



# Shaping the Future of Physics in South Africa

- growing concern expressed with regard to the state of physics in South Africa
  - dwindling student numbers; underrepresented groups
  - research funding
  - the role of, and state of funding for, physics in general
- A proposal for the process of review and foresight was therefore developed by
  - South African Institute of Physics (SAIP)
  - Department of Science and Technology (DST)
  - National Research Foundation (NRF).

# Terms of reference

- **Purpose of the review/foresight process**
  - to review the state of physics in South Africa
  - to formulate a strategy to revitalize physics in South Africa.

# Terms of reference cont.

- **Scope of the review/foresight process**
  - reviewing the funding regimes which promote physics and technology developments through research efforts in the private sector, science councils, academic institutions and/or any other donor agencies
  - reviewing institutional infrastructure for the development of physics research capacity
  - reviewing the human resources and skills development in physics
  - consolidating existing reviews of physics
  - proposing strategies to revitalize physics.

# The Approach

- Material sand visits planned by MPC
  - Policy documents, review reports, submissions from physics community, interview and site visit programme
- Panel met and interacted with about 230 people,
  - Students to Directors General
  - Universities: executive, staff, students, but few labs
  - Industry and businesses
- Panel visited about 13 National Facilities and sites
  - Including a theoretical site visit
  - And about 7 cities
- Panel has seen a selection of SA physics as the basis for its recommendations
  - Acknowledges the effort and input made by all groups involved.

# Opening comment on findings

- Physics is needed by society
- The strength of physics is uneven
- Physics is in danger
- Physics can be saved, and grow strongly.

# Panel's vision is based on building further on...

- Interpersonal communication
- Transformation
  - Open participation in community
- Connectivity
  - Enabling communication
- Major enabling missions
  - Communities centered on facilities
  - Attractive and exciting for physicists

# Major recommendations: schools

1. In many countries, elementary and secondary school teaching of mathematics and science is a considerable worry. In South Africa this situation is exacerbated in the historically black schools. Although beyond the scope of this inquiry, we must flag this very serious situation. We acknowledge that steps are being taken to address this matter, but urge the relevant authorities to pursue it with even more vigour, as it is a crisis situation. Individuals in the physics community are to be commended for their activity in this regard, but more involvement is needed, particularly at the structural level. [SAIP, NRF, Department of Education]

# Major recommendations: transformation

- 2. The long-term sustainable future of physics in SA depends on the country's commitment and investment in the development of a workforce that is representative of its demographic diversity. Evidence indicates that, while there is a rapidly growing cadre of physics students from previously under-represented groups, there are perceived difficulties that need to be addressed by the established physics community and by the funding authorities. Apart from financial barriers to both undergraduate and postgraduate study (addressed below), there are others matters of concern, such as that relating to the integration of students of different cultures into existing departments, particularly in regard to the transfer of students from HDI's to HWU's. These questions need to be addressed urgently, and interpersonal communication is of the essence. [University community].

# Major recommendations: job prospects

- 3. Job prospects in Physics are perceived by many young people to be poor, and this affects the take up of the subject in schools and universities, but this is illusory. Both industry and business welcome them, for both technical and managerial careers, but this is not made apparent. The fault appears to lie on both sides, employers not making it clear that physicists are welcome to apply for their vacancies, and physicists not being sufficiently proactive. We recommend that SAIP mount a "connectivity-campaign". [SAIP]

# Major recommendations: Public Understanding of Science

- 4. The "Public Understanding of Science" is increasingly important, not least for a democratic nation where the wide appreciation of science is vital. Much is being done but we recommend more, particularly as "the public" consists of many constituencies, all of which are important. [SAIP]

# Major recommendations: remuneration and bursaries

- 5. There is considerable concern in the community about the low level of remuneration in academe, school-teaching and student bursaries. In particular, we propose a revised bursary scheme with the intention of minimising the financial barrier for students to enter physics and to stay in physics, especially in comparison with competing career paths. The proposed bursary scheme is ideally based on the concept of free tertiary education for science students. We recognise the competing claims on national resources but an upward revision is essential. A serious "brain-drain" will result if salaries are kept low. [SAIP, NRF]

# Major recommendations: Information Network

- 6. We recommend the creation of a National Research Information Network to enable non-commercial research. This is vital not only for the National Digital Library suggested below, but in order to permit the maximum exploitation by South African scientists of data provided by national investments similar in scope to the proposed Square Kilometer Array. Projects of this type are likely to be the trend of the future and the lack of a system like the NRIN will mean that the dissemination of high value knowledge skills will, at a minimum, be severely constricted. [NRF, DST]

# Major recommendations: Library

- 7. We recommend the Creation of a National Research Digital Library Resource. Such a structure would provide subscription to electronic journals which will be accessible over the internet, and hence available to all universities (both staff and students), and selected non-commercial researchers. If the physics programmes of this nation are to be competitive, this is a vital need. It is clear that such a resource will have a transformational nature also, since even remotely located Universities will also be able to access the latest research findings, with the caveat of the necessity of ready internet access.  
[NRF, DST]

# Major recommendations: flagships

- 8. The Panel noted with pleasure the overall level of research and the existence of some excellent projects, although relatively few in number. Particularly impressive is the attitude of researchers towards the new ‘flagship projects’ - projects that we applaud. We recommend that these projects be seen both to act as a focus for much of the scientific work in their respective areas, and to provide links to apparently unrelated branches of physics. [SAIP, DST]

# Major recommendations: research strategy

- 9. The onus is on the physics community to develop a long-term strategy for the subject, which addresses national developmental priorities as well as keeping the research internationally competitive. Such a strategy should, inter alia, aim at optimising both access to and the efficient use of, expensive equipment, and to facilitate the use of existing expertise by encouraging collaboration, thereby reducing the barrier to innovation. This may lead to the establishment of a limited number of other "flagship" projects and/or National User Facilities (NUF's) on a scale more comprehensive than hitherto, and with an emphasis on facilitatory governance. Proposals for such projects should ensure a balance between funds for equipment, including its periodic updating, and those of staffing and maintenance. [NRF]

# Major recommendations: small science

- 10. Preoccupation with flagship projects and National User Facilities should not lead to the neglect of other areas of research. International experience has shown that "small science" has not only been a major training ground, and the forerunner, scientifically, of many large projects, but has also been a major vehicle for innovation and intellectual property development. Thus there is a need for strong support for "small science", preferably in the context of collaboration. [NRF, SAIP]

# Major recommendations: infrastructure

- 11. There is considerable concern about the state of research infrastructure. According to the data received, much of the equipment in university departments is out of date or inadequate. We recommend that serious attention be given to this problem. [NRF, Department of Education]

# Major recommendations: Theoretical Physics Facility

- 12. The state of theoretical physics is characterised as internationally competitive in some areas, but there is fragmentation and a coherent policy is needed in the nation. We recommend the establishment of a National Theoretical Physics Facility (either real or virtual); the community will then be able to nimbly respond to national science policy initiatives. [NRF]

# Major recommendations: spin-off

- 13. An important effect of physics research projects is technological spin-off. Advanced research projects not only bring immediate "rewards" to industry and commerce in the form of orders for technologically advanced equipment, but they also raise the possibility of new, previously unforeseen, developments. "Astro-technology" is an excellent example and we recommend that it be used as a prototype, and that physicists make use of the structures that encourage links to industry and innovation. [NRF, DST, SAIP]

## Major recommendations: follow-up

- 14. We recommend that the Management and Policy Committee should remain in existence as a monitoring body, and that the SAIP, DST and NRF should report back to it in a year from now. The MPC should inform the community on the extent to which the Panel's recommendations have been implemented. [MPC]

# Academy of Sciences of SA

- Relevance of our report to the wider field of science.

# Shaping the Future of Physics in SA

- We commend this Report to the community in general and to the initiators (SAIP, NRF and DST) in particular.
- Our view is that if the recommendations are followed there will be an improvement in the areas where the initial concerns prompted the review, viz.
  - Student numbers will rise, at both undergraduate and postgraduate level
  - The demography will be transformed
  - Research funding will increase
  - Funding for physics in general will increase,
- in other words,

**PHYSICS IN SOUTH AFRICA WILL BE REVITALIZED**