FOM - 07.1281/D

Evaluation 2000-2006

FOM-Institute for subatomic physics NIKHEF

The Hague/Utrecht, 2007

Netherlands Organisation for Scientific Research

and

Foundation for Fundamental Research on Matter

CONTENTS

1 Introduction

1.1 Scope and context of this evaluation

The Netherlands Organisation for Scientific Research (NWO) and the Foundation for Fundamental Research on Matter regularly evaluates the scientific performance of its research institutes. As part of this evaluation scheme, the FOM-institute for Subatomic Physics SAF/NIKHEF[1] has been evaluated by an international committee. The aims of the assessment system are:

- Improvement of the quality of research through an assessment carried out according to international standards of quality and relevance.
- Improvement of research management and leadership.
- Accountability to higher levels of research organizations and funding agencies, government, and society at large.

The committee is asked to produce a reasoned judgement on the mission, strategy and performance of the institute. The evaluation contains retrospective and prospective elements. The assessment is based on the Standard Evaluation Protocol 2003-2009 (Standard Evaluation Protocol) (ISBN 90-5588278x/FOM-03.0536), which calls for an evaluation both of the research institute itself and of the research programmes it conducts. The research institute submits details of the results that have been achieved in each research programme over the previous six years (including quantitative data about staff input, key publications and a list of publications), a short outline of the mission statement of each programme, and details of developments anticipated in the context of the research profile of the institute. Important elements of each review are a site visit, which includes interviews with the management and the programme directors, and a tour of the facilities.

1.2 The evaluation committee

The evaluation committee was appointed by the Governing Board of NWO following consultation with FOM. Its members are:

- Professor Ken Peach (chair), Oxford, UK
- Professor Sander Bais, University of Amsterdam, The Netherlands
- Dr. Jos Benschop, ASML, Veldhoven, The Netherlands
- Professor Roger Cashmore, Brasenose College, Oxford, UK
- Dr. Hugh Montgomery, Fermilab, Batavia, USA
- Professor Felicitas Pauss, ETH Zurich, Switzerland
- Dr. Christian Spiering, DESY, Zeuthen, Germany

A short curriculum vitae of each of the members is included in Appendix 7.1. The committee was supported by FOM programme officer Drs. Job de Kleuver.

All members of the committee declared that their assessment had been free of bias, personal preference or personal interest, and that it had been reached without undue influence from the institute, the programme directors or other stakeholders. Any existing professional relationships between committee members and programmes under review were brought to the attention of the committee. The committee concluded that there were no conflicts of interest.

[1] In this report, NIKHEF will refer to the collaboration of the laboratory SAF/NIKHEF and the four University groups. SAF/NIKHEF will refer specifically to the FOM laboratory located in the Science Park in Amsterdam.

1.3 Data supplied to the committee

The documentation included all the information required by the Standard Evaluation Protocol.

It included:

- The self-evaluation report 2000-2006 by SAF/NIKHEF;
- The strategic plan SAF/NIKHEF 2007-2012;
- A selection of full text papers for each programme;
- A bibliometric study of SAF/NIKHEF by the Center for Science and Technology Studies (CWTS).

During the site visit, handouts of all the presentations were made available.

1.4 Procedures followed by the committee

The committee proceeded in accordance with the Standard Evaluation Protocol 2003-2009. The assessment was based on the documentation provided by the institute, the selected key publications, and the interviews conducted during the site visit on 6-8 September 2007. The programme of the site visit is included in Appendices 7.2 and 7.3.

The documentation was sent to the committee one month before the site visit. The chair and the secretary of the committee established a timetable for the site visit (see Appendix 7.2) and the committee members divided up the task of reading the full text papers to ensure total coverage.

The committee was installed on the first day (Thursday 6 September 2007) by the vice chairman of NWO, Prof.dr. Charles Buys, and the director of FOM, Dr. Hans Chang. Prof.dr. Frank Linde, director of SAF/NIKHEF, gave a short introduction to his institute. Afterwards the committee met in closed session to finalize the division of tasks and finalize the agenda for the site visit on day two and three.

On day 2 (Friday 7 September 2007), the committee discussed progress with all programme leaders and members of the research teams. The committee had the opportunity to visit some of the technical facilities in NIKHEF, and also to talk to about 30 of the PhD students about their experiences.

On day 3 (Saturday 8 September 2007) the committee met the director and discussed the completed programs, long term future plans, the lab infrastructure and technical skills, knowledge transfer, education, outreach and finances, including the request for an increased mission budget. After that day 3 was spent discussing and writing a preliminary draft of the evaluation report and formulating the conclusions of the committee together. The conclusions of the committee were presented to the director of FOM and several members of the staff of NIKHEF by Prof. K. Peach over dinner. After the visit, the chairman together with the secretary prepared a proposal for the final version of the evaluation report**.** This report was approved by the committee members on 21 September 2007, and sent to the director of SAF/NIKHEF to be checked for factual errors. The report was completed on 2 October 2007. The report was sent to the Governing Board of NWO on 3 October 2007. The Governing Board accepted the report on 23 October 2007.

1.5 Assessment scale

The committee used the scale provided in the Standard Evaluation Protocol (see Appendix 7.4).

2. General introduction to particle & astroparticle physics, experiments & collaborations

Particle Physics is concerned with identifying the most basic constituents of the universe around us, and describing how they interact. Towards the end of the nineteenth century, it was realised that that atoms, then still not universally accepted as physical entities, were probably not fundamental but had internal structure. Much of the twentieth century was devoted to exploring the consequences. The twin pillars of quantum mechanics and relativity led eventually to the development of the Standard Model of Particles and their Interaction, or simply the Standard Model. This describes the sub-atomic (actually, sub-nuclear) domain in terms of twelve constituent particles (six quarks and six leptons, arranged in three families) and their anti-particles, together with five force-carrying particles (the gluon, the photon and W^+, W^- and Z bosons). Over the past thirty years, the Standard Model has been subjected to increasingly stringent tests, and has been found to describe an enormous range of phenomena with astonishing precision. Despite this enormous success, the Standard Model is known to be incomplete, and must itself be derived from an even more fundamental theory.

Some of the motivation for physics "beyond the Standard Model" comes from the model itself – while it is very successful in describing the physics universe, its basic structure is unexplained. Further clues that there is a more fundamental theory come from astronomy and cosmology – it seems that the Standard Model accounts for only about 5% of the energy content of the universe, and that other forms of matter ("Dark Matter") and energy ("Dark Energy") are all pervasive. There is thus an increasing interest in astroparticle physics, which uses particle physics techniques and high-energy cosmic rays to study astrophysical phenomena, providing valuable insights to both particle physicists and astronomers.

Experiments in both particle and astroparticle physics use very advanced technologies on a gigantic scale, often operating close to the limit. For example, the detectors for the Large Hadron Collider (LHC) currently under construction at CERN weigh thousands of tonnes and have millions of electronics channels distributed over detectors tens of metres in length, and yet can measure the position of individual particles to a precision of a few microns. Both the wide range of technical skills needed and the vast scale of the construction require that the experiments are organised as large collaborations, involving dozens of institutes (universities and laboratories) and hundreds of physicists, engineers, PhD students and technicians.

Alongside the experimental work, there is a need for theoretical studies, which range from the development of robust tools (e.g. Monte Carlo algorithms, parton distributions functions) essential to the analysis of the data from experiments to the exploration of the consequences of extensions to the Standard Model and to the creation of new theoretical ideas to explain new phenomena or address perceived defects in existing theories.

The Netherlands have a long tradition of experimental and theoretical research in particle physics. S. van der Meer shared the 1984 Nobel Prize for his work on stochastic cooling, an essential technological breakthrough key to the discovery of the W and Z bosons at CERN. The award of Nobel Prize to G. 't Hooft and M. Veltman in 1999 for their role in establishing the basis of the Standard Model, which predicted the existence and masses of the W and Z bosons. C.J. Bakker was the Director-General of CERN from September 1955 to April 1960, and L. van Hove (born in Belgium) was Director of the Theoretical Physics Institute at the University of Utrecht from 1954 to 1961, when he left to become leader of the Theory Division at CERN and later (1976-1980) was Research Director General of CERN. W. Hoogland was Research Director at CERN from 1989 to 1992. This tradition of excellence continues today, with the appointment in 2004 of J. Engelen, the director of SAF/NIKHEF from 2001-2003, as the first Chief Scientific Officer and deputy Director General of CERN.

3. FOM Institute SAF/NIKHEF

The scale of modern particle physics experiments, and the range of technical skills required to design, build and operate them, make it difficult for all but the largest institutes to take full responsibility for a major contribution of the detector. As a response to this, many countries have developed a consortium approach, with universities and national laboratories working together on a coordinated programme of advanced research. Such networks exist in Belgium, Italy and the UK, for example, and the US has organised its contribution to the ATLAS and CMS detectors at the LHC on similar lines. Recently, Germany has created an alliance of 17 universities and two HGF laboratories (DESY and FzK) to pursue physics at the high-energy frontier. The NIKHEF collaboration implements this model in an exemplary way as a tightly-coupled collaboration of four university groups and a national FOM laboratory, with many of the senior scientific staff having joint appointments between one of the universities and the laboratory. While there is some administrative overhead involved in managing the network, this is more than compensated through the reduction in the duplication of administrative effort that would be required in each of the institutes were they to participate individually in the research programmes.

The NIKHEF collaboration consists of the SAF/NIKHEF laboratory at the Science Park Amsterdam, and four universities, the Universiteit van Amsterdam (UvA), the Free University Amsterdam (VU), the Radboud University Nijmegen (RU) and the Utrecht University (UU). NIKHEF coordinates and supports all activities in experimental subatomic physics in the Netherlands. SAF/NIKHEF is an integral part of the FOM organization, the Foundation for Fundamental Research on Matter. Through the NIKHEF collaboration, which builds upon the international reputation of the SAF/NIKHEF laboratory over many years, the Dutch universities are highly visible in particle and astroparticle physics world-wide.

3.1 Mission

In the last review in 2000, SAF/NIKHEF undertook "*to study the interactions and structure of elementary particles and fields and to coordinate and lead all Dutch activities in this field*".

For the next period, it is proposed that "*the mission of NIKHEF is to study the interactions and structure of all elementary particles and fields at the smallest distance scale and the highest attainable energy, and to connect the findings of today's research in a qualitative and preferably quantitative manner to the fierce processes occurring in the early Universe, 13.7 billion years ago. Two complementary approaches are followed:*

- *Accelerator-based particle physics*

  Experiments studying interactions in particle collision processes at particle accelerators, in particular at CERN;

- *Astroparticle physics*

  Experiments studying interactions of particles and radiation emanating from the Universe, with the Earth.

NIKHEF coordinates and leads all Dutch experimental activities in these fields."

3.2 Research

During the period of the review, most (about 80%) of the resource was devoted to preparations for the LHC (see Figure 1), although this includes data-taking and analysis from other experiments (D0, STAR, HERA-B, BaBar) which can be viewed as preparation for the LHC. The period includes the completion of major research programmes at LEP and the phased withdrawal from programmes at HERA, as well as the initiation of new research programmes in astroparticle physics. The overall programme is summarised in the table below.

Experiment	Facility	Status	Comment
AmPS	NIKHEF	complete	
CHORUS	CERN	complete	
DELPHI & L3	LEP	complete	
ZEUS	HERA	complete	
HERMES	HERA	complete	
ATLAS	LHC	ongoing	Construction 2000-2006; includes work on D0 at the Tevatron, Fermilab, US
ALICE	LHC	ongoing	Construction 2000-2006; includes work on STAR at RHIC, Brookhaven, US
LHCb	LHC	ongoing	Construction 2000-2006; includes work on HERA-B, DESY, DE and BaBar, SLAC, US
Theoretical Physics	NIKHEF	ongoing	
Astroparticle Physics	ANTARES Auger VIRGO	ongoing	Construction and operation
R&D & Grid	NIKHEF	ongoing	

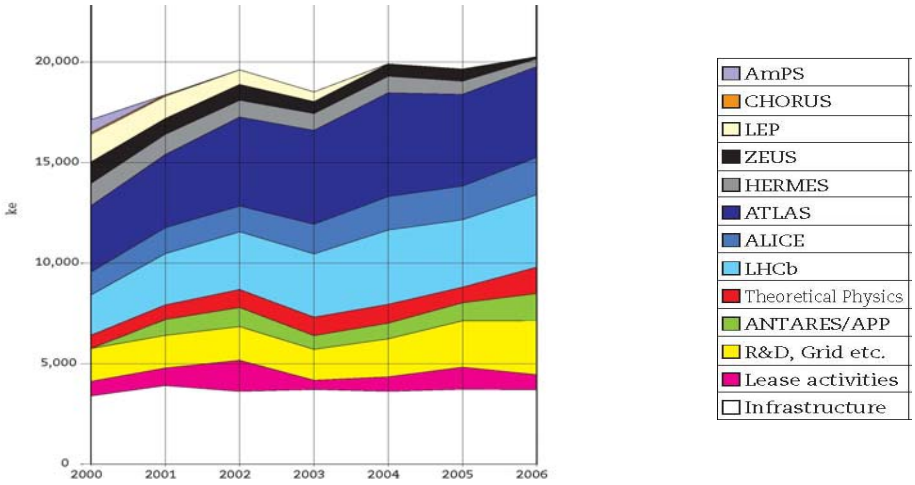

Figure 1: allocation of resources to research programmes

3.3 Organizational structure

The organisational structure is compact (see Figure 2), with a small senior management team led by the director and consisting of the institute manager and the head of personnel, supported by the head of the secretariat. Each of the projects and technical departments has a project or technical group leader, reporting to the director. In addition, technical support in the university groups is embedded locally. Each project or programme has its own internal structure and project plan, agreed with the director. The projects are structured across the collaborating institutes of NIKHEF in an integrated way.

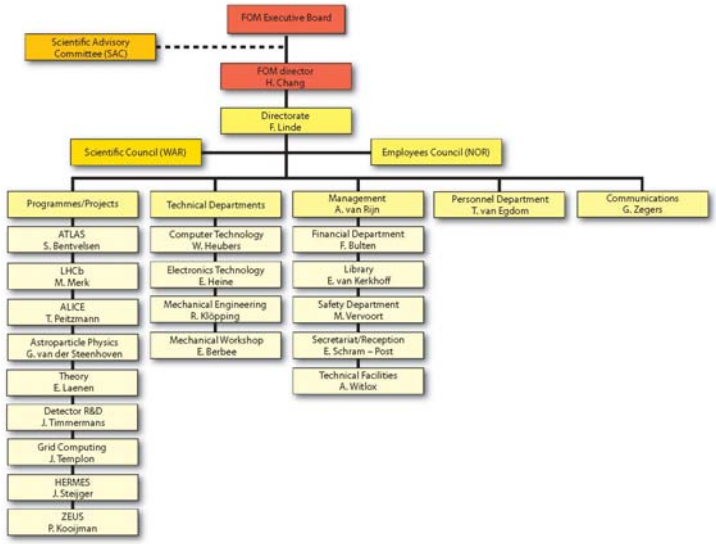

Figure 2: organisational structure

3.3.1 *Location*

The SAF/NIKHEF laboratory is located in the Science Park Amsterdam, and the collaboration also has a presence in the four collaborating universities, Universiteit van Amsterdam, the Free University Amsterdam, the Radboud University Nijmegen and the Utrecht University.

3.3.2 *Financial matters*

The research programme of the NIKHEF collaboration is funded by four separate sources (see Figure 3) – FOM funding of the base budget of the institute, FOM funding for the university groups, university funding for personnel and materials in the universities, and additional project funding acquired competitively by the institute from FOM, the EU, NWO, the Ministry of Economic Affairs etc, as well as income from the lease of the former accelerator buildings and from hosting a large part of the Amsterdam Internet Exchange (AMS–IX). In 2006, the total funding of NIKHEF was about 20.5 MEuro, 63% from FOM, 17% from the universities and 20% from third-party funding. Over the seven years under review, the funding of NIKHEF has increased by about 20%, mainly from the strong increase in the additional funding acquired competitively, which partly compensates for the reduction in the mission budget of the Institute and the erosion of its purchasing power through inflation.

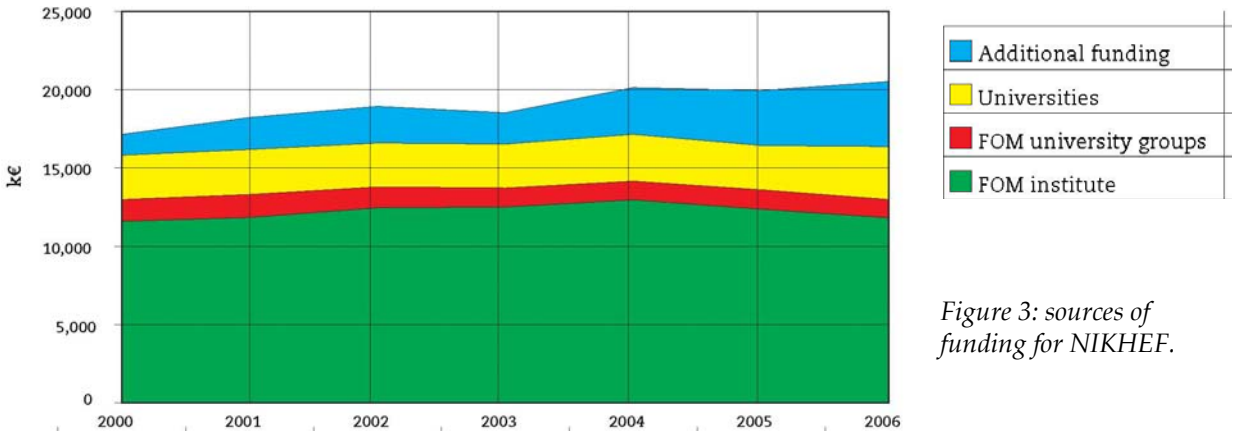

Figure 3: sources of funding for NIKHEF.

3.3.3 *Current staff*

The number of personnel, expressed in full–time equivalents (FTE) at NIKHEF has gradually decreased in the period 2000–2006 from about 253 to about 240 (see Figure 4). The number of permanent scientific staff has remained at about 57 FTE, although this includes the impact of two university theory groups joining the NIKHEF collaboration. There are about 15 post–docs and 60 PhD students. The number of technical staff varies depending upon the phase of the construction projects, and is currently (end 2006) about 85 FTE, down from a peak of about 109. About 40% of the permanent scientific staff, including all full professors, is employed by the university partners. In addition, there are about 22 FTE in managerial, secretarial, safety, library and technical services.

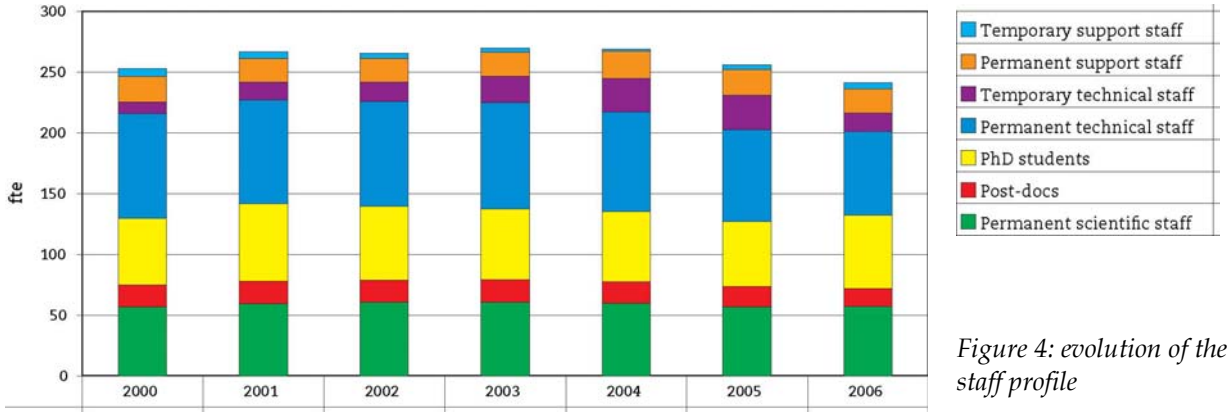

Figure 4: evolution of the staff profile

4 Assessment of the Institute

4.1 Answers to the Standard Evaluation Protocol

Evaluation of the institute with respect to Score (scale 5 – 1; see also appendix 7.4)

1. Leadership	5
2. Mission and goals	5
3. Strategy and policy	5
4. Adequacy of the resources (€)	4
5. Funding policies	5
6. Facilities	5
7. Academic reputation of the institute	5
8. Societal impact of the institute	4.5
9. Balance of the strengths and weaknesses of the institute	Not graded
10. Overall assessment of the institute	5

Overall assessment of the institute	**5**

There is no doubt that SAF/NIKHEF is one of the leading laboratories in experimental particle physics in the world, with an outstanding record of achievement in detector and electronics design, construction and commissioning, physics analysis and advanced computing techniques, supported by a strong phenomenology group. The period under review has seen the transition from an institute built upon the foundations of a strong portfolio of particle physics experiments, primarily at CERN but also at DESY and in the US, and a nuclear physics programme based on an in-house accelerator, to one with a continuing strong portfolio of particle physics projects together with an emerging astroparticle physics programme.

The accelerator-based particle physics programme is focussed on three LHC experiments – ATLAS, LHCb and ALICE – which are each coming to the end of their construction phase. NIKHEF has delivered on all of its commitments, and taken the lead in many areas, including the development of Grid technology. As part of their preparations for the analysis of the LHC data, NIKHEF engaged in experiments in the US (D0 at Fermilab, BaBar at SLAC and STAR at Brookhaven), where their contributions have been significant. Their pioneering work in ZEUS at DESY has been widely acknowledged.

NIKHEF has very quickly established itself in the relatively new field of astroparticle physics through its participation in the ANTARES project, where NIKHEF made an immediate and major impact, the benefits of which are just now being realised.

NIKHEF also has a strong and innovative outreach and educational programme which is internationally recognised, and is developing a strong knowledge transfer portfolio.

Overall, the SAF/NIKHEF institute has an outstanding reputation in the field. The committee notes that this conclusion is strongly supported by the independent bibliometric analysis by CWTS at the Universiteit Leiden, which found that, for example, a trend analysis of the citation impact of NIKHEF was about twice world average, consistent over the past 20 years; this is a remarkable achievement.

4.1.1 Leadership	5

The SAF/NIKHEF institute benefits from the strong and dynamic leadership of its director, Prof.dr. F. Linde, who has a very clear vision and direct management style, supported by an excellent management team under the Institute manager, Drs. A. van Rijn. There is a good atmosphere within the institute, communicated through the enthusiasm and pride which the members of staff display in their work. The leadership response to the sharp reduction in mission funding from 2004 was robust, and the programme of the Institute has been actively managed to achieve an outstanding return on past investments while delivering on their commitments to the ongoing programme and preparing the way for new opportunities in the medium to long term, even though this has meant withdrawing from some activities while they were still producing physics.

4.1.2 Mission and goals	5

The committee endorses the clear mission statement of NIKHEF (see paragraph 3.1) and supports it following two approaches based on accelerator-based particle physics and astroparticle physics. Furthermore it is pleased to note that the recommendation of the previous evaluation committee has been followed in establishing a clear astroparticle physics activity.

4.1.3 Strategy and policy	5

The strategy to achieve this mission is based on clear choices. The origin of mass (the search for the Higgs particle) is performed with the ATLAS experiment, the study of matter-antimatter asymmetry (CP violation) with LHCb and the early universe (quark gluon plasma) with ALICE. These experiments are all based at the LHC at CERN. In the area of astroparticle physics NIKHEF has chosen the theme 'What is the origin of high energy cosmic rays?', studying high energy neutrinos in ANTARES, high energy cosmic rays in AUGER and searching for gravitational waves in VIRGO.

The strategy is based on designing, building, installing and operating important components of the apparatus using NIKHEF's proven areas of expertise and facilities and then taking a major role in the analysis of the data.

In order to make a major impact, given the size of SAF/NIKHEF, difficult choices were made which has resulted, for example, in the absence of any accelerator based neutrino programme. The committee endorses this approach and this policy of the institute.

4.1.4 Adequacy of resources (€)	4

The resources of SAF/NIKHEF are divided into program budgets and a base funding in the form of a mission budget. The mission budget is currently foreseen to decrease quite substantially over the period 2007-2011, in spite of some temporary compensation that was provided to smooth the transition.

In its strategic plan the institute has expressed the strong ambition to become a significant player in astroparticle physics continuing a successful initial stage participation in ANTARES. Up to now this was mainly funded from special project income.

The committee endorses the ambition to broaden the primary mission of the institute to include a significant involvement in astroparticle physics and shares the view of the management that to become a significant player in this field a stable base funding is necessary to attract a number of young permanent staff, meaning that an increase of the mission budget will be needed if this is to be achieved without reduction of the LHC commitments.

4.1.5 Funding policies	5

As the budgets for the institute SAF/NIKHEF have been decreasing, the management has vigorously pursued other ways to secure funding to maintain the appropriate level of operation in the various programs. The philosophy is to stimulate the program leaders to pay temporary staff, notably post-docs from other external funds. This has led to a considerable amount of temporary funding also from sources other than NWO/FOM.

In spite of the remarkable success that the programs have had in these concerted efforts, the committee is concerned about the fact that the funding of an institute of this stature has decreased to a level where such a core component of the scientific activity has to be financed in this *ad hoc* fashion. This reinforces the view of the committee expressed under the previous point on the adequacy of resources.

4.1.6 Facilities	5

The facilities within SAF/NIKHEF include electronic capability, mechanical shops, and assembly facilities. These are complemented by a networking and computing installation. All are of the highest quality and have completed major construction projects for the different programs. For example, NIKHEF produced and assembled approximately 30% of the enormous ATLAS muon detector, a complete end cap of the ATLAS silicon tracker and substantial fractions of both the LHCb and ALICE detectors. This capability and capacity is a major factor in the ability of the NIKHEF physicists to contribute in a vital and meaningful way to the experiments in which they participate. In turn this also makes NIKHEF physicists very attractive collaborators within the particle physics field. It has also enabled a remarkably strong entry into the astroparticle physics field with innovative contributions to, for example, the ANTARES experiment. The laboratory is to be commended for giving an appropriate level of attention to these enabling skills, facilities and technologies.

4.1.7 Academic reputation of the institute	5

NIKHEF activities are embedded in a worldwide community of particle and astroparticle physicists. In this highly competitive and creative community, NIKHEF has a remarkable scientific reputation. It rests on its excellent work within large international experimental collaborations as well as on the theory sector. The committee was impressed by the high number of coordinator positions held by NIKHEF physicists in various programmes and collaborations. Many NIKHEF members serve in distinguished international committees, like ECFA, ApPEC, NuPECC, CERN Council Strategy Group, HEP board of EPS, and others. Prof. J. Engelen was appointed as Chief Scientific Officer and deputy Director General of CERN. Normalized to the number of scientists, NIKHEF's international representation is extremely high and demonstrates the excellent reputation of the institute as well as of many individuals.

4.1.8 Societal impact of the institute	4.5

Over the last few years NIKHEF has strongly increased the level of its educational and outreach activities. It has been very successful in communicating the meaning and importance of science and particle physics in particular, on many different levels of society, e.g. the HiSparc project for high schools which won several educational prizes.

In addition NIKHEF's increased emphasis on knowledge transfer over the last years to 'third parties' (including industry and other scientific organizations) is delivering results.

It is important to maintain this positive momentum and further capitalize on it.

4.1.9 Balance of the strengths and weaknesses of the institute	Not graded

The committee confirms the accuracy of the SWOT analysis presented in the strategic plan.

5 Past performance: research programme assessments

5.1 Research programme ATLAS

Current research programme leader:	Stan Bentvelsen
Tenured staff:	18.4
Other personnel (end 2006):	2.3 Postdocs, 16.8 PhD-students, 25.1 Technical Staff
Publications (2000-2006):	121

Quality	5
Productivity	5
Impact	5
Vitality	5
Overall	**5**

Overall assessment

The NIKHEF Group in ATLAS has been prominent since the initial approval of the experiment, for many years under the leadership of the current NIKHEF Director, F. Linde. The current leader S. Bentvelsen has been coordinator of the ATLAS Top Quark Physics Group.

On the detector front, NIKHEF was the largest contributor in the construction of the huge ATLAS central muon detection system. They were leaders, in the overall system design. There is a very ambitious goal for the system wide precision which imposes ferocious construction and alignment requirements and NIKHEF was responsible for the design of the crucial RASNIK system which enables this precision.

In addition, the NIKHEF Group was a strong partner in the fabrication of the SemiConductor Tracker (SCT) taking responsibility for the assembly of one complete end cap.

Both of these systems have been delivered to CERN and installation is well advanced.

Beyond the detectors, SAF/NIKHEF engineering and support was a vital factor in the construction of the two End Cap Toroids in industry and their installation at CERN. Each assembly contains eight individual superconducting coils, which together generate the toroidal field. With the barrel toroids, the system constitutes a frighteningly large magnetic system.

All the components delivered by The Netherlands and coordinated by NIKHEF for ATLAS are working well.

The planning for participation in the commissioning of the ATLAS apparatus with beam appears to be sound. It is intended that various techniques such as the use of top quark pair production to understand the detector performance, which the group is transferring from its Tevatron experience with the D0 Experiment, will initially provide the cornerstone of the approach. This approach accommodates/demands an understanding of the two detectors in which NIKHEF has had construction responsibilities.

A sub-group of the ATLAS group has participated in the D0 Experiment at the Fermilab Tevatron. Thereby the group has developed techniques for hadron collider physics, which will be directly transferred to the work on ATLAS. This initiative has also maintained a steady publication output and developed and graduated a number of students.

The excellent computing support and infrastructure has permitted SAF/NIKHEF to develop a fully-fledged Tier 1 site in Amsterdam. One of the NIKHEF group, K. Bos, is coordinator of ATLAS Computing Operations.

The strategic plan discusses the likely participation of NIKHEF in the upgrade of ATLAS to support operations with increased (SLHC) luminosities. While there is discussion of participation in the B–layer replacement, the group anticipates needing substantial funding to support a more extensive tracker replacement project.

Within ATLAS, the NIKHEF group holds numerous positions of responsibility. Overall this is an excellent programme.

Recommendations

- The NIKHEF ATLAS group should continue to energetically pursue the commissioning tasks in ATLAS as beam collisions appear in order to place its physicists in key roles, close to the critical path to physics.
- The NIKHEF ATLAS group should continue to accept leadership roles within ATLAS; ideally these should include a complete spectrum including physics leadership.
- While a complete understanding of the ATLAS upgrade plans may only come with experience with real data, the NIKHEF group should continue to devote a measured degree of attention to these issues to ensure their continued full participation and leadership in shaping the project.

5.2 Research programme LHCb

Current research programme leader:	Marcel Merk
Tenured staff:	9.2
Other personnel (end 2006):	3.1 postdocs, 10.4 PhD-students and 24 technical staff
Publications (2000-2006):	227

Quality	5
Productivity	5
Impact	5
Vitality	4.5
Overall	**5**

Overall assessment

The LHCb scientific programme aims at precision measurements of the charged weak interactions in the B-meson sector to search for new phenomena that could explain the matter-antimatter asymmetry observed in Nature.

NIKHEF is one of the founding members of the LHCb collaboration, with funding starting in 1999. First data are expected to be collected during the second half of 2008. The LHCb collaboration consists of 530 physicists from 10 countries. From the very beginning the NIKHEF group took a leading role in the construction of the LHCb experiment via the substantial hardware contributions to the Outer Tracker (OT) and the Vertex Locator (VELO). These detectors play a key role in measuring charged tracks and vertices of particles from B-meson decays and are thus essential for the physics exploitation.

In addition to the construction of the VELO and OT detectors, large efforts have been devoted to the software development for precision measurement of charged tracks and decay vertices. Furthermore, the group is also strongly involved in the preparation of physics analyses

focusing on B_s meson decays. The experience gained by participating in the HERA-B experiment at DESY (Germany) and the BaBar experiment at SLAC (USA) is very important for the data analysis preparation at the LHC. Particularly, joining BaBar in 2002 had a very positive impact: it enabled the group to perform measurements before the LHCb start-up, gaining experience with large data samples of B-mesons and resulting in an impressive number of publications signed by NIKHEF members since 2003.

The outstanding contributions of the NIKHEF group to LHCb are also illustrated by various coordination functions (e.g., project leader of the OT, deputy-project leader of VELO and convenor of one of the analysis groups), demonstrating at the same time excellent management skills of NIKHEF's staff members. Overall, the highly motivated group is excellently positioned to play also a leading role in the exploitation of LHCb data to be collected till 2014. According to the present schedule, an upgrade of LHCb is foreseen after 2014, which will certainly depend on the physics results obtained, on the detector performance during the first years of operation as well as on a strong physics case to operate LHCb beyond 2014.

Recommendations

- The NIKHEF group is strongly encouraged to closely follow the commissioning of the OT and VELO. Special emphasis should be put on the development of the observed signal degradation in the OT after irradiation with radioactive sources. It is important that all necessary steps are taken to cure the problem in order for the OT to operate with the expected performance.
- A stable level of scientific manpower should be maintained in order to achieve the scientific goals and to continue the already existing leading role in different coordination/management tasks within the LHCb collaboration. The group should pursue additional funding to enhance their analysis capability.

5.3 Research programme ALICE

Current research programme leader:	Thomas Peitzmann
Tenured staff:	6
Other personnel (end 2006):	1.3 postdocs, 7.7 PhD-students, 12 technical staff
Publications (2000-2006):	170

Quality	5
Productivity	4.5
Impact	5
Vitality	4
Overall	**4.5**

Overall assessment

NIKHEF has a long history of involvement with relativistic heavy ion collisions, from the WA98 experiment in the Ω spectrometer at CERN in the 1980s, and the NA49 and NA57 experiments at CERN in the 1990s. This work continues through the ongoing STAR experiment currently running at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven (Au+Au collisions at a centre of mass energy of 200 GeV per nucleon), and will transfer to the ALICE experiment at the LHC in due course (Pb+Pb collisions at a centre of mass energy of 5.5 TeV per nucleon).

The results from RHIC have shown unexpected behaviour of nuclear matter under extreme conditions, leading to a new description of such matter as a strongly interacting opaque liquid with extremely low viscosity. NIKHEF has made significant contributions to the analysis of the elliptical flow mechanisms, and to di-jet structures, as well as contributing to the completion and commissioning of the electromagnetic calorimeter. This experience leads directly into preparations for the analysis of the data from ALICE.

For the construction of the ALICE detector, the NIKHEF group has built upon its strength in silicon detector technology to lead the design, test and construction of the Silicon Strip Detector, part of the Inner Tracking System, in collaboration with 7 other groups. The final assembly was done in one of the university partners (Utrecht) and shipped to CERN at the end of 2006.

Overall, this represents a significant research programme, well balanced between construction and exploitation, with considerable impact, confirmed by the bibliometric analysis.

The next few years should see a rather rapid transfer of the analysis activity from the STAR experiment to ALICE, with the first few years (until 2009 at least) commissioning and understanding the detector and extracting the first physics, with more detailed analyses and deeper understanding coming in the later years. This is a challenging prospect for the period 2007-2013.

Recommendations

- The committee recommends that there should be a sufficient number of research physicists (post-docs and PhD students) to exploit fully the investment made in ALICE, even if this requires a reduction in support for STAR.

5.4 Research programme Astroparticle physics

Current research programme leader:	Gerard van der Steenhoven
Tenured staff:	7
Other personnel (end 2006):	1.9 postdocs, 9.1 PhD students, 7.1 technical staff
Publications (2000-2006):	14

Quality	5
Productivity	5
Impact	5
Vitality	5
Overall	**5**

The main research area of the NIKHEF astroparticle group is high energy neutrino astroparticle physics with ANTARES, and later with its successor KM3NeT. This group already has an excellent record of success. Next in priority is cosmic ray detection with the help of radio techniques. This work is in the phase of prototype operation. Third in priority is work on gravitational waves being in an early phase of preparing contributions to existing and planned experiments. In the spirit of a "multi-messenger" approach, the three research lines nicely complement each other. Cosmic ray and gravitational wave activities at NIKHEF are comparatively small at this point, but are contained in a national strategic plan. The increase of astroparticle activities nicely follows the recommendation of the previous review committee. These activities are clearly on an upward curve, and the preparatory work is expected to translate into exciting physics results within the next programme period.

a) ANTARES/KM3NeT

The NIKHEF group has made significant contributions to hardware, software and analysis tools in ANTARES and earned international reputation. Most notable is a data transmission scheme very different to the one originally conceived by the collaboration which provides very increased flexibility in data acquisition. It is flanked by highly innovative filter algorithms successfully installed at shore. The group merits and needs strong support in order to be able to harvest the physics results from ANTARES and to maintain its prominent role. It belongs now to the 2-3 leading players in the collaboration. The election of Maarten de Jong as deputy spokesperson speaks for the leadership of the group.

The group is also vital in preparing KM3NeT – by development of new light detectors as well as by extensive detector simulations. The new light detectors would lead to dramatically improved light collection and background suppression. If this concept can be realized economically, NIKHEF's contribution would result in a significantly improved quality of the device. KM3NeT is on the prestigious ESFRI list of large European infrastructures.

b) Auger

The Auger effort rests on the implementation of the radio technique in Auger. This technique would extend and complement present detection methods for a comparably low price. Research is done together with the Nijmegen group which has pioneered the method in the context of the LOFAR observatory. Present prototype tests with one antenna at the Auger site are planned to be extended to a stepwise growing array of antennas. The group will take part in the scientific exploitation of Auger and also of LOFAR.

c) Virgo

Gravitational wave detection is the third leg of the Dutch strategic plan on astroparticle physics. Physicists from NIKHEF and VU Amsterdam focus their present initial activities to the Earth-bound interferometer Virgo+. On a longer scale, participation in the Earth-bound Einstein Telescope (E.T.) and in the space experiment LISA is considered. Both E.T. and LISA have a guaranteed discovery potential and would open full gravitational wave astronomy.

Recommendations

- The committee endorses the plan to further develop astroparticle physics into one of the main components of NIKHEF programme. This policy is in accordance with profiles of many other particle physics laboratories worldwide.
- An increasing role and impact of Dutch astroparticle physics, without compromising the LHC program, requires an increase of the mission budget as suggested by NIKHEF.
- The ANTARES/KM3NeT group merits strong and firm support in order to be able to harvest the physics results from ANTARES and at the same time to prepare for the investment in KM3NeT and to maintain its prominent role in European neutrino astrophysics. Early availability of investments like those recently submitted as a NWO investment proposal would give the Netherlands a strong role in early decisions on technology and site.
- Activities on radio detection of cosmic ray detection in Auger and gravitational wave detection are based on a strategic plan on astroparticle physics in the Netherlands. They nicely complement the neutrino activities and should get increasing support.

5.5 Research programme Theory

Current research programme leader:	Eric Laenen
Tenured staff:	8.8 (including two recently joining university groups)
Other personnel:	2.4 postdocs, 4.3 PhD-students
Publications (2000-2006):	128

Quality	5
Productivity	4
Impact	5
Vitality	4.5
Overall	**4.5**

Overall assessment

The theory group of the NIKHEF is of moderate size, but covers a wide range of topics, varying from developing symbolic manipulation programs to perform complicated higher order diagram calculations, to topics in string and conformal field theory. The group members set to a large extent their own agenda and most of them do collaborate with the experimental groups. The group maintains strong ties with the other university based theoretical institutes in the Netherlands through joint appointments, regular meetings, and through participation in the Dutch Research School for Theoretical Physics. The publication output is moderate in volume but of high quality and has high impact.

The program has some outstanding components. Remarkable is the achievement of Jos Vermaseren and co-workers, who developed the FORM package of computational tools which has set a new standard in the field of computerized diagrammatic calculations in quantum field theory. These tools are widely used. Another outstanding component with a clear link to the LHC experimental programme is the extensive work on perturbative QCD, consisting of analytical calculations and Monte Carlo event generators.

The number of externally funded PhD students and postdocs in the past period appears to be rather low, also reflected in a relatively modest number of publications. Fortunately this situation is changing at present. The committee was surprised to hear of problems to attract qualified candidates for PhD positions in particle theory.

Recommendations

- In view of the overall NIKHEF mission the institute should make sure that in starting up astroparticle physics programs, a proportional theoretical component should be included.
- The committee strongly endorses the proposed focus on theoretical work that is directly linked to the LHC. This would make the phenomenological research effort more robust and coherent, ensuring that the Dutch (theoretical) physics community will optimally profit from what the LHC will deliver.
- The committee encourages the theory group to continue its efforts to obtain external funding to enlarge their overall research output.

5.6 Research programme Detector R&D

Current research programme leader: Jan Timmermans
Tenured staff: 3
Other personnel: 0 postdocs, 2 PhD-students, 2.5 technical staff
Publications (2000-2006): 42
Awards,

- 3rd prize Science Park Competition 2006 "Nieuwe Ideeen": RasIce: a monitor system for sag of roof constructions.
- 1st prize FOM60 Competition 2006 "Win the Future": RasClic: a new seismograph.

Quality	5
Productivity	5
Impact	5
Vitality	4.5
Overall	**5**

Overall assessment

This is an impressive contribution given the size of the team.

The RASNIK alignment system, invented and developed by NIKHEF, is being used in multiple programs (L3 experiment at LEP, ATLAS at LHCb), and is planned to be used for a future Compact Linear Collider.

A novel and promising micro patterned gaseous detector allows 3D particle tracking using CMOS pixel read-out chips as active anode in a gaseous detector. Proof of principle was realized in 2004 using a Medipix2 chip.

The group has a strong track record in collaborations with external technology competence centres like MESA+ at University of Twente and IMEC and the company PANalytical.

Recommendations

- Since three out of five senior staff members will retire within next three years it is of prime importance to find the right replacements to maintain the competence. The committee was pleased to hear two positions were approved. Finding the right quality people should have higher priority than filling both positions within same year. Scouting for top talent should be done on world-wide basis.
- Deep sub-micron CMOS and MEMS technology is likely to become of increased importance. It important to maintain a strong link to competence centres.

5.7 Research programme GRID

Current research programme leader:	Jeff Templon
Tenured staff:	3
Other personnel (end 2006):	6.6 FTE technical staff
Publications (2002-2006):	13

Quality	5
Productivity	5
Impact	5
Vitality	5
Overall	**5**

Overall assessment

The SAF/NIKHEF group has a long history of involvement with advanced computing technology, and has been very active in the development of the grid technology in Europe. Amsterdam is a key networking hub in the international academic network, and NIKHEF is able to capitalise upon this excellent connectivity. The installation of a full LHC Tier 1 site at SARA and SAF/NIKHEF will give the NIKHEF a significant advantage in the analysis of the LHC data. The SAF/NIKHEF group was instrumental in driving the BIG Grid project, and in securing a significant amount of funding for its development.

SAF/NIKHEF was a core member of the EU Datagrid, and is a core member of the successor EGEE project, which plays an important role in making Grid developments available to the wider scientific community, and society at large.

The Grid team is relatively small, with a heavy service role. As the Grid develops, both for the LHC and for other application, including outside particle physics, it will be essential to consolidate the commitment to maintaining the grid resources and modestly invest in its future development, as is planned through the increase to about 14 FTE over the next two years.

This is not an area where there is a high publication rate, and many of these are conference reports, but the rate of publication is reasonable, and they have a relatively high impact. The pioneering work of K. Bos is recognised through his appointment as the coordinator of the ATLAS Computing Operations, and as chair of the LCG Deployment Board. Further international recognition comes from the appointment of D. Groep as chair of the International Grid trust Federation and as area director for Grid security of the Open Grid Foundation.

Recommendations

- The committee strongly endorses the plan to increase the number of staff, particularly in the area of Grid operations.

5.8 Completed programmes

5.8.1 AmPS, LEP and Chorus

AmPS
The scientific goals of experiments at the AmPS facility using electron beams at energies up to 720 MeV focused on nucleon-nucleon correlations, the proton spectral function of the nuclei, the neutron charge form factor and the spin structure of the deuteron. After the decision to close AmPS in 1998, the scientific programme terminated in 2001. Since 2000 additional 43 publications and 10 PhD theses resulted from the data collected at this national facility. Besides the scientific achievements of the AmPS programme, it is also important to recall that several of the high-tech equipments have been made available for experiments at other facilities in the US (MIT/Bates and Jefferson Laboratory) and Germany (Mainz), with NIKHEF participating in the later.

LEP at CERN
In November 2000 the LEP accelerator was stopped after 12 years of very successful operation. The main physics goals were to perform precision measurements of the electroweak theory and searches for the Higgs Boson as well as for physics beyond the Standard Model. The NIKHEF group participated in two LEP experiments: DELPHI and L3. The data analysis was terminated at NIKHEF in 2004. During the period of this review, further 228 scientific papers were published and 18 PhD theses were completed, illustrating the very impressive scientific output of the LEP programme.

NIKHEF played a leading role in both experiments, starting from the design and construction of detector components to the running of the experiment as well as in the analysis and publication of results. Furthermore, members of NIKHEF have been convenors of different physics analysis and steering groups as well as represented the collaborations in top-level management functions (J. Timmermanns was spokesperson of DELPHI and G. Bobbink chairperson of the L3 management board).

Based on the achievements at LEP, the NIKHEF group is very well positioned to establish itself as a leading institute with major contributions to a future linear collider experiment.

CHORUS experiment at CERN
A small group of NIKHEF has joined the CHORUS experiment in 1992. The experiment ended in 2002 and analysis of the neutrino scattering data continued till 2006, resulting in 12 scientific papers and 2 completed PhD theses since the year 2000.

The main physics goal was the first observation of muon-neutrino to tau-neutrino oscillations using as a key signature the tau-lepton decay in the 800 kg of emulsion. No oscillation was observed, resulting in neutrino oscillation exclusion limits. Important other physics results of neutrino-induced charm production and charged-current nuclear structure function measurements were obtained.

The NIKHEF group contributed to the construction of the CHORUS detector as well as to the development of the automatic scanning and analysis software. Furthermore, the NIKHEF group pioneered the charm production analysis.

5.8.2 ZEUS (Programme Completed)

Current research programme leader: Paul Kooijman
Tenured staff: 0.4
Other personnel (end 2006): 0 postdocs, 2 PhD-students
Publications (2000-2006): 89

Quality	5
Productivity	5
Impact	5
Overall	**5**

Overall assessment

Over the last 25 years the NIKHEF group made major and vital contributions to the ZEUS experiment. It was responsible for providing and maintaining major detector systems (the forward and rear calorimeters, pre-shower detectors, triggering, and the Si vertex detectors) which built on existing NIKHEF strengths (e.g. triggering) or developed new capabilities (e.g. Silicon detectors). These components were all crucial in producing results of high quality.

The NIKHEF group led the structure function measurement of F2, one of the flagship measurements at HERA, which led to the discovery of an unusually rapid rise in F2 with decreasing Bjorken-x. The results on the quark and gluon distribution functions, while important in their own right, will be vital in the understanding and interpreting the data from the LHC. In the final period of HERA these pioneering measurements were followed by the development of techniques for identifying heavy quark events in the collisions and evaluating the heavy quark contributions to F2.

The final period of operation at HERA did not produce the luminosity expected although reasonable lepton beam polarisations were achieved. This allowed the extraction of weak interaction effects (e.g. xF3) but the statistical significance was not as good as was originally hoped.

The ZEUS activities demonstrated the usual NIKHEF strengths: the ability to build and operate high quality innovative detectors and then use them to take a leading role in the analysis of the data producing important physics.

Recommendations

- The institute should be congratulated on completing, in a responsible manner, an impressive programme and FOM on supporting this major scientific activity.

5.8.3 HERMES (Programme Completed)

Current research programme leader: Jos Steijger
Tenured staff: 1.8
Other personnel (end 2006): 0 postdocs, 3.2 PhD-students
Publications (2000-2006): 64

Quality	5
Productivity	5
Impact	4.5
Overall	**5**

Overall assessment

NIKHEF provided major components to the HERMES detector over the duration of the experiment (lead glass calorimetry, multi-strip gas vertex chambers, and Si vertex detectors). The Lambda wheel was particularly important in the extraction of the strange quark contribution in the spin of the proton.

NIKHEF–led results have been noteworthy in their impact. Contributions have included analyses on the spin structure function g1, the flavour (u,d,s) decomposition of the spin structure and crucial asymmetry measurements leading to improved determinations of the gluon contribution to the proton spin. The final running at HERA has also allowed a study of transversity measurements which will contribute to studies of GPD's (Generalised Parton Distributions) and innovative experiments with ion targets.

This HERMES involvement demonstrates again the traditional NIKHEF strengths of building and operating innovative detectors and then using them in the analysis to produce important results.

Recommendation

- The NIKHEF HERMES group should be congratulated on completing a very substantial and important programme of spin studies and FOM on supporting an important scientific activity.

5.9 Future initiatives

While ensuring the strength of its current program, NIKHEF has positioned itself well for participation in future projects. The general Strategic Plan designates branch points or decision points at which it expects to decide on specific projects. The lines of accelerator-based research are dominated by participation in the CERN program. There is a clear understanding that the ATLAS program will persist for more than a decade. It is envisaged that NIKHEF will seek a significant, perhaps leadership, role in a project to replace the ATLAS inner detector as the luminosity of the machine increases.

In contrast to the ATLAS program, the LHCb and ALICE programmes are foreseen to continue only if, after the initial phases, attractive long-term physics programmes emerge. This creates flexibility by allowing the possibility for the introduction of new programmes.

Different options for such new programmes are foreseen in two areas. One such direction would be participation in an experiment at a future lepton-antilepton collider. This could be the International Linear Collider, the Compact LInear Collider or a muon collider depending on the world strategy. At present, the astroparticle physics line of research consists of one strong experiment ANTARES which will lead very soon into participation by NIKHEF in the much larger underwater detector, KM3NeT. This participation is the subject of current proposals.
In addition, there are also other possible astroparticle physics projects such as the gravitational wave detector Lisa and/or a possible successor to Auger.

In order to be ready for these possible future projects, NIKHEF is attempting to ensure the continuation of its strong research and development group.

5.10 Education and outreach

Over the last few years NIKHEF has strongly increased the level of its educational and outreach activities. It has been very successful in communicating the meaning and importance of science and particle physics in particular, on many different levels of society.

It is clear that the management of NIKHEF actively stimulates staff to organize and join such activities. NIKHEF is regularly organizing visits to CERN for stakeholders in science, such as politicians, governing bodies and journalists. The press coverage of NIKHEF activities has shown a sharp increase in recent years. Very successful is the HiSPARC project (which won several educational prizes) in which a collection of high schools spread over The Netherlands collaborates in a joint cosmic ray experiment. NIKHEF has been also very active in participating and initiating other educational and outreach initiatives which have a broader scientific scope (Techniek Toernooi, Open days of the Science Park Amsterdam, EurekaCup etc.). The institute maintains an attractive website which provides a rich source of material for educational purposes.

As far as graduate education is concerned the NIKHEF is directly involved in a two year master program with the University of Amsterdam and the Free University Amsterdam. The PhD program is well organized in the Research School in Subatomic Physics in which all universities of the NIKHEF collaboration take part. The committee has talked to a representative number of graduate students, which were very enthusiastic about the way in which they participate in exciting research and about the way they are supervised. The point raised by a number of them was the highly appreciated package of additional professional training programs that is offered to those employed by the FOM, but not to those employed by the universities. See also appendix 7.3.

The committee rates the educational and outreach activities of NIKHEF as excellent and appreciates it as an important tool to raise the public awareness of and support for science in general and high energy physics in particular. A serious involvement in the graduate education is necessary to breed the necessary number of specialized scientists that will be needed to shape the future of the field.

5.11 Knowledge transfer

NIKHEF's increased emphasis on knowledge transfer over the past years to 'third parties' (including industry and other scientific organizations) is showing good results. It is important to further capitalize on this positive momentum.

In grid computing NIKHEF is a recognized worldwide expert, they play a key role in 'Gridforum NL', knowledge is transferred to other scientific disciplines via NIKHEF leadership of the 'Data Intensive Sciences' and 'Scaling and Validation' programmes of the Dutch National Virtual Laboratory (VL–e) project. Grid knowledge is used in DANS (archiving and analysis tools for researchers in the humanities), the Max-Planck Institute for Psycho-Linguistics in Nijmegen, and the Academic Medical Center in Amsterdam. There is also significant industrial partnership planned and funded with Philips Research over the next four years.

A striking example of successful technology transfer is work on detector R&D to PANalytical resulting in the first commercially available X–ray detector based on Medipix. PANalytical is successfully using NIKHEF experience and facilities.

The project is funded by the Dutch and Flemish ministries of economic affairs as well as by the European Union (project E!3624–RELAXD).

6. Conclusions and recommendations

The committee was very impressed with the scientific achievements of the SAF/NIKHEF institute. NIKHEF has an excellent reputation in particle physics as a world-class partner, with strength in breadth and depth, from detector development and construction to physics analysis, with a first class record of innovation and leadership. The close collaboration with the four Universities within the NIKHEF consortium allows the Netherlands to make major contributions to large projects, and enables them to take on highly visible leadership positions. This experience is now being used in the development of a new programme in astroparticle physics, where NIKHEF has established itself in a remarkably short time.

Achieving this within a constrained budget has required strong leadership and active management within the institute itself. The portfolio of projects, whilst covering many areas of current activity, is very selective. NIKHEF has a clear policy of joining those projects where it can have a major impact, and which builds upon their core competences. However, there are major areas of experimental activity, such as accelerator-based neutrino physics, which cannot be included through limitations on resources. Given the long time-scale involved in all of the projects (at least 10 years and sometimes more than 20 years), it is necessary to have the clear vision of the medium and long term, and the appropriate balance of resources between the exploitation of past investments, construction for future projects and R&D into new technologies. All of this is clearly laid out in their Strategic Plan 2007-2012, with indications of the programme beyond. Nevertheless, NIKHEF retains the flexibility within the plan to respond to circumstances as they develop, as it has done so successfully in the past.

Given that NIKHEF is a centre of excellence with a world-wide reputation, the committee is very concerned at the erosion of the Mission Budget, both in absolute terms and through inflation. NIKHEF has been very successful in gaining external support through open competition, but this success is built upon the solid foundation provided by the Mission Budget, and should be used primarily to enhance the programme and to provide opportunities for young researchers to develop.

Recommendations

- The committee strongly endorses the SAF/NIKHEF Strategic Plan 2007-2012, and the proposed programme of accelerator-based particle physics (ATLAS, LHCb and ALICE at the LHC at CERN) and astroparticle physics (ANTARES, KM3NET, Auger and VIRGO/LISA), supported by a vigorous theoretical programme and excellent GRID infrastructure.
- The committee strongly endorses the programme of R&D for future detectors, and the request for resources to enable NIKHEF to prepare for the next generation of major experiments.
- In order to enable the astroparticle physics programme to develop so that NIKHEF can become a leader in this emerging field, building upon its established reputation in particle physics and its achievement in ANTARES, while fully exploiting its investment in the LHC experiments, the committee strongly endorses the request for an increase in the Mission budget contained with the Strategic Plan.
- The committee strongly endorses the "NIKHEF consortium model" with its close collaboration between the national laboratory (SAF/NIKHEF) and universities, working together under a Director to define and pursue strong, coordinated national programmes in particle physics and astroparticle physics.

7. Appendices

7.1 Curricula vitae of the committee members

Curriculum Vitae Professor K.J. Peach

Biographical Details, Qualifications, Prizes and Membership of Learned Societies

- Kenneth Joseph Peach, born 5th November 1945 in Derby, UK.
- B.Sc. (Hons) Physics (1967) University of Edinburgh
- Ph.D. (1972) University of Edinburgh; Thesis *A Study of the charged decays of the* K_L
- EPS-HEPP Prize 2005 as a member of the NA31 Collaboration "*which showed for the first time direct CP violation in the decays of neutral K mesons*".
- Institute of Physics 2006 Rutherford Medal and Prize "*For his contributions to high energy physics as a leader of key experiments at CERN investigating CP violation, and as Director of Particle Physics at CCLRC's Rutherford Appleton Laboratory where he has played a key role in reviving accelerator science for particle physics applications in the UK.*"
- F.Inst.P, C.Phys (1989) (associate member since 1967)
- FRSE (1999)

Current Position

(Since May 2005) Director, John Adams Institute for Accelerator Science
University of Oxford and Royal Holloway University of London
Address for correspondence: Denys Wilkinson Building,
Keble Road,
Oxford OX1 3RH.
Tel: +44 (0) 7770 652548 e-mail: Ken.Peach@adams-institute.ac.uk

Previous employment and awards

1. *October 1967 to September 1970:* SERC Studentship
2. *October 1970 to September 1975:* Demonstrator, Department of Physics, University of Edinburgh
3. *October 1975 to September 1981:* Research Assistant, Department of Physics, University of Edinburgh.
4. *October 1981 to September 1986:* Advanced Fellow, Department of Physics, University of Edinburgh
5. *October 1986 to September 1992:* Research Officer, Department of Physics, University of Edinburgh
6. *October 1992 to September 1996:* Reader, Department of Physics & Astronomy, University of Edinburgh
7. *September 1996 to April 1998:* Deputy Leader of the Particle Physics Experiments Division, CERN
8. *October 1996 to March 2002:* Personal Chair in Particle Physics Experiments, University of Edinburgh.
9. *January 1998 t0 July 2005:* Director, Particle Physics, CCLRC Rutherford Appleton Laboratory
10. *January 2004 to October 2005* Director, CCLRC e-Science Centre, CCLRC

I was leader and principal investigator of the Edinburgh Particle Physics experimental group from October 1990 to September 1996.
Visiting chair Edinburgh (2003-2007).

Research Interests

1. K_L decays using a heavy liquid bubble chamber (1967-1973)
2. K_L decays, and on K_Lp scattering in a hydrogen bubble chamber (1970-1978)
3. Intermediate energy π^+p scattering (1975-1983)
4. CP-violation in K_L decays - NA31 (1981-1993) and NA48 (1990-1996)
5. Neutrino Factories and Muon Ionisation Cooling Experiment (1998-2005)
6. Accelerator R&D (2005-)
7. Non-Scaling Fixed-Field Alternating Gradient Accelerators for research (EMMA) and medicine (PAMELA) (2006-)

Academic and Research Responsibilities

1. Steward, Scottish Universities Summer School in Physics (SUSSP), Middleton Hall, (1973).
2. Organising Committee and joint Editor, SUSSP, St. Andrews, (1984).

3. Member, Sub-Committee on CERN of the Particle Physics Committee of the Nuclear Physics Board. (1977-1980).
4. Committee member and Tutor, Rutherford Laboratory Summer School for Young Experimentalists, (1978-1979).
5. Member, CERN Computer Allocation Committee (COCOTIME) (1983-1986).
6. Committee member and Tutor, Rutherford Laboratory Summer School for Young Experimentalists, (1987-1989).
7. Member of Particle Physics Experiments Selection Panel (PPESP) 1987-1990.
8. Member of the Particle Physics Committee (PPC) 1989-1993.
9. Chairman, RAL Users Advisory Committee (UAC) 1989-1993;
10. Member of the UK Committee on CERN (UKCC) 1989-1993.
11. Member of the PPC Strategy Group (Particle Physics 2000) 1989-1991.
12. Lecturer, British Universities Summer School in Theoretical Elementary Particle Physics, Oxford (1989).
13. Lecturer, British Universities Summer School in Theoretical Elementary Particle Physics, Glasgow (1990).
14. Member, Department of Trade and Industry Task Force on High-Energy Research facilities, (1991-1994).
15. Member, Management Advisory Board of the Industrial Liaison Unit, RAL (HERF-ILU) (1992-1995).
16. Lecturer, BUSSTEPP-Edinburgh (1992).
17. Member of the Nuclear Physics Board (NPB) (1991-1993).
18. Member of the SERC's Scientific Computing Advisory Panel (SCAP) (1991-1994).
19. Lecturer, 1st Balkan Physics Union Summer School in Physics, Istanbul (1991), and at 5th Turkish Physical Society Summer School in Physics, Bodrum (1991).
20. Director and lecturer, 6th Turkish Physical Society Summer School Physics, Bodrum (1992).
21. Director, Rutherford Laboratory Summer School for Young Experimentalists, (1993-1995).
22. Organising Committee, 27th Rochester International Conference on High Energy Physics, Glasgow, (1994).
23. Member, CERN SPS and Lear Committee (SPSLC) 1992-1996. (Acting Chairman February-April 1995)
24. Member, Editorial Board for Journal of Physics G (1993-1996).
25. Organising Committee and joint Editor, SUSSP, St. Andrews, (1993).
26. UK delegate, European Committee on Future Accelerators (ECFA) (1994-1996).
27. UK delegate, Advisory Committee of CERN Users (ACCU) (1993-1996), Chair (1994-1996).
28. Member, SERC Industrial Affairs Panel, (1993).
29. Member, PSAB Industry Liaison Advisory Panel, (1993-1994).
30. Chair, PPC Industry Liaison Panel, (1993-1994).
31. Member, T3D Resources Allocation Panel (TRAP), (1994-1997).
32. Member, SNO Advisory Research Committee and Scientific Sub-Committee (1999-2005)
33. Member, ANTARES External Review Committee (1999-2003)
34. Member, Frascati Scientific Advisory Committee, (1999-2005)
35. Director, SUSSP, St. Andrews, (2001).
36. Chair, Scientific Review Committee of the Department of Astrophysics, Nuclear Physics, Particle Physics and Associated Instruments (DAPNIA), CEA, Saclay (2000 and 2003), Member (2007)
37. Member, Steering Committee for the Institute for Particle Physics Phenomenology (2001-2005)
38. Member, CERN Scientific Policy Committee (2002-2007), Chair (2005-2007). As Chair, I was also member of several CERN Council Working Groups.
39. Member, Search Committee for CERN Director General for CERN, (April-May 2002)
40. Lecturer, BUSSTEPP-Glasgow (2002).
41. Member, Scientific Advisory Committee, FZK, Karlsruhe (2003-)
42. Member of the e-Science Steering Committee (2004-2005)
43. Member, Scientific Advisory Committee, ICE, Denmark (2004-)
44. Review of the Birmingham School of Physics Strategy (2005)
45. Member, Evaluation Committee of the Belgian Particle Physics Integrated project (December 2005-)
46. Co-chair, Strategy Group for European Particle Physics (September 2005-July 2006)
47. Member, Particle Physics Advisory Panel (2005-2006)
48. Secretary and Member of the Board of the British Accelerator Science and radiation Oncology Consortium (BASROC) (2006-)
49. co-Director, SUSSP, St. Andrews (2006)
50. Member of the Review of the Helmholtz Society Call for Alliances (2006-2007)
51. Member, CERN Council Working Group on the implementation of the European Strategy for Particle Physics (2006-2007)
52. Member, Local Organising Committee, ERL07
53. Chair of the Review Panel, Osaka Centre of Scientific Excellence (2007)
54. Chair, Search Committee for CERN Director General for CERN (2007)
55. Member, Organising Committee, KEK-Fermilab Neutrino Summer School (2007)
56. Editor-in-Chief, PhysMathCentral (PMC) Physics A (April 2007-)

Curriculum Vitae Ferdinand Alexander Bais

Personal data

Status: Born June 27 , 1945 in Geleen, The Netherlands
Registered partnership with Vera de Vries (2004)
3 children (Polo 1978, Esmee 1980, Melisse 1982)
Work address:
Institute for Theoretical Physics
Valckenierstraat 65
1085 XE Amsterdam
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Education

Grotius College (Heerlen): 1964 Eindexamen HBS-B (Sec. school with Math/Sciences + Languages)
(Military service: Reserve Officer Artillery (1965-1967))
Technical University Delft: 1971 Bachelor degree (Physics) ,
1973 Master's (Ir) Degree (Appl. Physics)
University of California (Santa Cruz)/SLAC:
1977, PhD Theoretical Physics (advisor: Prof. Joel Primack)
Postdoctoral Education: Summer schools at SLAC, CERN, Les Houches, Cargèse, Trieste, Banff etc.

Recent and planned international activities:

November 2007, Invited lecturer, at International Summer school, ANU, Canberra, Australia
November 2007, Visitor of the Perimeter Institute, Waterloo, Canada
September 2007, Organizing Committee conference on Topological Quantum Computation, Dublin, Ireland
July 2007, Inv. Lecturer International Summer school on Topological Order, El Escorial, Spain
February - May 2006, Co-organizer Workshop "Topological phases and Quantum Computation, KITP, Santa Barbara, California
September – December 2005, Visiting Professor, Ukawa Institute for Theoretical Physics, Kyoto, Japan
July – August 2005, Visiting Scholar, ANU, Canberra, Australia
Febr – April 2005, Visiting Scientist, Santa Fe Institute, Santa Fe , New Mexico

Employment:

2007-'10 External faculty member, Santa Fe Institute, USA
1997-'05 Director of the Institute for Theoretical Physics Amsterdam
1985- Full Professor of Theoretical Physics, University of Amsterdam
1984-'87 Corresponding Fellow, CERN
1983-'85 Assoc. Professor, Leiden University
1980 Visiting professor Univ. of Pennsylvania
1980-'83 Research Fellow, Utrecht University
1979-'80 Scientific Associate, CERN, Geneva
1978-'79 Senior Research Fellow, University Leuven, Belgium
1978 (Summer) Scientific Associate, CERN
1977-'78 Postdoctoral research fellow, University of Pennsylvania, Philadelphia
1974-'77 Research Assistant, HEP-Theory, UCSC
1973-'74 Teaching Assistant, UCSC
1971-'73 Research Assistant, Interuniversity Reactor Center, Delft
1970-'71 Teaching Assistant, Theory Group, Delft University
1965-'67 Military service (Res. Officer Artillery)

Organization/management/reputation

2004- Dutch scientific delegate in CERN Council

2002- Elected member of the Royal Holland Society of Sciences and Humanities
2002- Member of the board of the Dutch Platform for Physics
2001- Member of the board of the "K.L. Poll Foundation for Education, Art and Sciences (Amsterdam)
2000- Member of the Council for Physics and Astronomy of the Royal Dutch Academy of Sciences (Chairman from May 2004)
1997- `05 Director of the Institute for Theoretical Physics (UvA)
1993- `98 Chairman of the executive board of the Dutch Research School for Theoretical Physics (DRSTP).
1991- `99 Member of the governing board of the FOM
1990- Member of the board of the Center for High Energy Astro-physics (CHEAF)
1986- Member of the Section for Theoretical High Energy Physics of the FOM (from 1991-1996 as chairman)
1986- '93 Member of the board of the Institute for Theoretical Physics (UvA) (from 1988-'92 as chairman)

- Active committee work at the UvA for the national educational and research evaluations of the Physics Departments in 1996, 2002 and 2004
- Member of organizing committees of following international conferences and workshops that took place in the Netherlands:
  - Meeting on trends in relativity and astrophysics `Journées Relativistes', May 1992, 180 participants
  - International Symposium on Lattice Field Theory `Lattice 92', September 1992, 300 participants
  - Conference on string theory `Strings '97', June 1997, 300 participants.
  - This also included the symposium `Gravity, Black Holes & Strings' with 600 participants. Speakers were Brian Greene, Hawking, 't Hooft, Susskind and Witten.
  - Symposium "Trends in Theory", Dalfsen, The Netherlands, 1997 and 1999
  - Symposium in honor of H.C. Capel "Demons, Wavelets and Chaos", Amsterdam, The Netherlands, 2001
  - Workshops in Amsterdam on String Theory and Quantum Gravity in 1998, 1999, 2000, 2001 and 2002.

Research Activities Summary

My research has always been on fundamental aspects of high energy physics, varying from gauge theories and relativity (cosmology) to string theory. Recently I have been working on topological phases, anyons and topological quantum computation. I have published about 100 papers in refereed journals. I supervised 12 PhD theses and 8 postdocs. I was invited lecturer at many International Research Schools and conferences. Contributed Chapters to scholarly review books, and published two rather successful popular books on theoretical physics recently: *"The equations: Icons of knowledge"* (Harvard Un. Press, 2005) and *"Very special relativity: a pictorial guide"* (Harvard, Un. Press, 2007).

Curriculum Vitae Dr. J. Benschop

Dr. J.P.H. Benschop
Work phone: + 31 268 3968
Work e-mail: jos.benschop@asml.com

Positions

- **Jan 2002 - now: Vice President System Engineering & Research, ASML, The Netherlands**
  Heads a department of 60 people, 95% with academic degree (MSc or PhD).
  Responsible for execution of research program with international partners (total > 150 fte), responsible for ASML technology roadmaps, responsible for product architecture.
  Member of the product policy, a group of key people including two board members who decide which products to launch.
- **Jan 1997 – Dec 2001: Manager Research ASML, The Netherlands**
  Responsible for execution of research program with international partners on EUV, e-beam and Ion Beam. Lead to decision to concentrate all efforts on EUV and start a program on EUV which lead to successful shipments of two EUV alpha tools in 2006.
- **1995-1997: Innovation manager CD-Recordable/Rewritable Philips Laser Optics, The Netherlands**
  Responsible for development and engineering of CD-Recordable and CD-Rewritable.
- **1991-1994: Research Project Leader**
  Philips Research, The Netherlands
- **1989-1991: Researcher**
  Philips Research Sunnyvale, USA
- **1984-1989: Researcher**
  Philips Research Eindhoven, The Netherlands

Education

- **1989: PhD** from Twente University of Technology, physics faculty.
- **1984: MSc** (cum laude) from Twente University of Technology, physics faculty.

Over 20 presentations and publications

10 USA patents granted

Other activities

- Member of council of physics and astronomy of Royal Dutch Academy of Science
- Member of bestuursraad STW a Dutch institute for technical sciences which annual budget ~ 80 M$ starting ~200 academic projects per year (mostly PhD students).
- Member of advisory council physics department University of Technology Eindhoven.
- Associated editor of Journal of Microlithography, Microfabrication and Microsystems (JM3).

Curriculum Vitae Professor Roger Cashmore
Principal of Brasenose College, Oxford since 2004
Born : 22 August 1944 in Birmingham, UK
Nationality : British
Civil Status : Married, one child

Education:
Dudley Grammar School
St. John's College Cambridge (MA) Balliol College, Oxford (DPhil 1969) University College, Oxford (1967-69)

Appointments:

1968-1972	Research Fellow for the Commissioners for the Royal Exhibition of 1851.
1969-1974	Research Associate, Department of SLAC, Stanford University, Stanford, California.
1970:	Lecturer, San Jose State College, San Jose, California.
1974-1978	Research Officer, Department of Nuclear Physics, University of Oxford.
1976-1978	Teaching Lecturer, Christ Church, Oxford.
1977-1979	Senior Research Fellow, Merton College, Oxford.
1979-1991	University Lecturer at Oxford University, Tutorial Fellow of Balliol College.
1981-1984	Member SPS Committee CERN, Geneva.
1982	Visiting Professor at the Vrije Universiteit Brussels holding the special chair "Bijzondcrc V.U.B. Leerstoel".
1982-1987	SERC Senior Research Fellowship.
1984-1987	Member Physics Research Committee, DESY, Hamburg.
1985	Visiting Lecturer University of Padua, Fellow of the Institute of Physics.
1986-1989	Guest Scientist at Fermilab. Chicago USA.
1988.1992	Chairman Particle Physics. Committee of SERC.
1990	University Reader at Oxford University.
1991-	Professor of Experimental Physics, University of Oxford.
1991-1996	Head of Particle and Nuclear Physics, Oxford.
1992	Member Academia Europa.
1996	Fellow of Royal Society of Arts, Manufacture and Commerce.
1992-1996	Member LHC Committee CERN.
1997-1999	Chairman of Department of Physics in Oxford University.
1998	Fellow of Royal Society.
1999-2003	Deputy Director General and Director of Research, CERN.

Chairman, Sci Cttee, Nat. Lab.of Gran Sasso, Italy
Member Sci. Adv. Cttee, Nat Inst for Nuclear Physics and High Energy Physics, Amsterdam
Nuclear Research Advisory Council (MoD)
PPARC CMS Oversight Committee

Distinctions:

1993 C.V. Boys Prize, Inst. of Physics
1995 Research Award, von Humbold Foundation,
2003 Companion of the Order of St Michael and St George
2004 Honorary Doctor of JINR, Dubna

Publications:

Contributions "Nuclear Physics", "Physics Letters", "Physics Review", "Physics Review Letters".

Current Research Interests:

The study of High Energy pp Collisions at the LHC using the Atlas detector. The search for dark matter using cryogenic detectors in underground experiments.

Curriculum Vitae Hugh Elliot Montgomery

1966-1969 Undergraduate University Education,

1969 B.Sc. Hons 1st class, Dept. of Physics, Manchester University, England
1970 Diploma in Advanced Studies in Science (distinction).
Dept. of Physics, Manchester University, England
1972 Ph.D. in Physics. Thesis title: Virtual photo-production of piminus Delta(++) off protons."
1972-1978 SRC Research Associate
Daresbury Nuclear Physics Laboratory and
Rutherford High Energy Laboratory.
at NINA, Daresbury
at ISR, CERN
1978-1983 Staff Member, CERN.
European Muon Collaboration (EMC)
1982-1983 Spokesman EMC.
1983-1985 Associate Scientist, Fermilab.
1984-1987 Head, Computing Dept., Fermilab.
1985-1987 Scientist I, Fermilab.
1987-1995 Scientist II, Fermilab.
1987-1989 Spokesman, Experiment E665, Fermilab.
1989-1991 Deputy Head of Research Division, Fermilab.
1990-1993 (Nov) Co-Leader of D0 Upgrade
1993-1999 Co-Spokesman of D0 Experiment.
1995-Pres Scientist III, Fermilab
1999-2001 Assoc. Project Manager for D0 Upgrade Project
1999-2002 Head, PPD/D0 Experiment Department(Project Dept.)
2002-Pres Fermilab Associate Director for Research

Professional Committee Membership
(Not including several internal Fermilab Staff Committees and other committees involving ex officio membership.)

1985-1989 Hepnet Technical Co-ordinating Committee, Convenor.
1986-1988 Fermilab Users Executive Committee
1987-1988 High Energy Physics Computer Networking Committee, DOE/ER-0372, 1988.
1987-1994 Fermilab Scientific Advisory Group
1988 Session Organiser, American Institute of Physics Conference, Storrs, Connecticut.
1989 Fermilab Computing Program Management Group (Chairman)
1989-1991 Fermilab Accelerator Program Management Group.
1989-1990 HEPAP SUBPANEL ON THE U.S. HIGH ENERGY PHYSICS RESEARCH PROGRAM FOR THE 1990'S, APRIL 1990. DOE/ER-0453P.
1991-1992 HEPAP SUBPANEL ON THE U.S. PROGRAM OF HIGH ENERGY PHYSICS RESEARCH.
1991-1993 Texas National Research Laboratory Commission, Review Panel Member.
1989-1992 Fermilab Collider Program Management Group.
1992-1994 Organizing Committee of Intersections '94
1992-94 Member of the Lawrence Berkeley Laboratory Director's Review of the Physics Division.
1993-94 Consultant on DOE Annual Program Review of SLAC.
1994-97 Member of the Large Hadron Collider Committee, CERN.
1995-98 Member of the Committee on Experimental Particle Physics under the Board on Physics and Astronomy of the National Academy of Sciences.
1995-96 Member of the Bardeen, TeV33 Committee, Fermilab.
1995-96 Member of the Snowmass '96 Organizing Committee.
1998-2001 Member & Chairman of SLAC EPAC
1999-2006 Member of Evaluation Committee of Istituto Nationale di Fisica Nucleare.
2000-2005 Chair of Evaluation Committee of Istituto Nationale di Fisica Nucleare.
2003-2006 Member of the Scientific Policy Committee of Stanford Linear Accelerator Laboratory.
Reviewer for DOE Contract proposals.

Curriculum Vitae Prof. Dr. Felicitas Pauss

Present Position	Professor at ETH Zurich Institute for Particle Physics (IPP)	
Mailing Address	ETH Zurich Institute for Particle Physics Schafmattstrasse 20, HPK E26 CH–8093 Zurich	CERN Physics Department Bldg. 40-4B-02 CH–1211 Geneva 23
Telephone	+41 44 633 2040	+41 22 767 3129
Fax	+41 44 633 1104	+41 22 767 1520
E-Mail	pauss@phys.ethz.ch	felicitas.pauss@cern.ch
WEB	http://www.ipp.phys.ethz.ch http://wwweth.cern.ch/pauss/	

26. 03. 1951	Born in Vorau (A), Austrian nationality, married
1965 – 1970	High School in Salzburg (A), final examination with distinction
1970 – 1976	University of Graz (A), Theoretical Physics and Mathematics
April 1976	PhD in Theoretical Physics and Mathematics with distinction
1976 – 1978	University Assistant at the Institute for Theoretical Physics, University of Graz
1978 – 1983	Research Physicist at the Max Planck Institute for Physics, Munich (D), Experimental Physics Group
1983 – 1985	Fellow at CERN, Geneva (CH)
1985 – 1991	Staff position as Research Physicist at CERN
1991 – 1993	Senior research scientist at the Institute for High Energy Physics of ETH Zurich (CH)
Since 1993	Professor for Experimental Particle Physics at ETH Zurich
1993 – 1997	Deputy Director of the Institute for Particle Physics at ETH Zurich
1997 – 2006	Director of the Institute for Particle Physics at ETH Zurich (about 125 members)

Research Activities in the Framework of International Collaborations

1978 – 1979	*ACCMOR Collaboration (CERN):* Analysis of fixed target data using □-p, K-p interactions at 58 GeV/c
1979 – 1983	*CUSB Collaboration, Cornell University (USA):* e^+e^- collisions at $E_{CM} \sim 10$ GeV, first detailed measurements of beauty-antibeauty bound states
1983 – 1991	*UA1 Collaboration (CERN):* Data analysis: participation in the discovery of the Z particle in 1983, first measurement of the W decay in the □□□channel by exploiting the missing transverse energy signature as well as searches beyond the Standard Model
Since 1991	*L3 Collaboration at LEP (CERN):* Data taking terminated in November 2000; physics topics: Standard Model and searches for the Higgs and supersymmetric particles
Since 1994	*CMS Collaboration at LHC (CERN):* Strong involvement in the CMS design concept and in the evaluation of the CMS physics potential; hardware activity focuses on all aspects of the crystal calorimeter; physics topics: searches for the Higgs boson and physics beyond the Standard Model
Since 1995	*AMS Collaboration:* Experiment designed to search for antimatter in space, to be operated at the International Space Station (NASA, USA)
Since 2003	*MAGIC collaboration:* Overall responsibility for all ETH contributions to the MAGIC telescope located in La Palma, Canary Islands (E); observation of very high-energy gammy rays from galactic and extragalactic sources

Management Functions in International Collaborations

CMS Collaboration at CERN:
About 2900 scientists of 182 institutes and research laboratories from 38 countries worldwide are involved in the CMS experiment at LHC.

Since 1994	Member of the CMS Management Board
Since 2000	Deputy Chairperson of the CMS Collaboration Board
Since 2001	Responsible for all scientific, technical and financial matters as well as management of the large ETH Zurich involvement in CMS
Since 2001	Chairperson of the Swiss-CMS Executive Board, Member of the CMS Finance Board and Co-Chairperson of the CMS Steering Committee for the electromagnetic crystal calorimeter
Since 2007	Member of the CMS Executive Board

MAGIC collaboration (Cherenkov Telescope in La Palma, Canary Islands, Spain):
About 140 scientists of 19 institutes and research laboratories from 11 countries worldwide are involved in the MAGIC experiment.

Since 2003	Member of the MAGIC Collaboration Board

Membership in International Scientific Advisory Committees

1988 – 1991	SPS Committee (SPSC) at CERN, Geneva (CH)
1989 – 1992	Programme Advisory Committee (PAC) for the Superconducting Supercollider (SSC) Laboratory in Texas, USA
1993 – 1998	CERN Scientific Policy Committee (SPC)
2000 – 2002	Board (Aufsichtsrat) of the Hahn-Meitner-Institute, Berlin (D)
2001 – 2004	OECD Global Science Forum Consultative Group on High-Energy Physics
2001 – 2005	HEPP Board of the European Physical Society
2003 – 2004	ESA Fundamental Advisory Group, Paris (F)
2003 – 2005	DESY Scientific Council (Wissenschaftlicher Rat), Hamburg (D)
Since 2006	Scientific Advisory Board of the Max Planck Institute for Physics, Munich (D)
Since 2006	Scientific Advisory Board, University of Vienna (A)

Membership in International/Swiss Scientific Committees

1993 – 1995	Chairperson of the CERN Summer Student Lecture Programme Committee
2001 – 2002	Member of the CERN Search Committee for Research Physicists on indefinite appointments
2001 – 2006	Scientific Council Centro Stefano Franscini, Ascona (CH)
Since 1997	Member or chairperson of election boards (Wahlkommissionen) for professor positions at Universities in Switzerland (ETH Zurich, EPF Lausanne, University of Zurich), in Austria (University of Vienna and Innsbruck) as well as for the Research Director of DESY (Hamburg, D)
Since 2004	Member of the Research Commission, ETH Zurich (CH)

Award

2003	"Grand Decoration of Honour" of the Federal Province of Styria (A)

Teaching Experience

Teaching at all levels at ETH Zurich and lectures at International Schools for Particle Physics

Publications

More than 420 publications in the period 1977 – 2007 (according to the SPIRES data base),
1120 citations of the Z discovery paper (UA1, 1983)

Talks

More than 250 talks at international conferences, colloquia and seminars as well as talks for government officials, funding agencies and general public

Curriculum Vitae Christian Spiering

1948:	born in Perleberg, East Germany
1966-71:	Student, Humboldt University Berlin
1971-74:	PhD student, Humboldt University and Institut für Hochenergiephysik (IfH), Zeuthen
1974:	Dissertation on Hadronic Interaction in Bubble Chambers
1974-78:	Postdoc at JINR Dubna, USSR, construction streamer chamber, hadron-nucleus interactions in a streamer chamber/Serpukhov
since 1979:	Scientific staff member IfH, since 1992 DESY
1979-82:	hadron-nucleus interactions in a streamer chamber/Serpukhov
1982-88:	construction, data analysis of a neutrino calorimeter in Serpukhov
1986-89:	search for periodicities in miocene tree ring widths
1986-89:	analysis axion search experiment PSI

Astroparticle Experiments

since 1998	Baikal Neutrino Telescope
since 1995	Amanda Neutrino Telescope
since 1999	Tunka Air Shower Detector
since 2000	IceCube Neutrino Telescope

Chair positions

since1988:	Chair of Astroparticle Group in DESY/Zeuthen
1990-2000:	Deputy Chair for Research in IfH Zeuthen, later DESY/Zeuthen
1997-2005:	Amanda European Co-Spokesman
2005-2007:	IceCube Spokesman

Committees

1990-1993:	Extended EFCA
since 2003:	Peer Review Committee, ApPEC (chair since 2006)
2003-2006:	Chair R.W.Pohl Price Committee, DPG.
since 2001:	External Review Committee Antares
2003-2006:	External Review Committee APC, Paris
since 2007:	KAT (German Komitee für Astroteilchen-Physik)

Awards

- DESY Communication Price 2001
- Markov Price Russian Academy of Sciences, 2006

Books

- „Auf der Suche nach der Urkraft“, („Searching for the basic force“)
  Teubner Verlag Leipzig 1986, 1989, Harry Deutsch Verlag Frankfurt 1986

7.2 Programme of the site visit 6 - 9 September 2007

Thursday, 6 September 2007
Location: NH Grand hotel Krasnapolsky

All day		Arrival of committee members
17:30	- 19:15	Installation of the committee by prof.dr. Charles Buys, vice chairman NWO and dr. Hans Chang, director FOM General introduction to NIKHEF by prof.dr. Frank Linde, director of the institute SAF/NIKHEF
19:15	- 19:45	Internal discussion
20:00		Working dinner with prof. Charles Buys at Restaurant Vermeer

Friday, 7 September 2007
Location: SAF/NIKHEF

08:30	- 09:00	Taxi from NH Grand hotel Krasnapolsky to SAF/NIKHEF
09:00	- 09:15	Reception with coffee
		ATLAS
09:15	- 09:20	Internal committee preparation
09:20	- 09.30	Presentation by programme leader Stan Bentvelsen
09:30	- 10:00	Discussion with several staff members
10:00	- 10:05	Internal committee discussion
		LHCb
10:05	- 10:10	Internal committee preparation
10:10	- 10:20	Presentation by programme leader Marcel Merk
10:20	- 10:50	Discussion with several staff members
10:50	- 10:55	Internal committee discussion
11:00	- 11:10	**Coffee break**
		ALICE
11:10	- 11:15	Internal committee preparation
11:15	- 11:40	Presentation by programme leader Thomas Peitzmann
11:40	- 12:00	Discussion with several staff members
12:00	- 12:05	Internal committee discussion
		Theory
12:05	- 12:10	Internal committee preparation
12:10	- 12:25	Presentation by programme leader Eric Laenen
12:25	- 12:55	Discussion with several staff members
12:55	- 13:10	Internal committee discussion
13:15	- 14:10	**Lunch with programme leaders in Spectrum**

			Scientific Advisory Committee
14:10		14:40	Meeting with chairman of the SAC prof. John Dainton
			Detector R&D
14:40	-	14:45	Internal committee preparation
14:45	-	14:55	Presentation by programme leader Jan Timmermans
14:55	-	15:15	Discussion with several staff members
15:15	-	15:20	Internal committee discussion
15:20		16:20	**Lab tour**
16:20	-	16:55	**Tea break with PhD students in Spectrum**
			Astroparticle Physics
16:55	-	17:00	Internal committee preparation
17:00	-	17:15	General overview by programme leader Gerard van der Steenhoven
17:15	-	17:30	Presentation ANTARES / KM3NeT by Maarten de Jong
17:30	-	17:45	Presentation AUGER / LOFAR by Sijbrand de Jong
17:45	-	17:55	Presentation VIRGO / LISA by Jo van den Brand
17:55		18:10	Discussion with several staff members
18:10	-	18:15	Internal committee discussion
			GRID
18:15	-	18:20	Internal committee preparation
18:20	-	18:30	Presentation by programme leader Jeff Templon
18:30	-	18:45	Discussion with several staff members
18:45	-	18:50	Internal committee discussion
			ZEUS/HERMES
18:50	-	18:55	Internal committee preparation
18:55	-	19:05	Presentation ZEUS by programme leader Paul Kooijman
19:05		19:15	Discussion with several staff members
19:15	-	19:25	Presentation HERMES by programme leader Jos Steijger
19:25	-	19:30	Discussion with several staff members
19:30	-	19:35	Internal committee discussion
19:45	-	20:00	Taxi from NIKHEF to restaurant
20:30			Working Dinner and report writing at NH Grand hotel Krasnapolsky

Saturday, 8 September 2007
Location: SAF/NIKHEF

08:30	- 09:00	Taxi from NH Grand hotel Krasnapolsky to SAF/NIKHEF
		Meeting with the directorate (Frank Linde & Arjen van Rijn)
09:00	- 10:30	Presentation Frank Linde about * Completed programs (AmPS, LEP, Chorus) * Long term future plans (ILC, etc.) * Technical skills, infrastructure * Knowledge transfer * Education, outreach * Finances Discussion
10:30	- 10:45	**Coffee break**
10.45	- 12:45	**Internal committee discussion**
12:45	- 13:45	**Lunch in Spectrum**
13:45	- 16:45	**Report writing**
16:45	- 19:00	**Report consolidation**
19:00	- 19:30	**Meeting with SAF/NIKHEF director Frank Linde**
19:35	- 19:45	Taxi from NIKHEF to restaurant 'de Kas'
19:45		Dinner at restaurant 'de Kas' with presentation of main conclusions

7.3 List of programme leaders, staff members and PhD students interviewed

Program presentations

On Friday, the committee heard presentations and discussed with following staff members:

ATLAS:	Stan Bentvelsen, Paul de Jong, Sijbrand de Jong, Auke-Pieter Colijn, Wouter Verkerke, Nicolo de Groot, Folkert Koetsveld, Wolfgang Liebig
LHCb:	Marcel Merk, Gerhard Raven, Antonio Pellegrino, Eddy Jans, Hella Snoek, Peter Vankov, Niels Tuning
ALICE:	Thomas Peitzmann, Raimond Snellings, Paul Kuijer, Ingrid Kraus
Theorie:	Eric Laenen, Jos Vermaseren, Bert Schellekens, Hylke Koers, Marieke Postma, Chris White
R&D:	Jan Timmermans, Harry v/d Graaf, Jan Visschers, Els Koffeman, Jan Visser, Maximilien Chefdeville, Marc Kea
APP:	Gerard v/d Steenhoven, Maarten de Jong, Els de Wolf, Sijbrand de Jong, Charles Timmermans, Jo v/d Brand, Ronald Bruijn, Jose Coppens, Mieke Bouwhuis
GRID:	Jeff Templon, Maurice Bouwhuis, Arjen van Rijn, Dennis van Dok, Ronald Starink, Sander Klous
ZEUS/HERMES:	Paul Kooijman, Jos Steijger, Els Koffeman, Gerard v/d Steenhoven, Paul van der Nat

Lunch with programme leaders

On Friday, the committee had an informal lunch with the following programme leaders (in the absence of the SAF/NIKHEF management):

Stan Bentvelsen, Marcel Merk, Gerhard Raven, Raimond Snellings, Thomas Peitzmann, Antonio Pellegrino, Nicolo de Groot, Leo Wiggers, Eric Laenen, Jan Visschers, Jan Timmermans, Bert Schellekens, Jeff Templon, Els Koffeman, Gerard van der Steenhoven, Sijbrand de Jong, Jo van den Brand, Maarten de Jong, Els de Wolf, Paul Kooijman

Tea break with PhD-students

On Friday, the committee had an informal tea break with the following PhD-students (in the absence of their advisors and SAF/NIKHEF management):

Folkert Koetsveld, Zdenko van Kesteren, Pieter Houben, Caroline Magrath, Gustavo Ordonez, Jochem Snuverink, Miruna Anastasoaie, Nicole Ruckstuhl, Manouk Rijpstra, Jeroen Hegeman, Hella Snoek, Aras Papadelis, Edwin Bos, Jan Amoraal, Peter Vankov, Martijn Russcher, Mikolaj Krzewicki, Yuting Bai, Oleksandr Grebenyuk, Hylke Koers, Patrick Motylinski, Maximilien Chefdeville, Marc Kea, Ronald Bruijn, Jose Coppens, Gordon Lim and Paul van der Nat.

Figure 5: Tea break with NIKHEF PhD-students and the committee

The committee were impressed by the enthusiasm of the students who particularly appreciated the atmosphere at NIKHEF where they were treated as colleagues by their supervisors and other staff members. They also appreciated the financial support they received, the international nature of the student cohort, the opportunities to work at CERN and other laboratories where they acquired many skills beyond training in particle physics. They enjoyed considerable freedom in the choice of their research and perhaps the only slight hesitancy that was expressed was that some felt they might have received more direction in their first year. The committee recommends that NIKHEF reviews this issue, but with a light touch.

7.4 Extended description of the five point scale

(source: Standard Evaluation Protocol, Appendix 2)

5: Excellent
Work that is at the forefront internationally, and which most likely will have an important and substantial impact in the field. Institute is considered an international leader.

4: Very good
Work that is internationally competitive and is expected to make a significant contribution; nationally speaking at the forefront in the field. Institute is considered international player, national leader.

3: Good
Work that competitive at the national level and will probably make a valuable contribution in the international field. Institute is considered internationally visible and a national player.

2: Satisfactory
Work that is solid but not exciting, will add to our understanding and is in principle worthy of support. It is considered of less priority than work in the above categories. Institute is nationally visible.

1: Unsatisfactory
Work that is neither solid nor exciting, flawed in the scientific and or technical approach, repetitions of other work, etc. Work not worthy of pursuing.

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National institute for subatomic physics

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Amsterdam, 3 december 2007

Ref.: br-FL-1020-ed
Onderwerp: weerwoord missie-evaluatie rapport SAF/Nikhef

Geacht bestuur,

Met grote interesse (en enige trots!) heb ik kennisgenomen van het rapport van de internationale evaluatiecommissie die het FOM-instituut SAF/Nikhef heeft geëvalueerd. Ik stel met genoegen vast dat de commissie de nieuwe missie en strategie van het Nikhef met zeer sterke bewoordingen ondersteunt. Dat is van groot belang voor ons, omdat deze nieuwe strategie het resultaat is van een moeilijke selectie uit een veelheid van uitdagende projecten in de subatomaire fysica. Dit geldt in het bijzonder voor de door de commissie zeer positief ontvangen ambitie van het Nikhef om naast onze LHC-activiteiten in Nederland een in de missie verankerde structurele inspanning in de astrodeeltjesfysica op te zetten.

Voor enkele programma's en procedures heeft de commissie concrete inhoudelijke aanbevelingen gegeven die wij zullen implementeren.

Naast aanbevelingen die de ingeslagen wetenschappelijke koers van het instituut (en ons wetenschappelijke programma) bevestigen, vestigt de commissie ook de aandacht op de personele en financiële middelen die daarvoor nodig zijn.

Het Nikhef hoopt nadrukkelijk op de medewerking van FOM en NWO bij de implementatie van deze aanbevelingen, in het bijzonder daar waar de budgettaire consequenties de huidige mogelijkheden van het Nikhef overstijgen.

In dat verband ben ik zeer verheugd met de recente honorering van twee nieuwe FOM-programma's: één op het gebied van de Astrodeeltjesfysica (getiteld *'The origin of cosmic rays'*) en één op het gebied van de Theoretische fysica (*'Theoretical particle physics in the era of the LHC'*). Uit de toegekende middelen van deze nationale programma's zal Nikhef een substantieel deel ontvangen, waarmee de aanstelling van tijdelijk personeel (promovendi en postdocs) op deze onderzoeksgebieden goeddeels is gefinancierd voor de komende jaren.

Om echter – zoals de commissie aanbeveelt – een leidende rol te kunnen vervullen in de astrodeeltjesfysica zonder de exploitatie van de LHC-programma's te compromitteren, is een verhoging van het missiebudget van cruciaal belang. Alleen dan zal het mogelijk zijn om ook (tijdig) nieuwe stafleden aan te stellen op dit nieuwe vakgebied en tegelijkertijd recht te doen aan de andere aanbevelingen van de commissie met betrekking tot het oogsten van LHC-resultaten, het GRID programma en het Detector R&D programma. Het werk in de laatstgenoemde gebieden, waar wij zowel nationaal als internationaal een zeer prominente rol spelen, is tot nu toe vrijwel geheel gefinancierd uit incidentele middelen.

Indien gewenst ben ik uiteraard bereid een uitgebreidere mondelinge toelichting te geven op het rapport van de evaluatiecommissie.

Hoogachtend,

Prof. Frank Linde
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