

5. RECOMMENDATIONS

Here we list all the recommendations in detail.

They are numbered according to the section in Chapter 4 in which they appear. The abbreviation (Exec *) designates recommendations that appear in the Executive Summary.

Partial duplication arises from the presentation of abbreviated and combined recommendations in the Executive Summary.

It is expected that action should be initiated by the bodies listed in brackets at the end of each recommendation.

RECOMMENDATION 4.1.1 (Exec 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]

RECOMMENDATION 4.1.2

(a) The state should introduce a bursary-loan scheme for students training as teachers of “scarce skills” such as physics. Students awarded a bursary to study towards a B.Sc. majoring in physics would be required to serve society by teaching for an equivalent number of years, failing which the bursary would be transformed into a loan.

(b) Differential salaries should be introduced, with science teachers being paid a premium over and above salaries paid to teachers involved in subjects that are not designated as “scarce skills”. [Such teachers would need to prove their subject proficiency through some means of objective assessment.] [Department of Education]

RECOMMENDATION 4.1.3

(a) The Panel recommends that the state should provide earmarked funds for the establishment of laboratories at all secondary schools teaching science, and ensure that the laboratories are adequately equipped and maintained to enable proper teaching of physics to take place.

(b) The state should establish a suitable number of posts of laboratory technician/assistant to provide the necessary support structure for the physics teachers.

(c) Finally, the state should, in consultation with the Physics community and Higher Education Institutions, ensure that a suitable training programme is set up for the optimal training of school laboratory technicians/assistants in different parts of the country. [Department of Education, SAIP, HEI sector]

RECOMMENDATION 4.1.4

The Panel recommends that the physics community (led by the SAIP) should seriously take up the challenge of preparing South African schoolchildren for participation in the International Physics Olympiad. [SAIP, Physics community]

RECOMMENDATION 4.2.1

The Panel recommends that the Department of Education and the SAIP should conduct an audit of academic support programmes in “unplugging the Physics pipeline”, and on the basis of their success, the state should allocate targeted funding to HEI’s for appropriate academic support programme to develop the necessary Physics base for the country. [Department of Education, SAIP]

RECOMMENDATION 4.2.2

We recommend that special effort be expended from the first physics lecture to expose students to applications, SA research opportunities and the role of physics in society. Examples from astronomy to illustrate physical principles are welcomed by students. We noted that where students had been encouraged to attend conferences as undergraduates, contentment was relatively high. We recommend further that where they are missing, community projects, vacation jobs and internships be instituted to provide a better link between study and the possible workplace. [University community]

Medical physics students should be exposed to the practice environment from their first year. [Medical physics community]

RECOMMENDATION 4.2.3

We recommend that departments ensure that they, and through them their students, are kept well-informed about funding possibilities for students; that where possible they take steps to be of assistance to students in financial or other need; and that they ensure that their research supervision is of the highest possible standard, particularly in such situations where the student is not operating within the department, but is, say, at a research institution. [University community, Research institutions]

RECOMMENDATION 4.2.4

We recommend that, if they have not already done so, departments consult the references listed, undertake some soul-searching, and consider what they can do to ensure good staff-student relationships.[University community]

RECOMMENDATION 4.2.5

We recommend that students take the initiative in solving their problems, in conjunction with the department; further, that students be encouraged to form student physics societies on their respective campuses, and that the SAIP play a facilitatory and supportive role in this regard.[Physics students, university community, SAIP]

RECOMMENDATION 4.2.6

We recommend

- (i) free education for all physics major students, and
- (ii) the replacement of race discrimination in bursaries by means tests.

Realising that strong measures such as these may not be immediately implementable, but without abandoning the rigorous position, we suggest as interim measures

- (a) providing tuition and accommodation loans for all 3^d year students in Physics, which are transformed into bursaries for those completing their degrees in the minimum period (three years),
- (b) providing tuition and accommodation bursaries for all Honours students in Physics, including Medical Physics students, and
- (c) that the bursaries should entail an agreement to remain in SA for a specified time, negotiable if a substantial opportunity opens for the student in another country.[NRF, Department of Education, Department of Trade & Industries]

RECOMMENDATION 4.2.7 (Exec 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 above), there are other 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 HBU's to HWU's. These questions need to be addressed urgently, and interpersonal communication is of the essence. [University community].

RECOMMENDATION 4.2.8

- (a) Prejudice in all forms needs to be overcome. Opportunities to promote and encourage underrepresented groups, including women, should be given special attention.
- (b) Departments should ensure that women students are aware of the special opportunities available to them through the NRF and other bodies.
- (c) All students need to be aware of applications of physics and the career options available, and this may be even more critical for women.
- (d) Where NRF rules make it difficult for women to advance, attention should be given to changing them. Specifically, the bar to re-entrants further than 5 years from their PhD should be removed. [University community, NRF, employers]

RECOMMENDATION 4.2.9

We recommend that a much more vigorous policy of providing postdoctoral fellowships be pursued, and that special funds be made available for outstanding young scientists to develop new lines of research (existing funding for P-rated scientists does not provide adequately for equipment infrastructure). [NRF]

RECOMMENDATION 4.3.2

The Panel recommends that research groups take positive action to develop collaborative research, across institutions and disciplines, and particularly with industry, in order to strengthen the research endeavour in South Africa, and to benefit from the resultant advantages. [University community]

RECOMMENDATION 4.4 (Exec 6)

We recommend the creation of a fast, inexpensive, broadband National Research Information Network to support non-commercial research. This is vital not only for the National Research 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]

RECOMMENDATION 4.5 (Exec 7)

We recommend the creation of a National Research Digital Library Resource. Such a structure would provide subscription to electronic journals that 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]

RECOMMENDATION 4.5.1

The Panel recommends that the physics community, through the SAIP, should investigate the SARIS project, and, if appropriate, align itself with and be supportive of it, in its attempt to develop a Research Information system in South Africa that is appropriate to the needs of the new millennium. Furthermore, the Panel calls upon the Physics community to keep on the lookout for other such developments (e.g. for an improved digital network), as appropriate, and to act coherently as a community in support thereof. [SAIP]

RECOMMENDATION 4.6.1 (Exec 11)

There is considerable concern about the state of the research infrastructure. According to the data received, much of the equipment in university departments is out of date or inadequate. The panel recommends that SA makes a rational investment in modernizing its research infrastructure to meet the scientific requirements as well as with the objective of training the future generation of young scientists and engineers with globally competitive skills. The panel recommends that appropriate mechanisms for funding and optimal utilization of existing resources be put in place at all levels of the scientific needs. [NRF, DST, Department of Education]

RECOMMENDATION 4.6.2

The panel recommends that “government laboratories” enhance their user base through aggressive outreach effort to universities and other outside users in order to ensure full utilization of their unique capabilities. A more user-friendly facilitatory governance needs to be pursued. An increase in mobility grant and regular research grants are needed for this purpose. [NRF, Science Councils, National Facilities]

RECOMMENDATION 4.6.3

The panel strongly recommends an increase in the nation’s investment in university research infrastructure through upgrade and acquisition of major research instrumentation, as well as through support for instrument development. In order for SA’s researchers to remain competitive and vibrant it is crucial to have a modern infrastructure that meets the demands of modern science and technology. Modern equipment at the universities is crucial for training purposes. Lack of training in the utilization of modern equipment will severely hurt South Africa’s future generations. [NRF, DST]

RECOMMENDATION 4.6.4

The panel recommends an increase in the individual research grant to allow for the acquisition of these small but critical tools for research, and education and training, and that significant funds be provided for maintaining and upgrading of existing equipment.[NRF]

RECOMMENDATION 4.7 (Exec 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, Physics community]

RECOMMENDATION 4.7.2

The panel recommends that SA’s physicists plan and prioritize their needs for a future large instrument. We recommend that funding agencies provide the necessary seed money to carry out these studies and to build up the user community in critical areas, such as, for instance, the South African Synchrotron Initiative. [Physics community, SAIP, NRF]

RECOMMENDATION 4.8.1

In order to optimize the utilization of the limited resources available, the panel recommends considering various mechanisms for sharing equipment. One possibility is the creation of a distributed network of National User Facilities (NUF’s). [NRF]

RECOMMENDATION 4.8.2 (note also 4.7.2, 4.8.1) (Exec 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. The concept of a NUF is described in more detail in Chapter 4 and Appendix 4 of the Report. [NRF]

RECOMMENDATION 4.9 (Exec 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]

RECOMMENDATION 4.10 (Exec 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]

RECOMMENDATION 4.11 (Exec 12)

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

RECOMMENDATION 4.12.1

- (a) Medical physics (including radiation oncology, nuclear medicine, and radiation quality assurance and quality control) should be designated as “scare skills” professions.
- (b) An urgent training programme to provide an adequate number of registered graduates, particularly to public service, is required. Funding is a major factor in this programme. Increased funding from the sources involved is required to provide staff and student numbers, but consolidated and well-coordinated use of the funds is an important factor.
- (c) Funding from the NRF or MRC should be provided to Medical Physics Departments, particularly in order to resolve the problems of funding for Honours students, transformation, the development of research and the development of young staff members. [DTI, Department of Health, Provincial governments, NRF, MRC, SAIP]

RECOMMENDATION 4.12.2

The panel recommends that South African physicists consider establishing closer links and collaborative research endeavours with biophysics, geophysics, medical physics, bio-informatics, engineering, etc. and similar physics-related disciplines. [Physics community]

RECOMMENDATION 4.13.1 (Exec 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, Physics community]

RECOMMENDATION 4.13.2 (Exec 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]

RECOMMENDATION 4.13.3

With the assistance of physics departments, the SAIP should urgently build up a database of physics graduates who are not working in academic physics or research organizations, with a view to re-establishing contact with them. Such a network could form the basis for improving physics-industry linkages, and wider employability of physics graduates. In addition, it could

lead to regular contact with decision-makers who influence science. [SAIP, Physics departments]

RECOMMENDATION 4.14

It is recommended that funding be made available (from DST) for a restricted period (say 5 years, renewable) to enable an office with a full-time secretariat of a small number of “employees” to be formed. They would be responsible for implementing the programme of the Council of the SAIP, which would include serving physics and physicists nationwide. Special emphasis would be placed on:

- developing a national strategy for physics;
- increasing public awareness;
- interfacing with government departments on science issues;
- interfacing with and improving the lot of physics teachers, particularly in schools;
- forging stronger links between universities, national facilities, science councils, industry and commerce;
- ensuring a greater acceptability of a physics training for posts in industry and commerce;
- improving students’ access to information on both bursary sources and employers;
- making sure that both the joys of physics and the availability of jobs are known in schools and elsewhere; and
- monitoring the implementation of reviews such as this and reporting back to the community.[SAIP, DST, NRF]

RECOMMENDATION 4.15 (note also 4.1.2, 4.1.3, 4.2.6, 4.2.8 and 4.2.9) (Exec 5)

There is considerable concern in the science 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 of salaries and bursaries is essential. A serious “brain-drain” will result if salaries are kept low. [SAIP, NRF, Department of Education, Universities]

RECOMMENDATION 4.16.2

We recommend that the Management and Policy Committee should forward this Report to the Academy of Science of South Africa for its consideration and possible action in the broader context of science in South Africa.[MPC]

RECOMMENDATION 4.16.3 (Exec 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]

