SOUTH AFRICAN INSTITUTE OF PHYSICS

THE STRATEGIC PLAN ON THE ENHANCEMENT OF PHYSICS TRAINING IN SOUTH AFRICA

DECEMBER 2015

EXECUTIVE SUMMARY

As part of the collaborative endeavour involving social partners, the revitalization of the Physics discipline requires concerted efforts aimed at meaningful enhancement of undergraduate physics education within the broader South African context. Meaningful enhancement of undergraduate physics education ought to be largely informed by policy imperatives such as the National Development Plan-Vision 2030, the Department of Higher Education and Training White Paper on Post School Education and Training as well as the Mathematics, Science and Technology Strategy promulgated by the Department of Science and Technology. In terms of its over-arching strategic goal, the South African Institute of Physics Strategic Plan on the Enhancement of Physics Training in South Africa seeks to create sustainable opportunities for the maximization of the transformational impact of its inherent innovative interventions. Enhanced coordination of innovative interventions forming an integral part of this strategic plan would, in essence, be central to the fundamental development and shaping of the science and technology landscape in its broadest sense.

The implementation of this strategic plan is essentially viewed by the South African Institute of Physics as a critical basis for far-reaching reforms with profound ramifications for socio-economic development in South Africa. When pursued with renewed vigour, it is sincerely hoped that the practical benefits that accrue from this bold undertaking would serve to give practical expression to the aspirations of the broader physics community with a view to building sustainable communities of practice. Mindful of constantly changing local and global conditions, this is certainly an opportune moment for this process to unfold.

Key strategic goals that underpin meaningful implementation of the strategic plan include:

- Improvement of physics core skills at undergraduate level
- Meaningful curriculum reform
- Adoption of the Draft Benchmark Statement Establishment of a national Physics teaching and learning platform
- Improving the quality and skills of Physics teachers in South Africa
- Improvement of undergraduate Physics instruction at institutions of higher learning
- Attracting and keeping students in physics
- Promotion of the role of Physics in industry and commerce

The implementation of the strategic plan would be undertaken by the South African Institute of Physics in partnership with Physics departments at various institutions of higher learning in South Africa. Practical benefits that accrue from the implementation of the strategic plan would serve to reinvigorate the overall health of the Physics discipline.

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1. INTRODUCTION

It is now recognised by Physics Departments across South Africa, and by the Department of Science and Technology (DST), that there is a continuing crisis within undergraduate training of physics majors in South Africa. While reasonable numbers of graduates are, in many cases, being produced, both the quality of understanding of physics, and competence in the subject, has fallen among BSc graduates across universities [reference to Review].

In South Africa, we host the major portion of the world's largest science experiment, the Square Kilometre Array (SKA). To sustain the prevailing excellence of research in South Africa, we need a constant flow of physicists who are well prepared to specialise not only in diverse aspects of the SKA, but also across research, innovation, and academia (figure 1). These are the people who will be working with the best scientists in the world, and should be excellent enough to be included among their number.

However, the current model is not sustainable, because we do not have the capacity to ensure that good physicists will continue to be fostered. This report contains a strategy and implementation plan arising from a Review of Undergraduate Physics Education in Public Higher Education Institutions in South Africa. The background is provided below, and refers to the preceding successful initiatives jointly undertaken across the physics community (universities, research councils and industries) to identify, and overcome, obstacles to success. The background section is followed by an analysis identifying strengths, weaknesses, opportunities and threats. A Workshop of representatives of all Physics Departments (in most cases, Heads of Departments) has been held, and the Action Plan that follows was formulated from the building blocks based on the Review and put in place at this two-day event.

The Physics Community displays a remarkable ability to act based on common concerns worked out by consensus. SAIP, as the Voice of Physics in South Africa, has been able to facilitate the conversation and catalyse interactions. Support for requesting the assistance of Department of Science and Technology (DST), Department of Higher Education and Training (DHET), Department of Basic Education (DBE), and University decision-makers in addressing the core components of the plan is presented here. We can project that in twenty years, we will be able to look back at this point as a watershed from which we were either unable to sustain the physics researchers in upholding the science aims and ambitions of the country, or we were able to take joint action.

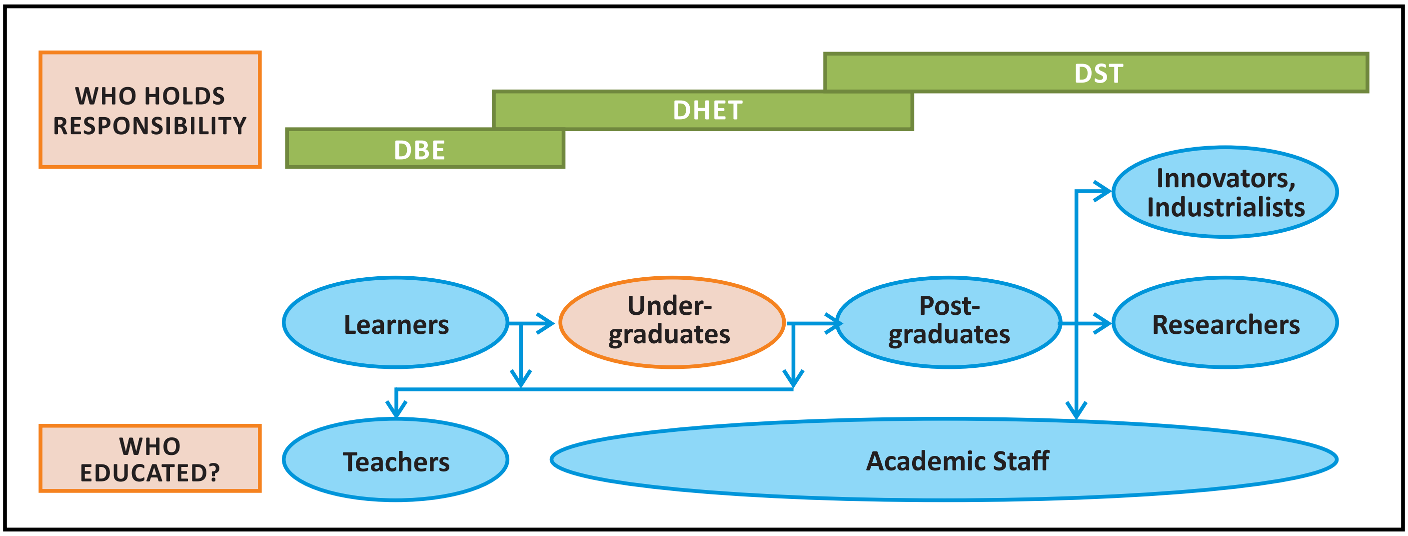

Figure 1 : A representation of the pipeline

Focus is on undergraduates (in gold) to supply the needs at post-graduate and researcher level; but the capabilities of school learners are vital input to the undergraduate stream. While the relationships of teachers and academic staff to the pipeline are indicated, it is noted that academic staff may also be researchers or post-graduates.

2. BACKGROUND

The Review of Undergraduate Physics training in South Africa arose from the need to address the fundamental concerns expressed by Heads of Physics Departments about the state of undergraduate teaching and learning in South Africa during meetings held in 2008 and 2009. It was felt at the time that the state of undergraduate Physics teaching and learning in South Africa constituted a state of crisis that needed to be confronted with utmost urgency. Faced with this imperative, the South African Institute of Physics (SAIP) duly responded by undertaking a Review of Undergraduate Physics Education Project in partnership with the Council on Higher Education (CHE). This project resonated with the recommendations emanating from Shaping the Future of Physics in South Africa Report.

The project has gone through three stages thus far in terms of its chronological evolution. The first stage involved the development of a Draft Benchmark Statement on BSc Physics and BSc Hons Physics training in South Africa. This was followed by an extensive process that made provision for physics departments to undertake a self-evaluation exercise culminating in the National Report on Undergraduate Physics Education in Public Higher Education Institutions in South Africa.

The National Report recommended (Recommendations 1 & 10) that SAIP should execute the planning and coordination of the implementation strategies that seek to enhance the undergraduate physics education by virtue of its constitutional mandate as the custodian of the physics discipline. The report further recommended that the SAIP ought to organise a strategic planning conference to craft a strategy that would serve to enhance student success in undergraduate physics education. The strategy encapsulated in this document was crafted as the outcome of the National Strategic Planning Meeting that involved all universities in South Africa.

3. OVERALL GOAL

The overall goal of this strategy is to strengthen the Physics Educational Pipeline with a view to contribute to socio-economic and technological development of South Africa.

4. MOTIVATION

It is recognized worldwide that physics is a basic science, vitally important to the development of mankind through broadening our understanding of the world we live in and indeed the universe. In particular, physics often acts as a lead science. For instance, a 2013 IOP1 report indicated that the *"Physics-based businesses contribute 8.5% of the UK's economic output and employ more than a million people and the sectors that will power the UK's economy in the future, from agri-tech to business services to offshore wind power, are built on the innovative application of physics and the skills of physics-trained people".*

Physics also plays the role of the canary in the mine in the sense that if Physics gets seriously ill, it is a warning that science and technology as a whole, and hence the growth of a knowledge-based economy, are in grave danger. Figure 1 below summarises some of the key science and technology fields whose success depends on coherently well-crafted physics education strategy and the pipeline being nurtured

* IOP Report on The Importance of Physics for Economic Growth – available at
https://www.iop.org/publications/iop/2013/file_60318.pdf

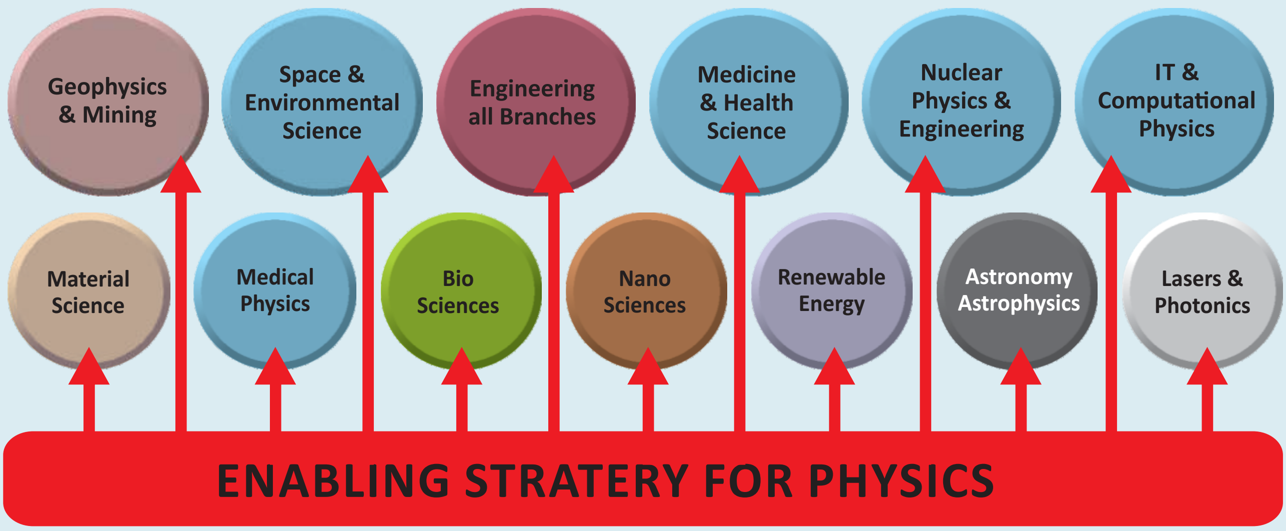

Figure 2 : Enabling Physics strategy underpinning science and technology

4.1 Human capital to support key government strategies

This strategy will ensure that South Africa produces physics graduates benchmarked at an internationally competitive level. The acquisition of the required physics skills is commensurate with key government initiatives such as the National Development Plan (NDP) and the pursuit of the Strategic Integrated Projects (SIPs). More specifically, the following SIPs require a great deal of physicists: the Square Kilometre Array & MeerKAT, Green Energy and Electricity Generation.

4.2 Transforming South Africa towards a knowledge-based economy

As already mentioned above, the physics research and development of today will become the cutting edge-technologies of tomorrow. For example, the current robust growth in innovation in areas such as nanotechnology, biotechnology, advanced materials, micro-electronics, advanced medical diagnostic technologies, among others, can be ascribed to earlier investments in physics research, education and training. Hence these strategies will serve as a guarantee for a future knowledge-based economy for the country.

4.3 The need to increase PhDs five fold

The Department of Science and Technology's Ten Year Innovation Plan states that the level of economic growth envisaged by our country requires continual advances in technological innovation and the production of new knowledge. According to the Ten Year Innovation Plan, South Africa's PhD production in Science, Engineering and Technology must increase five-fold. However, closer scrutiny reveals that the weakest link in the educational pipeline occurs at the transition from BSc level to Honours. Consequently, some of the honours graduates do not possess appropriate skills required to undertake post-graduate studies. This strategy would serve to address this critical challenge in order to improve PhD throughput.

4.4 The need for more inclusivity in the SET sector

In broad terms, the strategy aims to address the inherently skewed demographic picture as a characteristic feature associated with the SET sector. It is a known fact that there is acute shortage of young black South Africans and women taking physics at honours level leading to low enrolment figures at postgraduate level and beyond. The problem also manifests itself in the form of unsustainable utilisation of available bursaries provided by funding agencies earmarked for South African nationals. In addition, the Green Paper on Post-School Education and Training advocates that "... blacks and women students continue to be under-represented in science, engineering and technology".

5. THE DRAFT BENCHMARK STATEMENT

The first phase of the project took the form of the development of a 'Draft Benchmark Statement for Physics' that, along with the BSc Qualification Registration Statement, represents the minimum standards for undergraduate training in Physics. The Draft Benchmark Statement for Physics in South Africa was promulgated in 2011. It characterizes the skills and achievements that physics graduates should develop and includes a core curriculum (approximately 50%) for undergraduate physics.

The statement articulates that students in physics should learn:

- How to formulate and tackle problems in physics. For example, they should learn how to identify the appropriate physical principles, how to use special and limiting cases and order-of-magnitude estimates to guide their thinking about a problem and how to present the solution, making their assumptions and approximations explicit;
- How to use mathematics to describe the physical world. They should have an understanding of mathematical modelling and of the role of approximation;
- How to plan, execute and report the results of an experiment or investigation. They should be able to use appropriate methods to analyse their data and to evaluate the level of its uncertainty. They should also be able to relate any conclusions they make to current theories of the physics involved;
- How to compare critically the results of model calculations with those from experiment and observation.

The Draft Benchmark Statement further suggests that a physics degree should enhance the following type of skills:

- ***Problem solving skills -*** physics degree programmes involve students in solving problems with well-defined solutions. They will also gain experience in tackling open ended problems. Students should develop their ability to formulate problems in precise terms and to identify key issues. They should develop the confidence to try different approaches in order to make progress on challenging problems.
- ***Investigative skills -*** students will have opportunities to develop their skills of independent investigation. Students will generally have experience of using textbooks, and other available literature, of searching databases and the Internet, and of interacting with colleagues to derive important information.
- ***Communication skills -*** physics and the mathematics used in physics deal with unexpected ideas and difficult concepts; good communication is essential. A physics degree should develop a student's ability to listen carefully, to read demanding texts, and to present complex information in a clear and concise manner.
- ***Analytical skills -*** physics helps students learn the need to pay attention to detail and to develop their ability to manipulate precise and intricate ideas, to construct logical and reasoned arguments and to use technical language correctly.
- ***Information and Communication Technology (ICT) skills -*** during their studies, students will develop their computing and ICT skills in a variety of ways, including their ability to use appropriate software such as programming languages and analysis packages.

6. RECOMMENDATIONS EMANATING FROM THE NATIONAL REVIEW OF UNDERGRADUATE PHYSICS EDUCATION

A summarised list of recommendations emanating from the national review of undergraduate physics education is provided below.

RECOMMENDATION 1 :

The SAIP should continue to coordinate the implementation of ways to enhance the undergraduate physics education.
The implementation of envisaged innovative interventions as stipulated in this strategic plan would be central to the enhancement of undergraduate physics education within the broader South African context.

RECOMMENDATION 2 :

A four-year Physics undergraduate programme should be adopted.
Coordinated efforts in this regard would hinge on the formal response of DHET to the proposed four year flexible curriculum.

RECOMMENDATION 3 :

The utilization and production of research on the teaching of Physics must become a key priority for Departments.
It is particularly important that Physics instruction should be underpinned by research-based instructional strategies and relevant philosophical assumptions in order to ensure pedagogic innovation.

RECOMMENDATION 4 :

More appropriate and rigorous techniques of monitoring and evaluating Physics teaching should be employed.
There is strong evidence that even experienced teachers can benefit from constructive peer coaching which should for all intents and purposes be encouraged.

RECOMMENDATION 5 :

The issue of student work ethic needs to be better understood.
While all departments raised the issue of unsatisfactory student work ethic, one must recognize that the issue is a complex one. Research shows that the problem can be attributed to the complexity of meta-learning and meta-cognition.

RECOMMENDATION 6 :

It is imperative that Physics Departments play a more active role in teacher training.
Few Physics Departments are actively involved in teacher professional development and departments are urged to put turn-around strategies in place to address this imperative. In particular, it is imperative that all prospective Further Education and Training (FET) physical science teachers should enrol for BSc with Physics and Chemistry as majors followed by a Postgraduate Certificate in education with didactic in Physical Science. The training in this regard should be provided by physics education specialists situated in physics departments.

RECOMMENDATION 7 :

Support is needed for initiatives aimed at encouraging and supporting women in the Physics community.
Given the need to significantly increase the number of students in physics by retaining more women, the existing activities of the WIPISA (Women in Physics in South Africa) forum should be strongly supported. Findings from substantial research carried out elsewhere could be utilised for the realisation of envisaged outcomes in this regard.

RECOMMENDATION 8 :

Physics communities of practice should be encouraged at regional level.
The regional meetings undertaken during the review process were profoundly valuable. Participants emphasized, for example, the benefits of the opportunity to exchange information and to learn from each other's experiences. We would encourage regional groupings of physicists to share ideas with a view to encourage the pursuit of Physics education research on a larger scale.

RECOMMENDATION 9 :

The experiences of graduate students should be more closely tracked.
Departments should make every effort to set clear goals for incoming students and keep track of graduates after graduation in order to ascertain if the set goals have been achieved. Motivation for tracking graduates is even wider than just assessing their skills sets as the tracking process would also provide valuable department-specific or national information for future students in terms of physics related job opportunities.

RECOMMENDATION 10 :

Taking this undergraduate Physics review into account, the SAIP should formulate an action plan to move to the next stage.
Final recommendation follows first recommendation, namely that the SAIP should continue to coordinate the implementation of ways to enhance undergraduate physics education.

7. SWOT ANALYSIS

This section summarises the strengths, weaknesses, opportunities and threats for undergraduate physics training in South Africa as discussed on various platforms such as meetings of Heads of Department, regional meetings, departmental visits, and the national strategic planning meeting.

7.1 Strengths

The existence of the following strengths has been observed.

- South Africa has a proactive physics community that is willing to collaborate in solving the challenges it faces. The community pioneered the basic science discipline review in 1994 termed Shaping the Future of Physics in South Africa, after which other science disciplines followed suit. Faced with the imperative to improve university undergraduate training, the physics community partnered with CHE to implement the First Discipline Specific Teaching and Learning Review which was essentially unique in many ways. CHE never undertook a discipline review as its mandate is primarily premised on programme reviews (complete qualification).
- Sufficient consensus on the Benchmark statement was obtained in 2011. The statement would assist in setting minimum standards for BSc & Honours physics training, levelling the playing field and facilitating student mobility across universities.
- Physics departments are willing to collaborate in sharing skills and teaching materials.
- There are pockets of excellence in physics education research within South Africa; these can lead to the expansion of physics education research within the country.
- South African Physics community enjoys strong cordial collaborations with the international community through which best practices, benchmarking and technical support in physics education can be derived.
- Physics teacher development initiative by SAIP and IOP presents an ideal opportunity for the physics community to intensify efforts to actively improve the skills of entering students.
- As a registered professional body, SAIP can be utilised as a key vehicle by the community to pursue a vision geared towards the improvement of physics education within the broader South African context
- Departments have adopted some innovative ways of teaching to deal with poor quality of entering students and this pedagogic innovation is laudable in the main.
- The Physics community appears to have been largely successful at maintaining the quality of teaching despite desperate issues surrounding student under-preparedness faced by departments over the years.

7.2 Weaknesses

The following weaknesses were observed within the undergraduate physics education system.

- Low student pass rates
- Poor Student work ethic coupled with poor learning skills, poorly prepared students may simply regurgitate information without developing the much needed capacity to operate at various cognitive levels.
- Some graduating students lack essential skills required by the job market thus stifling their capacity to undertake post-graduate studies.
- There is low enrolment of black South African nationals studying physics honours level and beyond with the pipeline characterised by an inherent weakest transitional link.
- Undergraduate students are not staying in physics, most students are using it as a stepping stone to other professional degrees such as engineering and medicine
- Physics education research is not afforded the recognition it deserves by the physics community.
- Most departments felt that physics education research is not given the same importance/weight by HoDs as other areas of physics research hence a mind set change is imperative in this regard.
- Most MSc and PhD students in physics education are registered under the Education department not Physics Department at various institutions in South Africa.
- Few physics departments are actively involved in physics education research and publishing papers in this domain.
- It was observed that most lecturers undertake physics education research as a secondary priority and not as part of their main area of research.
- There are short term uncoordinated efforts within the community that attempt to improve undergraduate physics education.
- Most departments expressed concerns in relation to high workloads and large undergraduate physics classes.
- All universities indicated that their staff were overloaded because departments have to teach large classes in line with DHET instructions to increase students intake
- There is a prevailing high student lecturer ratio; some as high as 1:250 at first year
- Departments do not have adequate budgets to recruit additional staff
- Inadequate Laboratory Facilities - Intrinsically linked to problem of high workloads and large classes, some departments bemoaned lack of adequate laboratory facilities. For example, there will be 5 – 10 students per practical work station. There is a crucial need for a laboratory facilities audit to be undertaken with a view to provide recommendations to university administrations for consolidated action.
- Most departments do not have adequate funding for:

- Recruitment of additional staff
- Funding the extended and bridging programmes
- Equipping and expansion of laboratories
- Partnerships between industry and the physics community are not well established.
- Limited mutual interaction between physics departments for purposes of training physics teachers.
- Lack of tracking mechanisms for graduates linked to marketing of the discipline in terms of available job opportunities.

7.3 Threats

Some of the identified threats that plague physics education in South Africa are listed below.

- The poor quality of the school system which gives rise to poor quality of entering undergraduates. Entering students lack the following skills:
  - Mathematical skills
  - Problem solving skills
  - Communication and writing skills
  - Computer and IT skills, and
  - Physics related scientific skills
- Lack of appreciation of physics by South African Industry. There is low level participation of the local industry in physics; industry advertised jobs that mention a physics qualification as a key requirement are a rarity.
- Lack of physics jobs for graduates with only an undergraduate physics degree. Most physics related jobs require MSc and a higher qualification.
- Poor skills of physical science teachers. The state of affairs is compounded by the fact that some teachers who teach physical science did not receive physics training at university.
- Lack of appropriate training of physical science teachers at university.
  - In most universities physical science teachers are trained in the Education Faculty without adequate exposure to practical work thus adversely affecting the quality of their training.
  - A few universities indicated that physical science teachers do physics up to 3rd year in the physics department.
- Undergraduate students choose physics as a last study option upon failure to gain admission into fields such as Engineering, IT, medicine and accounting.
- Physics and Chemistry are not taught as separate entities in South Africa as is the case in other countries.
- Physics is perceived to be the most difficult subject by teachers and learners alike.
- There is a prevailing poor public awareness of available physics related career opportunities.
- Undue pressure put on departments by university administrations to produce anticipated numbers of graduates as in the humanities at the expense of quality for the sake of government subsidy is unsustainable. This phenomenon is also not consistent with global trends in terms of the production of physics graduates as compared to humanities graduates.

7.4 Opportunities

Existing opportunities to improve undergraduate physics education are provided below.

- Physics is a basic science is a key requirement for many SET disciplines.
- A large pool of young black South Africans and girls can be persuaded to study physics leading to long term physics careers.
- Identification of excellent physics teachers.
- Encouraging teachers to attend SAIP conferences.
- Encouraging teachers to become SAIP members.
- Facilitating the establishment of the South African Association of Physics Teachers.
- Universities should nurture talented learners identified through the SAPho initiative.
- Physics skills are vital for key projects such as the SKA, Big Data, Nanotech NDP, SIPs, so as to increase PhDs five-fold.
- The physics community enjoys cordial relationship with the Department of Science and Technology and practical benefits that accrue from this relationship would certainly serve physics as a discipline well.
- Establishing collaborations with local industries in a bid to strengthen support in terms of role physics can meaningfully play in industrial development.
- Work in collaboration with industry to design physics degree programmes that meet the needs of local industry.
- Support and create linkages with the DST proposed Basic Sciences Framework
- Introduction of a proposed 4 year degree programme by DHET.
- Working with the Department of Basic Education (DBE) to improve skills of physical science teachers already in the field and the quality of physics at school level.
- Partnering with SAASTA in publicising physics careers both at School and at university level.
- Partnerships with science centres with a view to expand the physics teacher development project.
- International collaborations, benchmarking and technical support on physics teaching and training.
- Leveraging significant funding support for postdoctoral fellows from countries such as USA and UK.

8. STRATEGIC GOALS

The following strategic goals were identified as key pillars through which weaknesses and threats can be addressed in order to make significant strides in terms of available opportunities.

8.1 Improve physics core skills at undergraduate level

There is consensus within the physics community that the poor skills of entering students must be addressed by the community itself as opposed to relegating the problem to DBE. This can be achieved, inter alia, through establishment of robust tutoring systems to remediate knowledge gaps of underperforming and struggling students and thereby implementing innovative ways to impart skills such as problem solving, work ethic, ability to learn and communication.

8.2 Engaging DHET on meaningful curriculum reform

A report from CHE provided the case for extending the regulation time for a BSc degree from 3 years to 4 years. The key motivation of the report is primarily premised on the complexity of the problems associated with the articulation gap between school and higher education. The report further asserts that: "While the Task Team believes that the level of dysfunction in schooling must continue to be a primary focus of corrective effort, it has concluded that the overwhelming weight of evidence from current analyses of the school sector is that there is effectively no prospect that it will be able, in the foreseeable future, to produce the numbers of well-prepared matriculants that higher education requires."

Real systemic change cannot be realised by simply suggesting and implementing interventions on undergraduate physics training while foundational education is still in dire need of reform. Improved cooperation between SAIP and the Department of Basic Education (DBE) should be fostered with a view to meaningfully address student under-prepared in order to give effect to the quality of student pipeline at secondary level.

It is a known fact that a substantial number of under prepared students do not complete their degrees within the normal prescribed duration. The need for a flexible four year BSc degree programme is paramount. However, the initial response of DHET to the proposed four year flexible curriculum is premised on the following considerations:

- The proposed four year flexible curriculum would cater for a limited number of undergraduate students.
- The implementation of the proposed four year flexible curriculum is an expensive exercise which requires allocation of additional resources.

Given the initial DHET response to the proposed four year flexible curriculum, universities would be faced with an imperative to consolidate efforts to formalise the four year BSc extended programmes which largely served as an institutional response to student under-preparedness over the years. Key focus should be on meaningfully addressing student under-preparedness with the improvement of graduate quality as the envisaged eventual outcome.

8.3. Adoption of the Draft Benchmark Statement

The Physics Undergraduate Draft Benchmark Statement sets the minimum standards for the BSc curriculum and aims to enable mobility of students. The existing synergy between the Draft Benchmark Statement, BSc Qualification Registration Statement and the Quality Enhancement Project of the CHE ought to be harnessed to a significant extent. As the key outcome of the development process ably spearheaded by Professor Edmund Zingu, the Statement stipulates that:

The Draft Benchmark Statement for Physics in South Africa characterizes the skills and achievements that graduates of physics-based degrees should develop, and includes a core curriculum (approximately 50% of the content for undergraduate physics). The statement specifies that students should learn: how to formulate and tackle physics problems, use mathematics, conduct experiments, and assess results critically. It lists skills to be acquired and enhanced, like problem-solving (tackling open-ended problems, trying different approaches), investigative skills (using books, databases, internet and interacting with colleagues), communications skills (applied to unexpected ideas and difficult concepts), analytical skills (attention to detail, manipulating precise ideas, and reasoned arguments), and ICT skills (using appropriate software and analysis packages).

The Draft Benchmark Statement should not be viewed as a prescription for departments by any means, but a guiding document that could serve to provide strategic insight into meaningful development of physics skills. As the custodian of the Draft Benchmark Statement, SAIP is fully aware of the fact that further evolution of the Statement itself is clearly inevitable so that it can serve as a powerful instrument that can potentially respond to changing global and local conditions. Suffice to indicate that the adoption of the Draft Benchmark Statement received favourable support during the National Strategic Meeting while it was also acknowledged that essential tweaks can be made to the Statement leading to its eventual endorsement by the broader physics community.

"Validation" of the Statement would signify that departments are agreeable to concepts as encapsulated in the Statement. While endorsement is deemed voluntary, it was particularly accentuated that endorsement would serve to enhance social cohesion within the physics community through a unified voice and provide a formalisation of key processes through which the development of essential scientific skills can be meaningfully realised. The following actions would then be undertaken in the short term:

- Validation and endorsement of the Draft Benchmark Statement through the SAIP website.

- Validation and endorsement of the Draft Benchmark Statement should, in essence, involve the participation of Vice Chancellors.
- On-going improvement of the Draft Benchmark Statement to make it a living document that remains relevant.
- Provision and implementation of Draft Benchmark Statement inspired curriculum by departments.

The following actions would be undertaken as part of the long term mission.
- Provision of endorsement to Departments by SAIP for the quality of courses offered.
- Provision of assistance in respect of voluntary review of departments for which graduates are seeking Professional Physicist status.
- Ensuring adherence to the core curriculum as contained in the Draft Benchmark Statement.
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8.4 Establishment of a national Physics teaching and learning platform

Development of the National Physics Teaching Platform for Shared Teaching Materials would go a long way towards the provision of shared resources for the benefit of the broader physics community. It is envisaged that the platform would have two key components:
- A sustainable and scalable electronic National Physics Teaching Platform as a Library for Shared common core Teaching Material for the development of skills as advocated by the Draft Benchmark Statement,
- A Video-Conference Shared Teaching Facility located within each Physics Department for shared distance teaching, collaborative teaching, guest lectures and seminars as well as collaborative interactive discussion sessions.

The establishment of the National Physics Teaching Platform is consistent with the stipulations of the DHET White Paper on Post School Education and Training with regard to open and distance learning as well as flexible and innovative modes of delivery in terms of shared learning and support centers, improved access to and use of appropriate technology and collaborative development of high quality learning resources. The inherent structure of the National Physics Teaching Platform would be based on the following key characteristics:
- Voluntary participation by Universities
- Utilization of the Draft Benchmark Statement to develop shared core teaching material
- Branding of universities based on their niche expertise and strong research areas as opposed to teaching of core material
- Development of teaching capacity through excellent delivery of material
- Facilitation of uniformity based on niche competence as opposed to core competence
- Development of shared core teaching material in order to promote student mobility in line with international initiatives like the Bologna Protocol in Europe
- Development of a shared reservoir of well-structured physics problems, solutions to problems, examination papers etc. in order to assist novice lecturers to develop their portfolios
- Optimizing participation levels through removal of barriers in order to build a sense of community in fields such as Astrophysics, Nanotechnology, Nuclear Physics, Particle Physics, etc.
- Promotion of equitable standards
- Appropriate infrastructure development and human personnel in the form of:
- Physicists with technical document preparation skills and library skills.
- IT experts with web development skills, content management systems skills, and data base development skills.
- IT experts with skills to maintain the high end server system to house and share the Library.

As opposed to reinventing the wheel, the NECSA Teaching System would serve as a critical basis upon which the National Physics Teaching Platform will be developed. This is a free Latex based system capable of high end interactive textbook development with embedded media, links, quizzes, tests, tutorials, computer aided learning and exhibiting superior formatting and professional standards of sophistication in document production and presentation. The SAIP would coordinate the overall management of the National Physics Teaching Platform through innovative ways in order to ensure its sustainability. The regulation and management of intellectual property and branding would be performed on the basis of a legally binding document in the form of a Memorandum of Agreement. Additional funding for the development of the National Physics Teaching Platform would be leveraged from the DHET as a key partner in this undertaking.

8.5 Improving the quality and skills of Physics teachers in South Africa

The physics community faces the key imperative to take the lead in the enhancement of teacher professional development within the broader South African context. The need for increased quality pass rates is central to the realisation of human capital development priorities and also augurs well for the increase in the pool of high quality entering students who can be trained in physics. Provision of training should target both in-service and pre-service teachers in order to holistically and adequately address physics teacher competency and professional development needs. This development can be incentivised in order to make it attractive to teachers to take advantage of professional development opportunities in Physics. This drive can be undertaken in parallel with visible advertisement of the role of SAIP in the in-service training initiative through liaison with respective institutions providing the training.

8.6 Improving and expanding the SAIP physics teacher development project

The improvement and expansion of the physics teacher development project will to a large degree be informed by the formal impact evaluation to be carried out shortly. The comprehensive report emanating from the impact evaluation would be made available to the broader physics as well as key stakeholders. It is imperative for SAIP to conduct an audit of all the current physics teacher development initiatives in South Africa in a bid to establish how various stakeholders can collaborate and share experiences as opposed to operating in silos. In addition, collaborative partnerships with Mathematics and Chemistry bodies ought to be established in order to enhance teacher professional development and facilitate sharing of instructional resources.

8.7 The need to establish collaborative partnerships with DBE on teacher professional development

The importance of the collaborative partnership between and SAIP and DBE on teacher professional development cannot be over-emphasized. This partnership should serve to strengthen and improve communication channels between the two parties for purposes of addressing key concerns in relation to the quality of physics teaching, setting of examination and moderation as well as assessment methods. In this regard, the synergy between the Curriculum and Assessment Policy Statement (CAPS) and the Draft Benchmark Statement ought to be fully harnessed.

8.8 Improving university training of Physics teachers

Science Faculties must be persuaded to build socially cohesive and inclusive relationships with Education Faculties within institutions for collaborative provision of teacher training. This would require closer cooperation between the respective Executive Deans and the Deputy Vice-Chancellors (Academic). The training of physics teachers in particular has to be intensified by ensuring that physics content is offered by physics departments while pedagogy is provided by the Education Faculty in the interest of fostering best practice.

8.9 Improving undergraduate Physics instruction at institutions of higher learning

In terms of their key mandate, higher education institutions face the key imperative to provide student-centred tuition that seeks to promote social transformation and social justice. However, key issues associated with the articulation gap between school and higher education within the broader South African context require a coherent confluence of key ideas in order to ensure the fundamental transformation of the education landscape. Student under-preparedness has to a large degree posed immense challenges to higher education institutions leading to the adoption of various interventions in grappling with the complexity of the challenges involved.

The South African education landscape requires a fundamental paradigm shift underpinned by the provision of meaningful platforms for various key stakeholders to clearly define a sustainable developmental path to be navigated towards the realization of the envisaged broad long-term strategic goals. By the same token, the development and improvement of Physics instruction at undergraduate level requires ideological clarity more than ever before. In view of these crucial imperatives, the training system within the broader South African context should be coherently aligned to provide skilled personnel required by the mainstream economy and Physics training is no exception.

8.9.1 Deepening insight into Physics teaching and learning

Critical reflection on the dynamics associated with physics teaching and learning is an inevitable daunting task facing the broader physics community. The following key strategies have been agreed to in terms of the provision of intellectual insight into physics teaching and learning.

- Establishment of Physics regional communities of practice to galvanise efforts aimed at sharing professional expertise, resources as well as forging closer collaboration between institutions located within particular regions
- Establishment of a Physics specialist lecture series spearheaded by prominent physics education scholars (Carl Wieman, Joe Redish, Steve Pollock, Eric Mazur, Ramon Lopez, to name just a few) to stimulate intellectual thought in terms of the development and improvement of Physics instruction in line with global trends. It is envisaged that the Physics specialist lecture series would be made possible through platforms such as regional seminars and SAIP annual conferences. Attendance can lead to the accrual of continuing professional development (CPD) points which would serve to enhance the professional status of SAIP membership commensurate with the constitutional mandate of SAIP as a South African Qualifications Authority (SAQA) recognised professional body.
- The presence of a physics education plenary speaker ought to be a permanent feature of all SAIP annual conferences.
- Exploration of key strategies and creative ways in which physics education research can be made increasingly attractive to the broader physics community. This mission can be accomplished through the introduction of enticing prizes for best physics education research papers, leveraging significant funding for physics education postgraduate bursaries and post-doctoral fellowships, promotion of physics education research within departments and schools largely informed by changing of the

prevailing mindset to the effect that physics education domain should not be perceived as a Cinderella research field, recognition and reward for innovative teaching efforts as well as ensuring that physics education expertise forms an integral part of departmental recruitment practices as a key requirement. Meaningful implementation of research-based instructional strategies plays a key pedagogic role towards the improvement of instruction in various educational settings. It is imperative for students to be engaged in complex tasks and higher-order thinking skills as advocated by the Draft Benchmark Statement. Coherent diffusion of research-based instructional strategies is a key imperative in physics education. In this regard, it is imperative for instructors to adopt and utilize innovative research-based instructional strategies to maximize students' academic experience. This imperative requires instructors to become reflective practitioners in their own right. The teaching-learning environment is a dynamic instructional setting by its very nature and the significance of a critical reflection on both intrinsic and extrinsic contextual factors cannot be over-emphasized. Innovative research-based instructional strategies may be utilized to circumvent student under-preparedness within the broader South African educational context. In addition, recognition of physics education research can be achieved through the introduction of a new NRF rating category for evaluation of researchers in this field. Physics education domain is a globally recognised research field with unique research opportunities coupled with the existence of specialised research journals and conferences. It is thus an established research field with research results being recognised and successfully implemented worldwide. Furthermore, due to its specialised theoretical frameworks and modelling methods, majority of pure physics researchers may not be able to efficiently evaluate the work of physics education researchers. Research in physics education, chemistry education, mathematics education, engineering education and technology education have a lot in common. Therefore, one NRF category (STEM education) can be used for all. SAIP is urged to liaise with the NRF to explore this matter further.

- Establishment of teaching and learning committees that provide professional mentoring for young lecturers and critical oversight in terms of the management of tutorials, examinations and assessment methods. Meaningful provision of tuition ought to be underpinned by meaningful assessment strategy that makes provision for formative, summative, criterion-referenced and integrated forms of assessment in order foster cognitive and reflective skills.
- Putting in place coherent systems geared towards the improvement and enhancement of professional status of physics teaching as a career while recognising the crucial role Physics plays as a fundamental discipline in terms of scientific, social and economic development.

8.9.2 Professional development of Lecturers

Professional development of Lecturers remains a key goal that should essentially inform the improvement of undergraduate physics instruction. Concomitant strategies through which the attainment of this goal can be realised include the following:

- Introduction of a Lecturer Continuous Professional Development System that leads to the accrual of continuing professional development (CPD) points within 3 years or period of reasonable duration.
- Rolling out of a professional development programme for lecturers similar to the American Association of Physics Teachers (AAPT) programme for new lecturers in the United States of America (USA) while due consideration is given to accreditation of modules and qualifications for Lecturer professional development.
- Establishment of regional communities of practice for sharing professional best practices through colloquia, workshops, seminars, symposia as well as other sustainable and viable mechanisms.
- Setting up a sustainable induction and professional mentoring programme for new lecturers.
- Designing a meaningful evaluation system for lecturers as part of ongoing professional development.
- Harnessing the New Generation of Academics Programme (nGap) as part of the national effort to produce the next generation of academics.
- Setting up and utilisation of a grant to enhance professional development of Lecturers.
- Sustainable utilisation of the vital tools as encapsulated in the Council on Higher Education (CHE) Quality Enhancement Programme.

9. SAIP AS A SAQA RECOGNISED PROFESSIONAL BODY

The recognition of SAIP as a professional body by SAQA represents a significant milestone in itself. Consolidation of gains in this regard should be underpinned by the following set of agreed strategies.

- Constructive engagement with Vice Chancellors, Deputy Vice Chancellors and Executive Deans in relation to the critical role Physics Departments can play in teacher training and concomitant discipline-specific requirements within universities.
- Developing voluntary evaluation system that makes provision for departments to obtain SAIP endorsement for the quality of courses offered commensurate with the Draft Benchmark Statement
- Forging links and vibrant partnerships with industry and commerce in order to create increased awareness of the professional designation
- Enhancement of continuing professional development through accrual of continuing professional development (CPD) points.

9.1 Promoting the professional physicist (Pr.Phys) designation

The Pr.Phys professional designation would serve to elevate the status of the physics profession in a variety of ways. The designation itself is poised to provide enticing and appealing benefits to students and employers alike. The admission requirements to the Pr.Phys professional designation ought to be diversified to cater for various levels of professional expertise. 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 through which professionals can maintain and update their knowledge after the formal education process has been completed. Becoming a professional member of SAIP requires demonstration of commitment to maintain appropriate levels of competence in various physics fields through continuing professional development. This can be accomplished through active participation in key activities such as conferences, seminars, workshops and abiding by an acceptable code of conduct.

Some of the valuable benefits of the professional designation to physicists include:

- Certification as a Professional Physicist will serve to enhance personal credentials
- Continuing Professional Development (CPD) will contribute to dynamic knowledge generation
- The professional designation will serve to provide a competitive edge to registered Physicists

Benefits for employers include:

- The recruitment process is supported by a recognised professional registration with clear criteria
- Pr. Phys designation can be used as part of criterion used for promotion, skills development or salary benchmarking
- Professional physicists will adhere to a Code of Conduct providing added benefits for belonging to a recognised professional body.

9.2. Using the new SAIP Professional Body Status to strengthen the physics discipline

The broader physics community is duty-bound to fully utilise the officially recognised SAIP professional body status to strengthen the physics discipline. SAIP must be seen as the custodian of the discipline in South Africa by providing meaningful opportunities for constructive engagement with other professional bodies. In this regard, it is indeed imperative for SAIP to:

- Lobby and engage various key stakeholders as the "Voice of Physics" in South Africa
- Safeguard the quality of physics training through active involvement in quality assessments
- Provide continuing professional development courses
- Forge vibrant partnerships with industry and commerce

10. ATTRACTING AND KEEPING STUDENTS IN PHYSICS

It is incumbent upon the physics community to attract and keep as many students as possible in physics. This goal can be achieved through strategies summarised below.

11. PROMOTING PHYSICS CAREERS

Creation of public awareness of physics careers is of critical importance for both industry and commerce. In the interest of growing a globally competitive economy, insightful elucidation on the fundamental role physics can fulfil ought to be provided in more creative and innovative ways. Thus, SAIP must increase its visibility and market existing career opportunities to physics students through establishment of regional nodes, forging collaborative partnership with SAASTA and actively participating in all national events. It is also imperative to facilitate physics outreach activities in order to build the SET human capital pipeline by attracting school learners into physics and making resources available to both learners and teachers. In addition, SAIP should promote public understanding of physics so that members of public can become important role players in terms of shaping the science and technology landscape.

At another level, effective marketing of physics careers can be accomplished through active engagement with industry and commerce as well as departments playing a leading strategic role as part of regional communities of practice. It would also be useful to actively involve graduate students and postdoctoral fellows in outreach activities to engender interest in potential students.

12. INTRODUCING INDUSTRY RELEVANT SPECIALISED PHYSICS FIELDS

The introduction of industry relevant special fields such as Physics and Electronics, Applied Physics, Industrial Physics, Physics and Nuclear Engineering should be given careful consideration as a matter of priority. The development of relevant courses in this regard has to be undertaken in collaboration with industry. This undertaking would serve to ensure that the physics discipline fulfils a meaningful role in industrial development. In addition, a task team to engage industry on issues of mutual concern has to be established.

13. BUILDING A SENSE OF COMMUNITY

The physics community must adopt strategies that would serve to instil a sense of community. To this end, it is recommended that all first year physics students would qualify for free SAIP membership while receiving the Physics Comment Magazine as well as careers and opportunities in physics brochures.

14. PROMOTING THE ROLE OF PHYSICS IN INDUSTRY AND COMMERCE

Physics plays an increasingly significant role with regard to the stimulation of economic growth through innovation and development of new technologies. This contribution should be sustained through:

- Visiting and engaging relevant industries
- Lobbying industry to provide bursary opportunities to physics students
- Expanding the Entrepreneurship Programme for Physicists
- Introducing industry relevant degrees
- Forging collaboration with the Department of Labour with a view to create an incentive scheme for industries to provide meaningful platforms for the training of postgraduate students through joint supervision.

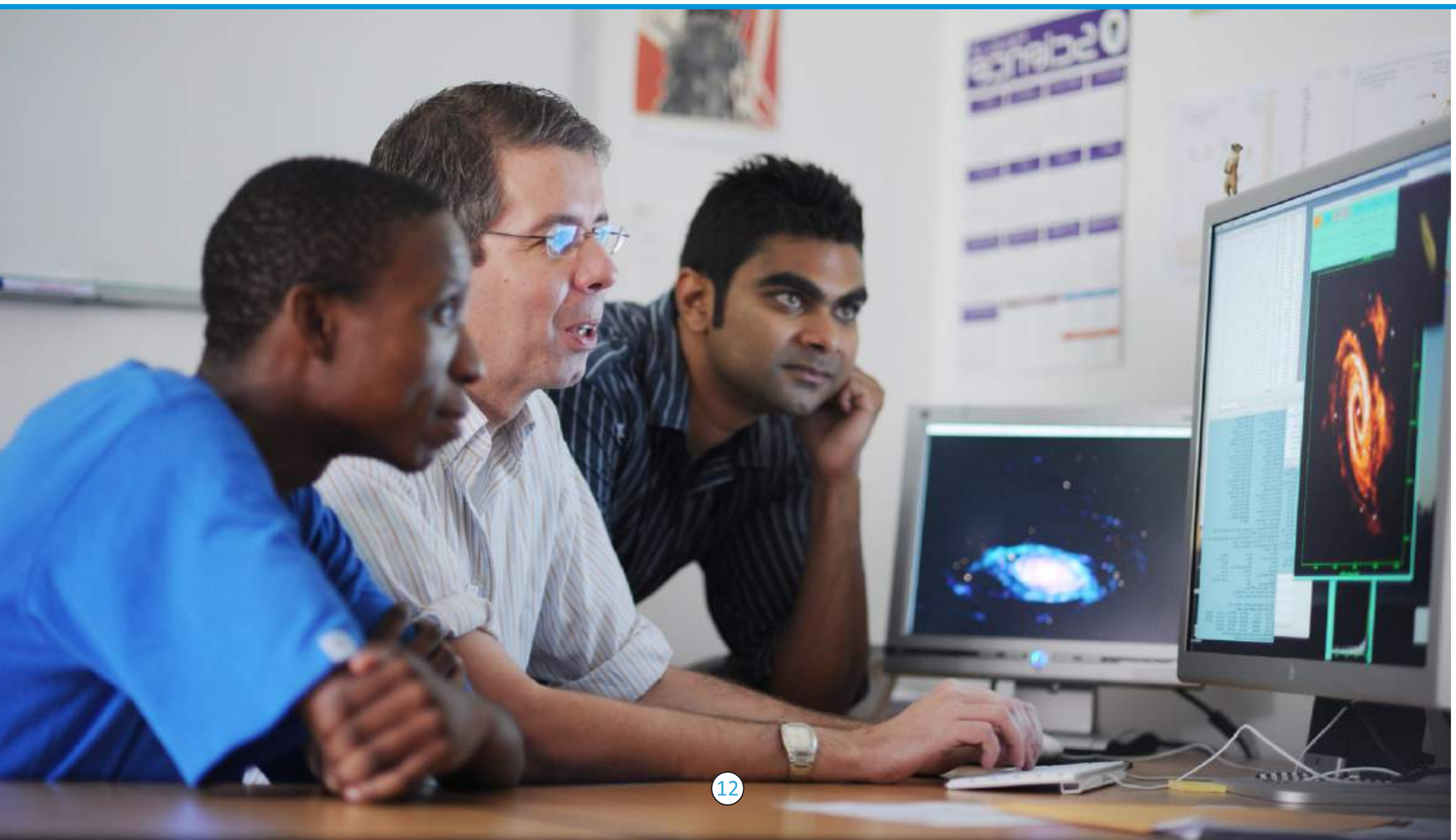
15. PROMOTING WOMEN IN PHYSICS

Given the need to significantly increase the number of students in physics by retaining more women, the existing activities of the WIPISA (Women in Physics in South Africa) forum should be strongly supported. Strategies that could be employed to accomplish this mission include:

- Intensify efforts aimed at increasing WiPiSA visibility
- Establishing a WiPiSA forum in each department
- Developing the "Waterloo Charter" for Women in Physics
- Promoting activities that seek to bring women physicists together
- Presentation of women as physics role models during outreach activities
- Promoting a culture of sensitivity towards women among staff and students

16. MONITORING AND EVALUATION

The need for monitoring and evaluation is intrinsically linked to the successful implementation of the strategic plan. The efficacy of the stipulated innovative interventions would be measured through constant monitoring and evaluation.



17. IMPLEMENTATION MATRIX

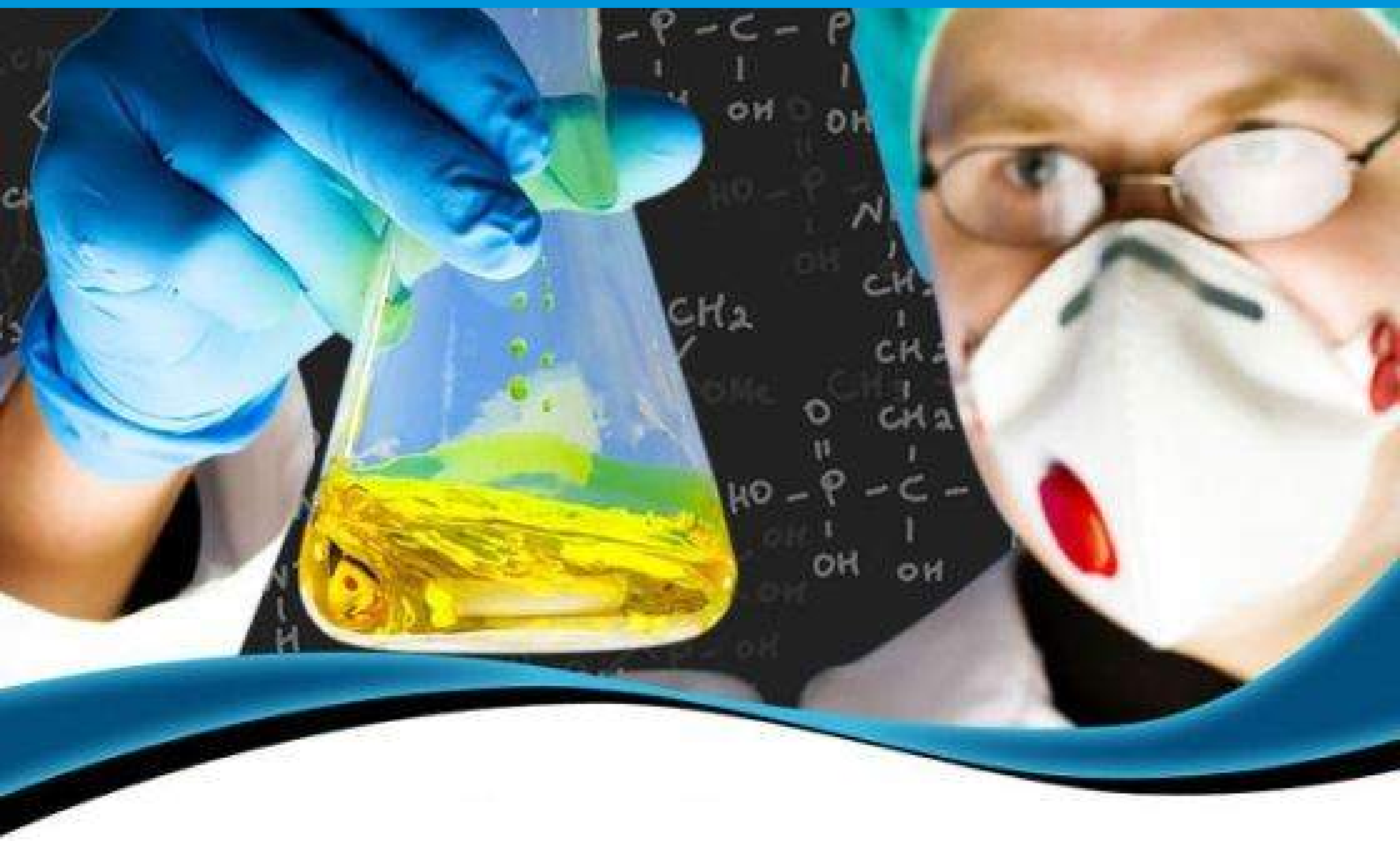
STRATEGIC GOAL	STRATEGIES	ACTIONS & METHODS	KPI	RESP
Adopt the Undergraduate Benchmark Statement	Validate and endorse the Benchmark Statement is 2015 through the SAIP web site.	• Each Department or School is asked to compare its own curriculum with the Benchmark Statement	Endorsement logos	Dpts
		• Departments are asked todeclare to the Executive Officer their willingness to endorse before 31 March 2016		Dpts/SAIP
		• Endorsing departments should provide the use of their University logo on the website to signify endorsement		Dpts
		• Raise funding for adoption of benchmark statement	Funding Available	SAIP
	Departments and Schools should **implement** the Draft Benchmark Statement inspired curriculum	• Voluntary implementation of the Benchmark Statementin the curriculum by the Departments/Schools is encouraged (noting that the Benchmark Statement certainly does not prevent departments or schools from including material of their own choice, or of relevance to local research, in the undergraduate curriculum.	Number of Dpts who have implemented	Dpts
	Continuously **improve** the Benchmark Statement to make it a living document that stays relevant. e.g. "Benchmark Statement 2010")	• SAIP will make the Statement available for comment periodically and update it & Comments will be made through the SAIP contact person within a Department or School • Topics that must be covered so that mobility is facilitated must be proposed.	Revisions done	SAIP & Dpts
	Develop the ideas around voluntary SAIP evaluation to ensure quality BSc Physics training	SAIP must organise a workshop to explore future adherence to the benchmark statementin terms of voluntary evaluation and departmental accreditationas follows. • Departments should receive endorsement through SAIP for the quality of their courses, • In future only admit Pr.Phys from departments forwith that accreditation • Assessment for these purposes would be based on the core curriculum contained in the Benchmark Statement for the year in which the Department endorsed the Statement. • Such assessment could be in parallel with Departmental Review, conveniently every 5 years or at a similar interval. • The assessment would use external moderators appointed by agreement between the HOD and SAIP. • For this purpose, fund raising for the expenses of the moderator(s) should be considered by SAIP.	Proposal on voluntary accreditation Number of depts. Voluntary accredited	SAIP Dpts
Improve physics core skills at undergraduate	Address poor skills of entering students	• Integrate methods for communication, language and problem solving into undergraduate courses based on Benchmark Statement		Dpts
		• Where available use the extended and bridging programme		Dpts
	Establish robust tutoring system to help underperforming and struggling students	• Set learning goals and evaluate if they are achieved continuously and address gaps via tutorials		Dpts
		• Use interns to increase staff available to help with tutorials e.g Use students from the DST/NRF internship programme		Dpts
		• Establish mechanisms to quickly identify and support struggling students Refer struggling students for internal university counselling and support services		Dpts
Propose to DHET for Physics to Pilot the 4 year BSc	Design a flexible 4 year BSc degree (based on assumption DHET approves 4 yr proposal)	• Structure the 4 year degree programme that is based on the benchmark statement and estimate to resource and cost requirements		SAIP
		• Collaborate with maths and chemistry in designing the flexible 4 year degree programme	Meetings	Dpts & SAIP
		• Design a tool to screen students into either 3 year degree programme or 4 year degree programme	Screening tool	Dpts
		• Lobby DHET to provide required resources for running a pilot 4 year degree programme		SAIP & Dpts
	Formalise the 3 year BSc extended programme (if 4 yr is not approved)	• Survey the existing academic support, bridging and extended programmes to develop an impact assessment report	Survey report	SAIP
		• Collaborate with HoDs, Deans and Universities to lobby DHET to formalise and fund some f orm of extended programme	Formalisation of extended programmes	SAIP

STRATEGIC GOAL	STRATEGIES	ACTIONS & METHODS	KPI	RESP
Address the shortage of resources such as teaching materials, laboratory facilities and teaching staff	Develop SA Physics Teaching and Learning Platform	• Develop an online system for sharing teaching and learning materials	System developed	SAIP
		• Develop the policies and procedures for contributing materials, acknowledging and IP	Policies document	SAIP
		• Identify a core of at least 3 universities to kick-start the project as pilot and make materials available for the system	Pilot implemented	SAIP
		• Roll out the project to the rest of the community once	System Roll out	SAIP
Improve the quality and skills of Physics Teachers in South Africa	Improve and expand the SAIP physics teacher development programme	• Carefully consider the mechanisms of moving forward from pilot.		SAIP
		• Introduce a Teachers Forum Day at all SAIP annual conferences	Day at conference	SAIP
		• Make info available to explain the project to stakeholders	Info available on Website	SAIP
		• Each physics department must be involved in teacher	Number	Depts
		• Design a tool to screen students into either 3 year degree programme or 4 year degree programme	Screening tool	Dpts
		• Lobby DHET to provide required resources for running a pilot 4 year degree programme		SAIP & Dpts
	Formalise the 3 year BSc extended programme (if 4 yr is not approved)	• Survey the existing academic support, bridging and extended programmes to develop an impact assessment report	Survey report	SAIP
		• Collaborate with HoDs, Deans and Universities to lobby DHET to formalise and fund some form of extended programme	Formalisation of extended programmes	SAIP
Address the shortage of resources such as teaching materials, laboratory facilities and teaching staff	Develop SA Physics Teaching and Learning Platform	• Develop an online system for sharing teaching and learning materials	System developed	SAIP
		• Develop the policies and procedures for contributing materials, acknowledging and IP	Policies document	SAIP
		• Identify a core of at least 3 universities to kick-start the project as pilot and make materials available for the system	Pilot implemented	SAIP
		• Roll out the project to the rest of the community once	System Roll out	SAIP
Improve the quality and skills of Physics Teachers in South Africa	Improve and expand the SAIP physics teacher development programme	• Carefully consider the mechanisms of moving forward from pilot.		SAIP
		• Introduce a Teachers Forum Day at all SAIP annual conferences	Day at conference	SAIP
		• Make info available to explain the project to stakeholders	Info available on Website	SAIP
		• Each physics department must be involved in teacher	Number	Depts
		• Explore the idea of a physics education day at all SAIP conferences	Day at SAIP conference	SAIP
		• Promote the importance of physics education research to physics departments schools and authorities, i.e. that physics research must be recognised and rewarded similar to recognition given to other areas of physics	Articles and material	SAIP
		• Departments must promote active physics education research ,departments could do much to promote this branch of Physics research by elevating its importance in staff recruitment practises advertise and recruit for physics education specialists • Promote recognition of teaching efforts same way publications are recognised	Number of researchers increase	Depts

STRATEGIC GOAL	STRATEGIES	ACTIONS & METHODS	KPI	RESP
	Establish a Physics Specialist Speaker Series	• Invite international speakers the Big Names to start these series may include i. Cedric Linder ii. Steve Pollock iii. Joe Reddish iv. Eric Maz ur v. Ramon Lopez • Arrange that invited speakers can travel to given regional seminars, participate at SAIP annual conference, participate at regional communities of practice and give these through Webinars • Attach CPD points to these seminars	Series established Number of lectures done Number of speakers invited	SAIP
		• Identify and secure funding to bring the speakers	Funding available	SAIP
	Professional Development of Lecturers	• Departments are encouraged to establish teaching and learning committees that provide mentoring for young lecturers, peer review of tutorials, exams and assessment method	Committees established	Dpts
		• Departments must ensure sustainable mechanisms for induction and mentoring for new lecturers and Design meaningful evaluations of lecturers	Mentoring & induction documented	Dpts
		• Develop professional development programme for lecturers for example a courses similar to those run in the USA by AAPT for new lecturers, in addition consider accreditation of modules and qualifications for lecturer development	Courses developed	SAIP
		• Encourage the formation of regional clusters of practise for sharing teaching best practice holding colloquia, workshops etc. Such colloquia can form part of the CPD points system	Clusters Established	SAIP
Fully u tilise the SAIP professional body status to benefit physics	Promote the Pr.Phys designation	• Promote physics as a profession for industry and commerce	Number of Pr.Phys registered	SAIP / Dpts
	Develop CPD courses	• Develop and offer CPD course attach points to attending and contributing to e.g. 1. Physics Teaching and Learning 2. Professional Development	Courses developed	SAIP
	Quality Assurance of training	• Implement voluntary accreditation through the benchmark statement	Number Dpts accredited	SAIP
	Lobby and engage different stakeholders as Voice of Physics	• Exert Influence for multiple aims listed in the report, including role of Physics Departments in Teacher Training, discipline -specific requirements within the university,…sensitise U management to the issues		SAIP
Attract and keep students in physics	Increase SAIP visibility	• Implement the SAIP HuB and Spoke Model	Regional reps appointed	SAIP
	Market careers in physics	• Every First Year must receive the SAIP Careers brochure and the SAASTA Physics careers booklet starting 2015 and 2016	Dpts reached	SAIP
		• SAIP should be involved in the national science events e.g. NSW and Science Unlimited	National events participated in	SAIP
		• Work with Science Centres in promoting careers in physics	MoUs and joint events with SC	SAIP
		• School outreach – very important in rural areas; experienced motivating lecturers; young role models; inspiring topics •	Schools & number reached	SAIP
		• Physics Career counselling should be emphasised and career development services and courses	Introduction of services	SAIP

STRATEGIC GOAL	STRATEGIES	ACTIONS & METHODS	KPI	RESP
		• Improve jobs portal on SAIP website	Number advertised per year	SAIP
	Physics Departments to market physics careers	• Physics departments must arrange industrial visits and tours to industries and research facilities that employ physicists • Showcase career paths to undergrad and postgraduate students e.g. Invite previous students to address present cohort [link to tracking of students]	Events organised	Depts
		• Look out for the call and inform physics departments about SAASTA/DST call for students to internships in industry	Number	Dpts
		• Designate a person to go out and attact students within university catchment areas	Dpt reps appointed	Dpts
	Introduce industry relevant physics degrees	• Introduce industry relevant physics courses and degrees instead of continuing to teach the traditional physics course e.g. Physics with Electronics, Applied Physics, Industrial Physics, Physics and Nuclear Engineering etc. In designing such courses departments must extensively consult industry and incorporate their requirements in the degree programme • Design undergraduate and honours courses to incorporate an industrial attachment component so that link with industry and physics is strengthened and job opportunities identified • Use the best practice examples in restructuring (BSc Applied Physics, BSc Industrial, Nanotechnology, Renewable Energy, Nuclear Engineering and Physics, Photonics, Health Physics)	Degrees introduced Enrolments on new degrees	Dpts
	Build sense of community and belonging early starting at high school & undergrad students	• Bring interested students to SAIP meetings as early as possible • Popularise physics in communities • Offer free membership to undergraduate and below • Offer high school teachers membership • Pursue ICSU discussion of grants for membership subscription for undergraduates • Lecturers need to exhibit "positive" attitudes towards to students	Number of student members	SAIP
	Improve and market the SAIP Graduate Database	• Investigate linking it to LinkedIn and Facebook? • Think of possible incentives for people to update their details on the database(think)	Subscription on SAIP Grad database	
	Source travel grants to SAIP conferences	• Proposal for Travel Grants to SAIP con ference • seek sponsorship • reserve some for undergrads and Teachers	Funding secured	SAIP
Promote Role of Physics in Industry and Commerce in SA	Develop an industrial engagement proposal	Benchmarked along the lines of the IOP Industry engagement project. The following committees can work together [SAIP Council Ind ustrial Liaison, Marketing and Outreach, Exec Office, and Ed ucation Committee]	Proposal developed and implemented	SAIP
	Visit and engage relevant industries	• Arrange to visit industry with these aims: i. physics in job adverts; as a requirement ii. internships iii. check industry's reaction to Benchmark statement: expose the relevance iv. identify relevant training requirements for industry and incorporate in physics degrees	Visits and engagements	SAIP
	Lobby Industry to offer bursaries to physics	Encourage companies to offer bursaries to undergraduates- also indicates employability	Bursaries secured from industry	Dpts & SAIP
	Expand the Entrepreneurship for Physicists Programme	• Entrepreneurship: revive the Workshop, invite speakers 2016 [SAIP] • The Physics 500 project is extremely valuable in the context of attracting students, there are success stories	Workshops help	SAIP

STRATEGIC GOAL	STRATEGIES	ACTIONS & METHODS	KPI	RESP
Promote Women in Physics	Increased WiPiSA visibility and activities	• Forum of undergrad WIP in each department [Dept reps] • a message of encouragement to WiPiSA [SAIP Pres] • HODs take up the task continuously [HODs] • The Waterloo charter for WIP: consider how to do this [WIPISA]; send to membership, add to AGM agenda • Use the special funds available for outreach (not bursaries) WIPSA • Promote activities in forums that bring women physicists together. • Present women as role models in physics (during outreach, etc.)	Number of Women involved in WipiSA	SAIP



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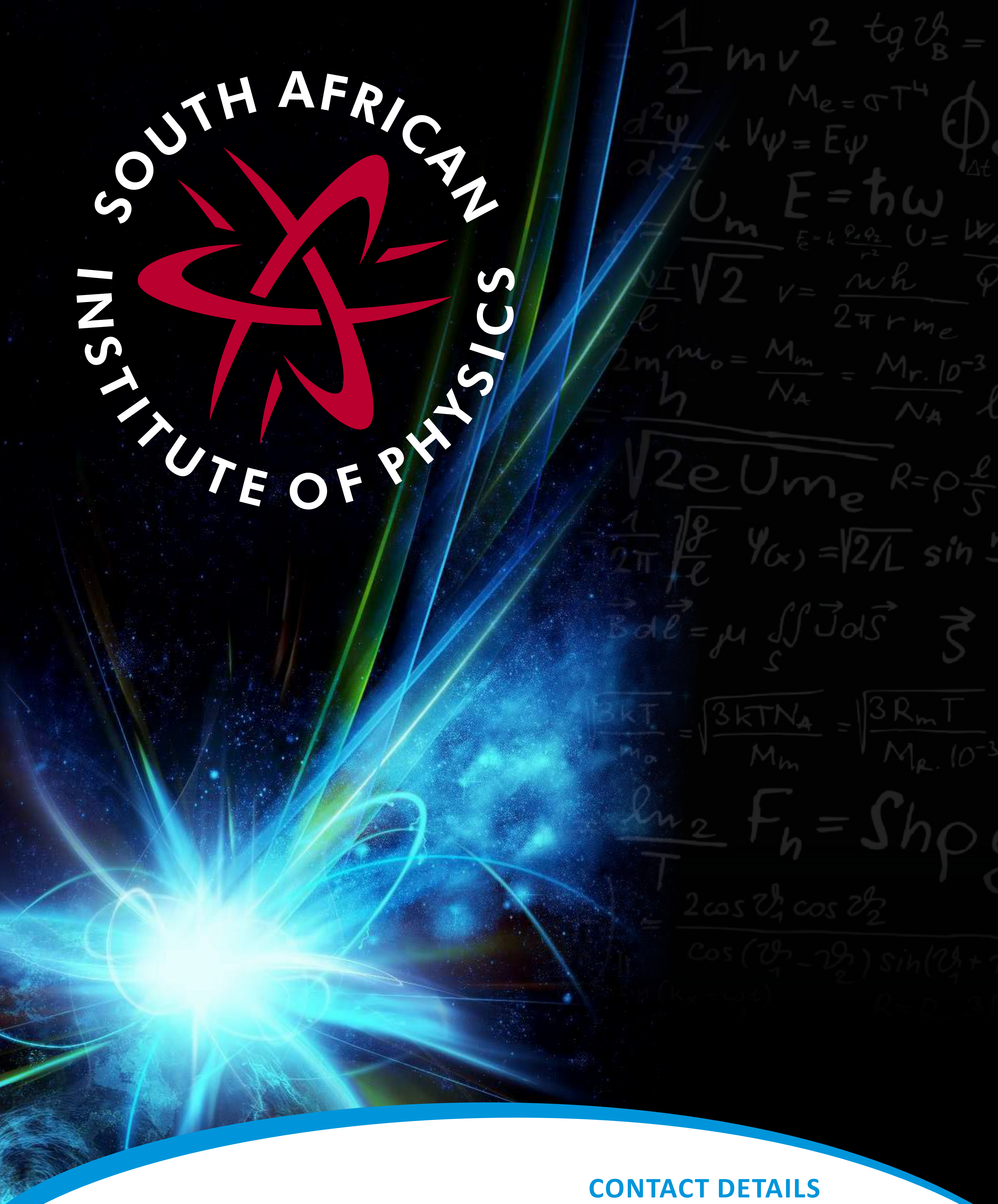

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