by publishing a 40 word resume of the author. 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.