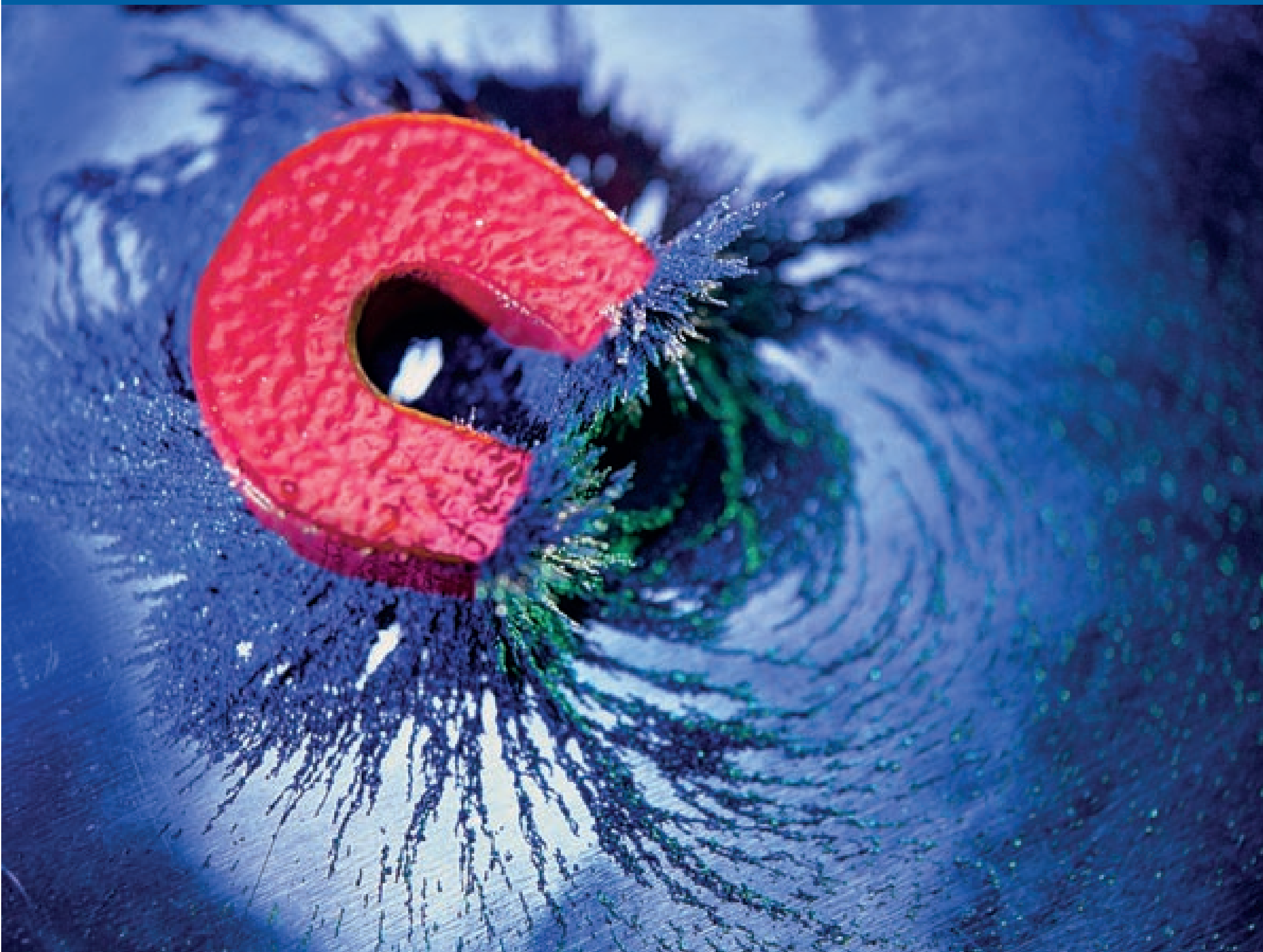
The Research Council of Norway

Basic Physics Research in Norway

– An evaluation

Evaluation
Division for Science



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To the Research Council of Norway

The Evaluation Committee for this review of basic research in physics in Norway hereby submits the following report.

The task of making a fair, adequate and comprehensive review of the research activities during the last five years in the required time frame has been a demanding one. The Evaluation Committee expects, however, that this review will be a useful instrument for the Research Council of Norway, the Ministry of Education and Research and other relevant ministries, and the departments, institutes, facilities and research groups concerned.

This report represents an agreed account of the assessments, recommendations and conclusions.

Bengt Gustafsson (Chair)

Nils O. Andersen

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Sandra Chapman

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Hans Hertz

Emanuele Rimini

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1 Executive Summary

Basic physics in Norway has been evaluated by an international committee of scientists. Individual research groups have been evaluated and grades have been given. The evaluation is based on written self-evaluations from the institutions, both at the department and research group level, hearings with representatives of the groups and the departments, published scientific papers, data on publication records, citations in international journals, and site visits at relevant departments.

The Evaluation Committee has, not unexpectedly, found research of varying quality. Many groups work at the research frontier, some are even world leading. Among the excellent research is work in atomic physics, biophysical and medical technology, complex systems, condensed matter physics, cosmology, electronics, elementary-particle physics, geophysics, solar physics and space physics. The average quality is relatively high, which is also seen in the citation frequency of Norwegian papers in international journals.

However, the Evaluation Committee has also noted many research groups that work under conditions that are close to or, in several cases, clearly sub-critical, in terms of personnel and other resources, including a supporting academic environment. Measures should be taken to remedy this situation. The Evaluation Committee recommends a number of actions. In some cases, concentration of resources seems possible. Other means proposed include strengthened mechanisms for national coordination and collaboration in research training, in using major facilities and infrastructure, and in building up more concentrated research efforts in certain areas. Further coordination is needed to stimulate mobility. A key in all cases will be an improved and continuous strategic planning with clear objectives and goals. These national initiatives may be taken by collaborating local groups or departments, but the National Committee of Physics (NFyR) has a certain responsibility, in collaboration with the Research Council (RCN). Also actions and means at the local departments to strengthen the strategic planning and concentration of resources are suggested. Recommended measures here include merging or restructuring of research groups, an increased flexibility both in the distribution of resources of various kinds, such as salaries, instrumentation and premises at the departments, as well as in the distribution of research and teaching obligations among staff members. Even in areas where Norwegian physics is already strong but scattered, a better coordination will raise its potential further, in research as well as in research training and in application and readiness to meet societal needs.

An improved national coordination is also of value for Norwegian physics in other respects, such as when it comes to decisions about major experimental facilities, in Norway and abroad, as regards opening up of new, often interdisciplinary areas of research. The Evaluation Committee points at the key roles that RCN and NFyR have in these respects. It is suggested that NFyR in consultation with RCN takes initiatives to set up a Strategy and Coordination Panel, which may also serve as an advisory body for the RCN. It is also suggested that RCN takes measures to develop a more systematic approach, e.g. by installing an Interdisciplinary Advisory Committee for recommending priorities among various larger infrastructure investments. Also, a number of special measures and programmes are suggested on a national level to enhance particular fields through directed efforts.

Although the quality of Norwegian basic physics research is satisfactory and in many areas high, the mere volume of it is not fully comparable to the build-up of physics in neighbouring countries. This can be seen in the publication volume, as well as in the number of scientists, when normalized on the total population. In view of the global long-term strategic aspects of basic physics, the Evaluation Committee believes that Norway is now in a position that motivates its responsibility to contribute even more actively to this important endeavour. An increase to the level of its neighbours corresponds to a growth of personnel and costs for physics groups by at least 30%. The Evaluation Committee recommends such an increase. It seems suitable that a considerable part of it could be distributed as grants and non-permanent positions or fellowships, given solely on the basis of scientific quality from RCN. The Evaluation Committee gives such a general enhancement, which at least partially should be given as additional resources for “free grants in science”, high priority among the various measures suggested for RCN. The effects of such an increase must, however, be monitored so that no further fragmentation into sub-critical groups results and a fraction of any increase might be used for special measures and programmes that are mentioned later in more detail.

The Evaluation has also included a number of engineering groups, working on various technical applications or developments of considerable societal interest, e.g. in petroleum industry, medicine or agriculture. Here, only the basic physics aspects have been within the perspective and competence of the Evaluation. Some of these projects are excellent also from a physics point of view. In several of them the Evaluation Committee has, however, only found a limited basic physics content of scientific interest. Sometimes this is natural, but in other cases it seems that the applications themselves would have benefited from a more solid physical base. Sometimes the roles of the university research groups as providers of solid science on an international level have not been very clear. A more intensive interaction between academia and industry, which seems valuable in general, would benefit from these roles being clarified.

2 Introduction

2.1.1 Mandate and the Review Process

This report presents an evaluation of research in physics in Norway, with particular focus on the last five-year period (2004–2008). The mandate for this review, including its detailed objectives, long-term goals, methods to be employed and specific aspects to be considered, is provided in full in Appendix D. The Evaluation Committee is presented in 2.1.6.

In summary, the main objectives of this evaluation are to provide a critical review of the strengths and weaknesses of basic research in physics in Norway, identify research groups that have achieved a high international quality level or have the potential to do so, and to identify areas of research that need strengthening. This evaluation should provide institutions with advice and recommendations, and provide the RCN with a base for future strategic decision-making and for giving advice to government on research policy.

The evaluation was conducted based on an overview of factual information (department organisation, staffing numbers, graduate production, funding and expenditure; presented in Appendix D) collected in April 2009, followed by detailed written self-evaluations from the departments and research groups. During September 2009, hearings were held in Oslo with representatives of the departments and research groups, as well as site-visits to institutions and facilities in the Oslo and Stavanger regions. In early October 2009, site-visits to Svalbard, Tromsø, Trondheim and Bergen were made. The letters from the Research Council to the departments and the schedules for the hearings and site-visits are provided in Appendix D. Preliminary versions of relevant parts of this review were submitted to the departments for checking of the factual information during December 2009.[1]

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[1] It is notable that figures often differed, sometimes substantially, between those in the factual information and those presented in the self-evaluations, the hearings and the site-visits. This is discussed in 2.1.3.

The Evaluation Committee has been asked to consider general aspects of physics research in Norway and at departments, including research infrastructure, gender balance and training and mobility. In evaluating the research groups, the mandate asks the Evaluation Committee to evaluate three key aspects of each group, which are the basis of the grading system described in 2.1.5.

2.1.2 Participants of the Evaluation

The assessments and recommendations are made on the research group, departmental, institutional and national level. In particular, the present evaluation is designed as an evaluation of research groups, not of individuals. The relevant university departments were approached in the initial phase and asked which of their groups they wished to be included in the evaluation. Similarly, the relevant research institutes, the Norwegian Defence Research Establishment, the Institute for Energy Technology, and SINTEF, were asked whether they wished to take part and, if so, to suggest groups for evaluation. From this procedure, almost all groups engaged in basic physics research have been included, while in areas of applied physics bordering technology, biology, medicine and geo-science, the selection of groups is less complete.

The participating institutions are:

- The Department of Physics at the University of Oslo
- The Institute of Theoretical Astrophysics at the University of Oslo
- The Department of Physics at the Norwegian University of Science and Technology
- The Department of Physics and Technology at the University of Bergen
- The Department of Physics and Technology at the University of Tromsø
- The Department of Mathematics and Natural Sciences at the University of Stavanger
- The Department of Mathematical Sciences and Technology at the Norwegian University of Life Science
- The Department of Arctic Geophysics at the University Centre in Svalbard
- The Norwegian Defence Research Establishment
- The Institute for Energy Technology
- SINTEF

2.1.3 Key Figures

The Evaluation Committee was provided with an overview of basic factual information on the departments and groups, which included number of employees by job category and number of students graduated between 2006 and 2008. These data, presented in Appendix D, were collected concurrently (with a deadline in April 2009) and in a consistent manner and thus presumably represents a fair and unbiased snapshot of all departments and groups in Norway at that time. All staffing and graduate numbers quoted in this report are taken from this factual information report. It should be noted that these numbers often differed from those presented in the self-evaluations, the hearings, or the actual situation during the site-visits or at the time of fact checking some 8 months later.

2.1.4 Previous Evaluation

In the year 2000, the Research Council of Norway carried out an international physics evaluation, resulting in the report "Physics Research at Norwegian Universities, Colleges and Research Institutes", published by the RCN in that year. In view of the considerable changes that have been introduced during the past decade, partly as a result of the previous evaluation, as well as the fact that the evaluation was considerably disputed, the Evaluation Committee was anxious not to use its results as a basis for its own work. In some cases reference will, however, be given to the suggestions from the previous evaluation, but this will not be done systematically. A detailed comparison will show that the present Evaluation Committee does not share some of the views expressed in the previous evaluation. This may reflect the changing conditions, but also in some cases differences of opinion. It illustrates the trivial fact that scientific judgements contain subjective elements, which should not be mistaken for arbitrariness or lack of reliability.

2.1.5 Grading

For the assessment of the research groups, a grading system has been applied that, in keeping with the mandate, focuses on the following aspects:

Scientific Quality and Productivity

- judged according to internationally applied standards for scientific quality and guided by bibliometric analysis
- number of PhD, masters students and grades awarded

- participation in international conferences

Relevance and Societal Impact

Aspects of the science that are not reflected by normal internationally applied scientific measures with particular relevance to Norwegian industry, health, national and global environmental issues and culture. This is, however, more difficult to assess quantitatively. It should be noted that the basis physics aspects are focussed in this evaluation – it has not been the aim to evaluate applied physics research as such. For some applied projects where the basic-physics component is weak, the grading may not reflect the full value of the project.

Strategy, Organisation and Research Cooperation

- arrangement of infrastructure to facilitate work of high quality
- organisation of research group activities to improve funding opportunities
- supportive environment

The grades are given according to the scale presented schematically below. In some cases, mixed grades are given. More precisely, if two grades are separated by a slash (/), this indicates mixed grades within the group; e.g. 4/2 indicates some parts of the group activity are given grade 4, other parts grade 2. In addition, if two grades are separated by a dash (–), this indicates a grade between the two; e.g. 3–4 indicates a grade somewhere between 3 and 4. The grades given include:

<u>Excellent = 5</u>

The group has an internationally leading position, undertaking original research and publishing in the best international journals. The group has high productivity and the research is very relevant to international research and to Norwegian society, including number of PhD graduates. Clear and convincing strategic planning exists. The Evaluation Committee has a very positive overall impression of the research group and its leadership.

<u>Very good = 4</u>

The group has a publication profile with a high degree of international publications in good journals. The group has high productivity and the research is very relevant to international research and to Norwegian society, including PhD training. Good strategic planning exists. The Evaluation Committee has a very positive overall impression of the research group.

<u>Good = 3</u>
The group contributes to international and national research with good quality research of relevance both to international research development and to Norwegian society. The productivity is acceptable and the number of PhDs is reasonable. Strategic planning is reasonable to good. The Evaluation Committee has a positive overall impression of the research group.

<u>Fair = 2</u>
The quality of research is acceptable, but the international publication profile is modest. Much of the work is routine in terms of design and publications. The relevance and productivity of research are not exciting. Few or marginal original contributions to scientific knowledge are produced. Strategic planning exists, but is not convincing. The overall impression is positive but with a degree of scepticism from the Evaluation Committee.

<u>Weak = 1</u>
The research quality is below good standards and the publication profile is meagre. The group produces international publications only occasionally. No original research and little relevance to problem solving. Diffuse strategic planning. No overall positive impression on the Evaluation Committee.

In practice, the various criteria used are not as clear-cut as presented above. For example, a research group may have a very high quality of its published research, but the productivity may be low. One reason for such a mixed impression may be that the group is heavily burdened by other obligations apart from research, such as teaching. The Evaluation Committee has tried to take such circumstances into consideration, but this has often not been possible. In other cases, when different criteria suggest different grades, a compromise grade was set.

2.1.6 The Evaluation Committee

The Evaluation Committee consisted of the following experts (their CVs are presented in Appendix B):

- Professor Bengt Gustafsson (Chairman)
  Department of Physics and Astronomy
  Uppsala University, Sweden

- Professor Nils Overgaard Andersen
  Niels Bohr Institute
  University of Copenhagen, Denmark

- Professor Elisabeth Bouchaud
  CEA - French Atomic Energy Commission, France

- Professor Sandra Chapman
  Physics Department
  University of Warwick, United Kingdom

- Professor John Ellis
  CERN - European Organisation for Nuclear Research, Switzerland

- Professor Hans Hertz
  Department of Applied Physics
  Royal Institute of Technology (KTH), Sweden

- Professor Emanuele Rimini
  Department of Physics and Astronomy
  University of Catania, Italy

Paul Barklem, a Royal Swedish Academy of Sciences Research Fellow at the Department of Physics and Astronomy, Uppsala University, served as secretary to the Evaluation Committee.

Special adviser Bjørn Jacobsen and Administrative Coordinator Malena Bakkevold of the Research Council of Norway presented the instructions to the research groups, and made all practical arrangements.

3 General Conclusions and Recommendations

3.1 The National Picture

The Evaluation Committee has evaluated Norwegian basic physics on the basis of the written self-evaluations from the research groups, hearings with representatives of the groups and departments, published scientific papers, bibliometric data, and through visits to the relevant departments. The Evaluation Committee has, not unexpectedly, found research of varying quality in Norwegian physics. Several groups are at the international frontier, some even world leading. Many perform science of a more ordinary scientific standard, while others are weaker. To some extent, most of these groups suffer from under-financing. A common remark from the group leaders is that the funds for basic research, e.g. from the RCN, are too limited. The Evaluation Committee shares this view (see further below). The Evaluation Committee feels, however, that with the present personal and economical resources available, it would be possible to accomplish even more, i.e. that some systemic changes might be very helpful. If implemented, they would make Norwegian science in general, and physics in particular, more prolific, interesting and competitive, and would indeed boost the outcome of Norwegian physics if they could be combined with some increase of funding. The changes to be suggested below have the background in some observations made in most groups.

Strategic Planning of Research

It seems that strategic plans for the development of the departments are missing in many places. Strategies seem often to be discussed only when old positions are to be refilled, and since the activities locally are often fragmented into too many research areas, the strategy to cling to the old definition of the position and claiming it to be absolutely necessary for the group as a whole is the default initial position in such a discussion. Often, this argument also seems to end the discussion.

The unwillingness or inability to set priorities when the financing is limited, is obviously a problem in many places. This is clearly not only rooted in an ambition to avoid conflicts between groups and individuals – the Evaluation Committee observed an astonishing and probably harmful amount of such conflicts, possibly reflecting the financial situation – but also due to the fact that adequate means to implement priorities seem to be missing on the departmental level. That is, the department leaders do not control the decisions on number of staff, salaries and other local costs such as rent, and as the resources in the hands of the department chair tend to shrink (in some places they are now close to zero) it has been impossible for the leadership to carry out any policy. In addition to this, the tradition to let every member permanent scientific staff enjoy a 45%/10%/45% -division of time for teaching/administration/research almost independently of the degree to which the person is producing high-quality research, is harmful – a much more open distribution of these activities among the staff members seems to be needed for making it possible for the department to optimize the teaching and research quality. Another personnel problem, related to the fact that the department cannot decide about salaries and positions, is that resources spent on technicians and workshops, as well as the general decision on what services and equipment should be bought and what should be constructed in-house, are not optimized.

National Coordination

Also on the national level the Evaluation Committee finds systemic problems. While the groups in certain scientific areas, and here the best examples are elementary-particle physics and the study of complex dynamical systems, seem well coordinated in Norway, the national collaboration between research groups in other areas is poorer, if it exists at all. In view of the fragmented structure of Norwegian science research (split among many universities – which the Evaluation Committee understands has a political background but may risk leading to sub-critical research groups), the Evaluation Committee sees the necessity for an effective national coordination. Instruments for such coordination have to be set up. Some examples where such coordination instruments are needed will be given below. They cannot only be built on collegial advisory committees, or infrequently occurring international evaluations. Instead, this coordination needs continuity for following up actions and results, resources to stimulate coordination, and independent expertise. It seems to be a task for the National Committee of Physics (NFyR) and RCN, in collaboration with the research group leaders, to set up such instruments that are cost effective.

A particularly important task for national coordination is that relating to the participation and organizing of large-scale facilities with a high international impact, which in several cases have both scientific and political strategic dimensions. There must be a structure in place to ensure that the best value for money is delivered in terms of high quality science, as well as meeting the strategic needs.

However, also in other respects a better coordination would be healthy, not the least for creating synergy within the diverse character of Norwegian physics. The split between many fields in many places may in this way be turned into an advantage, e.g. by organizing national schools of research training, where the diversity is taken advantage of and couplings between different areas with similar problems or methodologies are observed and developed further. Again examples of such possibilities will be given below.

Mobility

The Evaluation Committee observed a factor, which could contribute to a lack of coordination between different research groups – the lack of mobility in between different research institutions in, and outside, Norway. It is certainly a healthy order to require, as many departments do abroad, that PhD students be primarily recruited from other universities than those where they got their Master degrees, or that post-docs are not accepted among the PhDs of local production, or that professorial positions are always widely announced. To contribute ideas from somewhere else is after all one the most useful things a newly employed scientist can do. This also contributes to a stronger national network. Although such strict mobility rules may be hard to enforce in a Scandinavian culture, if for none other than family reasons, serious efforts should be made to enhance the mobility, both by universities and by the Research Council.

Gender Balance

The gender balance in the field of physics is in general not even. This is true internationally: very often, women are still a small minority at physics departments at Western universities. Typical figures in the Norwegian major universities are presently 10–15% women among the professors, and 15–30% among the postdocs and PhD students. In Norway, as in many other comparable countries, this is seen as a problem at the physics departments and active measures are being taken. The situation is improving, although one might wish a more rapid development. For example, at UiB, the percentage of female professors has increased from 3% to 14% in a decade, and of PhD students from 10% to 16%. Some other universities show even steeper increases in the percentage of female PhD students. The measures taken and mentioned by the departments include active recruitment policies both for permanent staff and for postdocs and PhD students. Measures are also taken to improve the recruitment of women to the Masters education – clearly, recruitment of women has also in several places been identified as a way to relieve the problems of a lack of student interest in physics in general. The Evaluation Committee has noted ambitious planning and constructive means developed at the major university departments to improve the situation, including establishing associate or adjunct professorships to promote recruitment of women to postdoc or PhD positions, installing special grants for travel or equipment for female staff, directed PhD positions to female supervisors, or to give female staff sabbatical years free from teaching on relatively generous conditions. The latter possibilities, to direct the resources and the division of labour within the department consciously so that the overall goals of the department are reached, and its scientific and educational output is optimized in the long run, is an obvious way to go in general, but it does require a common understanding among the staff what these goals are and what means can be used to reach them. However, during our evaluation the Evaluation Committee obtained the impression that there is such a common collegial understanding of the need to establish a fair gender balance.

Resources

A constantly made comment from the research groups that the Evaluation Committee has evaluated is that their resources for basic physics are too scarce. In view of width of the scope and the ambitions expressed be the groups the Evaluation Committee agrees on this. A natural reaction, given the amount of funding, would be to focus, concentrate and collaborate more in and between the physics departments, and has already been expressed above, the Evaluation Committee thinks that this, anyhow is necessary. However, comparing with other wealthy and comparable countries, the Norwegian expenditures on basic physics are, indeed, relatively small. This can be seen in the number of senior physicists or the research council expenditures in physics per capita, and is reflected in the resulting volume of publications. The situation is further explored in a comparison with Danish and Swedish physics, given in Appendix C. Although still preliminary, an overall conclusion from this study is that the Norwegian productivity per scientist, as well as the quality as it is reflected in the number of citations per scientist, is similar to its Swedish and Danish correspondence. The lower total volume of publications may be naturally explained by the smaller number of physicists per inhabitant. A secondary factor is that the RCN project support was smaller per scientist in Norway until recently.

If the volume of Norwegian research in basic physics is to be increased to the level of its neighbours, an increase of the number of physicists per capita by 25–30% seems to be the natural way. If no increase of teaching is needed, the increase in terms of full-time position equivalents may be estimated to 15%. This would then correspond to an increase by about 90–160 physicists (including post-docs and graduate students). The estimated cost for the salaries would be about 70–120 MNOK. A corresponding increase of grant money for various running costs would also be needed.

While understanding the historical reasons for the comparatively small volume of Norwegian basic physics, the Evaluation Committee thinks that there are now very good arguments for expanded financing. The division of resources between basic and applied science in physics and similar fields is mostly a question of whether one wishes to make long- or short-term investments. Experience has shown that most important technological developments during the last century were based on new discoveries in basic science, and not the least in physics. In fact, the most recent developments in technology and applied natural sciences are to an astonishing degree based on physics development and methodologies. Examples here are nano-technology, quantum optics and quantum computers, DNA-technology, PET-cameras and other imaging devices in medicine, solar-cell-technology, the World-Wide-Web and other advances in information technology. Thus, basic physics can be seen as an important strategic long-term investment for any country that has intellectual and financial resources to reach above a sub-critical level in its research endeavours. The Evaluation Committee feels that Norway does not only have the capacity, but could also with its present economical situation be regarded to have a moral obligation, relative to the world community, to take a responsibility that would match the share in terms of BNI or at least in terms of population with the commitments taken on by other comparable countries. The Evaluation Committee therefore suggests a gradual build-up of the research resources spent for basic physics. A suitable form for this is to increase the "free" project frame for grants in basic science of the Research Council for curiosity-driven projects for young scientists, including post-doctoral positions and PhD stipends. Such a build-up should, however, be matched by setting up a physics panel to advise on how the resources should be distributed. An important task for this panel will be to see to that the increased funding does not lead to further fragmentation, but sooner is used to stimulate more collaborative and well coordinated efforts.

In addition to the supply of sufficient and well-trained personnel, a necessary condition of vital significance for research in physics (as well as for physics education) is the availability and standard of instrumentation, laboratories and workshops. Also the access to modern high-performance computers is vital. The general impression of the Evaluation Committee is that the standard of such resources for Norwegian physics is good, and in several areas excellent. In particular, the local resources at UiO for physical electronics, materials processing, and geophysics, at NTNU for nano-sciences, materials characterization and biophysics, at UiB and UNIS for space physics, and at IFE for neutron diffraction studies, are state of the art. For electron microscopy it is necessary to update the instrumentation with an aberration-free microscope. A national facility for the design, the elaboration and the characterization of materials would help several teams in condensed matter physics. For some other areas, e.g. atomic and optical physics, the available resources are good though still a restriction of importance in the choice of research areas. In several cases it seemed, however, that the laboratory standard, as well as the workshop standard, was a limiting factor for the success of the activity. This partly reflected the lack of adequate space and suitable buildings.

The "big sciences", dependent on international research facilities, are also in a favourable situation: the particle physicists are active users of CERN, the space physicists and astronomers of various ESA satellites, as well as ground-based facilities like EISCAT, SST and QUIET, although the lack of membership in ESO is a limiting factor.

The geographical location, not the least Svalbard, offers special possibilities of space and ionospheric research, which has led to considerable infra-structure investments (KHO, ESR, SPEAR). In terms of large international projects, the Norwegian groups are not only to be seen as "consumers"; they are also actively and technically contributing to the experiments, which reflects their home-base resources in terms of workshops, technical staff and laboratories for testing and developing of instrumentation.

Also the computer resources, e.g. available for astronomy in Oslo, are excellent. On the national level, the national infrastructure NOTUR funded by RCN, offers several multi-processor computers with coordination and planning supplied by the non-profit UNINETT-sigma company. The only concern here is that these resources must be continuously updated.

The Main Research Areas

3.1.1 Astronomy, Astrophysics and Cosmology

Astrophysics and cosmology in Norway is predominantly concentrated in the Institute of Theoretical Astrophysics at UiO with its two relatively large research groups, in solar physics and cosmology. These groups cover both observational and theoretical aspects in their work. Smaller groups in astroparticle physics exist at NTNU and UiB, and a small group in cosmology and general relativity also works at UiS. This activity in general has high quality. The two Oslo groups are established and very well known internationally, and the minor and more recent initiatives elsewhere are very good and have considerable potential, if supported properly.

In view of the general interest, among the public as well as among students, in these subjects and the dramatic development of astrophysics in general during the latest decades as well as its prospects, the panel has identified astrophysics and cosmology as a suitable field for future initiatives for RCN and the universities. In practice, both the strong Oslo groups would in the long run benefit from a broadening of the astrophysical activities, filling the gap between the vastly different scales of solar physics and cosmology. In fact, most probably such a broadening will be necessary. Thus, the study of the Sun is inevitably linked to the study of other stars, and the more physically based this science becomes, the more significant is this link. Non-solar stars offer other experimental set-ups for testing the more basic principles under study. Also, modern observational techniques make it possible to study "solar phenomena" like spots, granulation, differential rotation, magnetic fields, coronae, etc, on an increasing number of different stars in increasing detail. In addition, other types of stellar activity may be studied, not present on the solar surface. Furthermore, the careful study of the Sun also opens up new and important ways to contribute to stellar physics in general, and a successful solar-physics group thus has an important mission in the extra-solar world.

Likewise, the study of cosmology needs increasingly more and better understanding of the physics of the objects used as tracers of the evolution of the Universe as a whole, i.e. individual galaxies, quasars and clusters of galaxies, as well as intergalactic clouds, star-formation in early époques, etc. For the astro-particle groups in Trondheim and Bergen, connections to observational and theoretical astrophysics, including both the study of compact objects and of the physical conditions in the Early Universe, are of key significance. Natural areas of expansion for Norwegian astronomy, neighbouring the fields of the two Oslo groups, are thus stellar physics and extragalactic physics. Also planetary systems research may be highly suitable, with relations also to Norwegian geosciences. Furthermore, work on supernovae, neutron stars, black holes and active galaxies, would be an important complement to the astro-particle groups. If initiatives to broaden astrophysics in such directions are taken, the resulting groups do not necessarily have to be situated in Oslo; if not, however, a national coordination of teaching, research training as well as research, with Oslo in a leading role is highly motivated. Such coordination would already in the present situation be well warranted. The Evaluation Committee suggests that a national strategy for astrophysics is worked out, and that an instrument for coordination be established after that.

Another topic of relevance for such a strategy would be the interaction between astrophysics on one hand and other fields of physics, n b plasma physics, space physics, geophysics, computational physics and elementary-particle physics. Such bridges between different fields or areas of common interest do exist, but they are often dependent on individuals, such as the plasma-physics group at UiO, which is now under threat due to retirements.

Presently, the main sources of solar observations in Norwegian astrophysics are the Swedish Solar Telescope (SST), the Hinode solar satellite and the SOHO mission with ESA involvement. For Norwegian cosmology, the ESA Planck satellite as well as the international QUIET experiment in Chile to study the polarization of the Cosmic Microwave Background are presently most important. In the solar group, plans are also developing to take part in a possible Large European Solar Telescope (EST), as well as in the NASA project Interface Region Imaging Spectrograph (IRIS) while the cosmology group discusses participation in the ESA Euclid mission, mapping the geometry of the dark Universe. All expansion directions of the science areas proposed above would lead to an even better use of ESA resources, but would also naturally lead, or even require a future engagement in ESO. The Norwegian engagement in the Nordic Optical Telescope, NOT, may be seen as a provisionary means to keep such options open -- the telescope may serve as a training and testing tool for young astronomers interested in new developments, or astronomers who wish to extend their area of interest. However, NOT is not a sufficient tool for Norway to take an international position in observational astronomy. Instead, instruments like ESO's Very Large Telecscope or ALMA are necessary. ESO is presently finalising plans for its next great investment – the European Extremely Large Telescope. This will open up unprecedented possibilities, not the least in observational cosmology. A number of smaller European countries have recently joined ESO in order to take part in this venture; among those are Finland, Czech Republic and Austria. It seems that the possibilities for Norway to contribute and benefit from joining would be excellent. This perspective was also brought up in the recent valuation report initiated by the Institute of Theoretical Astrophysics at UiO on the future of Norwegian ground-based night-time astronomy. The present Evaluation Committee suggests that the most ambitious alternative brought up in that report, a full ESO membership, be seriously considered by RCN and other relevant authorities. The Evaluation Committee also suggests that RCN initiates a mechanism for setting priority between different major infrastructure investments for science (and also be given proper funding), see below.

3.1.2 Atomic, Molecular and Optical Physics

The Norwegian activity in AMO physics is relatively modest, seen on an international or Scandinavian scale. Students trained in this area, and in particular experimentalists, are of considerable interest for many areas of society, including several industrial branches. From a recruitment point of view, the research activities have a sensible geographical distribution, with groups in Oslo (FFI), Trondheim (NTNU) and Bergen (UiB) (The activity in Tromsø (UiT) in Molecular Quantum Mechanics is expected to close in a foreseeable future in connection with retirement). Compared to their size, all three groups perform well to very well in terms of volume and quality of their scientific output. This is to a large degree supported by extensive collaboration with leading research groups at universities abroad, including extensive exchange of students and researchers for longer or shorter periods of time.

The group at FFI should get more involved in educational activities in collaboration with relevant departments at UiO for the benefit of both sides. The groups at NTNU and UiB face considerable challenges in terms of (i) lack of sufficiently adequate technical infrastructure and (ii) problems with funding of new medium size experimental equipment. This problem should be discussed and addressed at the local and national level. To the extent that additional resources will not become available, the groups may have to consider a further focusing of their experimental efforts in order not to spread out resources too thinly.

Some ”hot topics” in contemporary AMO physics are not addressed at all by the Norwegian physics community. Here in particular the exploding and fascinating new fields of cooling and trapping of ions and atoms are missing completely, despite the fact that entirely new phenomena can be studied with, e.g., Bose-Einstein condensates and many novel applications can be foreseen in areas such as microscale electronics or quantum computing. Experiments in this area, though indeed technically demanding, are not particularly expensive in terms of equipment and manpower.

3.1.3 Biological Physics

Biological and medical physics are rapidly growing fields internationally. Physical and mathematical concepts and tools are increasingly used for understanding biological issues. Furthermore, the step from basic molecular understanding to clinical practice is decreasing. Thus, the field has an important long-term role to play also in controlling the rapidly increasing health costs of an aging population.

Norwegian biological physics is located in three major sites, NTNU Trondheim, University of Oslo (UiO) and University of Life Sciences (UMB), Ås, and a few minor, in Bergen and Tromsø. Overall the quality and output of the major sites is very good, with Trondheim as the leading site. Here relevant, timely topics in molecular biophysics and biosystems are attacked with modern tools. The UMB activity in computational biology has a more narrow scope but the topic is timely and they have a significant potential for establishing themselves on the world scene. The groups at NTNU and UMB are led by young and ambitious team leaders. UiO has a long and strong history in radiation-oriented biophysics. This topic is relevant but an evaluation of the future research direction is recommended as the two leading scientists retire in a few years. The activities within biological physics at minor sites have weak publication records and sometimes raise relevance issues. This fact should be observed if there is a research priority discussion.

Successful efforts in biological physics benefit from a multidisciplinary environment, preferably including competences ranging from clinical and pre-clinical medical researchers over chemistry and biotech to basic and applied physics and mathematics. Critical size helps to address relevant problems with appropriate methods. In experimental groups it is valuable to have this environment locally while theoretical groups certainly can have the network wide spread. Trondheim has been successful in building such an environment. The computational neurobiology of UMB has a working distributed network. UiO collaborates closely with the strong medical environment in Oslo, where historical, personal, and professional ties knit together the medical faculty and the physics department. The biological physics at UiB and UiT is experimental and is presently significantly below the appropriate critical size. It is difficult to foresee a funding increase that would remedy this problem within a reasonable time frame. Thus, the Evaluation Committee recommends NFyR and RCN to perform an analysis of the consequences of focusing available resources to the major environments.

3.1.4 Condensed-matter Physics and Materials Science

The field of condensed matter and materials physics has enlarged its scope enormously in recent years. In this sector basic and applied physics are interconnected, they are the opposite sides of the same coin. As a matter of fact, just to frame the problem the six areas considered by the Condensed Matter and Material Physics (CMMP) 2010 committee of the American Physical Society as those of predominant interest are listed: i) complex phenomena, ii) renewable energy, iii) physics of life, iv) phenomena far from equilibrium, v) nanoscience, vi) information technology.

The Norwegian research activities are within these six large areas, or at least they can be classified according to one or another of them. The question now shifts toward the accomplishments of these activities so far and the strategy and planning of future activities and how these compare with similar initiatives in other parts of the world. Before proceeding, a point needs to be stressed: the activities in materials science are typically interdisciplinary, involving usually several departments and faculties at universities as well as research institutions. The present evaluation refers only to the basic physics research at universities and at a few research centres (IFE and SINTEF) and thus it is, of course, partial. The research activity performed under the Complex National Network is considered separately below.

Research in condensed matter physics and materials science (CMMS) is pursued at UiO, NTNU, IFE, SINTEF and recently at UiB. A modest activity is present at UiS. The overall trend in Norway for this scientific area is positive, with an increase in staff members, topics and funding since the last evaluation. Key areas of experimental research at UiO are wide band gap semiconductors, semiconductor nanoscience/technology, and materials for solar energy technology. At NTNU the experimental activity deals with studies of material structure at the nano-scale, adsorption behaviour at bimetallic surfaces, organic electronics and third generation solar cells. The theoretical activity concerns interacting many-body systems, nano-scale and meso-scale electronic properties of small systems, spin transport and spin dynamics in superconductors, ferromagnet semiconductors, quantum critical phenomena. At UiB the main activity is related to processing technology of nano-carbon materials and to the development of a helium-atom microscope with a focus on bio-functionalized surfaces. At IFE, activities are performed on synthesis of materials for hydrogen storage, on the structure and magnetic properties of complex oxides, on complex systems and soft materials. The group is also responsible for the JEEP II research reactor for the application of neutron scattering to materials science. The research at SINTEF concerns the study of precipitation mechanisms in Al 6xxx alloys, the characterisation and modelling of thin films and interfaces in solar cell structures, electronic structure studies with *ab initio* modelling.

The overall activity evaluated spans from outstanding to weak in terms of scientific quality and productivity. Activities, mainly experimental, of relevance to renewable energy are those connected to third generation solar cells, to thermoelectricity and to hydrogen storage. Outstanding results have been obtained in the theoretical analysis of spin and charge transport in nanostructure magnetic materials. The research on aluminium based alloys and nano carbon structures has reached a good standard. In some cases the analysis facilities are the main driver behind the research instead of the problem to be solved. In the worst case, the activity only is a mere routine service to industrial interests.

A general recommendation to all players in this field is to reduce barriers between experiment and theory and between basic and applied physics. A close interaction between theory and experiment should characterize this field: they inform and guide each other.

The research on renewable energy should be strengthened. In almost all cases the material itself is crucial and at the focus. Photonic crystals and nano-semiconductors will enhance the photosensitive response range and then the solar energy-collecting efficiency. The recent progress in thermoelectricity by means of bulk materials with embedded nano-particles of controlled sizes is a guideline for the future activity in view of the previous know-how on the behaviour of Si and Ge nano-clusters. Regarding hydrogen storage, if the worldwide goal to achieve 9% (by weight) by 2015 is to be reached, it will probably require new materials to be the modelled, designed and tested. Collaboration with materials chemists and other materials scientists is necessary.

Energy-related research offers a good opportunity for international collaboration and for MSc and PhD students.

Several groups at universities and research centres perform research on carbon-based materials. At this stage a better coordination is required particularly in view of the interdisciplinary character of such research.

Nanoscience is another hot subject. It encompasses a wide range of topics, including research in condensed-matter physics, atomic, molecular, and optical physics, materials science; electrical engineering; chemistry and biology. It is a heavy undertaking for the RCN to maintain and support both existing and new initiatives in this field. An *ad hoc* committee is needed in the near future. A substantial effort is being made at NTNU to build a Nanolab with several state-of-the-art facilities. This is a unique opportunity for the NTNU community to plan well-defined projects taking into account the available competences e.g. in spintronics, nanomaterials for third generation solar cells. The Nanoscience activity at Bergen needs a better-defined plan and the involvement of other staff members or new appointed personnel.

The Evaluation Committee has often regarded the fragmentation of research and the rather common one-man operation as a weakness. This is, on the other hand, a characteristic of CMMS research worldwide in which most investigators work in small research groups. Strong support should be maintained for these kinds of activities, but with a strong reviewer base, either internal within the department or external such as RCN. In any case, internal duplication of topics or new one-man projects based on expensive and unavailable instrumentation should be avoided.

State-of-the-art instrumentation and facilities are critical to the field in general. The relevance of two facilities is to be stressed: i) TEM aberration-free electron optics for atomic resolution and ii) ancillary equipment for the neutron scattering lab at Kjeller as preparatory for the European Spallation Neutron Source at Lund. The NORTEM initiative should be continued and a decision should be taken by RCN where to locate a new TEM. In addition, but on a general basis including chemistry and materials science departments, RCN should develop a national facility in support of design, discovery and growth of new materials for both fundamental and applied CMMS research. The availability of exotic materials is extremely relevant for curiosity-driven research. Maintaining and developing high performance computing resources for condensed matter and materials science is another priority of RCN. A general comment for the whole field regards the low presence and participation in European projects. A substantial increase of these research projects will help the condensed matter physics and the materials science community to overcome geographical barriers.

Complex National Network

Born in 2000, the Complex Network spans over three research physics departments at UiO, NTNU and IFE, and is composed of 13 senior scientists, 18 post-docs and 18 PhD students. The focus is on complexity, i.e. on systems for which collective effects may be qualitatively different from singular ones, whatever the specific disciplinary field. For this reason, a large variety of topics are addressed. At UiO and NTNU, the approach is experimental, theoretical and numerical. At UiO, studies mostly concern heterogeneous systems and dynamics, including granular materials, porous media, breakdown processes, vortices in superconductors, domains walls in magnetic films, and electronic micro- and nano-devices. At NTNU, the experimental research concerns mostly soft materials, polymers, nano-particle physics, ferroic materials and surfaces. The theoretical and numerical approaches focus on granular materials and porous media, non-linear growth processes, fracture, quantum optics and biophysics. At IFE, the Complex group investigates the connections between the microscopic and macroscopic properties of soft and complex materials, such as nanocarbon materials, polymers and biopolymers, and ferrofluids.

The scientific quality and productivity of the network is excellent, and this national structure has also a large degree of international collaboration. The network has a reasonable production rate of PhD graduates compared to the national average, but not outstanding. It is a transverse organization spanning over three institutions, and it has a more collaborative rather than strongly directed activity. Each of the three groups has its own programme, including collaboration within Norway. This arrangement seems to work quite well, evidenced by the existence of a common activity report.

This network, although quite heterogeneous, is at the forefront of its field on the international scene. There are several possible strategies for it to constitute a "network of excellence" within the country. One of them would be to focus on soft and granular materials, rheology, and fracture activities and join with the physicists at PGP in Oslo. The other would be, for the present Complex Network to keep all its activities (which, in nanoscience, are sometimes only loosely related to complexity), and establish tighter links both with the theoretical and experimental (Nanolab in particular) condensed matter physics groups. The decision to be made depends on the strategy chosen within the various institutions, particularly NTNU.

3.1.5 Electrical Engineering and Measurement Technology

Electrical Engineering and Measurement Technology (EE-MT) spans a wide field from basic engineering science to end-user (often industrial) motivated projects. Given the increased level of complication of industrial processes and products the academic community certainly has an increasing role to play. In an ideal interaction new measurement problems stimulate basic academic engineering science and the knowledge of academia helps industrial development, both in existing companies and via start-ups. However, such interaction is not without generic problems, e.g., that academic environments lose track of the long-term academic goal while solving yet another urgent problem. Both sides of the coin are visible in Norway.

EE-MT in Norway spans a wide field but often has connection to basic and successful industries as, e.g., fishing and oil. This is a strength, it assures that academia pursues research in relevant areas. Major sites are Bergen and Tromsø, and minor Stavanger and UMB. In general, several of the groups attack industrially relevant issues and are clearly playing an important role for existing as well as future commercial enterprises. However, the committee was not always impressed by the academic level and worries that the application-oriented focus will be long-term detrimental for basic academic engineering science. This, in turn, risks leading to less industrial interest for future collaborations. This conclusion would normally call for a larger fraction of funding from government to match the industrial funding, which (again normally) places constraints on the type of activities that are pursued. However, in Norway it seemed like the large majority of the funding of the applied EE-MT projects already comes from the government and only a small fraction of the money is from industry. Furthermore, in at least a few cases pointed out to the committee the relevant intellectual property produced goes fully to the industries, despite their low funding fraction. This is surprising and possibly indicative of a too weak emphasis on basic engineering issues in the EE-MT area. In addition, such ownership may hinder the emergence of new companies. In summary, the committee feels the balance between basic engineering science and more applied work needs to be shifted. However, a simple change of government/industrial funding fractions would probably not remedy the situation.

3.1.6 Physics Education

Physics (and technology) education studies are pursued at the three large physics departments in Norway, UiO, NTNU and UiB, thus providing a satisfactory national coverage for recruitment into education and research in this field. The area of activity has in recent years gained increasing attention in Norway as well as in other Western countries suffering from a steady decline in recruitment into science and technology studies, unsatisfactory compared to national needs. The physics department at UiT is most likely too small to host a similar activity unless there is an increased focus on this area as a consequence of the recent merger with the local university college. Though somewhat different in nature from other activities at a physics department, it is vital that education activities of this kind are rooted in the faculty of science and not transferred to general pedagogical departments.

However, all three Norwegian groups are close to having subcritical mass. Closer, or even better, formal ties with similar local activities within other science departments should therefore be seriously considered. Furthermore, a national structure for collaboration, coordination and division of labour with respect to research and education in the field, including a national PhD school, should be initiated and supported by RCN. Relatively modest means would enable a considerable increase of the impact of the resources already available. Such collaboration should preferably include all fields of science education and possibly also mathematics, since only in this way the necessary volume will be achieved, and moreover, these activities in different fields could benefit considerably from closer collaboration. The national network should in particular support mobility of MSc and PhD students. In this context also the partly neglected didactics of technology education should be addressed at a national level. Participation of the Norwegian network in Nordic and European activities including PhD training programmes and exchange of guest researchers should be supported in order to secure that the Norwegian effort becomes an integral part of the international activities.

3.1.7 Space Physics

The drivers for space physics research in Norway are both scientific and strategic. Both these aspects have a regional/national and an international context.

Scientifically, Norway is geographically well placed to host ground based observations of solar–terrestrial coupling. Ground based incoherent scatter radars at Svalbard (Longyearbyen), and northern Norway (Tromsø) provide observations of the daytime and nighttime aurora respectively, and coupled with optical methods give almost continuous coverage from the middle atmosphere to the ionosphere. These are complemented by rocket-borne payloads, which sample the ionospheric plasma in-situ. These facilities play pivotal roles in international coordinated campaigns that involve the wider EISCAT (network of incoherent scatter radars) community and in-situ spacecraft observations at low earth orbit and out to several earth radii in the magnetosphere. These facilities also satisfy a national commitment to the peaceful exploitation of Svalbard and regional development of the Norwegian mainland. The EISCAT radar facility at Tromsø is nearing the end of its operational life and a next generation facility – EISCAT 3D – is proposed based on fields of phased array dipoles rather than a few, high powered Klystron/dish based technology. Ideally the EISCAT international community would support this but international commitments for this are evolving and the RCN may commit to a smaller scale unilateral programme. Given their heritage with the existing EISCAT facility, EISCAT 3D would, based on 'historical' considerations, fall to the Tromsø Space group but there are significant structural problems with respect to academic staffing. It is recommended that RCN consider an open bidding process for any future funding related to EISCAT 3D to encourage both a coherent approach across the national community and adequate institutional support. Also, it is recommended that a panel for ground-based facilities be set up which includes representatives both of the scientific community and those determining national interests to optimise delivery of both scientific excellence and response to national need.

There are small, but highly effective centres of excellence in space-based instrumentation at UiB and UiO, focussed on X Ray/ gamma ray detectors and Langmuir probes, respectively. Both these groups have significant international engagement and have competitively achieved selection for e.g. ISS, and ESA and NASA mission payloads. These groups have benefited from the availability of rocket programmes to develop and demonstrate their detectors to an international audience and thus secure selection for international missions, and a case would need to be made for the future need for rocket programmes in this context. As with much of Norwegian physics, these groups are at marginal or subcritical size due to staff retirements and deliver an impressive level of international impact given the staffing available. Given the international context of this work they may be considered as ambassadors for Norwegian science. It is recommended that there needs to be a mechanism for tensioning between the space- and ground-based programmes which is transparent, peer reviewed, and which adequately weighs scientific excellence against strategic needs.

Technology for space exploration traditionally has a security dimension, which is also evolving. This has in the past been the driver for the rocket programme but this is now regarded as no longer of strategic importance. Science currently funded by RCN includes rocket borne in-situ ionospheric observations, and these attract international support. Until recently the Norwegian Defence Establishment has supported the testing and integration of rocket borne payloads, but this no longer has strategic priority. If this capability is to be maintained it will need to be picked up by the University sector. However, it is notable that, for example, there is adequate capability in the private sector to support integration and testing of X Ray detectors developed at UiB. It is recommended that RCN and relevant stakeholders establish a mechanism to determine whether rocket based in-situ observations be continued in the context of the wider ground- and space-based programme.

A robust programme of theory, simulation and data exploitation is needed to fully exploit the investment in these observational programmes. The evidence presented to the Evaluation Committee is that these activities are rather weak – there are no dedicated academic staff for these areas not near retirement age. There is a risk that without this activity, Norway will not realise the full potential of its investment in observational infrastructure. The cost of exploitation is small compared to the infrastructure cost so there is potentially a significant leverage opportunity here.

It is recommended that the RCN's strategic planning for engagement in, and commitment to, instrumentation and infrastructure for international missions, and the ground-based programme, should include an element of earmarked High Performance Computing and exploitation support to be bid for subject to peer review. High Performance Computing, data mining and instrumentation development relevant to these programmes have clear industrial application and train young researchers in relevant skills. Norway's academic sector benefits from a strong commitment to relevance in its academic programmes and there are already mechanisms in place for the flow of staff between academia and industry. It is finally recommended that the infrastructure and large-scale facilities needed for space physics in Norway be developed in the context of strengthening national industry, by targeted funding programmes.

3.1.8 Subatomic Physics

This field comprises both particle physics and nuclear physics. Experiments at CERN's LEP collider in the 1990s and at the Fermilab Tevatron collider during the past decade have established a Standard Model of particle physics. Particle and nuclear experiments at CERN's LHC collider are now opening a new era, and will address important open questions such as the origin of particle masses, the nature of dark matter, the difference between matter and antimatter, and the nature of the quark-gluon plasma thought to have filled the Universe when it was a fraction of a second old.

Particle physics is closely related to astroparticle physics, and nuclear physics has two components: high-energy heavy-ion collisions and low-energy nuclear structure physics. Norwegian activities in high-energy particle and heavy-ion collider physics are coordinated through a national programme for CERN-related physics, and are mostly focused on the ATLAS and ALICE experiments at CERN's LHC. Historically, this programme has also included experimental activities exploiting other, lower-energy facilities in the US (BABAR, RHIC) and in Europe (DESY): these activities provided valuable research opportunities during the period of preparation for the LHC experiments, but have now largely been phased out. Some of the low-energy nuclear structure physics is associated with CERN's ISOLDE facility, other aspects with the Oslo cyclotron and with SPIRAL at GANIL. Interest has been expressed by some particle physicists in joining a non-accelerator astroparticle physics experiment, and some heavy-ion physicists would like to join an experiment planned for the FAIR facility.

The national programme for CERN-related physics has fostered successful collaboration between groups at UiO and UiB that have been working on the construction of the ATLAS and ALICE experiments. In the case of ATLAS, special mention should be made of Norwegian work on the Silicon central Tracker, and in the case of ALICE the PHOS detector and the higher-level trigger. The previous Norwegian experience with LEP, BABAR and RHIC has prepared the UiO and UiB teams for exploitation of these investments via physics analysis projects, e.g., in the searches for the Higgs boson and supersymmetric particles. In this connection, mention should also be made of the leading role that Norway has taken in developing and deploying distributed Grid computing in the Nordic area.

Theoretical activities in particle physics are very integrated with the experimental work, particularly in UiB. There are also close relations between the experimental and theoretical work on relativistic heavy-ion collisions in both UiO and UiB. In view of the increasing connections between particle physics, astrophysics and cosmology, it would be good to see closer relations between the particle physics groups, cosmologists in UiO and UiS, and the astroparticle group in NTNU.

Regarding the plan of the particle physics group in UiB to use a new recruitment to extend its experimental activities to include astroparticle physics, the Evaluation Committee sees useful synergies in this development, as long as it does not have any negative impact on the exploitation of ATLAS. Regarding the wish of heavy-ion physicists in both UiO and UiB to participate in the CBM experiment at the FAIR facility, there is a risk of over-straining the present experimental groups, particularly in view of the personnel issues discussed below. Another important issue for nuclear physics at UiO is the future of the Oslo cyclotron.

The Norwegian subatomic physics community is in good shape overall: it is highly regarded, and some of its members have taken leading international positions. The research programme in particle physics and nuclear physics is generally very promising. There are, however, problems associated with retirements, particularly of nuclear physicists at UiO. The continued vigour of this group will hinge upon its revitalization.

3.1.9 Theoretical Physics

This field is a natural complement to experimental physics, in that it may serve as a source of underlying ideas and phenomenological models as well as tools for analyzing experimental data. A good balance between theory and experiment is therefore essential for the healthy development of physics as a whole.

Whilst some aspects of theoretical physics are quite specific to certain areas of experimental physics, there are also broad theoretical approaches that find applications in many fields, such as quantum field theory and computational methods. It is therefore beneficial to nurture relations between theorists working on different fields, as well as with the corresponding experimental groups.

The main concentrations of theoretical physicists are in UiO and UiB, and there are also some theorists in NTNU, UiT and UiS. The Evaluation Committee offers below comments on their present activities and some recommendations for their improved coordination in the future.

The theorists in UiO are organized into one general group that has members working in several different fields, and another team focused specifically on heavy-ion physics. Some members of the former group have well-established international reputations, and the Evaluation Committee is glad to note the planned recruitment of a phenomenological theorist working on particle physics, who may be expected to work closely with the ATLAS teams in both UiO and UiB. In view of the dispersion of interests in this group, it is important that its members should nurture contacts and collaborations with theorists elsewhere in Norway, in Scandinavia and further afield.

Closer contacts with the theoretical cosmologists in the Institute of Theoretical Astrophysics could also be beneficial.

In UiB, the theoretical particle activity is of very high level and integrated with the local ATLAS team, there is very good theoretical work on relativistic heavy-ion collisions that is organized independently from the local ALICE team, and there is theoretical work on nuclear structure that is less connected with the corresponding experimental activity. Greater co-operation between the different UiB theorists is desirable, but may be unrealistic at the present time.

The astroparticle group at NTNU includes members doing very good work on QCD and cosmic-ray physics, who are relatively isolated. It would be natural for the former to work more closely with the relativistic heavy-ion groups in UiO and UiB, and for the latter to work more closely with the experimental astroparticle group now emerging at UiB. Likewise, it would be beneficial for the promising theoretical cosmological activity at UiS to have closer relations with the cosmology group in the Institute of Theoretical Astrophysics at UiO. The solar physics group at UiO has several possible areas of fruitful interaction with theoretical plasma physics at UiO and UiT, as well as with hydrodynamics at FFI.

The condensed matter theory group at NTNU is quite strong and clearly involved in extensive national collaboration. Within the Complex Network a number of scientists take part in theoretical and computational efforts, with a fair deal of interaction within the Network, but not so much with other potentially interested Norwegian partners like solar physicists and geophysicists.

Altogether, theoretical and computational physics in Norway, in view of the multitude of foci but with some common aspects methodologically and even more fundamentally, seems to have possibilities to develop fruitful interdisciplinary collaboration in research as well as in education. This could, e.g., form a basis for an excellent research school in applied computational physics, of considerable interest also far outside academic physics. The Evaluation Committee appreciates that all collaboration takes time – priorities must be set, and selections made among possible partners and projects. Active steps should, however, be taken to regularly survey possibilities for further collaboration also across the disciplinary boundaries, and well-trained theorists are for several reasons able to be rather flexible in these respects.

3.2 General Recommendations

3.2.1 Local Research Departments

A rather general observation of the Evaluation Committee has been an absence of strategies, and adequate means to develop strategies for the individual departments. The impression is that setting of strategies is now rarely a continuous activity but sooner rather sporadically re-active: it primarily occurs as a response of evaluation or possibly in connection with retirements when positions are becoming free and have to be defined or defended. It would, however, seem advantageous to initiate strategy work on the department level as a continuous and pro-active process, defining priorities: what research areas should be enhanced, what programs should be de-prioritized, and at what timescales should suitable measures be taken to realize such intentions. Corresponding endeavours could also be beneficial for the development of education. **The Evaluation Committee suggests that suitable measures be taken by the Department leaderships to establish such continuous strategy work at the departments.** At least for the larger departments one could follow the example from several major departments abroad, to establish a Visiting Committee of external colleagues, in order to benefit from their variety of perspectives and to resolve collegial impasses. An important objective in this strategy work must also be to systematically and continuously consider what closer collaboration with other national departments and groups should be established. In all respects, the strategy work must be based on active participation by the research groups of the Department; it should never be looked upon as a work done for solely administrative reasons by the Department Head.

One reason why strategies may be difficult to set is the fact that so much of the resources of the departments are already committed to staff positions, whether scientific, technical or administrative, or to cover costs for premises. **The Evaluation Committee suggests that the decisions about the distribution of the total university resources to a department be put in the hands of the leadership of the**

Department (yet under the oversight of the Faculty Board), so that at least in the longer-term perspective a scientifically initiated prioritization of the resource allocation between such different expenditures is established. Another problem in accomplishing an efficient prioritization is the tradition to allow every scientific staff member to use 45% for research, 45% for teaching and 10% for administration. Although this rule is now not followed strictly in several places, **a much more relaxed attitude is recommended**. The Evaluation Committee certainly believes that every academic staff member at a university should be engaged in teaching as well as in research, but the percentage of time used for either of these activities should be determined by the Department leadership to ascertain a good output in terms of research and teaching, in order to optimize the results of the total activity and most efficiently reach the goals set in the Department strategy.

As regards the collaboration with external organizations, including private interests or state agencies, it is certainly appropriate for physics departments to eagerly seek and engage in such projects when motivated on scientific grounds. However, the **Evaluation Committee must recommend that the external organizations cover their share of the collaboration costs**. It is important that projects initiated by external bodies where the intrinsically academic interests are small, whether research-wise or educational, are covered by the initiating body, and that when laboratory facilities or consulting is offered by the academic institutions, full cost be charged. The obligation for science departments to serve the surrounding society should not be interpreted as an obligation to subsidise it.

As was commented on above, the Evaluation Committee has noted that the mobility of the Norwegian physicists between the institutions in Norway, as well as abroad, is not very great, although a more systematic study of this is missing. On circumstantial evidence it seems, however, that a considerable number of physicists have spent their full career at one single institution. **The Evaluation Committee recommends that the leaderships of the departments consider what measures can be taken when admitting PhD students and post-docs and at hiring of staff, to stimulate mobility**. One obvious line of action is to consider coming from a different environment as a considerable merit in itself when evaluating candidates.

At least at the major university departments the Evaluation Committee has found an active and engaged activity to promote the establishment of a reasonable gender balance among staff and students. Although much still remains here, the situation is improving. **The Evaluation Committee recommends that this work be continued with unabated strength, and that the increased possibilities opened up by the relaxed rules suggested concerning distribution of resources and working hours above, be used systematically to promote the recruitment and development of female staff**.

3.2.2 The Role of the National Committee for Physics

The Evaluation Committee has noted a need for improved coordination between the various physics departments and groups in several respects, concerning the use or establishment of major equipment, concerning a division of labour as regards nationally important projects or tasks, or concerning the build-up or development of research or teaching in particular fields which are now scattered along the country. The Norwegian National Committee of Physics (Norsk Fysikkråd, NFyR) is established by the Norwegian Association of Higher Education Institutions (Universitets- och Høgskolerådet, UHR). It contains representatives for the major physics departments and meets several times a year. It seems to be a suitable body to undertake a number of coordinating tasks. **The Evaluation Committee recommends that NFyR take an enhanced responsibility for coordination in general**. Particularly urgent issues, noted by the Evaluation Committee are presently: i) mobility, ii) research training collaboration (e.g. in computational physics, optical and laser physics, or other topics of common interest where synergies may be developed, perhaps organised in short intensive courses), iii) the development of EISCAT and ground-based space physics in general, iv) the national coordination of instrumentation, e.g. in atomic physics or condensed-matter physics, v) the development of nanophysics in light of several major investments, and vi) the development of astrophysics, biophysics/medical physics and physics education. In particular concerning tasks of the latter more disciplinary character they probably should be given to particular sub-committees with representatives for the groups involved, but the supervision could still be in the hands of NFyR. Needless to say, all these coordination efforts must be made in close collaboration with relevant research groups and departments, and also with continuous contacts with the Research Council. In many cases it may also be fruitful to engage the non-governmental organisation the Norwegian Physical Society (Norsk Fysisk Selskap). As regards a number of other important tasks, like the future of the Oslo Cyclotron Laboratory (OCL) and physics education (if considered with other science education programmes), contacts outside the physics community must also be taken. The Evaluation Committee is not in the position to recommend whether the needed policies in such interdisciplinary cases should be developed within the auspices of UHR or RCN or both. Concerning OCL, initiatives are presently being taken by the Faculty of Mathematics and Natural Sciences at UiO, but obviously also RCN has a role to play here.

3.2.3 The Role of the Research Council of Norway

The Research Council certainly has a key role for Norwegian science in general, and for assisting in establishing and supporting disciplinary national strategies for the various physics areas in particular. **The Evaluation Committee recommends, however, that this role should be primarily re-active, in the sense that initiatives in the normal case should emerge from the research groups and departments involved**. In fact, the impression of the Evaluation Committee is that this is also the present situation. In order to guarantee realism and balance in the strategic work, it is important that the contacts with the Council continue to be active. Also, it seems quite relevant that the Council economically supports strategy and coordination work of the type discussed above when needed.

In one particular respect, the Research Council has a leading role of very great significance for Norwegian physics. This regards the building up and participating in large infrastructure investments, national as well as international. A number of such issues are now at stake, e.g. the future of the Oslo Cyclotron Laboratory, the continuation of the EISCAT programme and of a national rocket programme, the Norwegian matching of the ESS in Sweden, and others are on the horizon such as the possible future participation in FAIR/CMB and in ESO and its E-ELT project, etc. It is the impression of the Evaluation Committee that these various issues are handled in a relatively ad-hoc manner within the RCN in interplay with the individual research groups. **The Evaluation Committee recommends that the RCN considers strengthening and**

develops adequate modes of operation for handling and prioritizing between the various large-scale projects of this type on a national level. One model would be setting up an Interdisciplinary Advisory Committee for large-scale infrastructure, consisting of international experts. It should advise on international research developments and large-scale projects and the possible Norwegian engagements in these, recommend priorities for such projects including national ones, and if possible assist in developing a continuous roadmap lining out the investments and costs involved.

The funding by the Council is of fundamental significance for physics research. Here, **the Evaluation Committee wishes to stress the significance that "free grants in science" have, i.e. grants that are solely given on scientific merits and not directed towards special projects or programmes defined on more political or administrative grounds.** Although these grants have increased in recent years in physics, they are still quite restricted and only a very small share of the proposed projects can be supported that way. This situation is more strained than in other comparable countries. The risk is obvious that Norwegian science is hindered in its healthy development into unexpected or unplanned directions, and this may be fatal in a field like basic physics since, from experience, so much of the most important scientific discoveries and the most useful commodities resulting from those, came unplanned and unexpected. **The Evaluation Committee therefore strongly recommends that the allotments to the "free sector" grants for science be further increased**.

In discussing the productivity of Norwegian physics in terms of published papers, the Evaluation Committee noted that the relatively small volume seems to be a natural consequence of the comparatively small number of physicists (see 3.1 and Appendix C). **The Evaluation Committee recommends that Norwegian physics be strengthened so that the country at least contributes as many research physicists per capita as its Scandinavian neighbours.** (In fact, a build-up to a level in proportion to BNI could seem reasonable.) This requires a build-up of positions, and additional grants to support this, as sketched in 3.1. It seems that the Research Council would have a key role initially in such a process by granting resources for PhD and postdoc positions. A special programme, administered by RCN, for time-limited (e.g. 6 years) special research positions for very able young scientists in fields that need prioritization, and also including extra resources for equipment and travel, could be considered; such programmes exist elsewhere, and have been proven to be very successful. It must be pursued, however, in close collaboration with the universities so that a continued tenure-track system results. If resources can be found, **the Evaluation Committee recommends that disciplinary panels with national and international physicists be established for advising the Council in the distribution of grants and positions**. (Such panels would probably be useful even in the present working mode by the RCN.) Although the new positions should entirely be given on scientific merits, it is necessary not to split the resources to prevent an increase in the number of sub-critical groups.

3.2.4 Special Measures and Programmes

Although the Evaluation Committee gives an increase of the "free" grant resources that are not earmarked for a special sector the highest priority in the recommendations to RCN, it has also discussed a number of areas where coherent efforts could be made, presumably by earmarked funds. Some of these have the character of "center-of-excellence" programmes, in view of the already superb quality of the science. Others are more reflecting the strong potential that is present in Norway for a very great scientific impact in the particular direction, not the least of interdisciplinary character, while others just reflect a very important need. They are here given in alphabetic order – prioritization between them requires further scrutinizing and deliberations on a national level.

Advanced materials

In view of the substantial effort made by several departments (UiO, NTNU, UiB) to do research in condensed matter a national facility in support of design, discovery and growth of new materials for both fundamental and applied condensed matter and materials science research is highly recommended. Platforms such as Nanolab at NTNU could also be organized at the national level. The National Complex Network, which includes several activities related to materials science, could of course be interested in using all these facilities.

Atomic and Optical Physics

The groups at NTNU, UiB and FFI, all being successful, form a suitable basis for a directed programme as regards coordination of research, instrumentation and teaching. Increased funding for shared instrumentation would definitely help them to flourish even more and to play a more active role in interesting applications.

Biological Physics

The biological physics at UiO, UMB. NTNU, UiB and UiT would benefit from some focussing and coordination (see 3.1.3). At the major places it is, however, of very high quality. This would be a good area for a multidisciplinary excellence programme, linking the physics activities with relevant groups in biology and medicine.

Computations in Applied Physics

A considerable number of the Norwegian physics groups, not the least in applied physics, are involved in advanced calculations and simulations. Many of these groups are at the frontier in their respective fields. This in itself has great potential, but since these groups do not interact with each other so much, this potential is not realized efficiently. For physics, but probably even more to promote applications, the potential should be used, for training of PhDs and master students, and for research and development. It is proposed that RCN examines this.

Cosmology and Particle Astrophysics

The fact that the very good particle-astrophysics groups at NTNU, UiB and the cosmology group at UiS are all (close to) subcritical, and the existence of the larger excellent cosmology group at UiO, makes it natural to suggest a closer collaboration between them. Such collaboration would be stimulated by defining a special RCN excellence program in this direction. It should then, in addition to non-permanent staff enhancements at the smaller institutes, contain resources for common meetings and intensive PhD courses, as well as for guests. The cost-effectiveness of such a programme could be expected to be very great.

Nanoscience

The strong effort at NTNU to build a nano-science laboratory is a reason to examine whether also a more national effort can be made to benefit from and take part in the development in the field, and find ways to promote collaboration and continued growth. It is suggested that this be examined by the RCN and the NFyR through a special panel.

Physics of Geological Processes

The excellent and unique group in geological processes will lose its funding when the present centre-of-excellence financial support stops in 2013. It is very important that the work continues – maybe in a modified configuration (the Complex Network is one of the possibilities, already mentioned in 3.1.4; increased industrial collaboration could be another solution). The RCN seems to have a key role in promoting such a development.

Physics Education

Research in physics education is present at the three major universities, in good but close to subcritical groups. Coordination between these, and with other groups in science education, has been proposed in 3.1.6. There seems to be a potential for raising the level of ambition of this activity to quite high international standards. The consequences of a coordination effort, which needs some support from the RCN should be monitored, and if the development is positive and stimulated by the universities, further support could be given.

Space Physics – Dynamics and Coupling on All Scales from Sun to Earth

Norway has a rather unique combination of world-leading solar physics, space and plasma physics, and upper-atmosphere research. This provides an excellent opportunity to contribute to our understanding of the detailed fundamental plasma physics of the ionosphere and upper atmosphere and in particular stressing the dynamical connections between upper atmosphere, magnetosphere, ionosphere and ultimately the Sun and heliosphere. The potential for existing groups in Norway, through enhanced collaboration with each other, and maybe with climate scientists, to contribute to this issue seems very considerable. The possibilities of setting up a special programme in such a direction should be discussed between the departments involved and the RCN. A possibility could be to make such a programme Nordic, or European, but Norway should then play a leading role.

Subatomic Physics

This is one of the strongest fields in Norwegian physics, with excellent groups at UiO, UiB and NTNU. They are already in general collaborating very well, but could, not the least because of that, form a very good basis for a centre of excellence. The direction of the efforts in such a centre is not obvious. It could be focussed on particle physics or heavy-ion physics, on theory or experiments and their interaction, on instrumentation or massive data analysis. With the latter directions, it might be coordinated with astrophysics and space physics and also be useful for applied sciences. A plan should be produced by the community and discussed within RCN.

4 Evaluation of Departments and Institutes

4.1 University of Oslo

4.1.1 Department of Physics

The Department of physics at the University of Oslo is the largest physics department in Norway. The total academic staff is 40 professors, 10 associate professors, 11 adjunct professors, 7 adjunct associate professors, 22 postdocs, 91 PhD students and 14 technical and administrative staff, totalling 196 staff members. The staff work in research groups in Advanced Materials and Complex Systems, in Biophysics and Medical Physics (including some quantum optics), in Electronics, in Plasma and Space Physics, in Physics Education, in Structural physics, in Experimental particle physics, in Nuclear and Energy physics, and in Theoretical physics. In addition to these there is a Centre for Physics of Geological Processes (PGP). The department is spread between several locations within the UiO campus area, and suffers from some severe space restrictions. It has extensive and partly outstanding laboratory facilities and large workshops.

4.1.1.1 Advanced Materials and Complex Systems

The group has 5 professors, one adjunct professor, one adjunct associate professor, no technical staff, 11 PhD students, and 6 postdocs. During 2006–2008, 9 PhD and three MSc degrees were completed. Research is done in physics of condensed matter: granular media, flow instabilities and flow through heterogeneous media; fracture processes and avalanches in various materials incl. vortex matter in superconductors; flux dynamics incl. thermo-magnetic instabilities in superconductors; particle manipulation using mobile magnetic walls, dynamics of Coulomb glasses, and in theoretical nanophysics with an emphasis on transport and kinetic properties of various nanostructures, in particular, sensors, detectors and devices for quantum computation. The group is one of the nodes of the national Complex network.

Assessment and Grading

The scientific quality and productivity of the group is high. Collaboration is strong and well organised within the Complex network and hence there are numerous national collaborations. The group has a strong record of international collaboration with a large fraction of the publications being joint papers with a foreign institution, and numerous visitors from abroad, mostly first-rate scientists. The group participates in the organisation of international conferences, and schools. A good number of PhD students have been graduated. The group has very strong connections to national industries, with two professors partially externally employed. The group participates in outreach and science popularization, through articles in magazines and newspapers, and through participation in national events.

Regarding research organisation, the administrative and scientific leadership is shared, which seems to be efficient here, and allows every professor to actively take part in the research programmes. The different topics of research are not at the same level in terms of impact. Collaborations in nanophysics research could be developed further within the Department of Physics.

Overall grade: 4–5

Recommendations

Discussions seem to be on their way to getting more industrial grants. However, the Evaluation Committee would not advise exceeding a certain fraction of such financing; the group does excellent fundamental work, and should be allowed to focus on it. The infrastructure is adequate, and the beauty of a large number of the experiments performed in this group is their relative simplicity. However, improving on the nano-front would of course require more elaborate equipment. The organisation of the group is very good, but could be improved. A more tightly organized structure could be obtained within a Centre of Excellence. The Evaluation Committee has two main suggestions for this group. First, the part of the group interested in granular materials, flow and fracture problems, could merge with the physics part of PGP. Second, the nanophysics activity could link to possible collaborations with the Electronics group.

4.1.1.2 Biophysics and Medical Physics

The Oslo Biophysics and Medical Physics (BMF) group consists of three professors, one associate professor, two adjunct professors, one adjunct associate professor and several informal collaborators, who have their daily duties at medical facilities (e.g., Radiumhospitalet, Rikshospitalet etc.). The group has two technical staff members, 7 PhD students, and graduated 5 PhD and 18 MSc students during 2006–2008. Its work is focused on biological effects of ionizing radiation. Work is concentrated around the Cell Lab, for studies of the influence of oxygen concentration cellular parameters, and the EPR Lab, for dosimetry and radiation damage studies. In addition there is a small activity in quantum optics.

Assessment and Grading

This is a productive group. The leading scientists publish reasonably to frequently and are well cited historically. The group coordinates an EU project and collaborate well with the medical faculty. The productivity as regards PhD and MSc graduates is reasonable, although the Evaluation Committee had some difficulty understanding who does what (see below).

Overall grade: 4

Recommendations

The cell-lab projects, including the hypoxia studies, are timely topics well worth continued effort. Here the group has a good standing as evidenced by being coordinator for a major EU project. Although the Evaluation Committee has no expertise in dosimetry it is worrying that the EPR-project may become less competitive as time goes, given the increasing accuracy of other state-of-the-art calorimetric methods. The quantum-optics project is discussed separately below.

The BMF group has strong interaction with researchers at hospitals in the Oslo area. This is good, since BMF-type research benefits from having clear biomedical goals (in fact, in many places these types of activities are located at the medical faculty). The group should certainly be complemented for having a high degree of biological relevance in their projects. However, the many affiliates also make it somewhat difficult to determine which faculty is the prime scientific driver and definer of the projects. For a large majority of the PhDs graduated 2006–2008, adjunct professors with their main activity at the hospitals are listed as supervisors.

In 5–7 years the two senior BMF faculty members will approach retirement. Given the growth of biological physics worldwide, it certainly would be natural to continue the activities biophysics and medical physics. However, the Evaluation Committee does not have the full picture to provide a detailed suggestion of suitable new or old fields within the broad scope of biological physics but would recommend the department carefully evaluate the future strategy. Here both interactions within the physics department and with the strong Oslo medical environment should be taken into account.

The Evaluation Committee has difficulty understanding the scientific motivation for starting a small group in experimental quantum optics, which falls within the BMF group for historical reasons. This is a highly competitive field and the chance to make an impact for a subcritical group is small. The Evaluation Committee would rather have recommended the resources be used to strengthen the physical aspects of the collaborative biophysics research.

4.1.1.3 Electronics

The Electronics Group consists of 5 professors (one emeritus), three associate professors, two adjunct professors, two adjunct associate professors, one research fellow, 11 PhD students and two technical staff. During 2006–2008, the group graduated 14 PhD and 24 MSc students. The group is divided into two subgroups: i) Instrumentation/Sensor Technology and ii) Physical Electronics.

The research activity of the first subgroup is of a more technological character with emphasis on several aspects belonging to Applied Physics and Electrical Engineering. They design and develop new instrumentation for the ALICE and ATLAS experiments at the CERN LHC accelerator. Similar activities concern biomedical, hydroacoustic and space technology instrumentation including data acquisition systems. The other subgroup, Physical Electronics, performs application-motivated basic research in condensed matter and materials science. The key areas of research are wide band gap semiconductors and transparent conductive oxides, semiconductor nanoscience/technology, high purity silicon and (N)MEMS and MOEMS. Most of the activity is performed at the MiNaLab/UiO micro/nanotechnology laboratory built in collaboration with SINTEF. Due to the significant differences between their activities, the two subgroups are considered separately in this evaluation.

Instrumentation/Sensor Technology

Assessment and Grading

The scientific quality and productivity of this subgroup is reasonable. The group contributes to international and national research, and there is a good balance between journals publications and conference proceedings. The research is carried out as part of several local, national and international collaborations; mainly with groups in need of instrumentation, e.g. the Department of Biomedical and Clinical Engineering, the Institute for Marine Research in Bergen, the University of Vienna, the Swedish Board of Fisheries, and Cornell University. As part of the space physics activity the section participates in the CubeSTAR project. A fair number of PhD and MSc students have been supervised, and several PhD students are presently under supervision. The activity is of relevance in the bio, space and fishing industries and thus of economical significance.

The research is organized in projects, and a member of the academic staff manages each project. The management and decision-making process is flat. External grants and participation in European Projects is quite limited. A better involvement of industrial partners as a funding source is probably necessary. The strategic plans of the group are reasonable in view of the actual financing constraints. The Evaluation Committee has a positive overall impression of the research subgroup and of the PhD students.

Overall grade: 3

Recommendations

The two subsections belong to the same group for historical reasons, and it is clear that the future planning of the department should consider reorganisation. This group is quite small and the activity is spread out over many different topics. A better focus is necessary and priorities must be assessed. A possible reorganization and strengthening could be made if the activity on support to experiments at CERN would merge with Experimental Particle Physics and that on bio instrumentation with the group Biophysics and Medical Physics. The presentation at the evaluation hearings already suggests this kind of organisation. The same arguments apply to the space instrumentation activity. This is also the focus of the group strategy: to do applied physics with other research groups nationally and internationally. Such mergers would help reach this goal and make the activity more profitable in the long term.

Physical Electronics

Assessment and Grading

The scientific quality and productivity of the Physical Electronics subgroup is excellent. The subgroup is a member of the Centre for Materials Science and Nanotechnology (SMN) at UiO/MNF, the national partners of the subgroup are SINTEF, IFE, NTNU and industries involved in renewable energy and in micro/nanotechnology fields. Together with these partners the group has common projects, joint publications and shares equipment. The group is also one of the four research partners in the Centre "Norwegian Research Centre for Solar Cell Technology". The group has international collaboration with many universities and industries. Concerning their role in education, many PhD and MSc students have been supervised, and a good number of PhD students are presently under supervision.

The management within the group is flat with a "bottom-up" structure, and this works quite well in view of the obtained results. The subgroup is not particularly well funded overall. Physical Electronics has 15-20 externally funded projects. The MiNaLab infrastructure is quite expensive in terms of running costs, required personnel and replacement of equipment. A better involvement of industrial partners or of public institutions is necessary in the near future to maintain the lab. The lab is well equipped and a large number of technological processes can be performed. At the present time, it is the only place in Norway with those facilities. The collaboration with SINTEF sharing expensive equipment and process steps provides good results and improves overall efficiency. The group maintains complete autonomy in the choice of research topics. The group has an internationally leading position in some activities (wideband gap semiconductors, photovoltaics cell), and a high degree of international publications in good journals. A relevant number of excellent PhD and MSc students is involved in the research that is also performed in strong collaboration with industries, national and international universities and with SINTEF. The management of sophisticated and complex facilities (MiNaLab) is very good, with good strategy and clear future planning.

Overall grade: 5

Recommendations

The Evaluation Committee highly recommends a greater involvement of the theoretical condensed matter group and of the advanced materials and complex systems in the electronics group activity. Putting together the outstanding competences of these groups will be worthwhile for the Physics department as a whole. The two centres, MiNaLab and that related to solar cell technology, both under the competence of the Physical Electronics group, constitute key points for the future activities of the department and for the recruitment of bright students. To strengthen the experimental activities at the department a more direct involvement or perhaps a merging of the Structural Physics with the Electronics group is recommended. In addition, as already pointed out in the self evaluation, a strengthening of the theory and modelling side with a dedicated theory activity in materials science would be highly beneficial.

4.1.1.4 Physics of Geological Processes

This centre of excellence created in 2003 at UiO spans over two departments, Physics and Geology. This evaluation is restricted to the Physics group at PGP. The group has 4 professors (although one is now moving elsewhere), one professor emeritus, two technical staff and 8 PhD students. Six PhD and 13 MSc graduates have been produced during 2006–2008. The group is involved in interdisciplinary studies of fluid processes, among which are fluidization, flow in granular media and hydro-fragmentation, and mechanical-chemical processes like stress corrosion in rocky materials and volume change processes. The studies involve experiments, theory and numerical simulations. The centre of excellence funding is planned to end in 2013.

Assessment and Grading

The scientific quality of the work is excellent, of a unique groundbreaking character [not only literally speaking!] with considerable publications in leading journals. It involves, in addition to the work together with geoscientists in Oslo, intensive collaboration with leading foreign institutions, which is also manifested in the number of foreign long-term visitors. There are also strong links with the petroleum industry (Statoil, Chevron, BP). The group takes part in PhD education and supervision and is quite active also in outreach (TV and radio, several science/art exhibitions). The work is well led and organized in several groups with common scientific interests, mixing geologists and physicists, and is supported by an external advisory board.

Overall grade: 5

Recommendations

The centre is quite well funded presently, but the closing of the financing within the not too distant future now requires that a strategy be developed in order not to lose what has been acquired. The possibility of developing collaboration with the National Complex Network should be explored, since there are several common scientific interests. The Evaluation Committee feels that the physics group within the centre is so strong that it should be strengthened further, e.g. by offering some permanent positions, or possibly seeing to that temporary positions be present after 2013 to further develop the links with the Complex network.

4.1.1.5 Physics Didactics

The group is very small, two associate professors only, and thus very vulnerable to even minor perturbations. The group has three PhD students and graduated one PhD and 4 MSc students during 2006–2008. The research is closely related to science education in general and to physics education in particular.

Assessment and Grading

The group has a good national and international network and contributes to a series of important and internationally recognized studies in science education (TIMSS, IRIS, Lilje-Con-Valg, etc.) and a satisfactory publication output. The group also has close contacts with teachers at schools. For its size, it has a good influx of MSc and PhD students.

Overall grade: 3–4

Recommendations

The Faculty of Science and the Department of Physics should consider the possibility of a co-location or even a formal merger with similar groups at other departments at the Faculty.

4.1.1.6 Plasma and Space Physics

The group consists of 4 professors and one professor emeritus, one adjunct professor, one adjunct associate professor and one postdoc supported by two engineers, a significant reduction on a decade ago. The group presently has 7 PhD students and graduated three PhD and 8 MSc students during 2006–2008. The group formed the STAR (Space Technology And Research) initiative in 2007, and carries a rather broad portfolio of activities. The main fields of research are UV and ozone research, ground-based, sub-orbital and orbital experiments, spatial and temporal structure of the reconnecting magnetosphere, and theoretical and computational studies of plasma phenomena.

Assessment and Grading

This is a world leading instrumentation group, with specific expertise in instrumentation for kinetic plasma physics (microphysics) observations. This group has an opportunity to play a key role in multi-spacecraft mission planning relevant to the ESA Cosmic Vision Cross-scale, e.g. the proposal to fly a cluster in low earth orbit. Multi-spacecraft observations are at the forefront of the space plasma observational effort, and therefore present an opportunity for considerable international impact. Theory support comes from the small plasma subgroup with advanced PIC simulations and theory of kinetic plasmas of very good quality, provided by faculty members in physics and in theoretical astrophysics, but it is unclear whether this will continue with the retirement of these academics. The group shows dynamic leadership focussed on developing and delivering excellent leading edge instrumentation, especially Langmuir probes. PhD and MSc throughput are reasonable. The publication rate is also reasonable, but could be improved given wider community access to data products.

Overall grade: 4–5

Recommendations

The group is overstretched with its current portfolio, but they have made a clear suggestion to lead on instrumentation and devolve involvement in science support for ground-based campaigns and facilities, specifically EISCAT/Svalbard and ground-based campaigns for ionospheric physics, to Svalbard. (UNIS).

A programme of rocket based observations (one every two years) and low earth orbit microsatellites (CubeStar) are asked for on the grounds of providing testbeds for instrumentation, in order to support bids for participation in international (ESA and other) programmes. Although it is reasonable that such testbeds are needed to provide both a stimulus for development of instrumentation and credibility when competing for the payload on such international missions it is arguable whether this is a sufficient justification *per se* given the rocket flight programme is costed at 6 MNOK per year, compared to the EISCAT subscription of 5 MNOK per year. The issue is also the size of scientific community supported by such a programme. See 3.1.7 for general recommendations concerning the rocket programme in Norway.

Engagement with a wider scientific community both in Norway and internationally depends critically on the availability of calibrated and understood data products. This is particularly critical for multipoint observations. No clear plan for facilitating routine production or dissemination of data products is currently in place. This is a missed opportunity as this would engage the auroral physics community (through EISCAT, Svalbard and beyond), and the group could potentially play a leading role in auroral campaigns and engage the wider plasma physics community. Such engagement might go significantly toward justifying the rocket programme and would thus ultimately strengthen the instrumentation programme. There is a real opportunity for international impact here. There are also some fundamental physics questions here that these approaches could address, with application beyond auroral physics, nonlinear kinetic plasma physics, electrostatic turbulence, particle acceleration and so forth. The 'missing step' is a framework for data calibration, archival and dissemination.

4.1.1.7 **Structural Physics**

The group consists of two professors, one associate professor, one senior engineer, three adjunct professors (SINTEF, IFE and UiS), two adjunct associate professors (SINTEF), two postdocs and 14 PhD students. Two PhD and 9 MSc students graduated during 2006–2008. The activity is performed at the Research Park and it is based mainly on Transmission Electron Microscopy (TEM) analysis in the materials science field. The group is a member of the initiative "Functional Energy Related Materials in Oslo" (FERMiO) and of BATE (Basic and Applied Thermo Electric) and collaborates with the MiNaLab. The topics under investigations are structure-properties-functions of materials with a particular interest for those of interest in renewable energy.

Assessment and Grading

The scientific quality and productivity of the group in terms of publications and conference proceedings is good. Research is performed in collaboration with other groups at UiO and with SINTEF, IFE and UiS due to the presence of several adjunct professors belonging to these institutions. On the international side the group collaborates with California Institute of Technology and Brookhaven National Laboratory. A reasonable number of PhD and MSc students have been supervised. Participation in projects with industry is moderate, though the engagement in the renewable energy field is noticeable.

External grants from industry and participation in European Projects are nonexistent. A better involvement of industrial partners is necessary and economic participation by the external users to the use of the TEM and of other facilities of the group should be considered.

The group is one of the leading TEM groups in Norway in the field of materials science and solid- state physics. As a common characteristic of this kind of analytical research the activities are spread over many different topics, some of them overlap considerably with that of other groups within the same university or other research institutions.

Overall grade: 3–4

Recommendations

The activities of the group are quite diverse; from analytical investigation of the atomic structure of materials to their properties and to modelling. This peculiarity is a consequence of the considerable number of adjunct professors coming from other institutions, SINTEF and IFE. A better focus is necessary and priorities must be assessed. The group to carry out this activity at high standard needs state of art instrumentation. Within analytical TEM the most pressing issue is the aberration corrected equipment. The planning of a new Centre for Advanced Transmission Electron Microscopy (NORTEM) in collaboration with NTNU and SINTEF has this aim in a coordinated effort. The NORTEM initiative should be funded by the Research Council and a decision should be taken regarding where to locate the new aberration corrected TEM, i.e. UiO or NTNU or both. With the exception of the TEM activity, all the other research finds a place in other groups of the UiO physics department. As an example, the energy related materials (BATE project) would fit within the Physical Electronics group and the theoretical materials physics would fit within Advanced Materials. At present this last activity relies on one adjunct associate professor in a part-time position.

4.1.1.8 Subatomic Physics

This activity consists of two separate subgroups, high-energy particle physics experiments (HEPPEX) and the Nuclear and Energy Physics group with their major activities within heavy-ion collisions (HIC) and nuclear structure (NS), the latter primarily with the in-house cyclotron. This activity was presented as one group in the hearing; however, it was presented as two groups, Experimental Particle Physics and Nuclear and Energy physics, in the written material. . Within this latter group there is also activity in computational physics, with focus on many-body problems in nuclear physics as well as solid-state physics and material science for solar energy applications.

The total group overall consists of 12 professors and one adjunct professor, 5 technical staff, 10 postdocs and 24 PhD students. The group produced 6 PhD and 22 MSc graduates during 2006–2008. Severe faculty staffing problems exist in both the HEPPEX and Nuclear and energy physics subgroups. The research is organised such that money and resources sit with the project leaders, with relatively little power with group leader.

High-energy Particle Physics Experiments (HEPPEX)

Assessment and Grading

The scientific quality and production of the HEPPEX subgroup activity on Higgs analysis, detector development and construction for ATLAS, Grid computing development and deployment for the general scientific community, is excellent. This group demonstrates excellent scientific leadership in these areas, including one faculty member acting as the secretary of the European Strategy for Particle Physics, and formerly acting as the deputy spokesman of ATLAS collaboration. HEPPEX have outstanding international (CERN, RHIC in US), national (Bergen) and local (theory group) collaborations, has close contacts with SINTEF on instrumentation and two spinoff companies have resulted from activity within this subgroup. Relatively few PhD and MSc students have been produced recently by the HEPPEX group, though this should change soon with the arrival of data from the LHC.

Overall grade: 5

Recommendations

While financial support for projects seems generally adequate, the main problem lies with staffing levels in this subgroup. Low staffing levels can and have led to it being vulnerable to events such as illness and other responsibilities taking time from the primary activity. Future retirements pose a threat to the groups being able to maintain present manpower levels as well as competence. The Evaluation Committee welcomes the planned recruitment of a particle phenomenologist in the UiO theory group, strengthening existing activity, namely one present theorist with some connection with HEPPEX, and one very mathematical (strings, condensed matter) 'particle' theorist, available as a consultant for the HEPPEX group. The subgroup should devise a realistic plan for accelerator R&D, perhaps including a professor working on NORDUCLIC.

Nuclear Structure and Energy Physics

Assessment and Grading

The activity on heavy-ion collisions, with experiments and instrumentation for ALICE, as well as theory, is very good. As for HEPPEX, the subgroup has very good international

(CERN, RHIC in US), national (Bergen) and local (theory group) collaborations, and close contacts with SINTEF regarding instrumentation. The activity in computational nuclear physics is of very good quality. The work on solar energy concerning heating and cooling systems is of practical interest.

The activity using the Oslo method for analyzing nuclear structure has provided this subgroup with a good niche. The subgroup is at the frontier in the simultaneous measurement of level densities and gamma-ray strength functions in the quasi-continuum. Though becoming somewhat routine, it has valuable applications in astrophysics and reactor physics. It is noted that this subgroup is actively using ISOLDE. They have good collaboration with the US and Asia and with some groups in Europe; there are, however, no national partners in the core area of the subgroup. We note in addition that the subgroup uses the cyclotron for producing radioactive isotopes for PET studies. The number of PhD and MSc examinations from this subgroup is very good during recent years.

Overall grade: 4/3

Recommendations

As for the HEPPEX subgroup, financial support for projects seems generally adequate, while the main problem lies with staffing levels and the threat posed by future retirements to the subgroup being able to maintain the present level and quality of activity. The Evaluation Committee is worried that involvement in CBM at FAIR may be overstretching the available resources, and should be considered carefully.

This subgroup should further develop international connections within Europe, e.g., ISOLDE at CERN. The department and the group should consider whether the cyclotron infrastructure should be sustained. The activity on solar energy should be framed and eventually developed within the research that other groups at the department perform in the field of solar energy, i.e. within the SMN collaboration. This is also suggested in the departmental report.

4.1.1.9 Theoretical Physics

The theory group consists of 6 professors, one associate professor, one adjunct professor, two postdocs and 6 PhD students. Five PhD and 15 MSc students graduated during 2006–2008. Five senior faculty members have retired since 2004, and 4 more retirements lie in the near future. A generation shift is occurring in the group with younger staff entering. The research in the group is directed towards low-dimensional systems, cosmological physics and high-energy particle physics, yet with a declared freedom for individuals to take up new areas of interest.

Assessment and Grading

The above-mentioned individual freedom inevitably involves risks for failure but also possibilities for success – both aspects are illustrated in the group report. The research is of very good quality and generally published in leading journals. The group is involved in extensive collaborations, with leading scientists and groups abroad, e.g. at CERN, as well as in the Nordic area and in Norway. In several cases this involves collaboration with experimentalists.

Overall grade: 4

Recommendations

Although some concentration of the efforts in the group could be considered, a continued programmatic diversity is sustainable, as long as relevant collaboration locally, and internationally, is developed. NORDITA can play an essential role here, as it has in the past. The support to this networking, with travel money and financed sabbaticals, is of great significance here, and a cost-effective way to promote high-class science.

4.1.1.10 Overall Assessments and Recommendations

The mean standard of research at the Physics Department is high. Among the highlights are the Advanced Materials and Complex Systems group, the Physics of Geological Processes group, the Physical Electronics group and the High Energy Particle Experiments group. With the width of ambitions at the Department and its research groups, several of the groups are, however, subcritical in size and resources. The Department leadership regards the diversity of activities as a problem, since it "reduces the focus and spreads limited resources". In spite of that, existing scientific strategies are outdated.

Merging of several of the groups, and some refocusing within the new larger units seem to be natural administrative steps as means to remedy some of these problems. This requires, however, evidently a strong and scientifically guided leadership, both on the group level as well as on the department level. Closer collaboration, between e.g. on the one hand the Elementary-particle and Nuclear physics groups (which were presented in the hearing as one "group"), and, on the other hand the Theoretical physics group as well as parts of the Electronics group is, at any rate, necessary. In addition, part of the activity of the Structural physics group would find a more appropriate location in the Physical electronics group.

Also, nationally, the UiO department with its width and competence has a certain role to play in unifying and networking with the several often weaker physics departments spread around in Norway. This need is obvious in several fields. Thus, the reprioritizations that are necessary within the UiO department should also be decided upon with a background of national strategies for Norwegian subatomic physics, materials physics and complex systems, space physics, geophysics, biophysics and physics education (see chapter 3).

The Department of Physics is quite large and has a very broad range of activities. The Evaluation Committee sees scientific and pedagogical advantages in connecting the high energy and space activities more closely to the theoretical astrophysics department. A smaller, more homogeneous department should be more manageable, and focus should be easier to reach. In the long run, however, it may be advantageous to create a larger department with all physics, including astrophysics. This could make it easier to set priorities, and use the resources in a flexible and optimal way. In order to be able to manage a department of this size it is important, however, that the distribution of total resources for salaries, premises, as well as running costs, be controlled in principle by the leadership bodies of the department (though advised by a scientifically competent external group, like an international visiting committee). Steps towards such a situation should be taken.

4.1.2 Institute of Theoretical Astrophysics (ITA)

The Department has 7 professors, 5 associate professors, one adjunct professor, two adjunct associate professors, 9 postdocs, 13 PhD students and 8 technical and administrative staff. The two main areas of research are Cosmology and Solar physics, but research in Plasma physics is also pursued as well as some studies of active galaxies. There has also until recently been a research group in Celestial mechanics. The work in the main groups is both experimental (observational) and theoretical. The main observational resources presently used by the groups are the space observatories SOHO, Hinode and Planck, as well as the Swedish Solar Telescope at the La Palma observatory and the QUIET experiment in the Atacama desert in Chile. Also NOT is still of some use. The most important infrastructures for the theoretical analysis of the data are considerable local, as well as national high-capacity computer resources. Several staff members are members of the of the Excellence Centre, Centre of Mathematics for Applications, CMA, at the University of Oslo.

4.1.2.1 Celestial Mechanics

The group was until recently led by an active professor who is now retired, and was well known internationally for its work in calculating orbits in the Solar system. It produced two PhD and two MSc graduates during 2006–2008, but presently it is only represented by a 20% adjunct associate professor, funded by the Norwegian Defence Research Establishment. The department does not suggest that the group-leader position should be refilled in this field, and the Evaluation Committee supports that view.

4.1.2.2 Cosmology

This group consists of two professors, three associate professors, 5 postdocs and 7 PhD students. Two PhD and 15 MSc graduates were produced during 2006–2008. The group is a relatively new group and so is relatively youthful in its academic staff age profile. It has a world leading position in a limited area of theoretical and observational cosmology having formal (i.e. Co-I) involvement/data access on QUIET (in a data processing role), and Planck.

Assessment and Grading

The scientific quality and productivity are excellent, with very good computing infrastructure, and good prospects in connection with the strong international collaboration around the Planck satellite and QUIET experiment. The research student interest is also striking with a good examination rate altogether. The group looks internationally rather than nationally for collaboration.

Financial support seems to be adequate, though the building is becoming too small. The institute has a strong computing facility. Being a young group implies no possibility for more academic positions in the near future and this may be an issue for this very active group, which is only just at critical mass.

Overall grade: 4—5

Recommendations

The QUIET main phase runs to 2015 and the group needs to secure funding beyond 2011. The Planck science results will be available in roughly 2011–2012, running to 2015, while the group is also proposing for involvement in Euclid, which is on the 2015 timeframe. There is a concern that the significant preparatory effort needed will impact on current activities; however, this is the right level of activity and balance between current and future projects for a cosmology group and these are the key international CMB missions.

Local collaboration with the UiO Physics Department could be expanded, both regarding teaching and research. Greater collaboration would give the potential for teaching students, including attracting students to physics, indeed science as a whole. There is no national collaboration with astroparticle physics with Trondheim, and should be considered as well as future collaboration with astroparticle physics in Bergen and cosmology in Stavanger. A long-term development could be a centre of excellence comprised of observational and theoretical cosmology and astroparticle physics.

There is limited scientific contact with the activity in solar physics at the same department. The fact that the institute does not have a broad activity in astrophysics may ultimately be harmful for the cosmology group as scientific frontiers move in other directions.

4.1.2.3 Plasma Physics

This is a very small group, of one professor and one adjunct associate professor and one PhD student; no PhD or MSc students were graduated during 2006–2008. The group is focussed and performs very good work on plasma HPC-PIC codes for kinetic plasma physics and RSPH for fluid problems (shocks, fluid turbulence). There is a strong collaboration with plasma physics in the physics department but no real collaboration with the rest of theoretical astrophysics.

Assessment and Grading

The science is of high quality. This activity will end within a 2-year timeframe unless there is a replacement, which is not currently the plan. Whilst local activities in this area are presently not necessary for the other activities in theoretical astrophysics its demise raises questions as to the overall national commitment to plasma physics research. Modelling of kinetic physics (i.e. PIC) is an important element in the science programme of space plasma physics in the physics department at UiO, and currently this group collaborates through STAR. It is not clear whether other collaborations are in place in the space physics group to pick up this expertise.

Overall grade: 4

Recommendations

The Evaluation Committee questions the current strategy, which appears to be to allow the area of theoretical plasma (kinetic) physics to decline to zero. This area not only offers strong synergy with fundamental plasma physics in space, but will also be needed for future developments in solar coronal physics.

4.1.2.4 Solar Physics

This group consists of 4 professors, two associate professors, one adjunct professor, 4 postdocs and 5 PhD students. The group has graduated 4 PhD and 6 MSc students during 2006–2008. It has world-class local computing facilities and access to a range of space and ground based observational facilities. The core strengths of the group are radiative hydro/MHD High Performance Computing (HPC) and strong emphasis on coupling this to observation (e.g. space based: Hinode, SOHO, ground based: SST). The age profile implies that there will be two new appointments in the near future due to retirement. The group is focussed on state of the art solar observations and using codes to model the physics with an adequate level of on code/algorithm development.

Assessment and Grading

This is a world leading solar physics group, which is well integrated into the current and future international programme in solar physics. There is strong collaboration with international groups both as regards theory and computational astrophysics as well as observations. The focus is on fundamental science and this has brought a reasonable share of the space budget to this group. This strong focus has resulted in the scientific strength of these activities and its international impact, which is high. The PhD and MSc student examination rate is very good.

Overall grade: 5

Recommendations

The great strength of this group is to a considerable degree the result of its high ability to focus. However, it is strong enough to now consider some broadening of activities, and in the long run this may be useful also for further success in its present focus area. A possibility for diversification or collaboration within the national programme is in principle in solar-heliospheric and solar-terrestrial connections. At this time there is no plan to do this. In practice the space group in Oslo is focussed on kinetic physics so there is no immediate overlap with the physics currently being undertaken by the solar group, which is MHD. However, there is a range of problems in coronal physics, which do require kinetic physics and with improving cadence of observations this may come more to the fore in solar physics so there is a potential overlap here in the future.

There may be an opportunity for industrial relevance should the group choose to build expertise in algorithmic development e.g. analysis of large volume complex data sets. Collaborations within the CMA, a centre of excellence at UiO, seem as yet to have had only limited results.

The preferred future emphasis of the group is on IRIS (on line 2012) and EST (on line 2019), which are given higher priority than SDO and Solar Orbiter. It was noted that

EST involvement might complement Norwegian participation in ESO, which would be a significant fraction of the national budget for astronomy/space so a strategic decision at the national level is needed.

4.1.2.5 Overall Assessments and Recommendations

This is a strong, internationally leading centre. Logically it would become, or would form part of, a Centre of Excellence at Oslo. The Evaluation Committee encourages it to take a more active national role, e.g., in collaboration with the cosmology group in UiS, and with the astroparticle groups in NTNU and UiB. The high degree of professionalism at the Department partly reflects its concentration into two main areas. These areas are, however, rather apart from each other – in fact, marking the two extremes along the astronomical distance scale. The groups have interests in data processing and a considerable need for extensive computer resources in common, and the Department is a main user of such resources in Norway, and it is necessary to continue keeping these resources at the forefront. There are also some possible further collaboration areas to develop, such as radiation hydrodynamics (in the early universe, e.g., close to recombination as well as in the solar and stellar atmospheres).

The possibility to open up yet another astronomical field has been, and should further be, considered (see 3.1.1). The institute as a whole is anxious to preserve its identity and focussed management structure and this has been a successful approach to date. The leadership has very definite ideas and more self-criticism may develop when needed. The department leadership should make clear the intentions of the department towards the postdocs working on galaxies.

The group at the Department is active in outreach activities, but has also a potential to serve Norwegian society and science in other areas, outside astronomy by extending or bridging the gap towards space physics and solar-terrestrial relations, or towards the Complex project by making the processes in the solar atmosphere examples in the more general study of complex dynamical systems. Such efforts must, however, be furnished with additional resources in order not to risk the qualities of the ongoing activities.

4.2 Norwegian University of Science and Technology (NTNU)

4.2.1 Department of Physics

The Norwegian University of Science and Technology (NTNU) in Trondheim carries out research at its Department of physics in several areas: theoretical physics with astroparticle physics and condensed-matter physics, experimental condensed-matter physics, complex systems and soft materials, biophysics and applied physics in laser physics and optics as well as in energy and environmental physics. The department, with a staff of 28 professors 10 associate professors, 7 adjunct professors, 25 postdocs, 57 PhD students and 24 technical and administrative staff. It has a wide range of laboratories in a rather new building, and a considerable set of advanced instrumentation, not the least for nanophysics. Teaching and research are administrated separately.

4.2.1.1 Applied Optics and Laser Physics

The group consists of three professors and one associate professor, all relatively recently hired, and 5 PhD students and a postdoc. No PhD and 9 MSc students were graduated during 2006–2008. All group members have had extensive international research experience before taking up a position at NTNU. The research covers a wide range of experimental and theoretical topics within optical spectroscopy, laser metrology, fundamental laser physics, imaging, etc.

Assessment and Grading

The group publication activities are strong, with a series of papers in leading international journals. Much effort has been put into the build up of a wide range of experimental infrastructure facilities, including even a new tower for drawing optical fibres. The laboratories visited by the Evaluation Committee are state of the art. As examples, a femtosecond laser facility is used for time-resolved spectroscopy of nano-materials and bio-molecular systems. Mueller matrix spectrometers are used for studying semiconductor surfaces. Several of the new experimental facilities are rather unique in a Norwegian context. On the theory side, electromagnetic phenomena in complex structures are being modelled. Many projects are carried out in collaboration with members of leading research groups abroad, in particular Sweden and France.

Several projects involve SINTEF and local industry as well as other departments at NTNU.

Overall grade: 4

Recommendations

The group members feel a lack of money for research infrastructure, both running costs and equipment, as well as for PhD students and postdocs, from local sources and from RCN. Although the Evaluation Committee normally strongly supports efforts to build strong research infrastructure its was somewhat surprised by the large investment in a fiber-optic drawing tower. This seemed to have weak scientific motivation and the Evaluation Committee questions if there money couldn't have been better used.

The Evaluation Committee felt a need to address the question of the competence (not necessarily the size) of the technical support staff in the light of the considerable amount of new and advanced equipment for research and teaching acquired by the group. Also, a special effort should be made to increase the number of postdocs in order to consolidate the many new initiatives in applied optics and laser physics, most of which require substantial manpower in order to fully exploit the investments already made. Further coordination with neighbouring groups at NTNU may also help alleviating this problem. The declared goal of the group of active participation in FP7 networks is laudable.

4.2.1.2 Astroparticle Physics

This theory group consists of 4 professors, one associate professor, one adjunct professor, two postdocs and 6 PhD students. One PhD student and 27 MSc students have graduated from the group during 2006–2008. The group is seen as very important for attracting students to the department, and for teaching theoretical physics. It includes two active people working in thermal QCD and cosmic rays. Other group members are less active in research, and less involved in astroparticle physics, and so despite its apparent size the group is in reality somewhat small and isolated. A theorist in a related field has moved to a different group.

Assessment and Grading

The scientific quality and productivity of the astroparticle activity is very good in parts, and is well known internationally. The high interest among MSc students is remarkable, and the PhD programme is rapidly growing. The fact that theorists with similar interests are in different groups at the department is not ideal. Nationally, the QCD theorist would do well to establish closer relations with the CERN-related physics programme now concentrated in Bergen and Oslo. The cosmic-ray theorist might also be able establish collaboration with this programme if he worked more on TeV-scale dark matter, for example. There may be opportunities to collaborate with the new astroparticle activity in Bergen.

Overall grade: 4/2

Recommendations

When the three older theorists retire, the two very good younger theorists will be very isolated. Two responses could be imagined. One would be to see them move to another Norwegian university, where they would find collaborators. The other would be to reinforce them by replacing one of the retirements with an astroparticle physicist.

More MSc and PhD students would be welcome. The leadership of the department should decide whether to reinforce the dynamic young researchers, allow them to wither, encourage them to change fields, or see them move elsewhere to a better environment. The Evaluation Committee does not consider it fair to treat them merely as pedagogical bait. If they cannot be reinforced or moved, the active young group members could consider changing their research fields, perhaps adiabatically.

4.2.1.3 Biophysical and Medical Technology

The Trondheim Biophysical and Medical Technology (BMT) group is a merger of two previous groups, Biophysics for Medical Technology and Biophysics for Biosystems. In total the group has 7 professors, one associate professor, three adjunct professors, 7 postdocs, 9 PhD students and two technical staff. They have examined 6 PhD and 45 MSc students during 2006–08. The BMT activities span from medical technology (OCT, radiation dose issues, delivery of nano-medicine, and multi-photon microscopy for clinical use), over bio-nano (organization of bio polymers and nano-structured bio-mimetic materials) to photo biophysics and biosystems (photo reactions in cells and plants as well as plant growth in space).

Assessment and Grading

The overall impression is that this group has a very high scientific level and that it manages to support the wide range of topics addressed. Not only is the physics of high quality, also the biological and medical relevance is high. This is evidenced by many publications in high-class journals and the faculty members have very good to excellent citation records. The laboratories have state-of-the-art instrumentation, and, equally important, competent staff to operate them. The only issue is the production of PhDs, 0.3 PhDs per year and professor. Although this rate seems to be slightly above average for Norway it is low by international standards. The groups should be able to do better in this respect.

Overall grade: 5

Recommendations

Experimental multidisciplinary research in the BMT area requires a certain critical size. This applies to instrumentation as well as staff competence. Both have to span from biology to physics and include engineering/mathematics. Trondheim has a very promising arrangement for creating such a multidisciplinary powerhouse. Furthermore, the group has certainly understood the importance of working on problems of relevance for modern medicine or biology as well as the importance of having the proper know-how and collaboration integrated into their interdisciplinary research groups. The collaborative atmosphere is commendable. This applies both within the group as well as with the Applied Optics and Laser Physics group. The Trondheim group should also have credit for having managed the transition from two strong professors and two groups into new professors and one group seemingly without convulsions. This effort to focus resources into fewer but stronger fields should be taken as an example for many other Norwegian groups, where fragmentation into subcritical units seems to be common. The Evaluation Committee recommends increased strong support to this scientific environment.

4.2.1.4 <u>Complex Systems and Soft Materials</u>

The group consists of 6 professors, one adjunct professor, one emeritus professor, two postdocs, and 9 PhD students. During 2006–2008 8 PhD and 38 MSc students were graduated. The main field of research is Statistical problems in condensed matter physics, particularly colloidal and polymeric systems, transport in porous media, fracture processes, complex phenomena on surfaces, in quantum and in nanophysics. A significant part of the measurement samples studied by the group are made in-house. The group is one of the most active Norwegian users of international synchrotron facilities and is one of the nodes of the National Complex Network. The group is mostly experimental but contains an important theoretical and computational part.

<u>Assessment and Grading</u>

The scientific quality and productivity of the group is high. The group has a large number of invited talks at international conferences during the evaluation period. Collaboration is also excellent with excellent organization within the Complex network since 2000, and hence there are numerous national and international collaborations. The group has ongoing collaborations within NTNU and with SINTEF including Chemical Engineering, Materials Technology, Applied Geophysics and Petroleum Technology at NTNU, and SINTEF Petroleum Technology. Links to national industries exist mostly through the Complex National Network. Negotiations for software licensing with Numerical Rocks AS are ongoing. The group also has significant outreach activities in science popularization, through articles in magazines and newspapers, and through participation in national events.

The organization at the national level within the Complex Network is remarkable and highly successful. It is not clear to the Evaluation Committee who has the scientific lead within the NTNU group, however, it is important to define clear leadership, even more so if the group is going to expand.

Overall grade: 4–5

Recommendations

The group should try to involve more industrial collaborations. In addition, a more tightly organized structure could be obtained within a Centre of Excellence. However, leadership needs to be defined in each of the three locations (NTNU, UiO and IFE), and the situation seems less clear at NTNU than elsewhere. The Evaluation Committee makes two main suggestions. First, transform the Complex National Network into a Centre of Excellence, defining a clear leadership structure at NTNU. Second, closer collaborations with the Condensed Matter Physics group, particularly the experimental part, should be established with a view to discussing merging the two groups in the future.

4.2.1.5 Condensed Matter Physics – Experimental

The group consists of three professors, three associate professors, one external adjunct professor, 12 PhD students, 7 postdocs, and one technical staff. There have recently been considerable changes in the staffing, three professors have recently retired, and the three associate professors have been recruited. During 2006–2008, three PhD and 43 MSc students were examined. The group has been reorganized within three fields of experimental expertise: Transmission electron microscopy, Surface science/Scanning probe microscopy and X- ray scattering techniques. The TEM group works closely with SINTEF through the Gemini Centre and it deals with studies of material structure at the nano-scale to understand macroscopic properties (e.g. nucleation of precipitate in Al alloys, nano-particles and support in catalyst materials, silicon solar cell). The STM is used to investigate nano-magnetic materials and adsorption behaviour at bimetallic surfaces. The X ray group is active over a wide range of materials from organic electronics to inorganic oxides and a significant part of the activity is performed at synchrotron radiation facilities.

Assessment and Grading

The scientific quality and production is evidenced by a high publication rate. Extensive collaborations exist with groups capable of delivering high-quality samples for advanced characterization and experimental method development, and very close work is carried out together with SINTEF at the Gemini Centre. In the future a better involvement of the theoretical condensed matter group is planned together with a direct participation in the NANOLAB activities.

A few PhD and many MSc students have been supervised since 2006, many within common projects with SINTEF. Links to industries are limited to SINTEF. The experimental group belongs to the section Condensed matter, one of the five in the department. The administrative and scientific leadership belongs to the head of department. A board chaired by the head manages planning of future research and new recruitments, which seems to work well. The X-ray group has been granted several European Projects.

The group has a unique expertise and good instrumentation for TEM, STM and related scanning apparatus, and X-ray analysis. The group contributes to international and national research with good quality activity. The number of supervised PhD students is reasonable. Strategic plans are reasonable, and the Evaluation Committee has a positive overall impression of research group.

Overall grade: 3–4

Recommendations

The previous evaluation of Physics in Norway concerning this group stated "Condensed matter physics/materials science: fields like solid-state magnetism, experimental low temperature physics and nano-scale materials should be considered. Some focused areas should be selected." This was followed by a recommendation from the national committee "Condensed matter physics should be further strengthened, and increased collaboration between experimental and theoretical activities promoted." Changes in the suggested directions have been made by the group in view also of the large number of retirements and new academic positions. However the total research output has become smaller due to a decrease in the number of staff members. The vacancies have not been refilled completely. The main weak point of the group is still the fragmentation of activities without yet reaching a critical mass to support research, which is generally at a high international level. The research will, as indicated in the strategic plan, move towards materials science, nanoscience and nanotechnology. For the last topic the group can take advantage of and at the same time contribute to the development of the new NanoLab infrastructure to establish a well-founded activity in nano-structured materials, nano-magnetism and nano-photonics. The NanoLab is a unique opportunity for the future experimental activity at NTNU in condensed matter. The group needs to identify and to choose one or more fields; it cannot limit its activity to the mere development and application of analytical tools, even sophisticated such as atomic probes. The field(s) should be selected carefully considering the overlapping activities in the Electrical Engineering and Materials Science Department.

Regarding the infrastructure the improvement of TEM facilities, with the acquisition of an aberration corrected TEM is a priority in view of the success of the previous activities at the GEMINI CENTRE. The NORTEM project should be pursued; it will be of relevance for the future development of the materials science Norwegian activity. The use of this infrastructure should be extended to other users in a collaborative manner. A better involvement of industrial partners and of external and internal users in the financing cost of analytical tools is necessary. Teaching and research activities should be balanced, and probably a reasonable policy will consist of giving a higher teaching load to staff less involved in research. In particular the experimental activities for students in the condensed matter field is of extreme relevance in view of the high technical profile of the University.

4.2.1.6 Condensed Matter Theory

The research group consists of three professors, one associate professor, 4 postdocs and 9 PhD students. Seven PhD and 13 MSc graduates were produced during 2006–2008. The group studies a broad range of topics: interacting many body systems; theory of nano-scale and meso-scale electronic properties of small systems; spin transport and spin dynamics in different materials such as superconductors, ferromagnet semiconductors, Bose Einstein condensates, strongly correlated fermion systems, and quantum critical phenomena.

Assessment and Grading

The scientific quality and productivity is very high, the group has published more than a hundred papers during the last five years in prestigious journals including Physical

Review Letters and Nature. The group has extensive national collaborations, members of the team have chaired several national projects and coordinated many programmes e.g. NANOMAT, STORFORSK. The group has participated in two networks within EU 6FP, two funded by ESF and one funded by Japanese Education and Science Foundation. International collaborations include the University of Massachusetts at Amherst, TU Delft, Harvard and many others. A good number of PhD and MSc students have been supervised.

The fundamental physical studies of functional materials will be addressed toward strategic areas of the NTNU future research and activity plan (Energy and petroleum – resources and environment, materials, information and communications technology). The planned activity of the group will be of strong support to the NANOLAB initiative.

This group has an internationally leading position, undertaking original research and publishing in the best internationals journals with high productivity. The group has a clear and convincing strategy and future planning. The Evaluation Committee has a very positive overall impression of the research group and leadership.

Overall grade: 5

Recommendations

The research activity is excellent, and the group has a unique opportunity in providing guidance to the development of the NANOLAB activity, it is a challenge but it is well worth trying. The competence of the group in the transport of carriers in magnetic materials is a good background for the assessment of spintronics as a major topic of Nanolab. The group should also improve collaboration with the other experimental groups in condensed matter and materials science in Norway.

4.2.1.7 Energy and Environmental Physics

The group consists of two professors, two associate professors, 5 PhD students, two postdocs, undertaking research in topics such as atmospheric physics, climate processes, third generation solar cells and studies of oil and gas reservoir physics. Three PhD and 31 MSc graduates were produced during 2006–2008. The research activity within atmospheric and climate processes has focused on the design and fabrication of instruments for the analysis of radiative transfer of ultraviolet radiation in the atmosphere. New activity will be related to the influence of solar radiation on the composition and dynamics of the middle atmosphere through ground-and satellite-based observations with modelling. The activity on oil and gas follows the main emphasis of the group, i.e. the development of instrumentation not available commercially, and it will be addressed toward the Microbial Improved Oil Recovery field. The solar conversion activity involves materials fabrication, characterization as well as device modelling, processing and testing for third generation cells making use of nanostructures of compounds semiconductors. Part of the activity (oil and gas) is of great economical significance and it is performed in tight collaboration with industries. The other part involves local, national and international collaborations. The research on solar cells is just starting.

Assessment and grading

The work of this group is quite diverse and it is not clear what the different activities have in common. They stay together probably for historical reasons. In any case the scientific and technological relevance is of high significance and it is supported by several publications and conference proceedings of good quality. The number of graduated PhD and MSc students is quite relevant, in particular that of MSc students. This indicates that the group is attractive and good at recruiting students. Collaborations are mainly local.

Overall grading: 3

Recommendations

The group should be reorganized, the investigated topics range from environmental physics, to the study of clouds, to that of interfaces between fluid phases and to third generation solar cells. In view of the presence of similar activities in other groups of the same department it seems worthwhile to merge them. For instance the activity on solar cells can be easily integrated in the condensed matter experimental group and may be of interest also for the Nanolab activity.

4.2.1.8 Physics Education

The group is dangerously small, only one permanent position, plus one very recently hired person for in-service courses for secondary school teachers. The group has two PhD students, and graduated no PhD students and 4 MSc students during 2006–2008. The research addresses science education in general with particular emphasis on physics.

Assessment and grading

Despite its small size, the group has a high activity level, including close collaboration with local schools. The publication rate is satisfactory. The contribution to the Nordic Journal of Science Education, NorDiNa, is important.

Overall grade: 3–4

Recommendations

An even closer collaboration at the local and national level would help consolidate the group, and the possibility of co-location with similar groups from, e.g., the Chemistry, Mathematics or Biology departments should be explored in order to form an environment above critical mass. In this way the group could probably accommodate a larger number of students than the present level.

4.2.1.9 Overall Assessments and Recommendations

The research activity at the department is partially strong, e.g. in the fields of Biophysical and medical technology and Condensed matter theory. However, the research suffers from being split into too many groups. Some prioritization as well as better coordination between the groups is needed and this is obviously also understood by the department leadership. Several of the activities at NTNU would also gain from a better national coordination. The needs in these respects are strengthened by the problems in efficiently running the present laboratories with a shortage of technical staff, as well as the worries expressed by several groups that financing for updates of the laboratory equipment will be hard to get. The problems with a fragmented activity, rather few links to other Norwegian groups and worries about financing are also obvious in the theory groups. It is strongly suggested that the leadership of the department, in collaboration with the group leaders, create an instrument for a more effective strategic planning and for setting clear priorities at the department.

The department presently has a good opportunity that is also a challenge: participation and possible leadership in the Nanolab. A considerable investment has been made by the RCN and some effort is required from the department to plan a successful activity in nanophysics. The investment in the new Nanolab facility at NTNU will certainly become of strategic importance. However, the Evaluation Committee was surprised that it seemed to live a life on its own, that user fees were not considered and, thus, the PI and end-user influence seemed to be low. The Evaluation Committee recommends the use of user fees to provide end-user-driven scientific priorities in this new lab.

In order to make full use of Nanolab it is also very important that adequate theory groups are engaged in its activities, both as regards the planning of new experiments and in the evaluation of the results. With the strong group on Condensed matter theory at NTNU there seems to be great possibilities to develop such contacts. Yet, also other theorists in other places should be invited into such collaboration, also in advisory functions.

4.3 University of Bergen

4.3.1 Department of Physics and Technology

The Department of physics and technology at the University of Bergen has 22 professors, 13 associate professors, three adjunct associate professors, 14 postdocs, and 78 PhD students. They work in research groups in Acoustics, Electronics and Measurement Science, Optical and Atomic Physics, Nanophysics, Petroleum and Process Technology, Space Physics, Science Education and Outreach, Subatomic Physics, and Theoretical Physics and Energy Physics.

4.3.1.1 Acoustics

The group had three full-time faculty members during the evaluation period (one recently turned emeritus), 6 PhD students and one postdoc. 5 PhD and 4 MSc degrees have been awarded during 2006–2008. The Bergen acoustics group contributes with basic engineering studies for applications in collaboration projects with other research institutions and industry. The common denominator is ultrasonic measurement technology. Most work is tightly coupled to national, international and local industry needs, e.g., detection of fish (e.g., without swim bladder), accurate measurements of fluid flows, liquids, and energy content in connection to the petroleum industry (for fiscal measurements), monitoring of hydrate build-up in pipes, and transducer technology. Simulations and development of numerical models are combined with laboratory experiments. External funding is primarily from the research council and to a smaller extent from the industrial partners (approx 10% was mentioned).

Assessment and Grading

The work has its strength as advanced industrial development rather than as basic research. This is also reflected in the publication profile, with few refereed publications but many conference contributions. Consequently the citation scores are low and the scientific impact limited, while the value for the society of its transfer of basic research into useful application seems considerable. Also it should be noted that the group has had a better-than-Norwegian-average production of PhD degrees and certainly has significant industrial impact and relevance, e.g., with its flow meters. The group has a significant network of collaborators with various local industries and institutes. The international interaction has been modest, but seems now to be increasing.

Overall grade: 2–3

Recommendations

The group has focused on ultrasonic measurements for problems of relevance for the local industry as well as state authorities, e.g., engaged in petroleum and fishing. Here the group certainly has found a niche where its expertise is useful and relevant and it deserves credit for this. A strong local connection to end-users with relevant problems is a strength for any research group. However, this group seems to focus almost exclusively on issues with immediate industrial needs. As a result much of the work is confidential and/or lacks scientific novelty and, thus, cannot be disseminated through classical academic channels. This prohibits the creation of international recognition and an international network for the group. Therefore, the Evaluation Committee feels it would benefit the group to also include projects of a more generic nature, which can be published academically and, thus, can be used to create an academic base for increased international recognition. This should be possible given that a large fraction of the total funding comes from the government. (In fact, the fraction of the funding coming from industry is surprisingly small given the industrial direction of the projects).

4.3.1.2 Electronics and Measurement Science

The group consists of two professors, three associate professors, one adjunct associate professor, one postdoc and 8 PhD students. The group produced one PhD and 34 MSc graduates during 2006–2008. The two main activities are grouped under i) Microelectronics and ii) Measurement Science. The first is related to read-out systems and control electronics for detectors related to subatomic physics, space applications and telecommunications. For these reasons a close collaboration has been established with the Subatomic physics and Space physics groups. Measurement Science makes use of chemical and physical properties (electrical impedance, time varying magnetic fields, absorption and scattering of light, gamma radiation, tomography) of the process to characterise its composition. The group is also involved in sensor design, geometry and measurement strategy for a range of problems and has a tight collaboration with several industries. The evaluation of the two subgroups is made separately.

Assessment and grading — Microelectronics

The scientific quality and productivity is good in terms of publications and conference proceedings, with a reasonable balance between the two. The group has a good record of international collaborations with large networks, such as CERN, ESA and NASA, and with several research groups at universities. The strategic plans of the group are good, and the Evaluation Committee gained a positive overall impression of the research group and of the PhD students.

Overall grade (Microelectronics): 3

Assessment and grading — Measurement Science

The group, according to its mission, performs its interdisciplinary research activity in tight links with industries, universities and research institutions through common projects with MSc and PhD student supervision. The group has played a major role in establishing the National Centre "Michelson Centre for Industrial Measurement Science with Technology" in collaboration with other research groups and CMR Instrumentation[2]. The group is involved in many industrial projects, some of them with limited physics content.

The infrastructure and equipment are adequate but to maintain the required standards and to exploit the foundation in physics research for engineering research and development of new measurement principles further investment is needed not only in equipment, but also in personnel. The quality of research is fair, and the international publication profile is relatively modest, which may at least partially reflect other obligations of the staff. Much routine work is done, and the relevance and productivity of research are not exciting, with only limited contributions to research knowledge. The overall impression of the Evaluation Committee is positive but with a distinct degree of scepticism.

[2] This is one of 8 Norwegian Centres for Research Based Innovation

Overall grade (Measurement Science): 2

Recommendations

Only one professor, two postdocs and several PhD students pursue the activity in microelectronics. The team seems subcritical considering the different investigated fields (instrumentation for subatomic physics, space applications and telecommunication). To continue and to improve the research it is necessary to recruit another professor or to merge part of the activity with one of the physics group directly involved in the subject and present at the department. The activity in Measurement Science suffers from a high amount of routine work to fulfil contracts with industry. The expertise and competence in the properties of micro- and nano-structured magnetic materials is of relevance for the new activity in nanoscience at the department and might be a research topic of the Nanolab.

As a general remark, the activity of this group in a Physics and Technology department is in the overlap region between physics (both applied and basic) and routine service. The group should be cautious in planning new activities, not directly involving physics and requiring instead competences belonging to other disciplines e.g. chemistry, medicine, engineering, etc. Collaboration is, of course, needed and welcome but the chosen subject should include substantial physical aspects. The group now has a good opportunity with the leadership of the consortium "Michelsen Centre for research-based innovation" to plan and to focus in part the activity toward a more basic or applied physics content. To be more explicit, consider, as an example, the activity on flow measurement techniques (gamma-ray absorption and ultrasonic) for deployment at the seabed. So far the systems have been tested at sea level and it is unclear when and if they will be deployed. The Evaluation Committee worries about this activity as this is industrial engineering that industry could do themselves. Industry pays a small fraction of the external funding (and, thus, only a few per cent of the total cost) and public funding might be better used.

4.3.1.3 Nanophysics

The group has been formed in 2006, and has two associate professors, three postdocs, three PhD students, and no technical staff. As this is a new group, no PhD or MSc graduates were produced during 2006–2008. The main activity is related to industrial nano-processing technology for the production of the nano-material Carbon Black, and to the development of a so-called helium atom microscope with a focus on bio-functionalized surfaces. This instrument is considered to be the foundation of a new initiative in nanoscience at Bergen University.

Assessment and Grading

The scientific quality and productivity of the group components during their previous research activity is quite good in terms of peer-reviewed publications and patents. Several national and international collaborations are ongoing and one very strong collaboration with a local industry within the nano- carbon project (Carbontech Holding AS). The group and the nano initiative are quite well funded by RCN (NANOMAT and GASSMAKS programme) and the Bergen Research Foundation and an additional private donation. The infrastructure is adequate, the helium microscope is near to be completed and working, and a fully equipped e-beam lithography facility will be installed soon, with an additional specialization in free standing nanostructures and in bio-functionalized surfaces. The initiative requires new faculty appointments and support from the other groups.

Overall grade: 3 (preliminary in view of the short existence of the group)

Recommendations

Nanoscience is one of the six main research priorities of the Bergen University and Nanotechnology is one of the five study programmes in which the department is involved. It is clear that there is an opportunity for the Physics department to play a strategic role for the future development of physics in Bergen. But this requires a clear strategy and some choices. First, some of the staff members have worked mainly for a company related to the production of nano-carbon material. In-house activity consists mainly in computer modelling of Carbon Black formation; the experimental part is instead weak. The group should have a basic project of its own and it needs to be more independent of the company. The activity of the remainder of the group is too wide and it should be also focussed toward some specific item in view of the hard work necessary to establish the group. At present, the participation of other staff members from different groups but with complementary competence and with interest in nanoscience is important and should be encouraged. This may be another method of recruitment! The group in any case requires additional manpower, otherwise the main activities will shift towards other fields and the physics contribution will be limited to a mere technological role.

A better coordination with other national groups working in nanoscience is essential to the future development. For instance, in nano carbon materials there is sound activity at IFE (carbon nanotubes) and at NTNU (Carbon Nano Cones). Another e-beam lithography facility will be available the next year at NTNU within the NanoLab and a better coordination with that facility is required. The helium atom microscope arrangement is unique on a world scale. It demonstrates the wave-particle duality explicitly. The problem is that all that was done few years ago, and so the group now needs a new goal. Unfortunately, upon question, answers were somewhat disappointing in terms of science depth. The idea seems to be to expand the project by acquiring an e-beam litho system and other process equipment for zone plate fabrication. It is not clear that the group is of sufficient size to be able to focus more on technology.

4.3.1.4 Optics and Atomic Physics

This group consists of three professors and one associate professor, supplemented by three strong postdocs and 7 PhD students, mostly externally funded. During 2006–2008, 4 PhD and 9 MSc students were examined. The group was formed by a merger of two close to subcritical size groups in Optical Physics and Atomic Physics, based on the rather audacious recommendation of the "follow up" committee of the previous evaluation of Physics in Norway. The research thus spans two fields, the optics of marine and freshwater environments including recently also medical physics, and theoretical atomic, molecular and optical (AMO) physics.

Assessment and Grading

Each subgroup shows excellent performance within their quite different fields. The AMO activities address photodissociation of molecules in strong fields and the physics of quantum dots. The group merger has catalysed collaboration and sharing of expertise of the two groups, very recently within the area of theoretical physics as well as the logistically more demanding area of experimental optical physics, and here in particular the creation of a joint femtosecond laser laboratory, still in its infancy.

The group studying the optics of marine and freshwater geophysics of the Northern Hemisphere, often combined with parallel studies of relevant environments in the Third World, are in this way supporting declared areas of priority of research at the University of Bergen, namely Marine Science as well as the education and training of the next generation of scientists in the Third World. This activity has in addition added medical physics and the creation of a spin-off company in medical physics to its activities by clever applications of its key competences. Such an effort would not have been possible by this very small group without an extensive and conscious collaboration with leading research groups at other departments at UiB (Biology) and abroad, and here in particular in the US. Similarly, the small atomic physics group has an impressive publication record in high-ranking journals for fundamental physics, with no less than five recent Physical Review Letters, all with the leading author from the Bergen group. Again, this would not have been possible without a structured collaboration pattern with strong research groups abroad, here in particular Stockholm, Aarhus and Paris. Both groups attract a good number of MSc and PhD students and they are also able to attract considerable external funding for their activities.

Overall grade: 4/5

Recommendations

The build up of a joint in-house experimental base is a key challenge if the full benefit of the group merger should be realised. The Evaluation Committee thus recommends strengthening the competences of the technical support staff of the new femtosecond laser facility in order to accelerate this process. The plans for a new experimental laboratory wing with up-to-date infrastructure are a crucial step forward. External funding from RCN for modern laboratory infrastructure will be necessary for the success of this development. In the future, a modest and cleverly planned increase in the permanent staff may have a significant effect on the already impressive scientific output in areas unique in Norwegian physics, including some with the potential of improving collaboration with industry.

4.3.1.5 Petroleum and Process Technology

The group presently consists of three professors, three postdocs and 9 PhD students. 12 PhD and 11 MSc students graduated from the group during 2006–2008. It is active in two major research areas, thermodynamic modelling and reservoir physics. In the first area, scales from atomic level via nano to micro scale and up to reservoir scale are included. Emphasis is laid on issues related to storage of CO2 in aquifers and hydrate reservoirs, salt precipitation and hydrate phase-transition kinetics. Also, the group takes part in further applications, such as a national research programme on hydrate resources of the coast of Norway and studies of mechanisms for PCB removal from fish oils. In reservoir physics multiphase flows in porous media are explored, with applications to fractured and heterogeneous reservoirs, CO2 sequestration and gas hydrates. Laboratory as well as in situ studies are performed. Both activities are carried out in collaboration with national and international groups and organizations. In particular the reservoir physics activity has very considerable economical consequences, and is supported by 5 international oil companies. Of particular interest economically is the work on fractured reservoirs and on the natural gas production from CO2 sequestration.

Assessment and grading

The work of this group seems highly professional and of great economical significance with extensive external collaboration. The PhD and MSc training in this area is very relevant for the oil industry. From the limited perspective of the Evaluation Committee, concentrating on the basic-physics importance of the research, it is interesting and competent, with a significant but still limited imprint on the international research on the physics of flows in porous media and on related physical processes, as well as on thermodynamic modelling of phase transitions and gas exchange in hydrates.

Overall grade: 3

Recommendations

Realizing that other objectives than contributing to basic physics research are at focus in this programme, the Evaluation Committee restricts its comments to suggesting that the group should explore the possibilities to connect its research and research training to other Norwegian groups involved in more basic but related research, such as the National Complex Network and the PGP.

4.3.1.6 Science Education and Outreach

This group consists of only one professor and one associate professor and thus faces a problem of critical mass. The group does research in the fields related to the public understanding of science and inquiry based science learning.

Assessment and Grading

The outreach activities are considerable and successful, both inside and outside the university. A "Space Science Suitcase" containing instruments for monitoring solar and geophysical activities has been made available for science classes in upper secondary school, and also inspired similar initiative abroad. Research within IBSE (Inquiry Based Science Education) should also be noticed. The department ascribes the relatively satisfactory recruitment situation for physics and technology studies in Bergen to the efforts of this group.

Overall grade: 3–4

Recommendations

Efforts to further increase the number of MSc and PhD students in this group should be undertaken. Similarly, co-location with neighbouring groups from, e.g. the nearby Chemistry Department should be seriously considered by the Faculty of Science in order to create an even more attractive environment for research and education.

4.3.1.7 Space Physics

This group consists of two professors, two associate professors, one adjunct associate professor and 5 PhD students. During 2006–2008, three PhD students and 10 MSc graduates were produced. The group performs research in several areas, particularly, remote sensing of auroral phenomena, remote sensing of terrestrial gamma flashes, space-based research and upper atmosphere research.

Assessment and Grading

This is an internationally leading space instrumentation group, which has played a pivotal role in several recent high profile publications. The focus is on X-ray and gamma ray detectors and these have been repeatedly competitively selected for international missions, which is strong evidence of a well-established excellent international reputation in this area. Highlights are recent results from IPY-ICESTAR, collaboration on the Cluster and PIXIE payloads and sprite observations on ISS (ASIM). The rate of publication overall is reasonable for a group focussed on instrumentation in space physics, as is the rate of production of PhD graduates.

There is a minimum level of activity in design, build, flight and exploitation required to maintain expertise. The group has successfully maintained this level in terms of international collaboration and flight opportunities. There is an active collaboration with the microelectronics group, which supports this critical level of activity in terms of the design and build phase. There is below critical support for data processing and exploitation, which is planned at the level of two or three PhD students.

Overall grade: 5

Recommendations

The group is subcritical with three academics, two of which will soon retire. It is planned to replace these staff, but even with replacement, this is a small group given the portfolio of current activities. The Evaluation Committee would recommend strengthening the group and concentrating on their core competences, and with reference to the recommendations for space physics in Norway in general (see 3.1.7). The group is proposing for ESA Cross-scale, which is a large-scale endeavour (multi-spacecraft mission). As with the rest of the magnetospheric community this is 'all or nothing' in terms of effort and presents a significant challenge to strategic planning. There is a perceived need to tension the space based instrumentation programme with the ground-based programme, and this needs to be done nationally.

4.3.1.8 Subatomic Physics

This group consists of 6 professors, three postdocs and 14 PhD students. 8 PhD and 17 MSc degrees were examined during 2006–2008. It is subdivided into three separate subgroups, high-energy particle physics experiments (HEPPEX), heavy-ion collisions (HIC) and theoretical particle physics (PPTH), as well as a special R&D sub-group, which supports the experiments of the HIC group and the HEPPEX group with detector technology, microelectronics and technical computing. The subatomic physics group has a new tenure-track faculty recruitment in astroparticle physics, closely connected with the PPTH and HEPPEX activities. The HIC activity has joint projects with the nuclear theory activity in the Theory group at the department.

Assessment and Grading

The work on detector components for ALICE including the High-Level Trigger is very good. The HIC subgroup has close contacts with heavy-ion theory, and the scientific leadership is also very good. The HIC subgroup also has close contacts with the technical high school in Bergen, and is active in IT development. The work of the HEPPEX subgroup on the exploitation of BABAR data and preparation for ATLAS is very good, though there have been problems of coordination with the BABAR activity. Both HEPPEX and HIC have outstanding international (CERN, RHIC in US) and national (Oslo, theorists) collaboration. The PPTH group work on phenomenology beyond the Standard model, Higgs, supersymmetry and dark matter is very good; excellent quality and good production limited only by the size of the group. The heavy-ion activity has excellent worldwide collaboration, though does not integrate with the PPTH work. A good number of PhD degrees have been produced, in particular by the PPTH group.

Overall grade: 4

Recommendations

It is clear that some collaboration problems have been detrimental to the group. The newly recruited astroparticle physicist will bring welcome new resources, but may be relatively isolated, and it is desirable to coordinate national astroparticle activities. The proposed HIC involvement in CBM at FAIR may be overstretching the available manpower and resources. It is recommended that the HEPPEX group should cut its activity in BABAR, and integrate the astroparticle activity without weakening ATLAS. There should be a plan for long-term continuation of the PPTH activity. The heavy-ion theory activity should reinforce collaboration between theory and experiment during the ALICE era.

4.3.1.9 Theoretical Physics, Energy and Process Technology

The group consists of three professors, three associate professors, one adjunct associate professor and 15 PhD students. Four PhD and 26 MSc students were graduated during 2006–2008. For historical reasons the group activities include also fundamental theoretical physics to study matter under extreme conditions such as those present in early universe or when stars explode. This research considers the formation of Quark-Gluon Plasma, the existence of cold matter and its relation to the nuclear halo. The second main part of the research activities are within oil and gas related process technology. These activities include the study of transport phenomena in multiphase systems by experimental, numerical and theoretical analysis; simulation and modelling of dust and gas explosions including measurement of flame propagation. A new project on macro scale energy production, based on previous knowledge of fuel cells for electricity generation, will start soon. As part of the activity performed within the "Centre for Integrated Petroleum Research" (CIPR- Centre of Excellence), NMR is used as a tool for characterising properties of porous media and fluid flow in it; the leader of this activity will retire at the end of 2009.

Assessment and Grading

The scientific quality and total productivity is good in terms of publications and conference proceedings but with large fluctuations among individuals. In particular, the theoretical activity on nuclear energy is of high international relevance. Collaborations in nuclear physics are with CERN's ALICE and GSI/FAIR GANIL/ SPIRAL. The group coordinates the RNBT (Russian-Nordic-British Theory) programme. The other subgroup, the Process Safety Technology unit, collaborates with the Industrial Explosion Protection Institute, and Multiphase Systems unit with several oil-related industries. The international publication profile of this subgroup is reasonable, as well as the number of PhD and MSc graduates, many within common projects with industry. The group has tight links to national industry through common projects, MSc and PhD projects. The external funding for this subgroup is important, but many of the industrial projects have low basic-physics content. The infrastructure and equipment are adequate but to maintain the required standards further investment is needed in equipment and in personnel to strengthen the basic physics aspects. The activity of the experimental energy and process subgroup contributes to national research with good relevance for Norwegian industry and it is of great economical significance. Strategic planning exists, but it is still not convincing enough. The overall impression of the Evaluation Committee is positive but with a distinct degree of scepticism.

Overall grade (Subatomic theory): 3–4, (Other activity): 2–3

Recommendations

The theoretical activity on high-energy nuclear physics is relevant and of high quality and one might consider remerging in the future with the subatomic group. The remaining activity is quite broad, that related to the use of NMR facilities in CIPR should be reconsidered given there is no future planning after the retirement of the key person at the end of 2009. The activity on nano-carbon from incomplete combustion should be tightly coordinated with that of the nanophysics group. The knowledge and the competence are of extreme interest for this new activity. It is not clear what the aim of the new project on "New Energy" is, nor is the involvement of the group, which is already overloaded with teaching duties and numerous collaborations. The Evaluation Committee recommends that in any new project the group should try to extend or to enhance the physics aspect (applied or basic) that must be at the fore. Participation in the Complex Network is highly recommended for the research on multiphase systems.

4.3.1.10 Overall Assessments and Recommendations

Some research groups at the department are strong, e.g. the groups in Atomic Physics, Subatomic Physics and Space physics. Yet, the diversity of the research effort is considerable and the split between the different groups too large. The leadership of the department ascribes this to internal tensions resulting from "too few 'team players' " in the department. Obviously, much of these tensions have become accentuated in an ongoing debate on the prioritization between basic and applied science. Now, several of the groups in basic research obviously consider that they are subcritical, and fear that their possibilities to make and follow long-term plans and live up to collaboration commitments are in danger. On the other hand, they also point at potential collaborations and alliances that could be initiated and further developed, with international and national and even local groups in basic science, and with industry and other actors in applied science. In order to accomplish this, a strong leadership is needed and a realistic strategy must be worked out and agreed upon by the research-group leaders. It seems to be in the interest of all groups that such a strategy be developed and implemented. It should contain a restructuring with some focussing as well as measures to further closer collaboration between the existing groups.

The department is engaged in large applied research programmes and in several cross-disciplinary collaborations with other departments. In basic physics the number of PhD students is of order a few per senior scientist, while some technology areas have an order 10. The difference is dramatic and some efforts should be done at both local (for example, a better and focussed allocation of faculty positions and funding) and national management toward a better balance of the two fields. The recommendations of the previous RCN physics evaluation (2000) are still valid concerning the suggested strengthening of experimental basic physics at the department, the activity at the more technological level being already quite high. In each activity the relevance of physics should be pointed out and the overlap between applied and basic physics should be increased. This might help the recruitment of brilliant PhD students in more basic fields. The nanoscience initiative should be planned carefully to avoid the start of several subcritical and weak activities.

The university has made a considerable investment in nanoscience and nanotechnology with the establishment of new laboratories with expensive facilities. The lab has been given to the department, and should be able to organize and plan a sound activity. This might require a substantial reorganization of some groups.

The department head pointed out an imbalance in the recruitment of students into technology and basic physics, with technology being the dominant component. The Evaluation Committee suggests that adding an activity in astronomy to the department should be considered as a possible strategic tool for enhanced recruitment into basic science, in particular physics. Such a move should be an integral part of a future coordinated national strategy, see 3.1.1.

4.4 University of Tromsø

4.4.1 Department of Physics and Technology

At the Department of Physics and Technology at the University in Tromsø there are presently 14 professors, 4 associate professors, one adjunct professor, one adjunct associate professor, 13 technicians and administrators, 18 PhD students and 7 postdocs. The research is organized in two relatively large groups, in Space physics and in Electrical engineering, respectively, where the latter includes work in Earth observation, sensors for oil and gas, and biomedical technology. In addition, there are two minor groups working in Complex systems with plasma theory, and Molecular quantum physics, respectively. The activity enjoys partly restructured laboratory facilities. It will be moved from a present more distant location to the main campus area that will enable more intensive local collaboration with other departments.

4.4.1.1 Complex systems

This group started its activity in 2004, but is a result of a redirection of earlier plasma-physics research, as was recommended in the earlier physics evaluation and the 2001 strategic plan. It is as yet fairly small, with one professor and one PhD student (with one more coming). No PhD graduates have yet been produced by this new group, but one MSc graduate was produced in 2008. The group collaborates locally with other departments at the University, as well as with the Norwegian Polar Institute, but has also engaged in considerable international collaboration. Its cross-disciplinary activity developed from a complex-system perspective on plasmas in the laboratory and in space, but is now widening its perspectives towards geosciences and climate dynamics, and further broadening towards biological systems and finance markets is planned.

Assessment and grading

It is premature to evaluate the accomplishments of the group in the wide context that is planned. The previous work of the members of the group and their collaborators is, however, of international standard. The close collaborations with other groups and departments, including with mathematics and space science, is of fundamental significance.

Overall grade: 3 (preliminary in view of the short existence of the group)

Recommendations

It is of vital interest for the group to keep and develop its collaborations and also actively make contacts with the National Complex Network. There may be a risk that the wide and rapidly developing field of Complex dynamical systems may tempt the group to broad its interests too much.

4.4.1.2 Electrical Engineering

The Tromsø Electrical Engineering (EE) group consists of 4 professors, 4 associate professors, one adjunct associate professor, two postdocs, 11 PhD students and a few technical staff. They have examined three PhD and 16 MSc degrees during 2006–08. The group divides into a sensor group and a signals group. The sensor group spans a wide field, from optics with optical trapping, waveguides and Raman spectroscopy, over microwaves for medical treatment and diagnosis, to ultrasound with both transducer development and medical and industrial applications. The group has recently received a large grant for "Sensors for Oil and Gas". The signals group employs a wide range of methods in signals processing machine learning and pattern recognition. Applications vary from marine seismics and earth observation SAR to audio, ultrasound and medical images.

Assessment and Grading

There are several publications in high quality journals and this is a good platform to build upon. However, the overall impression is that the publication rate and quality is modest, which is also reflected in the citation rates. Furthermore, the Evaluation Committee would have expected a higher production of PhD degrees.

The sensor group projects, although often with high aspirations, would benefit from end-user input and drive. Furthermore, the Evaluation Committee worries that resources are spread thinly on too many projects. The signal group are successfully exploiting existing techniques to address highly relevant questions. Although the EE group lists several international, national and local collaborators, the overall impression is still that the group works in some isolation.

The Evaluation Committee notes with pleasure that the faculty is actively involved in several companies, from the start-up phase to later stages. Furthermore, there is one "industrial" PhD student. The EE group clearly has potential for high relevance and a to fill a unique position for local industry.

Overall grade: 3

Recommendations

The EE group has about the right size for such an interdisciplinary electrical engineering group. However, the faculty could certainly handle many more PhD students. This would create an improved environment. Although the Evaluation Committee clearly values basic science, it seemed like this group worked too much in isolation. As an example, even a good project such as the optical trapping project (which publishes in good journals!) lacked a biological perspective and close collaborator. Such lack of user input will harm the projects and their success in the long run. Thus, the Evaluation Committee would strongly urge for a more intense collaboration with local end-user groups, both scientific and industrial.

The Evaluation Committee believes the group would benefit from focussing its efforts into fewer scientific areas and not trying to do everything that is possible with a certain technique that they master. The general area of advanced measurements and signal processing clearly suits the group well. However, to continue the bio/medical applications collaborations with relevant end users should be strengthened. It is in the industrial applications with local (i.e. northern Norway) relevance that this group has its major opportunity. The group has a broad knowledge base in several modern measurement-oriented technologies (optics, ultrasound, signal processing etc) that certainly will find many applications as well as motivation as industry moves north.

4.4.1.3 Molecular Quantum Physics

This group consists of only one researcher, however, well integrated in the Centre for Theoretical and Computational Chemistry at the Department of Chemistry. The group member will retire in a couple of years. The research is focused on computational models of electronic structure in molecules and solids, and the problem of electron correlation in electronic structure calculations.

Assessment and Grading

The group has a well-established reputation and a solid publication record in leading international journals.

Overall grade: 4

Recommendations

When the group member retires, the position, if still available, should be used to carefully consolidate and focus the other research activities of the department. An agreement might be negotiated with the Department of Chemistry concerning teaching and courses in graduate quantum mechanics for physics students.

4.4.1.4 Space Physics

The group consists of 8 professors, one adjunct professor, 5 postdocs, 6 PhD students and about 6 technical staff. Three professors will retire within the next three years. The group has produced one PhD and 4 MSc graduates during 2006–2008. The research focuses on dusty plasmas, mesospheric, ionospheric and auroral research, the solar wind, and also has a laboratory plasma activity and activity on fusion plasma physics. This group has played a pivotal role in EISCAT, which is an international facility for incoherent scatter radar observations of ionospheric structure and dynamics. EISCAT is at the point of requiring renewal and this group would be anticipated to lead in the design and oversight of a next generation facility. This is proposed to be EISCAT-3D, which is a large array of steerable (phase array) dipole antennae to be located on mainland Norway. This facility would also complement observations based on Svalbard.

Assessment and Grading

The main focus of the group is on technical development and, although very good theoretical work is pursued there is a lack of data analysis support and subcritical staff levels; however, this expertise is available nationally (through e.g. STAR) and internationally. The rate of graduation of PhDs, and the overall publication rate is adequate.

Currently there is a plasma group with a small-scale plasma experiment and also collaborations (Riso, JET) to support studies of turbulent transport in plasmas. Other studies are in principle relevant to plasma physical processes in space. However, this group is subcritical for an experimental activity and this small-scale machine is not well placed to compete with larger scale facilities for fundamental plasma physics internationally. The theoretical plasma work is worth continuing; there is also a need for plasma theory support nationally.

Overall grade: 3

Recommendations

The staff retirements soon will weaken the space group. It is unlikely to be able to fully support future radar development without replacement staff. There is a risk that a subcritical group cannot maintain this expertise, and the university has effectively imposed a hiring freeze due to structural problems. There is potentially a significant synergy with the signal-processing group in electronics but this has yet to be explored.

Recognizing that the scientific case for EISCAT-3D is still under development, and that the funding situation is unclear, the Evaluation Committee recommends that UiT sustain its capability to contribute to this opportunity, and to benefit from it. More general recommendations on a national level are given in 3.1.7. The group also actively participates in campaigns including EISCAT, ESR, and optical facilities on Svalbard, as well as space missions and rocket experiments. These appear to be embarked upon on an *ad hoc* basis as collaborations are formed. This group houses the only plasma experiment in Norway; however, the needed expertise to complement the observational programme could be met computationally.

4.4.1.5 Overall Assessments and Recommendations

The research at the Physics department has good quality. A basic problem for the department is the very limited internal university funding except for the salaries of the staff. This leaves no room for initiatives or implementation of new strategies. If increasing the local support, or finding new external financing cannot solve this dilemma, the Department must find ways to decrease its salary costs. Natural ways are to use resources that become free due to retirements, and to attempt co-financing of some technicians with other departments. In order to make such solutions possible, it is important that the University leadership guarantees that such freed salary money may be used within the Department. In the present predicament it is very important that the Department in collaboration with the University leaderships works out a strategy. Such a strategy should put the main emphasis on consolidating the Space physics and the Electrical engineering groups. The strategy for the first group must be worked out with a background of a national planning for Norwegian space physics (see 3.1.7). As regards the electrical engineering group some concentration of the activities seems necessary in order to reach criticality for some of the research projects. The activities in plasma physics may have to be reduced, and in molecular quantum physics they should be stopped in order to reach this consolidation. A special aspect is what theoretical physics that can then be maintained at the University. The possibilities of covering some teaching needs, e.g. in quantum mechanics in collaboration with the Chemistry department, should be explored.

4.5 University of Stavanger

4.5.1 Department of Mathematics and Natural Sciences

The University in Stavanger has a small physics programme with an academic staff of 5 professors, two associate professors, one adjunct professor and a small number of PhD students. The research is in three areas: in crystallography, exploiting the Swiss-Norwegian beamline at ESRF, in electromagnetism related to petroleum applications and in mathematical physics with applications in theoretical cosmology and gravity. The common denominator for these diverse activities is mathematical and numerical modelling of physical systems. There are no MSc and PhD programmes in Physics.

4.5.1.1 Diffraction Physics

The group of diffraction physics consists of one professor and one associate professor and one PhD student under supervision. The research activity, both experimental and theoretical, is related to the development of synchrotron X-ray diffraction. The emphasis is put in the description of size effects and imperfections on the coherent and incoherent scattering processes. The experiments are performed at the European Synchroton Radiation Facility in Grenoble using the Swiss Norwegian Beamlines.

Assessments and Grading

The group is heavily involved in teaching and administrative work; only a small fraction of time (10–15%) is dedicated to the research. The scientific productivity is then modest. The activity on the structure of Al alloys is of scientific interest in metallurgy.

Overall grading: 2

Recommendations

The group is quite isolated and it must try to integrate its expertise with the other in-house competences. Experimental activity must be improved and the choice of topics should be oriented toward materials science problems of interest at UiS or at other institutions (SINTEF has a large activity in metallurgy). The maintenance of the outstation at ESRF in Grenoble might be extended to other users to facilitate collaboration at other facilities like HASYLAB and MAX IV. Increased experimental work should also present good opportunities for the theoretical modelling activities, as well as being relevant for students and industry.

4.5.1.2 General Theoretical Physics

4 professors conduct research on an individual basis. At the present there are no PhD students or postdocs in the group. The activities concern general relativity and cosmology, mathematical physics, atomic physics and network theory. The scientific quality in terms of publications and conference proceedings shows a large fluctuation between individuals. Collaborations are few and only the university provides funding. The staff have substantial teaching duties for undergraduate courses.

Assessment and Grading

The cosmology activity consists of two staff members, of which one is attached to the mathematics section of this pluridisciplinary department. Recent recruitment in cosmology and general relativity was based on scientific quality, and is seen as very important for the department. The placement in the mathematics section provides an intellectual context. This work is rather different from the local physicists, but common interests with local mathematicians exist, e.g., mathematical modelling. There may be opportunities for national collaborations, e.g., with Oslo, and a large number of international contacts and a well-developed research network already exist.

The research work in general relativity and cosmology is very good. The quality of the other research is acceptable in view of the resources available and teaching duties, but the overall international publication profile of the group is quite modest; the relevance and productivity of this research are not exciting and only marginal contributions to research knowledge are made. The split of activities among a number of quite small or one-person research groups is a weakness.

Overall grade: 4/2

Recommendations

The group should put more effort in raising the interest of the other players at Stavanger, both academic and industrial, in physics. The section should take advantage of the existing teaching and research activities in other fields, in particular petroleum-and energy physics and materials science, where its expertise in mathematical modelling seems highly relevant. It should also seek greater collaboration on general relativity and cosmology with other centres in Norway (e.g., UiO) and Scandinavia (e.g., NORDITA).

4.5.1.3 <u>Overall Assessments and Recommendations</u>

A weak point is the lack of MSc and PhD programme in Physics and the substantial teaching duties at the undergraduate level. The department representatives suggest such a programme, focussed on mathematical modelling of physical systems, which is within the focus of the section on theory/modelling-dominated research. This would allow the recruitment of PhD students and postdocs, without which it is very difficult to maintain a reasonable research activity in a range of subjects. To accomplish this would, however, be a difficult challenge in view of the small size of the physics group. Although impressed with the ambitions, the Evaluation Committee stresses the significance of relating to other higher level education programs at Stavanger, as well as to closer collaboration with research programmes and technological development efforts driven by the needs in petroleum engineering and other energy applications. Certainly, there is a need for mathematical modelling on a physical basis in this area, and an ambition to provide and develop further in this direction is worth encouraging. It is, however, important also not to split the research efforts of a limited staff into too many areas, while simultaneously maintaining the competence in teaching. An efficient prioritizing and leadership, and local, national and international networking, are key factors.

4.6 Norwegian University of Life Sciences (UMB)

4.6.1 Department of Mathematical Sciences and Technology

At the Norwegian University of Life Sciences (UMB) and its Department of Mathematical Sciences and Technology there are research groups in biophysics (computational neuroscience and environmental biophysics), renewable energy, agricultural meteorology, and theoretical fluid mechanics. The group of physicists in the department covered by this evaluation consists two professors, 4 associate professors, one adjunct associate professor, two postdocs, 7 PhD students and two technical and administrative staff. Of these, the group in computational neuroscience, which does not only include physicists, is by far the largest with 14 group members, and 5 of the PhD students. The other research groups are fairly small. The physics programme attracts many good students on the MSc as well as the PhD level.

4.6.1.1 Agricultural Meteorology

This group consists of only one associate professor, and as such is subcritical. Three MSc and no PhD students have been examined during 2006–2008. The Evaluation Committee considers the physics content of the work done in the group to be low, and outside their main competence. Thus, the Evaluation Committee abstains from assessing the group, but makes some general comments.

The group has a long-term dataset relevant to climate change physics. Currently the data is still being recorded but there is no funded effort to calibrate the data and make it available. Short term (3-year postdoc) funding would be sufficient to perform the calibration task, and if this were done then it is likely that it would lead to high impact results and collaborators could be attracted, which could lead to the long term support needed to continue taking the data. For this to happen it would be necessary to prioritise this area against others.

4.6.1.2 Biophysics and Computational Biology

The UMB Biophysics group consists of one professor, one associate professor, two postdocs and 6 PhD students, and produced 4 PhD and 7 MSc graduates during 2006–2008. It divides into a larger computational biology group and a smaller environmental biophysics group. The computational biology group is much larger in reality since faculty from other departments (math, computer science, etc.) are connected to the computational neuroscience group. The computational biology activity is focused on computational neuroscience in a wide sense. The involved faculty members have their background in physics, mathematics, computer science and statistics – a suitable mix of expertise for the research. The environmental biophysics group primarily work on plants under stress, including ozone damage to leaves and root studies.

Assessment and Grading

The computational neuroscience group works on timely topics in a highly competitive environment. The group is clearly scientifically productive with publications in high-quality journals. The group is reasonably though not overwhelmingly visible, but is clearly on its way to becoming internationally recognized. It lists several graduate students in progress and two PhD examinations in 2006–2008.

Overall grade (Computational Biology): 4

The environmental biophysics group has examined two PhD students and 4 MSc students since 2006, but has a limited publication record. From the technology/physics perspective the Evaluation Committee was not overly impressed; thermography has been used for more than a decade for plant visualization, the root imaging appeared classical, and the influence of tropospheric ozone on leaves has been studied for some time. Thus, the physics grade would be low. However, the biological aspects of the field are clearly outside the competence of the Evaluation Committee. Thus, the Evaluation Committee will not grade this group.

Recommendations

The computational neuroscience group collaborates intensively both internationally, nationally, and locally. Experimental data are primarily obtained from international collaborators. The group leader is active in coordinating the field on national level and is also adjunct professor at the University of Oslo. Locally the group collaborates with CIGENE, also as regards education. Several faculty and postdocs from other departments (mathematics, statistics and computer science) are part of the computational neuroscience environment. In this way the group has the size and broad scientific competence for this interdisciplinary field. The computational neuroscience leadership has certainly succeeded in building a strong group in a short time, and is active on all levels, internationally, nationally and locally, in building the computational biology environment.

The Evaluation Committee has few recommendations for the computational biology group apart from continuing building this scientific environment to a stable group of, say, 15–20 persons. Although it would appear to be attractive with a closer connection between experimentalists, the Evaluation Committee is aware of the possible complications that might arise when creating such environments too fast. With the existing competent leadership, the group should determine their own priorities.

The environmental biophysics groups list a few collaborations but it is difficult to see to what extent they influence the research. It would probably benefit from stronger contacts to plant physiology and similar departments in order to develop to an internationally competitive group in its research field.

4.6.1.3 Renewable Energy

This group consists of two associate professors, and one adjunct associate professor, and one PhD student. 15 MSc and no PhD graduates were produced during 2006–2008. The group claims to cover a wide field of renewable energy topics, including from pyrolysis of biomass, biogas from household waste, wind energy, basic and applied aspects of solid-state solar energy technology, and energy system analysis.

Assessment and grading

The Evaluation Committee was disappointed to find that the work primarily seemed to consist of low-level technical studies and testing commercial equipment. It was difficult to identify a research component in the projects presented and the close-to-zero publication rate enhances this impression. Thus, the grade as regards any type of physics-related activity (combustion, thermodynamics, materials, measurements techniques, engineering etc) would be very low. The societal aspects are, however, outside the core competence of the Evaluation Committee, and the group is therefore not graded.

Recommendations

The field of renewable energy is clearly important. Furthermore, in the subfields worked on at UMB, the field provides ample opportunities for scientific studies based on combustion science (diagnostics, physics and chemistry), thermodynamics, material science, optics, etc. In fact, it is the role of the universities to create the basic knowledge based on such scientific studies, for the long-term benefit of society.

Unfortunately the UMB group seemed to lack a scientific agenda and is more focused on the practical functioning of existing equipment. Although this style does not contribute to basic knowledge, it has led to several spin-off companies. Unfortunately there seems to be strong ties between the university environment and the spin-offs, creating significant economic instability also at the university when the spin-offs experience commercial difficulties. With this background, the Evaluation Committee feels the group needs to decide if they want to be a university group or a commercially oriented entity.

The Evaluation Committee notes that the enthusiasm of the group leader attracts many students. This is good, but the Evaluation Committee worries that the scientific training provided lacks depth. Finally, the number of subjects covered by the group is far too large. No group this size can obtain any depth of knowledge in such a wide field. The Evaluation Committee strongly suggests focusing.

4.6.1.4 Theoretical Fluid Mechanics

This is a very small group, engaged in studies of free-surface flows and free convection in porous media. Four MSc but no PhD students were examined during 2006–2008. It is dependent scientifically on collaboration with stronger groups abroad. Master students have been supervised in more applied studies on wave power.

Assessment and Grading

The scientific output and impact are limited.

Overall grade: 2

Recommendations

As a research group, this is sub-critical. Closer contacts, e.g. with the large fluid-dynamics group at FFI or the more applied group on Petroleum and Process Technology (porous media) at UiB, might be rewarding. It is recommended that the department attempt to merge the two groups in Agricultural Meteorology and Theoretical Fluid Mechanics into one and discuss a common research profile for them.

4.6.1.5 Overall Assessments and Recommendations

Although the subjects of all physics groups seem relevant for teaching at a University directed towards environmental and agricultural issues, it is not clear to the Evaluation Committee how much basic research in physics is needed to maintain this teaching competence. For a relatively small research department in physics, the present activities are too split. Of the four groups, only the computational neuroscience group can be regarded to perform frontline research from a physics point of view. The Evaluation Committee fully realizes, on the other hand, that all of these groups are parts in a wider, inter-disciplinary context, and that a full evaluation of their achievements and potential require a different more interdisciplinary Evaluation Committee. The environmental biophysics seems to mainly be biological research even though physical methods are used, and the groups in renewable energy, agricultural meteorology and fluid mechanics seem more applied and/or from a basic-physics perspective rather subcritical in size. The Evaluation Committee was impressed with the enthusiasm demonstrated by the group leaders, but would encourage them to further strengthen the networks with similar groups at other departments, nationally and internationally, as well as with industry and other stake-holders in the more applied research. If research is regarded necessary for maintenance of the competence of the teachers in the respective areas, the Evaluation Committee still suggests that the agricultural meteorology and the fluid dynamics groups be brought together into one group with a coordinated research programme. The resources of the renewable energy group must be focussed on fewer topics. If the present scientific level persists, the future of the group should be evaluated.

4.7 The University Centre in Svalbard (UNIS)

4.7.1 Department of Arctic Geophysics

Among the groups at the Geophysics department at the University in Svalbard (UNIS), the middle/upper atmosphere group is evaluated here. The group contains three professors, three adjunct professors, and 4 PhD students. 4 MSc and no PhD graduates were produced during 2006–2008. There is a cohort of international visiting scientists, which invigorate and broaden the science programme of what would otherwise be a small team. They explore the energy input and interaction between the Earth's magnetosphere and atmosphere, and have the ambition to include the full vertical column into the analysis. The research has bearings on the effects of the solar wind and solar variations on the terrestrial climate.

4.7.1.1 Middle/Upper Atmosphere Physics

Assessment and Grading

The suite of observational facilities on Svalbard provide a unique window on the physics of the upper atmosphere and ionosphere; there is no comparable set of facilities so this should be seen as world leading in this area. There is a young, highly committed focussed group who have the relevant competence to support and develop these facilities and who are clear about their goal, which is "field based research and training" in the context of the atmosphere-ionosphere in the wider context of solar-terrestrial physics. There is a growing PhD programme that should be expanded. Publication levels are adequate.

The group focuses on developing and maintaining the expertise to operate a suite of ground based observational tools such as optical systems for observing auroral and airglow phenomena at the Kjeld Henriksen Observatory (KHO) and the ESR radar. These are their stated priorities as these reflect their core competence. These systems form part of well-established international collaborations such as EISCAT and serve coordinated campaigns with ESA space missions such as CLUSTER to observe the cusp, and auroral rocket campaigns (internationally, NASA, and nationally with UiO, STAR). There is thus high international impact of their work. SPEAR was an unplanned opportunity but fits well into the suite of systems on Svalbard. There is an active collaboration with Leicester University in the UK and a recently appointed postdoc trained on SPEAR, so the necessary expertise is available.

Overall grade: 4

Recommendations

Theory support is supplied by collaboration with the Polar Geophysical Institute (Russia) as well as STAR. This is particularly important to develop expertise and understanding in kinetic physics for ionospheric modification with the recently acquired SPEAR system. However, UiO will lose its expertise in PIC simulations within the next 5-year timeframe due to retirements. The space group at UiO expressed the view that these activities should be picked up by UNIS.

The main driver within UNIS is very much on coverage and improving instrumentation (cadence, resolution, sensitivity). Science drivers tend to emanate from outside as part of the international community, or from the national programme. There is no formal procedure in place to solicit science priorities from the wider community. This is, however, not a severe problem for UNIS within the ground based solar terrestrial physics community or the space based magnetospheric community where the role of UNIS is well recognised, and the importance of coordinated ground and space campaigns is well understood. However, it may be a missed opportunity in the context of climate change, where such optical observations covering almost all of atmosphere-space could be used to benchmark global climate models. As the observations are polar they will be an early warning signal for geo-engineering targeted at global dimming of the polar regions.

An adequate funding stream is in place, but the group could accommodate a small additional group of PhD students and postdocs. This would encourage more data exploitation locally.

4.7.1.2 Overall Assessments and Recommendations

The unique location of UNIS, its access to unique facilities for studies of the magnetosphere and the upper atmosphere, and the quality of its research strongly motivates a continuous support to the group. Some increased funding for postdocs and PhD students would be desirable. UNIS should be seen, however, as part of a national programme for Space physics and upper atmosphere research.

4.8 Norwegian Defence Research Establishment (FFI)

The Norwegian Defence Research Establishment (FFI) supports a basic physics programme in order to maintain and develop capability in research needed for its applied (defence) programme. The FFI is to more than 80% financed by the Ministry of Defence and the Armed Forces on longer or shorter contracts, with a block grant that is being successively reduced. Some projects are also financed by external money from industry as well as from RCN where the RCN has recently opened the physics funding programme to FFI in open competition with the University sector. FFI staff scientists involved in basic research typically hold adjunct positions with Norwegian universities and have PhD students on site. FFI conducts basic physics research in flow physics and turbulence, in laser research and in space physics. The total numbers of permanent academic staff in these programmes are 5, 9 and 4 respectively. In addition to these there are some graduate students working in the groups.

4.8.1.1 Flow Physics and Turbulence

This group has a programme focussed on developing and applying fluid dynamical codes. Applications within the remit of this review include high Reynolds number flow in the presence of boundaries, dispersal of airborne particles, and turbulence at boundaries. The team of 5 permanent and 11 non-permanent staff are above critical mass for these activities. The group has produced two PhD and 8 MSc graduates during 2006–2008.

Assessment and Grading

The group has recently acquired a dedicated 128-CPU cluster. The Direct Numerical Simulation (DNS) work is relatively small scale and focus is on Reynolds-Averaged Numerical Simulation (RANS), which is an ensemble average technique optimised to exploit dedicated access to a relatively small cluster (state of the art turbulence DNS are on the scale of 1000-CPU clusters). Scalability is tested by comparison with DNS performed by collaborators overseas rather than in house. Benchmarking is done by comparison with experiments, again not all in house. This is supported by an international collaboration with a leading turbulence group (Lille). There is no 'formal' access to national facilities for HPC and what is needed is dedicated access to a sizeable fraction of the nodes on such facilities which it was felt could not be made available by this route. Visualization techniques are adequate but not at the cutting edge. Full scale DNS are performed in collaboration with industry for specific development problems. The publications of the group are of high quality.

Overall grade: 3

Recommendations

This group is making good use of the available resources but it is questionable as to whether the group can operate at the basic research frontier with these limited computational resources. One would expect more of the collaborative supporting work and networks in related computational physics to be not only international, but also national in order to support the National science base in areas such as this to facilitate training and recruitment of Norwegian nationals in these areas.

4.8.1.2 Laser Physics

The laser group at FFI hosts 9 permanent scientists, working in two main areas, simulations and development of laser sources, and simulations of the interaction of laser light with semiconductor materials. The Evaluation Committee has no information on PhD or MSc graduates from this group.

Assessment and Grading

The group publishes in the open international literature and giving regular invited talks at international conferences. Part of the work of the group is classified and thus not available to us. Based on the submitted publication lists it may nevertheless be concluded that several of the scientists have an extensive or satisfactory international collaboration pattern with some recent papers in prestigious journals. Most of the research on laser sources has military or security applications, such as remote sensing, laser-based counter measures, laser rangefinders, and adaptive optics. The activities cover both experimental activities and parallel theoretical investigations, the latter including the development of widely used state-of-the-art numerical simulation codes for, e.g., lasers and nonlinear wavelength shifters. In particular the activities within nonlinear optics at high powers has a strong profile. The research programme of the group appears to be sufficiently funded. The laboratories are well equipped and of international standard, though none of the experimental facilities that the Evaluation

Committee visited fulfil the requirements for laboratory temperature control and cleanness necessary for many extreme applications.

The number of MSc and PhD students trained in the group is surprisingly small, at least based on the information available to us. This is particularly noteworthy in light of the fact that research activities within experimental and theoretical modern optics and laser physics is essentially nonexistent at the nearby Department of Physics of the University of Oslo or at SINTEF/Oslo. None of the programmes presented to the Evaluation Committee apparently involved Norwegian industry.

Overall grade: 3–4

Recommendations

The laser group at FFI represents a significant resource, rather unique in a Norwegian context that can and should be utilised much more efficiently in the training of the next generation of scientists, in particular with regard to basic experimental competences. This goal can be achieved in several ways. One obvious possibility would be to establish an experimental hands-on course in fundamental optics and laser physics offered to students at the Department of Physics, and possibly also Chemistry and Biology, at UiO, preferably at the university premises. This course would also serve as a natural way of identifying potential MSc and PhD students for training at the FFI site that offers students several possibilities for research of international standard. The possibilities for collaborative projects with Norwegian industry should in this context, or otherwise, be explored systematically in order to enhance and broaden the impact of the activity on society.

4.8.1.3 Space Physics

This is a below critical mass group which is being successively phased out; there will be two remaining staff scientists within a year. This activity is currently not regarded as a capability needed by FFI. The group has a strong heritage of space instrumentation, and a recent highlight is hardware contributed to CASSINI, and has served as the site for rocket payload fabrication, testing, calibration and integration and ground support (data collection, recovery). 4 PhD and two MSc degrees were examined during 2006–2008.

Assessment and Grading

The group produces work of high quality and participates in international collaborations and campaigns. Following the last review of physics the group has focussed on studies of middle atmosphere physics by scientific rockets and the ALOMAR LIDAR. The ALOMAR LIDAR is one of two such instruments that can perform daylight observations. It thus plays an important role in coordinated campaigns but has not attracted adequate funding from RCN. Rate of publication and production of PhDs is adequate.

Overall grade: 3–4

Recommendations

The rocket payload fabrication and testing is currently conducted in support of rocket campaigns led by university groups both within Norway and internationally. There is an informal plan to facilitate the transfer of this expertise to the university sector. A possibility under discussion is to join STAR to support Svalbard-based coordinated studies.

4.8.1.4 Overall Assessments and Recommendations

All of the three research groups have research of good quality. They have developed contacts with national and international academic institutions, but these should be further developed. The space-physics group, with its programme oriented towards middle-atmosphere research by sounding rockets, will soon be reduced to two scientists and is becoming subcritical. The military interest to support this activity further seems small. Transfer to a university institute is to be recommended after a general strategy for Norwegian space research has been established (see 3.1.7).

4.9 Institute for Energy Technology

4.9.1 Physics Department

The Physics Department is the only department at the Institute for Energy Technology (IFE) at Kjeller that performs basic research in physics. The department includes 5 researchers, three adjunct professors (UiO, NTNU), one adjunct associate professor (UiO), one "inverse adjunct professor" (from UiO), two external temporary researchers, 11 postdocs, 6 PhD students, and 6 technical and administrative staff. The department examined one PhD and 4 MSc degrees during 2006–2008. IFE has a "line management" within each sector. The department is one of the five units in the NTP sector and the department head reports directly to the sector director. Managers have direct responsibility for giving instructions to their subordinates. The distribution of resources is discussed among all staff members. It seems that for this kind of structure, neither public nor private, such an organization is quite adequate.

The departmental activity is foremost related to the JEEP II nuclear research reactor and application of neutron scattering to materials science. Activities are performed on synthesis of materials for hydrogen storage, on the structure and magnetic properties of complex oxides, on complex systems and soft materials. This is presently the only neutron source of any magnitude in the Nordic countries, a situation that will remain for at least the next 10–15 years until the European Spallation Source in Lund is in operation. It is used at the department for studies of the physical properties of solids, soft condensed matter and liquids. JEEP II is also used by industry, in particular for silicon doping; the income from this covers approximately half of the running cost of the reactor. The full potential of JEEP II is, however, not utilized due to lack of funding for covering running costs as well as due to shortage of scientific and technical personnel.

The group at the physics department studying complex systems and soft materials use neutron scattering at the reactor as a basic tool though complemented with other means, including synchrotron radiation from ESRF at the Swiss-Norwegian beam lines. Carbon tubes and cones are studied, as well as biopolymers and porous materials. The group is part of the national Complex Network (see 3.1.4). Another group at the department is systematically studying the structure and magnetic properties of complex oxides and light metal hydrides for hydrogen storage in wide international collaboration.

Assessment and Grading

Part of the research activity is coordinated through the Complex and FUNMAT Networks, and an excellent collaboration with UiO (theoretical modelling), NTNU (TEM) and SINTEF (material synthesis) has been established. Extensive international collaborations (e.g. Sweden, Denmark, Germany, UK, France, USA, Japan) also exist. The department also has several industrial partners through EU projects, and collaborates with start-up companies. The role of the department in researcher training is important, with 6 PhD and 8 MSc students supervised since 2004, within common projects with UiO, NTNU and industry. The biennial Geilo School organized by the department is considered one of the best of its kind.

The previous evaluation had noted that user community from Norwegian universities was too small. This has been improved, in particular through participation in two research networks, Complex and FUNMAT.

The infrastructure and equipment are adequate but to maintain the required standards further investments are needed to upgrade or replace existing apparatus. This seems necessary at least for the next 10-15 years before the ESS in Lund becomes fully operational. A continuous use of the reactor requires more funding for running and for personnel costs. Technical support is needed for operating the instruments and for providing access to the facilities.

The department has an international leading position in some activities (e.g. hydrogen storage, carbon nanocones), with international publications in good journals. Productivity is high and very relevant to international research and to Norwegian industry. A good number of PhD and MSc graduates are supervised and the collaboration with UiO and NTNU is very strong. The Evaluation Committee obtained very positive overall impression of the research group and of the PhD students.

Overall grade: 4

Recommendations

The organizational structure facilitates collaboration with the two main universities and allows a good presence of PhD students and postdocs. This must be extended to the other Norwegian universities regarding both the use of the neutron facility at Kjeller and the synchrotron-radiation source at ESRF. The experimental activity at the latter has been complemented by theoretical investigations using mainly DFT methods. A similar approach is suggested for the hydrogen storage materials activity. Given the large number of possible compounds for investigation, a preliminary selection can be guided by simulations in terms of maximising hydrogen storage and of the kinetics and thermodynamic behaviour. The theoretical approach must be further strengthened and this effort requires new recruitment or more postdocs, and/or more collaboration with external groups. One activity of particular relevance is the investigation on carbon cones (CC), a new nano-carbon form. Synthesis is done at NTNU while at IFE nano-carbon tubes are produced. It is useful at this stage to engage the activity of this sector, not only for the synthesis of single and multiwall nanotubes, but also for other carbon based forms. The activity on nano-carbon requires a deeper understanding of the electronic and mechanical properties in addition to the determination of the structure.

In view of the building of the ESS, the reactor has a key role to play in instrument and method development, knowledge transfer, as well as education. The paradigm of use at major facilities has been changing. While instrumentation and techniques are still driven by experts, access is increasingly available to general users who want only to solve one part of a large problem. Neutron scattering is now becoming relevant in the areas of surfaces and interfaces, complex fluids, and materials dynamics and new and appropriate equipment is required. This is a challenging task that the IFE will face in the near future, as the department management must establish priorities within all these activities, given the available scientific and technical staff. To support such a wide range of activities it would be necessary to increase staff and funding levels.

4.9.1.1 Overall Assessments and Recommendations

The department has a very good record within work on hydrogen storage and carbon nano cones. Activities are performed on synthesis of new materials and on their thermodynamical behaviour, in line with present international research on hydrogen storage materials. The main facility, which is the only one still working in the Nordic countries, is the neutron scattering apparatus. The researchers at IFE plan to engage in the building up of the ESS in Lund. Until this is finished in about a decade, and even beyond the completion, the reactor in Kjeller will be important for preparing and testing methods, materials and apparatus for ESS. A detailed plan, including proposed projects and required personnel and funding, is needed. It was obvious from the visit at Kjeller than IFE is able to attract promising and enthusiastic PhD students and postdocs. The possibilities to strengthen the scientific atmosphere at the IFE, by collaboration with the neighbouring FFI as well as with UiO and SINTEF in seminars and colloquia should be noted.

4.10 SINTEF

The SINTEF group is a non-profit polytechnic research organization. The Materials and Chemistry Division is to more than 75% financed by contract R&D projects for industry, while contract research for RCN contributes about 20%. The basic funding is only 2%. At the Department of Synthesis and Properties there is a research group on Material Physics with 10 PhD holders with half- to full-time (permanent) positions. The work of this group has been evaluated here. It is directed towards chemical and physical bulk and surface analysis with different methods. The ambition is to connect this experimental work with multi-scale modelling of the structure and properties of materials.

The research group interacts closely with NTNU, UiO and industry though a "pyramidal" collaboration model. The activity is organized in various research projects with well-defined goals, and a project leader who may refer to a steering committee depending on the size of the project. This organization is optimized for applied research projects.

4.10.1.1 Material Physics

The group has 11 permanent employees and is physically divided between Trondheim (7) and Oslo (4). The group has over several years developed generic competence within quantitative chemical surface analysis, quantitative analysis of surface topography, analytical and high resolution TEM, physical metallurgy, solid state physics, diffraction and crystallography, electronic structure of materials and calculation/characterisation of those, multi-scale modelling and surface and interface processes and characterisation of those. This forms the basis for research activities, spanning from fundamental studies of corrosion and precipitation mechanisms in Al 6xxx alloys, the characterisation and modelling of thin films and interfaces in solar cell structures, defect engineering in solar-grade silicon, modelling of the interaction between metals and hydrogen, ultra fine grain materials, catalysis, electronic structure studies with *ab initio* modelling and electron microscopy, and wear studies of ceramics for dental applications. The experimental activity takes advantage of the existing competence in surface analysis and analytical techniques (e.g. XPS and HR- TEM). The group is thereby involved in a range of problems related to the general use of materials for energy production and conservation. Some aspects are also investigated theoretically, such as precipitation mechanisms in aluminium alloys, thermoelectric materials, hydrogen storage in hydrides, etc., in collaboration with NTU and UiO. The group has various research infrastructures available to use for its specific problems.

Assessment and Grading

The scientific quality and productivity in terms of publications and conference proceedings is quite good and the rate of publications per senior scientist is well above average for this field. The group collaborates with national and international industrial partners, institutes and academia in almost all its research activities. The most important university partners are NTNU and UiO. The collaboration with the two most important universities, UiO and NTNU, is quite remarkable and substantial; researchers at SINTEF are also professors at these universities and several students perform their MSc or PhD thesis work at SINTEF Labs. Together with the physics department at NTNU, this group co-runs the Gemini Centre on TEM**.** Participation in EU projects, three in 2009, is important. The group has tight links to national industry through common projects, MSc and PhD programmes.

The research group is led by a research manager who is responsible for the scientific production and development of each person and the group as a whole. The group is quite well funded; the external funding amounts to about 97.5% of the total funding. Funding for “basic” or “generic” research amounts only to 2.3%, which is clearly insufficient, even for an Institute with a clear applied focus; basic research is necessary not only to validate new tools or concepts prior to their use for applications, but it is also necessary to keep the best scientists from leaving (an excessive turnover seems at times to be a problem at SINTEF). Due to its status and to the dependence on external funds the research has a prevalent applied character. The role of SINTEF is to enhance efficient innovation and industrial development by bringing together academia and industry to handle cross- disciplinary challenges, a role which is fulfilled by the overall activity of the group.

Overall grade: 3–4

Recommendations

The activity on silicon solar cells is in its initial stage and needs a clear strategy in view of the worldwide effort on this topic. It requires a stronger collaboration with the other usual partners and, of course, with the main industrial players. The group should extend collaboration with other research institutions and universities in Norway to built national teams of excellence. The activity in modelling and simulations should be increased and the fragmentation of scientific activities should be decreased so that the critical mass can be obtained in almost all investigated topics. The theoretical effort to the behaviour of different energy related materials requires a more coordinated effort among the groups working in materials science.

4.10.1.2 Overall Assessments and Recommendations

This relatively young group provides important services to Norwegian industry. It is dependent on having access to modern infrastructure and in particular electron microscopes, and updates in this respect are needed. It should be possible, however, to satisfy much of this need in collaboration with industry and other interests in the group activities. Proper paying of rates for external use of the instruments may ease the financing of new instrumentation and should be established. National planning of funding for buying, renewal and upgrading expensive instrumentation is needed from the Research Council (e.g., a state of the art aberration corrected TEM). The group, and SINTEF in general, already plays an important role in coordinating the efforts to build up, and efficiently use, infrastructure for materials science in Norway. Further, for the future a better balance between modelling, method development and physical insight is needed.

Appendix A List of Acronyms and Abbreviations

ALICE	An LHC Ion Collider Experiment (at the LHC at CERN)
ALMA	Atacama Large Millimeter/submillimeter Array (in the Andes)
ASI	Italian Space Agency
ASIM	Atmosphere-Space Interactions Monitor (on the ISS)
ATLAS	A Toroidal LHC ApparatuS (experiment at the LHC at CERN)
BABAR	Experiment exploring matter-antimatter asymmetry (at SLAC)
BATE	Basic and Applied Thermo Electric
BMF	Biophysics and Medical Physics (at UiO)
BMT	Biophysical and Medical Technology (at NTNU)
CASSINI	Spacecraft mission to Saturn by NASA/ESA/ASI
CBM	Condensed Baryonic Matter (experiment at FAIR at GSI)
CERN	European Organization for Nuclear Research
CIGENE	Centre for Integrative Genetics
CIPR	Centre for Integrated Petroleum Research
CLUSTER	An ESA space mission studying the earth's magnetosphere
CMA	Centre of Mathematics for Applications (at UiO)
CMB	Cosmic Microwave Background
CMMP	Condensed Matter and Material Physics
CubeSTAR	A student satellite project at UiO studying aurora
DESY	German Electron Synchrotron (in Hamburg and Zeuthen)
DFT	Density Functional Theory
DNS	Direct Numerical Simulation
EE	Electrical Engineering
EISCAT	European Incoherent SCATter Scientific Association
EPR	Electron Paramagnetic Resonance
ESA	European Space Agency
ESF	European Science Foundation
ESO	European Southern Observatory
ESR	EISCAT Svalbard Radar
ESRF	European Synchrotron Radiation Facility (in Grenoble)

ESS	European Spallation Source (to be located in Lund)
EST	European Solar Telescope (in planning phase)
FAIR	Facility for Ion Research (at GSI)
FERMiO	Functional Energy Related Materials in Oslo
FFI	Norwegian Defence Research Establishment
FUNMAT	FUNctional MATerials
GANIL	Grand Accélérateur National d'Ions Lourds (in Caen, France)
GASSMAKS	Maximizing Value Creation in the Natural Gas Chain (a RCN programme)
GSI	Institute for Ion Research (at Darmstadt in Germany)
HASYLAB	HAmburg SYnchrotron LABoratory
HEPPEX	High-Energy Particle Physics EXperiments
HPC	High-Performance Computing
HR-TEM	High-Resolution Transmission Electron Microscope (or Microscopy)
IBSE	Inquiry Based Science Education
IFE	Institute for Energy Technology
IPY	International Polar Year
IPY-ICESTAR	A Norwegian IPY programme
IRIS	Interests and Recruitment in Science
IRIS	Interface Region Imaging Spectrograph
ISOLDE	Isotope On-Line Separator Facility (at CERN)
ISS	International Space Station
JEEP	Joint Establishment Experimental Pile
KHO	Kjeld Henriksen Observatory (on Svalbard)
LEP	Large Electron–Positron Collider (at CERN)
LHC	Large Hadron Collider (at CERN)
MAX IV	Next generation Swedish Synchrotron Research Facility (in Lund)
MiNaLab	Micro- and Nano- technology Laboratory
MOEMS	Micro-Opto-ElectroMechanical Systems
Nanolab	Nanoscience and Nanotechnology Laboratory (at NTNU)
NANOMAT	Nanotechnology and New Materials (a RCN programme)
NASA	National Aeronautics and Space Administration
NFyR	Norwegian National Committee of Physics
(N)MEMS	(Nano) Micro-ElectroMechanical Systems

NMR	Nuclear Magnetic Resonance
NORDITA	Nordic Institute for Theoretical Physics (in Stockholm)
NORDUCLIC	Nordic Collaboration on the Compact Linear Collider
NORTEM	Centre for Advanced Transmission Electron Microscopy
NOT	Nordic Optical Telescope (on La Palma)
NOTUR	Norwegian Metacenter for Computing Science
NTNU	Norwegian University of Science and Technology
OCL	Oslo Cyclotron Laboratory
OCT	Optical Coherence Tomography
PET	Positron Emission Tomography
PGP	Physics of Geological Processes
PHOS	Photon Spectrometer of the ALICE detector
PIC	Particle-In-Cell
QCD	Quantum Chromodynamics (theory of strong nuclear interactions)
QUIET	Q/U Imaging ExperimenT (in the Andes)
RANS	Reynolds-Averaged Numerical Simulation
RCN	The Research Council of Norway
RHIC	Relativistic Heavy-Ion Collider (at Brookhaven National Laboratory)
RNBT	Russian-Nordic-British Theory (a research programme)
RSPH	Regularized Smoothed Particle Hydrodynamics
SAR	Synthetic Aperture Radar
SDO	Solar Dynamics Observatory
SINTEF	The Foundation for Scientific and Industrial Research
SLAC	Stanford Linear Accelerator Center
SMN	Centre for Materials Science and Nanotechnology
SOHO	Solar and Heliospheric Observatory
SPEAR	Space Plasma Exploration by Active Radar (on Svalbard)
SPIRAL	Linear Accelerator at GANIL
STAR	Space Technology and Research development centre
STM	Scanning Tunnelling Microscopy/Microscopy
STORFORSK	RCN programme for funding of large interdisciplinary projects in basic research
TIMSS	Trends in International Mathematics and Science Study

TEM	Transmission Electron Microscope (or Microscopy)
UHR	The Norwegian Association of Higher Education Institutions
UiB	University of Bergen
UiO	University of Oslo
UiS	University of Stavanger
UiT	University of Tromsø
UMB	Norwegian University of Life Science
UNINETT	State-owned company, develops and operates national research network
UNIS	University Centre in Svalbard
XPS	X-ray Photoelectron Spectroscopy

Appendix B Curricula Vitae of the Evaluation Committee Members

Bengt Gustafsson received his PhD in Astronomy (1974) from Uppsala University. From 1973 he was a Swedish Research Council fellow, until in 1983 he became Professor of Astronomy at Stockholm University. In 1987 he moved to become Professor of Theoretical Astrophysics at Uppsala University. During 2000–2002 he was director of the Sigtuna Foundation, and he has been a visiting professor at the University of Texas, the Australian National University and the University of Asmara. His fields of research include basic theoretical work on stellar atmospheres and stellar spectra, the study of stellar evolution, galactic chemical evolution, star clusters, galaxy evolution and nucleosynthesis. He has published over 110 papers in refereed international journals, over 40 invited reviews and many popular papers and several books. He was the recipient of the Sixten Heyman's Prize from Gothenburgh University in 1995, the Längmanska kulturfonden Grand Prize in 2002, and the Swedish Royal Institute of Technology Grand Prize 2002. He is a member of the Swedish, Danish and Norwegian Academies of Sciences. He has served on numerous administrative committees including those of the Swedish Research Council, the ESO Council, the board of Uppsala University and the Nobel Committee for Physics, and is also presently the chair of International Council for Science Committee on Rights and Responsibilities in the Conduct of Science.

Nils Andersen studied mathematics and physics at the University of Copenhagen and obtained his PhD there in atomic physics in 1973. Following a postdoctoral period at Université de Paris-Sud, he returned to the University of Copenhagen where he became a Professor in Experimental Atomic Physics in 1999. During 1999–2005 he was director of the Niels Bohr Institute, and is presently Dean of the Faculty of Science at Copenhagen University. He has been a visiting scientist at JILA, Université de Paris-Sud, University of Aarhus, Rijkuniversiteit Utrecht. His research interests have included atomic collisions, laser-atom interactions and more recently cold atoms. He has published over 140 papers in international journals and books and given about 150 invited lectures at universities, international conferences, summer schools, including invited plenary lectures at the European Conference on Atomic and Molecular Physics, the International Conference on the Physics of Electronic and Atomic Collisions, the General Conference of the European Physical Society, the European Group for Atomic Spectroscopy, and the International Conference on Atomic Physics. He is a member of the Danish and European Physical Societies, a fellow of the Institute of Physics (UK) and the American Physical Society, and a member of the Royal Danish Academy for Sciences and Letters.

Elisabeth Bouchaud obtained her PhD from University Paris XI-Orsay in 1988, following which she was a research scientist at ONERA in France, where she later became Associate Director of the Department of Metallic Materials and Processes, Office National d'Etudes et de Recherches Aérospatiales. In 1999 she became the director of the Service de Physique et Chimie des Surfaces et des Interfaces at the French Atomic Energy Commission (CEA). In 2007 she became deputy director of the Triangle de la Physique Research Cluster. She has been a visiting scientist or professor at the University of Cambridge, Louisiana State University, and the California Institute of Technology. Her research is in polymer physics, on the deformation and fracture of heterogeneous materials, in quantitative fractography, and on the stress corrosion of glass. Recently she has focussed on the mechanical behavior of glass in the vicinity of the glass transition. She has given over 80 invited talks at universities, international conferences and summer schools. She received the Jean Rist Prize from the French Materials Science and Metallurgy Society in 1996, the Louis Ancel Prize for Condensed Matter Physics from the French Physical Society in 2005, and in 2008 received the Ordre National du Mérite.

Sandra Chapman received her PhD in Physics from Imperial College, University of London in 1985, following which she was a postdoc at Queen Mary College London, then a Royal Society/JSPS Fellow at Kyoto University and a SERC Fellow. In 1989 she became a lecturer at the University of Sussex, and in 2000 became Professor of Physics at the University of Warwick, where in 2006 she became director of the Centre for Fusion, Space and Astrophysics. She has been Radcliffe/Harvard fellow, Nuffield Foundation research fellow, PPARC Fellow, NESTA Fellow and a visiting professor at Kyoto University and Uppsala University. Her research interests are in nonlinear processes in solar system, astrophysical and laboratory plasmas, including chaotic dynamics in waves and current sheets, high performance computing applied to wave-particle interactions and plasma acceleration, cometary dynamics, complex systems approaches to solar system and laboratory plasmas, turbulence, and nonlinear time series analysis techniques. She has published over 110 papers in refereed journals and around 100 invited presentations and lectures at universities and conferences. In 1993 she received the Young Scientists' Publication Award from the European Geophysical Society, and in 1994 she received the Zeldovich Medal from the Russian Academy of Sciences. She is a fellow of the Institute of Physics and the Royal Astronomical Society.

John Ellis studied mathematics before completing a PhD in Theoretical High Energy Physics at the University of Cambridge in 1971. This was followed by postdoctoral periods at CERN, Stanford and Caltech, before returning to CERN as a staff member in 1974. He has been a visiting fellow or professor at Cambridge, Stanford, the University of California, the University of Melbourne, and the University of Vienna. His research interests are particle physics, astrophysics, cosmology and quantum gravity. The discovery of the gluon by experimental teams at DESY in 1979 was based on an idea he published in 1976. He used a grand unified theory to predict the mass of the bottom quark, and precision electroweak data to predict the mass of the top quark. He also pioneered phenomenological studies of the Higgs boson, supersymmetry and dark matter. Most of his research work has been directly related to experiment, and also concerns the prospects for future accelerators such as LEP and the LHC. He has been a frequent contributor to studies of their physics capabilities, writing the first survey of possible LEP physics in 1976 and making the first survey of possible beyond the Standard Model physics at the LHC in 1984. The interface between particle physics and cosmology has also been one of his active research interests for many years. He is the author of some 900 scientific papers, with some 47,000 citations. He received the Maxwell Medal in 1982, and the Dirac Medal in 2005, from the Institute of Physics. He is a fellow of the Royal Society and the Institute of Physics, and holds honorary doctorates from the University of Southampton and Uppsala University. He is presently Adviser to the CERN Director General for Relation with Non-Member States.

Hans Hertz received his Ph.D. in optical physics at Lund University 1988. After postdoc research at Stanford University he returned to Lund. In 1997 he was promoted to full professor at the Royal Inst. of Technol. (KTH), Stockholm. His primary research interest is applied physics for biomedical applications, especially x-rays, optics and acoustics. He has pioneered several concepts in laboratory x-ray sources and systems. In soft x-rays, the high-brightness liquid-jet/droplet laser-plasma source enabled the demonstration of the first laboratory water-window x-ray microscope with sub-optical resolution. In hard x-rays, the electron-impact liquid-metal-jet-anode source shows promise for >100× higher x-ray brightness than present (rotating-anode) sources, enabling laboratory phase-contrast imaging with unprecedented resolution. Present research interests include multilayer and diffractive x-ray optics, biomedical soft x-ray microscopy, and biomedical hard x-ray imaging with very high spatial resolution and phase contrast. He also pursues biomedical applications of ultrasonic radiation pressure with a focus on ultrasensitive biomedical analysis and cell manipulation methods in microfluidic chips. He has published 110 scientific papers, holds 25 patents, has had over 90 invited contributions, examined 15 PhDs, and is co-founder of two start-up companies. He is a fellow of the Swedish Royal Academy of Sciences, the Royal Swedish Academy of Engineering Sciences, and the Royal Physiographical Society. He is presently Head of the Department of Applied Physics.

Emanuele Rimini has been Professor of Structure of Matter at the University of Catania since 1976. Before that, he was a Research Fellow at the Institute of Atomic Physics, Stockholm (1968–69) and at the California Institute of Technology (1971). He has been a visiting Professor at IMB, Yorktown, Cornell University, Chalk River (Canada), Sandia (Albuquerque) and AT&T Bell Labs (Murray Hill). He was Director (1998–2001) and President (2001–2006) of Scuola Superiore di Catania per la Formazione di Eccellenz, and director of the Institute for Microelectronics and Microsystems-National Council of Research (IMM-CNR) during 2002–2008. His research activity has spanned the following areas: point and extended defects in metals, channeling and de-channeling of light ions, analysis of defects, lattice location of impurities in single crystals, thin film reaction, ion implantation, laser annealing, ion beam mixing, silicide formation, ion beam assisted regrowth, mesoscopic effects in low-dimensional materials, morphology and structure of silicon nanocrystals for non-volatile memory, phase-change materials and single-photon optical detectors. He has published more than 350 articles, 15 chapters in books and edited 6 books. He has chaired several international conferences and schools on ion implantation and ion beam modification. He has supervised about 80 MSc and 20 PhD students. He is the presently the co-ordinator of a PhD program on "Nanoscience. He is Fellow of the Italian Physical Society, and of the American Physical Society for "his pioneering contributions to the fields of particle-solid and laser-solid interactions and his leadership in establishing research consortia."

Appendix C A Comparison of Output, Quality and Resources in Norwegian, Danish and Swedish Physics

In the bibliometric study accompanying the physics evaluation it is found that the productivity of Norwegian physics research, as measured by the number of articles published in international journals, is relatively low in comparison with some similar countries, and also low in comparison with Norwegian research in other fields (see *Evaluation of Physics Research in Norway: Bibliometric analysis* (*September 2009*) by Aksnes 2009, Fig 3.2 and Fig. 3.3). The number of papers in physics published in 2008 in Norway, Sweden and Denmark are given in Table 1. In the third column these numbers are normalized on the respective total populations. It is seen that the Norwegian figure is smaller than the corresponding figures for the neighbouring countries. In order to study this, the publication rate per physicist working at research institutions at universities and elsewhere has been explored[3]. It is found that the number of physicists at research institutions in Norway normalized on the population is smaller than the corresponding figure in Sweden and Denmark, and this is also true when normalized on the total populations (see columns 4 and 5 in Table 1). Obviously, some of the difference in productivity between the countries, when normalized on the total population, can be explained as the result of a smaller relative number of physicists in Norway.

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[3] The factual information material for Norwegian institutions provided to the evaluation has been used for this. For Sweden, a similar inventory was made by addressing the various institutions, comparable to those in the Norwegian statistics. For Denmark, a figure in the Annual Report 2008 of the Danish Agency for Science, Technology and Innovation, Table 10, was used, which gives the number of FoU full-time equivalents ("årsvaerk") in Physics. That figure was multiplied with 1.64 to convert it to the number of physicists. This latter figure was taken from statistical tables provided by the Danish Center for Research Analysis and Danish Statistics, covering the situation in 2006 and representing all natural science, which is then taken to represent physics in particular. In Table 13 and 16 of that material, it is found that the ratio ranges for the different personnel categories from 2.12 (professors) – 1.39 (PhD students). The figure applied is the mean value for all the research personnel. This analysis obviously assumes that the distribution of Danish physicists on different personnel categories is the same as that of the Natural scientists in general, the latter in fact being rather similar to the distribution among Swedish physicists.

Before worrying too much about the remaining difference, which is not greater than it might possibly be ascribed to some systematic errors, one should also note that the relative citation index for the Norwegian physics papers is higher than for the Swedish ones (Aksnes 2009, Fig. 3.7), though smaller than the corresponding Danish figures. If this index is now multiplied with the number of papers per scientist, one obtains a measure of the number of citations per scientist. As seen in Table 1, column 6, in this respect the Norwegian figures are hardly significantly below the Swedish ones, although Denmark is above.

One may then wonder whether the differences in financing could be a reason for the differences in productivity. A comparison has been undertaken, not of the total resources available for research, but of those administered by the national research councils. Here, "free project grants" have been included as well as grants related to use of international and national large-scale infrastructure, when not included in the member fees for these, and strategic research grants to the extent that physics is involved with attempts distinguish the resources going to physics groups.

Table 1 : A comparison of the productivity counted as the number of publications in international journals in absolute numbers and normalized on the total population as well as on the number of physicists at research institutions, in Norway, Sweden and Denmark. Also given is a measure of the number of citations per scientist and the support by grant money in absolute number and normalized on the number of scientists.

	n= #papers	n/million inhabitants	N= #physicists	n/N	Citation-index/N	Support [MNOK]	Support/N [MNOK]
Norway	430	120	592	0.73	106	71	0.12
Sweden	1500	165	1531	0.94	110	185	0.12
Denmark	760	137	755	1.01	157	?	?

It is seen that the present support to Norwegian physicists for the RCN is very similar in size per scientist to the corresponding Swedish support. It is, however, worth noting that the RCN support for "free projects" has gradually but swiftly increased from 27 NOK to 43 NOK in the period from 2005 to 2008. The publication statistics should be dependent on the support given before 2008, and therefore the expected productivity might be expected to be lower in Norway.

The Evaluation Committee concludes that the reason for the smaller productivity in Norway, as compared to Sweden and Denmark, may be explained by the smaller number of physicists in Norway per capita, and partially also by the smaller contribution of grant support to Norwegian scientists until 2008. The quality of Norwegian physics, as judged from the citation frequencies, is however comparable with that of Swedish physics, though still below the corresponding Danish numbers.

Finally, the preliminary character of the study must be stressed.

Appendix D Additional Information on the Evaluation

The following are included in this appendix:

- Letter to the departments announcing the evaluation with the following:
    - Fact sheet
    - Self-evaluations
    - Mandate for the Evaluation Committee
    - Tentative time schedule
- Letter to the departments in preparing for the hearings with the Evaluation Committee
- Time schedule for the hearing meetings and site visits in September
- Plan for the site visits
- Factual Information on the departments

Til kontaktpersoner ved institusjonene

Vår saksbehandler/tlf.	**Vår ref.**	**Oslo,**
Bjørn Jacobsen, 22 03 73 66	2008/06982	20.2.2009
	Deres ref.	

Evaluering av forskningen innen fysikkfagene

Vi viser til brev av 19. desember 2008 om Forskningsrådets forestående evaluering av forskningen innen fysikkfagene ved universiteter og relevante forskningsinstitutter og fellesmøtet med instituttlederne i Forskningsrådets lokaler den 21. januar.

Divisjonsstyret for Vitenskap har nå godkjent mandat og plan for evalueringen.

Plan for evalueringen
Tidsplan for evalueringen følger vedlagt. Evalueringen vil bli gjennomført av en internasjonal ekspertkomité. Et viktig grunnlag for komiteens arbeid vil være innsendte egenvurderinger fra instituttene/forskningsgruppene (se under). Videre legges det opp til at evalueringskomiteen møter fagmiljøene i perioden 15. august -15. oktober 2009. Nærmere informasjon om dette vil bli ettersendt når komitéen er på plass.

Når utkast til evalueringsrapport foreligger, vil instituttet/forskningsgruppen få tilsendt en egen omtale for faktakontroll før den endelige rapporten offentliggjøres. Evalueringen begrenses til vurderinger og anbefalinger på institutt-/forskergruppenivå, og enkeltforskere vil ikke bli omtalt ved angivelse av personnavn.

Faktaark. Frist for innsendelse <u>15.4.2009</u>
Hvert institutt/forskningsgruppe skal fylle ut et faktaark. Hensikten med faktaarket er å lette evalueringskomiteens arbeid med egenvurderingene, se vedlagte faktaark med veiledning. Faktaarket kan lastes ned fra Forskningsrådets nettside:
http://www.forskningsradet.no/no/Fagevalueringer/1182736860810

Som det går fram av faktaarket og veiledningen, spørres det primært etter informasjon om stillinger/ansatte ved det aktuelle instituttet/forskningsgruppen. Personer som har sin stilling ved annet institutt/forskningsgruppe og som i stor grad er delaktig i enhetens oppgaver/ansvar knyttet til forskningen skal omfattes av evalueringen. Disse personene føres derfor også opp i faktaarket med en merknad om stillingens tilhørighet.

Navneliste. Frist for innsendelse 9.3.2009
I tillegg til faktaarket skal det settes opp en liste med navn og adresse (e-post og vanlig adresse) for alt fast vitenskapelig personale og postdoktorstipendiater (alle de personer som skal sende inn CV). Dette er for å kunne oppfylle Datatilsynets krav om å informere direkte de personer som omfattes av evalueringen.

Frist for innsending av faktaark til Forskningsrådet er **15.4.2009**. Frist for innsending av navneliste til Forskningsrådet er **9.3.2009**. Materialet sendes elektronisk til Bente Gjelsnes: bg@forskningsradet.no

Egenvurdering. Frist for innsendelse 15.4.2009
Egenvurderinger fra instituttene/forskningsgruppene vil utgjøre viktig grunnleggende informasjon for evalueringskomiteen. Det er viktig at egenvurderingen, inklusive CVer og publikasjonslister fra det vitenskapelige personalet, er utfyllende og kvalitetskontrollert, da disse vil ha stor betydning for komiteens vurdering av forskningen og dens rammebetingelser og for evalueringsrapportens samlede kvalitet.

Vi ber om at instituttene/forskningsgruppene utarbeider egenvurderinger i henhold til vedlagte disposisjon med beskrivelse.

Egenvurderingen inkludert alle vedleggene bes innsendt på papir.
Frist for innsendelse av egenvurderingen er **15.4.2009**.

Før egenvurderingen utformes anbefaler vi at det leses gjennom vedlagte mandat. Videre minner vi om at evalueringskomitéen vil foreta vurderinger på både forskergruppe-, institutt-, institusjons- og nasjonalt nivå.

Egenvurderingene vil bli gjennomgått av Forskningsrådet før materialet oversendes evalueringskomitéen. Som tidligere nevnt, vil møter mellom komitéen og fagmiljøene etter planen bli avholdt i løpet av høsten 2009.

Nærmere informasjon
Forskningsrådet legger vekt på at hver enkelt forsker som omfattes av evalueringen skal få god informasjon. Vi ber derfor instituttledelsen sørge for at hver enkelt vitenskapelig ansatt og postdoc får nødvendig informasjon om evalueringen. Det vises også til Forskningsrådets nettsider (jfr. over) der informasjon om evalueringen vil bli lagt ut.

Vi står foran et utfordrende arbeid og håper at fagmiljøene vurderer den forestående evalueringen som interessant og viktig og at den vil være nyttig for den videre utvikling av faget og forskningen. Vi vil gjøre vårt beste for at arbeidet skal kunne gjennomføres så greit som mulig.

Ta gjerne kontakt hvis dere har spørsmål.

Kontaktpersoner
Spørsmål i tilknytning til fagevalueringen kan rettes til:

- Spesialrådgiver Bjørn Jacobsen, Avdeling for naturvitenskap og teknologi, Divisjon for Vitenskap, tlf. 22 03 73 66, e-post: bja@forskningsradet.no
- Spesialrådgiver Odd Ivar Eriksen, Avdeling for naturvitenskap og teknologi, Divisjon for Vitenskap, tlf. 22 03 70 23, e-post: oie@forskningsradet.no

Med vennlig hilsen
Norges forskningsråd

Asbjørn Mo
Avdelingsdirektør
Divisjon for Vitenskap
Avdeling for naturvitenskap og teknologi

Bjørn Jacobsen
Spesialrådgiver
Divisjon for Vitenskap

Vedlegg:
- Faktaark med veiledning
- Disposisjon for egenvurderingen
- Mandat
- Tidsplan

Kopi av brev: Rektor og universitetsdirektør, UiO, UiB, UiT, NTNU, UiS og UMB
Det matematisk-naturvitenskapelige fakultet, UiO/UiB/UiT
Fakultet for naturvitenskap og teknologi, NTNU
Teknisk-naturvitskapleg fakultet, UiS

Deadline April 15, 2009
e-mail:bg@forskningsradet.no

FACT SHEET
Department of …………

Organisation – Organisation chart

Personnel

	Research group/unit		*Research group/unit*		*Research group/unit*		*Total*	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***
Professor								
Associate professor								
Professor II								
Associate professor II								
Post-doctoral research fellow								
Doctoral students								
Technical/adm. position*								
Total								

"Univ" = persons financed by the university "Extern" = persons financed by external research grants
* Technical/adm.position: Positions supporting research

Professors, associate professors, professors II and associate professors II

Name and title	***Born***	***Research group/unit***	***Name***	***Born***	***Research group/unit***

Graduates

	2006	***2007***	***2008***	***Total***
Dr. ing./Dr. scient./Ph.D. graduated				
Research group				
Research group				
Research group				
M.Sc.graduated				
Research group				
Research group				
Research group				
Total				

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
University funding*, salaries			
University funding, other costs			
University funding, instruments and equipment			
University funding, total			
The Research Council, grants			
Other national grants (public or private):			
International grants(incl EU)			
External funding, total			
Total expenditures			
External funding as % of total expenditures			

* University funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

Contact person:

Phone number of contact person:

E-mail address of contact person:

Date of form completion:

Review of basic research in Physics in Norway

Fact Sheet

Please do not deviate from the template for the fact sheet, and make sure that the personnel and organisation in the Fact Sheet corresponds to that in the self-evaluation.

- ***Organisation – Organisation chart***
  Present a brief, concise description of where the department/research group fits into the university structure. Make a simple organisation chart in Word or Power Point, for example.

  It is important that individual research groups should not be identified by the name of the group leader but rather by the scientific activity of their fields of research.

- ***Personnel***
  List the number of the different types of positions per department or research group, if the si of the groups suggests that this would be useful. Please include colleagues that are affiliated other departments, but at the same time take part in the department's responsibilities regardi research and the education of physicists. Please give a comment regarding the number of su persons and to which departments their positions belong.

  The abbreviation "Univ" refers to positions funded over a university's basic budget, while "Extern" refers to positions funded by external sources.
  The term "Technical/adm. positions" refers solely to non-scientific positions that provide support services for the research.

  Please make sure that the name and number of the research groups are in accordance with th organisation chart.

- ***Professors, associate professors, professors II, and associate professors II***
  This table should include the name, title and year of birth of all the professors, associate professors, professors II, and associate professors II who participate in the research at the department, as well as the research group to which they belong, if the size of the group suggests that such a division would be useful.

- ***Graduates***
  In the table entitled Graduates, please list the number of doctoral and M.Sc students who completed their degree over the past three years (2006 to 2008); the numbers should be liste under the different research groups to which they belong. Please make sure that the name an number of the research groups are in accordance with the table entitled Personnel.

- ***R & D expenditures by main source of funding (NOK 1000)***
  This table is intended to furnish an overview of the department's basic grants (University funding) and external funding over the past three years (2006 to 2008). Overhead expenses financed by the University should be listed under University funding, other costs.

- ***Date and contact person***
  The fact sheet should be dated, and the name, telephone number and e-mail address of the person responsible for completing the sheet should appear ("faglig ansvarlig kontaktperson"

SELF-EVALUATIONS

Introduction

The department's self-evaluations provide essential information for the Evaluation Committee. Accordingly, ensuring the high quality of this material, including CVs and lists of publications by the scientific staff, will have a large impact on the overall quality of the evaluation.

The deadline for submitting the self-evaluations is April 15, 2009.

Please submit self-evaluations, including all attachments, on paper (one copy) and in a format that can be copied directly and forwarded to the Evaluation Committee.

We recommend that you read the mandate for the Evaluation Committee before you fill in the self-evaluations.

All self-evaluations will be reviewed by the Research Council before the material is forwarded to the Evaluation Committee. Meetings between the Evaluation Committee and the research units are scheduled to take place in the period August 15 - October 15, 2009. Once the Evaluation Committee has completed the draft report, the relevant sections will be sent to each department to check the facts before the final report is published. The evaluation is limited to assessments and recommendations at the department/research group level, and individual researchers will not be mentioned by name.

Fact sheet

In addition, a fact sheet for the institute/unit should be submitted electronically by **April 15, 2009** to Bente Gjelsnes at the following email address: bg@forskningsradet.no . The fact sheet form can be downloaded from the Research Council's website.

Please use the following outline. You will find a more detailed description of the content required under the various points.

Outline of the self-evaluation

A Department level

1. Organisation of the department
2. The recruitment of researchers
3. Leadership of the research
4. The strengths and weaknesses of the department
5. Previous evaluation of basic research in Physics
6. Strategy and plans for the future
7. Infrastructure (including major pieces of equipment)
8. General conditions for research
9. Other information of relevance to the evaluation

B Research groups

1. Description of research activities
2. Research collaboration (national, international, industry/public sector)
3. Strategy and organisation
4. Recruitment and mobility of researchers
5. Other information of relevance to the evaluation

Attachments to be included in the self-evaluation

- Brief CV and list of publications for all staff members in academic positions (professor I, professor II, associate professor) and all post-doctoral fellows, see p. 5
- List of doctoral graduates over the past three years (2006-2008)., see p. 5

Details about the self-evaluation and the attachments

English is the working language for the evaluation. This means that **the self-evaluation and attachments must all be written in English. Please** make sure that the information given in the self-evaluation and in the fact sheet is consistent.

The self-evaluation should be 10 to 30 pages long, depending on the size of the department. The attachments come in addition. Please use 12 pt Times New Roman.

A Department level

1. *Organisation of the department*
   Describe how the department is organised. Give a brief historical overview, with emphasis on significant organisational changes. Include any ongoing reorganisation and planned changes, and the reasons why they are being implemented.

2. *The recruitment of researchers*
   Describe the recruitment of doctoral and post-doctoral fellows to the department over the past five years (2004-2008).

   If the recruitment situation is difficult, discuss the possible reasons. Have any special initiatives to improve the situation been implemented? What strategy is the department pursuing in this context? Is there a strategy in place to improve the gender balance in academic positions?

   Do the doctoral students and postdoctoral fellows spend time at international research institutions and are researchers recruited internationally?

   Are doctoral students offered opportunities related to industrial research challenges?

3. *Leadership of the research*
   Describe briefly the governing structure, how the research is organised and led, and the allocation of resources and decision-making responsibilities in the department.

4. *The strengths and weaknesses of the department*
   Give a brief assessment of the scientific, financial, and organisational strengths and weaknesses of the department, listed as bullet points.

5. *Previous evaluation of basic research in Physics*
   A previous evaluation of basic research in Physics in Universities and Colleges was performed in 1999/2000 and was followed up by a national strategic plan.

   Were the evaluation and the national strategic plan useful for the department and in which way? How has the previous evaluation and the strategic plan been used by the department in its own strategic planning?

6. *Strategy and plans for the future*
   Present the department's strategy and plans for the future (max. 2 pages).

What are the department's visions and plans for research, and how are they expressed in the strategy for the years ahead? Is this perspective consistent with the department's identified strengths and weaknesses? List the high-priority scientific areas envisaged for the future. Describe also the extent to which the future plans will affect how research is organised at the department. Please identify any needs associated with the equipment situation and major operating expenses.

1. *Research infrastructure (including major equipment items)*
   Describe major research infrastructures available to the department's researchers and in particular investments made in recent years, including descriptions of equipment items with acquisition value of more than NOK 1.000,000 or major operating expenses associated with such equipment. Report any needs for upgrades or new equipment, including potential sources of funding, and discuss these needs in relation to section 6 "Strategy and plans for the future".

2. *General conditions for research*
   Discuss briefly the department's resources (human, monetary, time), emphasising the latitude this framework offers for basic research. Compare the assessment of resources with the department's ambitions. What is currently done to ensure an optimal sub-division of working time between research and teaching?

3. *Other information of relevance to the evaluation*
   Please feel free to include any other information that you consider relevant for the evaluation, which does not naturally fit in as part of the previous sections.

B Research groups

1. *Description of research activities*
   Describe the various research activities and the research profile of the group.

   Discuss briefly the extent and output of the research activities in relation to the resources and the number of researchers in the group.

   Does the group cover an adequate range of research activities in relation to its responsibilities as a university institution?
2. *Research collaboration (national, international, industry/public sector)*
   Describe the activities of the group with respect to <formal> national and international research collaborations, collaboration across department and faculty divisions, and collaboration with industry and public sector.

   The term "research collaboration" here refers to collaboration with a view to joint publications, project co-operation, staff researchers being hosted by other institutions, and hosting guest researchers.

   The main point is not to provide a list of partners, but rather to evaluate the impact of national and international collaboration on the research performed.

3. *Strategy, organization and research leadership*
   Describe strategies for the research, and to what extent these strategies are implemented. Describe briefly how the research is organised and led, how project management is executed, and how decision-making responsibilities are distributed within the research group.

4. *Recruitment and mobility of researchers*

Do the doctoral students and postdoctoral fellows spend time at international research institutions, and are researchers recruited internationally?

1. *Other information of relevance to the evaluation*
   Please feel free to include any other information you consider relevant for the evaluation, which does not naturally fit in as part of the sections above.

Attachments required for the self-evaluation:

CV

For each tenured academic employee (professor I, professor II, associate professor, associate professor II) and for each post-doc fellow. *Max 4 pages excluding appendices!*

Please use the following outline:

Name:
Born:
Nationality:

Present position:

Academic degrees:

Work experience:

Fields of interest and present research activities (max one page)

Indicate portion of time dedicated to research:

Membership in academic and professional committees, scientific review work including peer-review, outreach activities, and other professional merits:

Doctoral students presently under supervision

Selected academic and professional publications 2004-2008 (max two pages); please make separate lists for peer-reviewed journal papers and for international conference proceedings.

Appendix:
The two most important publications 2004-2008 (enclosed copies)

In addition, please submit up to two pages of text that corroborate and complement the publication list, i.e. a brief discussion/evaluation of the thematic content, scientific significance of the issues at hand and of the results brought to light.

Doctoral degrees

Please supply a list of doctoral degrees completed at the department over the past three years (2006-2008). The list should include each candidate's name, title of doctoral thesis, and the name of his/her supervisor.

Review of research in Physics in Norway

Mandate for the evaluation committee

I INTRODUCTION

The Board of the Division for Science, The Research Council of Norway, has decided that an evaluation of research activities in Physics in Norwegian universities and relevant contract research institutes should be conducted. The report of the evaluation committee will become a part of the basis for the future strategy of the Research Council.

The objective of the evaluation

The objective is to review the overall state of basic research in Physics in Norwegian universities and relevant contract research institutes.

More specifically, the evaluation process should:

- Provide a critical review of the strengths and weaknesses of basic research in Physics in Norway, both nationally and at the level of individual research groups and academic departments. The scientific quality shall be reviewed in an international context and related to internationally accepted benchmarks.

- Identify research groups that have achieved a high international quality level or have the potential to reach such a level.

- Identify areas of research that need to be strengthened in order to establish the necessary competences in strategic areas of importance for the nation. An assessment of the impending situation regarding recruitment in important fields of Physics should be included.

The long-term purpose of the review

The evaluation should provide the involved institutions with the knowledge, advice and recommendations they need to enhance their own research standards.

The evaluation should improve the knowledge base for strategic decision-making by the Research Council, constitute a platform for future work on developing the basic research in Physics, and represent a basis for determining future priorities, including funding priorities, within and between individual areas of research.

The evaluation should improve the knowledge base needed for the Research Council’s advice on research policies to the Norwegian Government and ministries.

Methods

An international Evaluation Committee will be appointed. The Evaluation Committee should base its assessments on self-evaluations provided by the departments/research groups, as well as on meetings with the involved departments/research groups giving oral presentations. The Evaluation Committee will also perform selected site visits to the institutions. Facts on the organisation and resources will be included in the self-evaluations, as well as future plans, CVs, and publication lists of the scientific staff. The Committee should address both the scientific quality of the research and quantitative aspects based on bibliometric analyses of the scientific publications. The Committee is requested to write a report with a set of specific recommendations. A preliminary report will be sent to the departments to check the factual information. The Committee's final report will be submitted to the Board of the Division for Science.

II MANDATE

Based on the self-evaluations provided by the institutions and site visits, the Evaluation Committee is requested to present the evaluation in a written report. This report should include a set of specific recommendations for the future development of the field, as well as suggestions of means for improvement when required. The Committee is requested to evaluate scientific activities with respect to their quality, relevance and international and national collaboration. The Committee is also requested to evaluate the way in which Physics research is organised and managed.

The conclusions of the committee's report should lead to a set of recommendations and possible scenarios concerning the future development and prioritization of Physics research in Norwegian universities and relevant contract research institutes, including challenges related to recruitment and possible reductions in the number of permanent scientific positions.

Specific aspects to be considered:

1. General aspects

- Which fields of research in Physics have a strong scientific position in Norway and which have a weak position? Is Norwegian research in Physics being carried out in fields that are regarded as important and relevant by the international research community? Is Norwegian research in Physics leading the scientific developments internationally within specific areas?

- Is there a reasonable balance between the various fields of Physics research in Norway, or is research absent or underrepresented in any particular field? Are any fields overrepresented, in view of the scientific quality or relevance of the research being carried out?

- Is there a reasonable degree of co-operation and division of research activities at the national level, or should these aspects be improved?

- Is the Physics research of today in Norway relevant to the needs of industry and society? Do research groups maintain sufficient contact with industry and/or the public sector?

2. Academic departments

- Are the academic departments adequately organised?
- Is scientific leadership being exercised in an appropriate way?
- Do individual departments carry out their research as part of an overall research strategy?
- Are there satisfactory policies in place guiding the recruitment and handling of employees, including gender balance in academic positions?
- How has the previous evaluation of research in Physics (1999/2000) and the associated national strategic plan been used by the departments in their own strategic planning?

3. Research groups

3.1. Strategy, organization and research leadership

- Have research groups developed satisfactory strategies for their research, and are these implemented?
- Is the size and organisation of the research groups reasonable?
- Is research leadership being performed in an appropriate way (e.g. in execution of project management), and is there in place an effective distribution of tasks and responsibilities within the research group?

3.2. Research activities, staff and scientific production

- Do the research groups represent a high scientific quality judged by the significance of contributions to their field, prominence of the leader and team members, and scientific impact of their research?
- Is the scientific production, e.g. the number of scientific publications and Ph. D. theses awarded, reasonable in terms of the resources available?
- How is the long term viability of the staff and facilities evaluated in view of future plans and ideas, staff age, facilities, research profile, and new impulses through recruitment of researchers?
- Do they play an active role in dissemination of their own research and new international developments in their field to industry and/or public sector?

3.3. Research collaboration (national, international, industry)

- Is there sufficient contact and co-operation among research groups nationally, in particular, how do they cooperate with colleagues in the contract research institutes?
- Do the research groups have contracts and joint projects with external partners at a satisfactory level?
- Do the research groups take part in interdisciplinary/multidisciplinary research activities at a satisfactory level?

- Is the international network satisfactory, e.g. in terms of contact with leading international research groups, number of guest researchers, and number of joint publications with foreign colleagues?
- Do research groups take satisfactorily part in international programmes or use facilities abroad, or should utilisation be improved by introducing special measures?
- Is their participation in international professional committees, peer review, work on standardization, and other professional activities satisfactory?
- Are there any significant differences between Norwegian research in Physics and research carried out in other countries?

4. Research infrastructure (RI), incl. scientific equipment

- How is the current situation and the future needs with regard to laboratories and access to modern RI?
- Is there sufficient national and international co-operation related to the use of expensive equipment?
- Is there sufficient awareness of new RI opportunities in Europe and globally, and are there plans for active participation in such RI projects?

5. Training and mobility

- Does the scientific staff play an active role in stimulating the interest for their field of research among young people?
- Is recruitment to doctoral training programmes satisfactory, or should greater emphasis be put on recruitment in the future, including strategies aimed at improving the gender balance?
- Are there sufficient educational and training opportunities for PhD students?
- Is there an adequate degree of national and international mobility?

The Committee's written report is expected to be based on the elements and questions above. The assessments and recommendations should be at research group, departmental, institutional and national level.

Please feel free to address any other aspects of Norwegian research in Physics you mean deserve attention and consideration.

Evaluering av forskningen i fysikkfagene – Tentativ tidsplan

Dato	**Milepæler**
17.12.08	Brev til institusjonene (innspill til komitémedlemmer, evt. kommentarer)
21.01.09	Møte mellom Forskningsrådet og institusjonene
04.02.09	Godkjenning av mandat og plan for evalueringen i Divisjonsstyret
20.02.09	Brev til institusjonene (egenevaluering, faktaark)
Primo april 09	Sammensetningen av komitéen er avklart
15.04.09	Innsendelse av faktaark og egenevaluering fra institusjonene
15.08.-15.10.09	Møter/*site visits*
15.11.09	Utkast til evalueringsrapport foreligger, til institusjonene for faktakontroll og kommentarer
15.11.09	Fagplanutvalg og opplegg for fagplan behandles i DSV
15.12.09	Tilbakemeldinger fra institusjonene
15.01.10	Endelig evalueringsrapport foreligger
Primo februar 10	Behandling av evalueringsrapporten i DSV
Ultimo juni 10	Fagplanen for fysikk ferdigstilles og behandles i DSV

To the Head of Department at:

Department of Physics, UiO
Institute of Theoretical Astrophysics, UiO
Department of Mathematics and Natural Sciences, UMB
Physics Department, IFE
Norwegian Defence Research Establishment (FFI)
SINTEF Materials and Chemistry

Evaluation of physics research in Norway

Hearing meetings in Oslo - Time schedule and guidelines for the departments' and research groups' preparations

We refer to previous information about the announced week of hearing meetings in Oslo.

Please find enclosed the time schedule for the meetings with the Evaluation Committee. The meetings will take place from Monday September 21 to Friday September 25 and will be located at the Research Council of Norway.

All meetings will follow the same basic structure:

- Introduction and presentation by the Head of department – 5 minutes (max. 3-4 slides)
- Questions and discussion
- Presentation of the individual research groups
- Questions and discussion after each group presentation
- General discussion

Information from the meetings should be regarded as additional information to the written material that the Committee has already received. The introduction and presentations should not take more than 20% of the total allocated time. We recommend that you focus solely on the groups' SWOT[1]-analyses (1-2 slides).

We kindly ask you to bring your Power Point presentations on a memory stick. Please also bring with you 10 handouts for the Committee (3 slides per page).

Participation

Please submit a list of the department's participants in the meeting (name and title) together with a plan for the presentations to Malena Bakkevold, post@malena.no before **September 11**. For practical reasons only a limited number of researchers may participate in the meeting with the Committee. The Research Council might require you to reduce the number of participants if the group is regarded to be too large.

Practical matters

All hearing meetings will take place in the Research Council of Norway, Stensberggata 26, Oslo.

[1] SWOT: Strengths and Weaknesses today, Opportunities and Threats in the future

If you have any questions, please contact:

- Special adviser Bjørn Jacobsen, phone + 47 22 03 73 66
  e-mail: bja@forskningsradet.no
- Administrative coordinator Malena Bakkevold, phone + 47 64 97 28 72/95 75 05 33
  e-mail: post@malena.no

For practical matters, please contact:

- Executive officer Bente Gjelsnes, + 47 22 03 73 65
  e-mail: bg@forskningsradet.no

The Committee and The Research Council are looking forward to an important meeting week and thank you in advance for your contributions.

Yours sincerely
The Research Council of Norway

Bjørn Jacobsen
Special Adviser
The Research Council of Norway

Enclosure
- Time Schedule

E-post til kontaktpersonen ved **NTNU** om høringsmøter og "site visits"

Evaluering av fysikk - Retningslinjer for høringsmøter og institusjonsbesøk/"site visits"

Retningslinjer for høringsmøtene
Vedlagt finner dere timeplanen for høringsmøtene 21. – 25.september og brev med informasjon om opplegget for møtene og instituttenes forberedelser til disse. Brevet blir også sendt med ordinær post til instituttet. Frist for innsending av navn på deltakere fra instituttene er **11. september.**

Institusjonsbesøk/"site visits"
Komiteen vil besøke NTNU torsdag 10. oktober kl. 1415 – 1645, se komiteens reiseplan.

Vi ber om at dere sender oss en plan over besøket innen fredag **18.september**. Planen må inneholde oppmøtested, kontaktperson og navn på de personene som deltar fra instituttet under de ulike postene. Bruk gjerne vedlagte mal som utgangspunkt.

Komiteen er opptatt av å komme i kontakt med stipendiater og postdoktorander og ønsker at disse står for guidingen under besøket. Dersom det er ønskelig å starte med en kort presentasjon, må denne også holdes av stipendiater eller postdoktorander.

Vi ber om at instituttet serverer en enkel lunsj i starten av besøket. Deltakerne under lunsjen er komitémedlemmer og fagsekretær (8 personer), Forskningsrådets representanter (2 personer), samt representanter fra instituttet som dere ønsker skal være til stede. Lunsjutgiftene kan faktureres Forskningsrådet.

Ta gjerne kontakt dersom dere har spørsmål eller noe er uklart!

Hilsen
Malena Bakkevold
Administrativ koordinator for evalueringen
957 50 533/64 97 28 72

Vedlegg:
- Timeplan for høringsmøtene
- Brev om forberedelser til høringsmøtene
- Mal for program for institusjonsbesøk
- Komiteens reiserute for "site visits" i oktober

Time schedule for the hearing meetings and site visits in September

Date	Time	Institution/department
Monday Sept 21 2009		**University of Oslo, UiO**
	0830–1030	**Department of Physics**
	1030-1045	Break
	1045 -1145	**Department of Physics cont.**
	1145-1200	*Committee Meeting*
	1200 -1300	Lunch
	1300 -1415	**Department of Physics cont.**
	1415-1430	Break
	1430-1445	*Committee Meeting*
	1445 -1630	**Institute of Theoretical Astrophysics**
	1645-1730	*Committee Meeting*

Date	Time	Institution/department
Tuesday Sept 22 2009	0830 -1130	*Site visits at UiO; Department of Theoretical Astrophysics and Department of Physics*
	1130 –1215	*Lunch at UiO*
	1215–1245	*Departure, return to Research Council*
		University of Science and Technology (NTNU)
	1245- 1415	**Department of Physics**
	1415 -1430	Break
	1430– 1600	**Department of Physics cont.**
	1600- 1615	Break
		The University Centre in Svalbard (UNIS)
	1615-1730	**Department of Artic Geophysics**
	1730-1800	*Committee Meeting*

Time schedule for the hearing meetings and site visits in september

Date	Time	Institution/department
Wed Sept 23 2009	0830-0900	*Committee Meeting*
		Institute for Energy Technology (IFE)
	0900– 1030	**Physics Department**
	1030-1045	Break
		University of Stavanger
	1045 –1215	**Department of Mathematics and Natural Science, Section of Physics**
	1215 -1315	Lunch
		Norwegian University of Life Sciences (UMB)
	1315 –1445	**Department of Mathematical Sciences and Technology, Section of Physics**
	1445 –1545	*Committee Meeting*
	1545 -	*Departure for site visit at UMB*
	1630 –1745	*Site visit at UMB*

Date	Time	Institution/department
Thur Sept 24 2009	0830 –0900	*Committee Meeting*
	0900- 1030	**Norwegian Defence Research Establishment (FFI)**
	1030-1045	Break
		University of Bergen, UiB
	1045 –1215	**Department of Physics and Technology**
	1215-1315	Lunch
	1315 -1445	**Department of Physics and Technology cont.**
	1445-1530	*Departure for site visits, Kjeller Campus*
	1530-1800	*Site visits at FFI and IFE*

Time schedule for the hearing meetings and site visits in September

Date	Time	Institution/department
Fri Sept 25 2009		**SINTEF**
	0900-1015	**SINTEF Materials and Chemistry Department of Synthesis and properties**
	1015 –1030	*Departure for site visit*
	1030 -1130	*Site visit at SINTEF Materials and Chemistry*
	1130 –1145	*Departure, return to Research Council*
	1145-1245	Lunch
		University of Tromsø, UiT
	1245- 1500	**Department of Physics and Technology**
	1500 -1700	*Final Committee Meeting*

Date	Time	Institution/department
Sat Sept 26 2009	0915-1100	*Site visit at University of Stavanger*

Site visits October 7 – 9

Wed 07.10	**Thur 08.10**	**Fri 09.10**
UNIS* Dept.of Artic Geophysics 1100-1400, incl.lunch	**NTNU***** Dept.of Physics 1415 – 1645, incl. lunch	**University of Bergen** 1115 – 1400, incl. lunch
University of Tromsø** Dept.of Physics and Technology 1645 – 1845	**SINTEF** 1645 – 1815	**Final Committee Meeting** 1400 - 1530

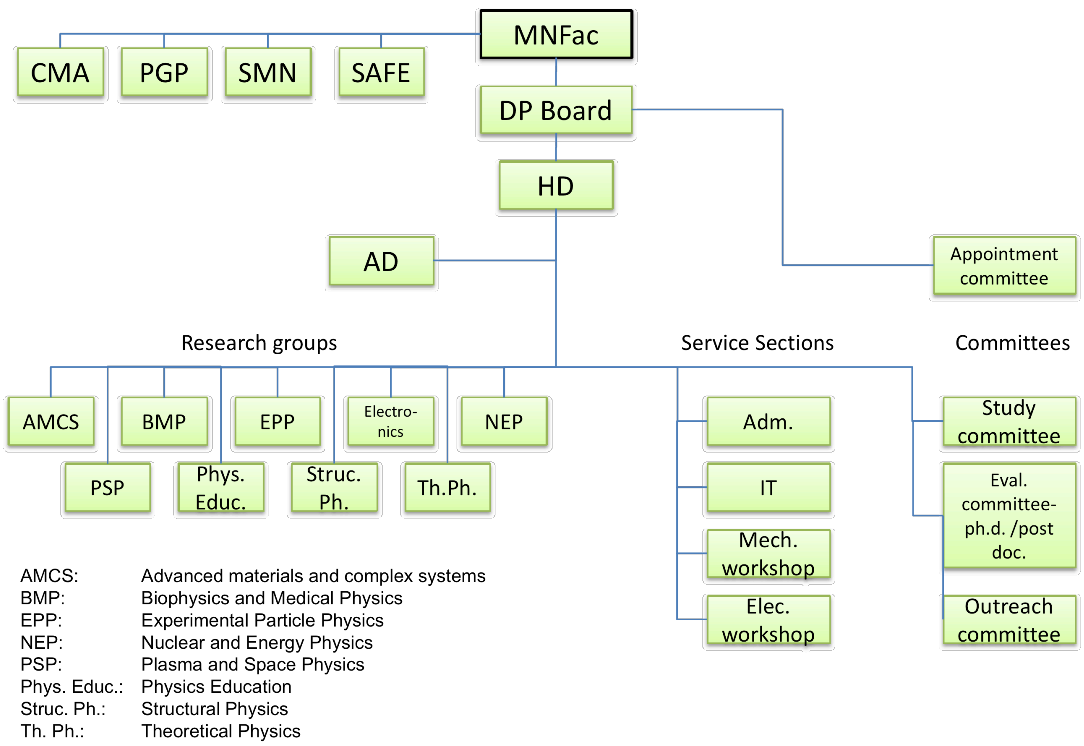
* Committee members: Bengt Gustafsson, Sandra Chapman, Emanuele Rimini and Paul Barklem (secretary).
The Research Council: Bjørn Jacobsen and Malena Bakkevold.

** Committee members: Bengt Gustafsson, Sandra Chapman, Emanuele Rimini, Elisabeth Bouchaud, Hans Hertz and Paul Barklem (secretary).
The Research Council: Bjørn Jacobsen and Malena Bakkevold.

*** For NTNU, SINTEF and UIB, the whole Committee: Bengt Gustafsson, Sandra Chapman, Emanuele Rimini, John Ellis, Elisabeth Bouchaud, Hans Hertz, Nils O.Andersen and Paul Barklem (secretary).
The Research Council: Bjørn Jacobsen and Malena Bakkevold.

Factual Information

Department of Physics, University of Oslo



Deadline April 15, 2009
e-mail:bg@forskningsradet.no

FACT SHEET
Department of Physics, University of Oslo

Organisation – Organisation chart

Personnel

Research group/unit	Advanced materials and complex systems		Biophysics and medical physics		Experimental particle physics		Electronics	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***
Professor	4	0	3	0	5#	0	5#	0
Associate professor	1	0	1	0	0	0	3	0
Professor II	1	0	0	2	1	0	2	0
Associate professor II	0	1	0	1	0	0	2	0
Post-doctoral research fellow**	2	4	0	0	0	6	0	1
Doctoral students	2	9	2	5	2	5	1	10
Technical/adm. position*	0	0	2	0	1	1	2	0
Total	**10**	**14**	**8**	**8**	**9**	**12**	**15**	**11**

Research group/unit	Nuclear and energy physics		Plasma and space physics		Physics education		Structural physics	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***
Professor	7#	0	5#	0	0	0	2	0
Associate professor	0	0	0	0	2	0	1	0
Professor II	0	0	0	1	0	0	1	2
Associate professor II	0	0	0	1	0	0	0	2
Post-doctoral research fellow**	0	4	0	1	0	0	0	2
Doctoral students	1	16	4	3	2	1	3	11
Technical/adm. position*	3	0	2	0	0	0	1	0
Total	**11**	**20**	**11**	**6**	**4**	**1**	**8**	**17**

Research group/unit	Theoretical physics		Physics of Geological Processes		*Total*	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***
Professor	6	0	3#	1		
Associate professor	1	0	1	0		
Professor II	1	0	0	0		
Associate professor II	0	0	0	0		
Post-doctoral research fellow**	0	2	0	0		
Doctoral students	4	2	1	7		
Technical/adm. position*	0	0	0	2		
Total	**12**	**4**	**5**	**9**		

”Univ” = persons financed by the university ”Extern” = persons financed by external research grants
* Technical/adm.position: Positions supporting research
#: the number includes retired professor(s) who has/have been employed during the evaluation period
**: the number includes (temporary) staff hired as researchers with a ph.d.-degree

Graduates

	2006	*2007*	*2008*	*Total*
Dr. ing./Dr. scient./Ph.D. graduated				
Advanced materials and complex systems	0	6	3	9
Biophysics and medical physics	0	1	4	5
Experimental particle physics	0	0	0	0
Electronics	4	5	5	14
Nuclear and energy physics	3	0	3	6
Plasma and space physics	1	1	1	3
Physics education	0	0	1	1
Structural physics	0	1	1	2
Theoretical physics	3	1	1	5
Physics of Geological Processes	1	3	2	6
Total:	12	18	21	51
M.Sc.graduated				
Advanced materials and complex systems	0	1	2	3
Biophysics and medical physics	4	4	10	18
Experimental particle physics	1	0	5	6
Electronics	9	9	6	24
Nuclear and energy physics	4	9	3	16
Plasma and space physics	7	1	0	8
Physics education	0	0	4	4
Structural physics	5	2	2	9
Theoretical physics	7	5	3	15
Physics of Geological Processes	9	1	3	13
Total	46	32	38	116

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
University funding*, salaries	58 000	59 000	64 000
University funding, other costs	20 200	21 200	21 250
University funding, instruments and equipment	800	3400	4250
University funding, total	**79 000**	**83 600**	**89 500**
The Research Council, grants	23 700	36 300	32 000
Other national grants (public or private):	13 250	13 050	9 340
International grants(incl EU)	2 940	2 050	1 860
External funding, total	**39 890**	**51 400**	**43 200**
Total expenditures**	**131 500**	**132 800**	**139 600**
External funding as % of total expenditures	30,33 %	38,70 %	30,95 %

* University funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

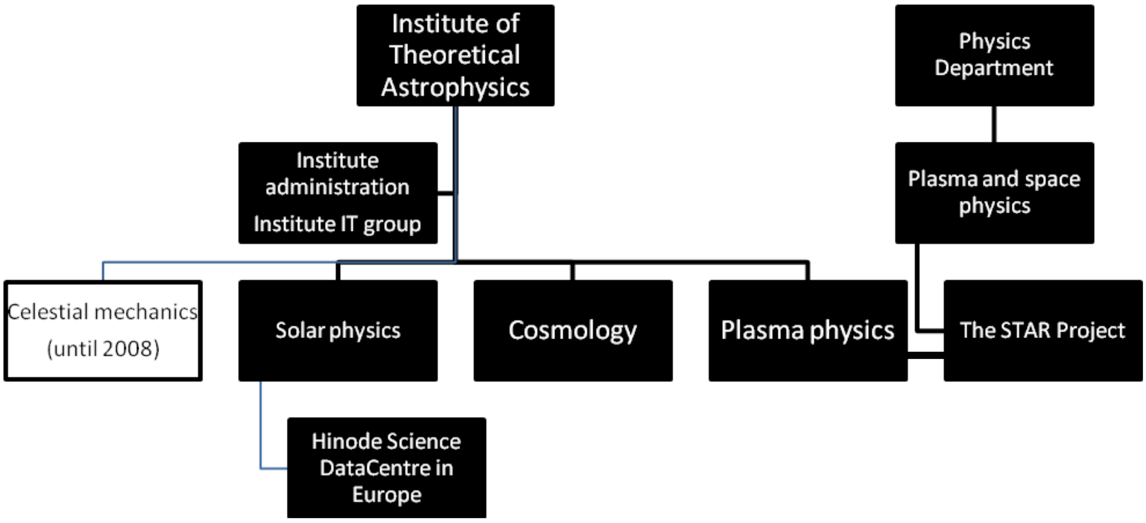
**: Major infrastructure (buildings, power, water etc..) 20 420 19 987 23 853

Date of form completion: 2009-04-15

Deadline April 15, 2009
e-mail:bg@forskningsradet.no

FACT SHEET
Institute of Theoretical Astrophysics, University of Oslo

Organisation – Organisation chart



Personnel

	Solar physics		*Cosmology*		*Plasma physics*		*Total*	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***
Professor	4		2		1		7	
Associate professor	2		3				5	
Professor II	1						1	
Associate professor II						1		2
Post-doctoral research fellow		4		5				9
Doctoral students	3	2	3	4		1	6	7
Technical/adm. position*		3						3
Total	**10**	**9**	**8**	**9**	**1**	**2**	**18**	**22**

”Univ” = persons financed by the university ”Extern” = persons financed by external research grants
* Technical/adm.position: Positions supporting research

Graduates

	2006	*2007*	*2008*	*Total*
Dr. ing./Dr. scient./Ph.D. graduated				
Cosmology		1	1	2
Solar physics	1	2	1	4
Celestial mechanics	1	1		2
Total	2	4	2	8
M.Sc.graduated				
Cosmology	7	4	4	15
Solar physics	0	2	4	6
Celestial mechanics	2			2
Total (only M.Sc.)	9	6	8	23

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
University funding*, salaries	9621	10348	9730
University funding, other costs	4044	3381	4306
University funding, instruments and equipment	1069	1058	1626
University funding, total	**14734**	**14787**	**15662**
The Research Council, grants	9762	10109	14763
Other national grants (public or private):	942	1124	1175
International grants(incl EU)	6932	6046	7133
External funding, total	**17636**	**17279**	**23071**
Total expenditures	**32370**	**32069**	**38733**
External funding as % of total expenditures	54,5%	53,9%	59,6%

* University funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

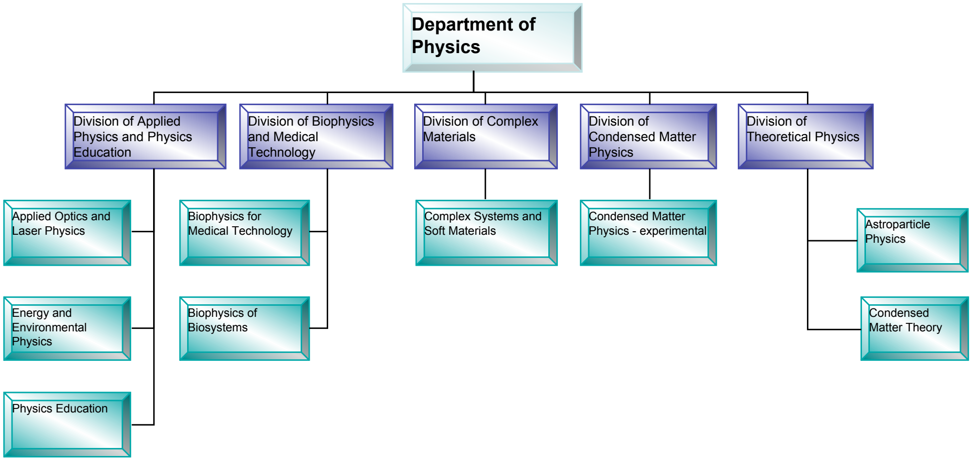
Other costs include instruments and equipment with low unit cost.

Date of form completion: 16 March 2008

FACT SHEET

Department of Physics - NTNU

Organisation - Organisation chart
Department of Physics is part of the Faculty of Natural Sciences and Technology at NTNU.



Personnel

Research group	Applied Optics and Laser Physics		Astroparticle Physics		Biophysics for Medical Technology		Biophysics of Biosystems	
Posistions	**Univ**	**Extern**	**Univ**	**Extern**	**Univ**	**Extern**	**Univ**	**Extern**
Professor	3	0	4	0	3	0	4	0
Ass. Professor	1	0	1	0	1	0	0	0
Professor II	0	0	0	1	2	1	0	0
Ass. professor II	0	0	0	0	0	0	0	0
Post-doctoral research fellow	0	1	0	2	2	5	0	0
Doctoral students	4	1	4	2	4	4	1	0
Techn/adm position	0	0	0	0	2	0	0	0

Research group	Complex systems and soft materials		Condensed matter theory		Condensed matter physics - experimental		Energy and environmental physics	
Posistions	**Univ**	**Extern**	**Univ**	**Extern**	**Univ**	**Extern**	**Univ**	**Extern**
Professor	6	0	3	0	3	0	2	0
Ass. Professor	0	0	1	0	3	0	2	0
Professor II	0	1	0	0	0	1	0	0
Ass. professor II	0	0	0	0	0	0	0	0
Post-doctoral research fellow	0	2	1	3	0	7	0	2
Doctoral students	3	6	4	5	2	10	2	3
Techn/adm position	1	0	0	0	1	0	0	0

Research group	Physics Education		Total	
Posistions	**Univ**	**Extern**	**Univ**	**Extern**
Professor	0	0	28	0
Ass. Professor	1	0	10	0
Professor II	1	0	3	4
Ass. professor II	0	0	0	0
Post-doctoral research fellow	0	0	3	22
Doctoral students	1	1	25	32
Techn/adm position	0	0	4	0

Graduates

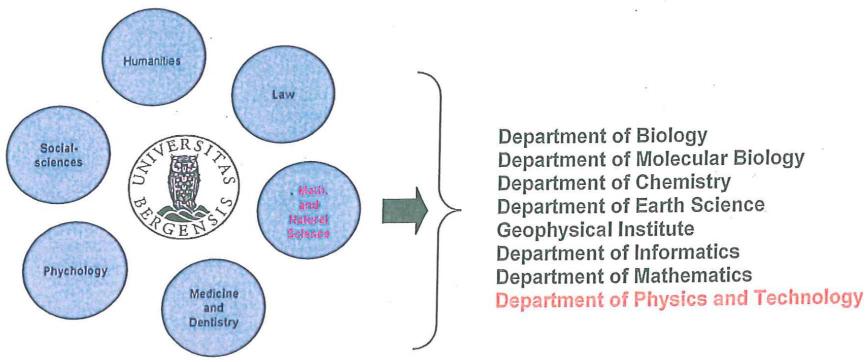
	2006	2007	2008	Total
Dr.ing/Dr.scient/PhD graduated				
Applied optics and laser physics	0	0	0	0
Astro- and particle physics	1	0	0	1
Biophysics for medical technology	2	0	2	4
Biophysics of biosystems	1	1	0	2
Complex systems and soft materials	2	3	3	8
Condensed matter physics - experimental	2	1	0	3
Condensed matter theory	2	0	5	7
Energy and environment	1	1	1	3
Physics education	0	0	0	0
Total	11	6	11	28
	2006	**2007**	**2008**	**Total**
M.Sc. Graduated				
Applied optics and laser physics	0	3	6	9
Astro- and particle physics	3	18	6	27
Biophysics for medical technology	17	10	9	36
Biophysics of biosystems	4	3	2	9
Complex systems and soft materials	7	20	11	38
Condensed matter physics - experimental	11	14	18	43
Condensed matter theory	2	2	9	13
Energy and environment	13	15	3	31
Physics education		1	3	4
Total	57	86	67	210

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	2006	2007	2008
University funding, salaries	49,135	50,680	54,129
University funding, other costs	5,738	3,195	9,012
University funding, instruments and equipment	4,065	8,217	1,860
University fundind, total	58,938	62,092	65,001
The Research Council, grants	38,560	36,896	27,686
Other national grants (public or private)	3,777	2,446	3,340
International grants (incl EU)	415	992	1,732
External funding, total	42,752	40,334	32,758
Total expenditures	101,690	102,426	97,759
External funding as % of total expenditures	42.0	39.4	33.5

Date of completion: April 1st 2009

University of Bergen



Department of Physics and Technology

The research groups are:

- Acoustics
- Electronics and Measurement Science
- Nano Physics
- Optics and Atomic Physics
- Petroleum and Process Technology
- Space Physics
- Science Education and Outreach
- Subatomic Physics
- Theoretical Physics, Energy and Process technology Unit

FACT SHEET
Department of Physics and Technology, University of Bergen

Personnel

	Acoustics		*Electronics and Measurement Science*		*Nano Physics*		*Optics and Atomic Physics*	
Positions	*Univ*	*Extern*	*Univ*	*Extern*	*Univ*	*Extern*	*Univ*	*Extern*
Professor	2		2				3	
Associate professor	1		3		2		1	
Professor II								
Associate professor II				1				
Post-doctoral research fellow		1		1		3		3
Doctoral students	2	4	3	5	1	2	1	7
Technical/adm. position*								
Total	**5**	**5**	**8**	**7**	**3**	**5**	**5**	**10**

Personnel

	Petroleum- and Process Technology		*Space Physics*		*Science Education and Outreach*		*Subatomic Physics*	
Positions	*Univ*	*Extern*	*Univ*	*Extern*	*Univ*	*Extern*	*Univ*	*Extern*
Professor	3		2		1		6	
Associate professor			2		1			
Professor II								
Associate professor II				1				
Post-doctoral research fellow		3						3
Doctoral students		9	2	3			5	9
Technical/adm. position*								
Total	**3**	**12**	**6**	**4**	**2**		**11**	**12**

Personnel

	Theoretical Physics, Energy and Process technology		*Total*	
Positions	*Univ*	*Extern*	*Univ*	*Extern*
Professor	3		**22**	
Associate professor	3		**13**	
Professor II				
Associate professor II		1		**3**
Post-doctoral research fellow				**14**
Doctoral students	1	14	**15**	**63****
Technical/adm. position*				
Total	**7**	**15**	**50**	**80**

”Univ” = persons financed by the university ”Extern” = persons financed by external research grants
* Technical/adm.position: Positions supporting research
** Includes 10 candidates with external main supervisor

Graduates

	2006	*2007*	*2008*	*Total*
Dr. ing./Dr. scient./Ph.D. graduated				
Acoustics		4	1	**5**
Electronics and Measurement Science			1	**1**
Optics and Atomic Physics	2	1	1	**4**
Petroleum and Process Technology	3	3	6	**12**
Space Physics		1	2	**3**
Subatomic Physics	1	4	3	**8**
Theoretical Physics, Energy and Process Technology	2	1	1	**4**
Total	**8**	**14**	**15**	**37**
Graduates with external main supervisor			1	**1**
M.Sc. graduated				
Acoustics	1	1	2	**4**
Electronics and Measurement Science	14	9	11	**34**
Optics and Atomic Physics	5	0	4	**9**
Petroleum and Process Technology	1	2	8	**11**
Space Physics	3	6	1	**10**
Subatomic Physics	5	6	6	**17**
Theoretical Physics, Energy and Process Technology	2	10	14	**26**
Total	**31**	**34**	**46**	**111**
Graduates with external main supervisor	3	1	4	**8**

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
University funding*, salaries	23000	24915	28134
University funding, other costs	4735	4312	5598
University funding, instruments and equipment	1310	3440	3243
University funding, total	**29045**	**32667**	**36975**
The Research Council, grants	25166	30186	16196
Other national grants (public or private):	8544	5910	15645
International grants(incl EU)	320	1240	2772
External funding, total	**34030**	**37336**	**34613**
Total expenditures	**63075**	**70003**	**71588**
External funding as % of total expenditures	53,95%	53,33%	48,35%

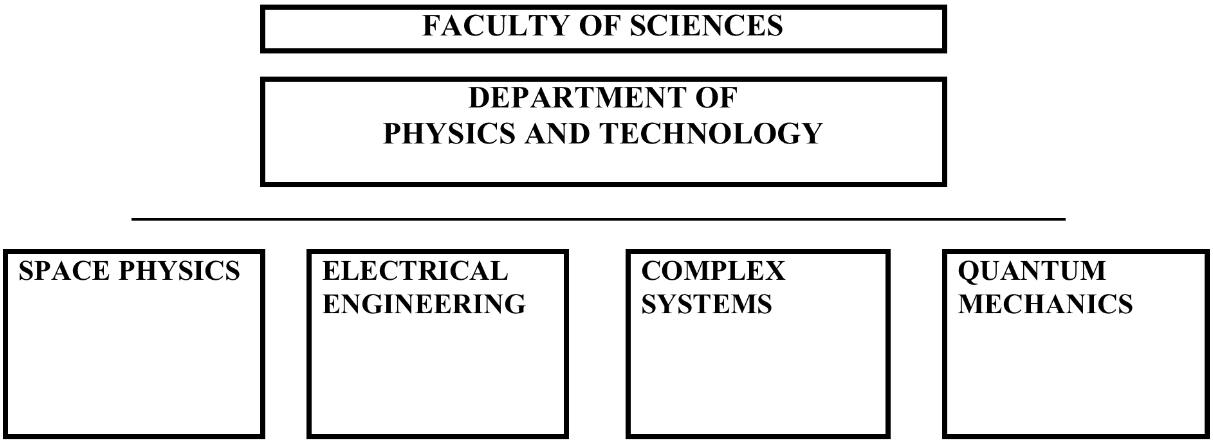
* University funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

Price increase from 2006- 2008: 4,6 %
Wage growth from 2006 – 2007: 2,4 %
Wage growth from 2007 – 2008: 5,8 %

Date of form completion: 15.04.2009

University of Tromsø
Department of Physics and Technology

Organisation map



FACT SHEET
Department of Physics and Technology, University of Tromsø

Personnel

	Space Physics		Electrical Engineering		Complex Systems		Quantum Mechanics		Total	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***
Professor**	8		4		1		1		14	
Associate professor			4						4	
Professor II		1								1
Associate professor II				1						1
Post-doctoral research fellow	2	3	1	1					3	4
Doctoral students	4	2	3	8	1				8	10
Technical/adm. position*	4+1,75		2+1,75		1,75		1,75		13	
Total	19,75	6	15,75	10	3,75		2,75		42	16

"Univ" = persons financed by the university "Extern" = persons financed by external research grants
* Technical/adm. position: Positions supporting research **Head of Department included

Graduates

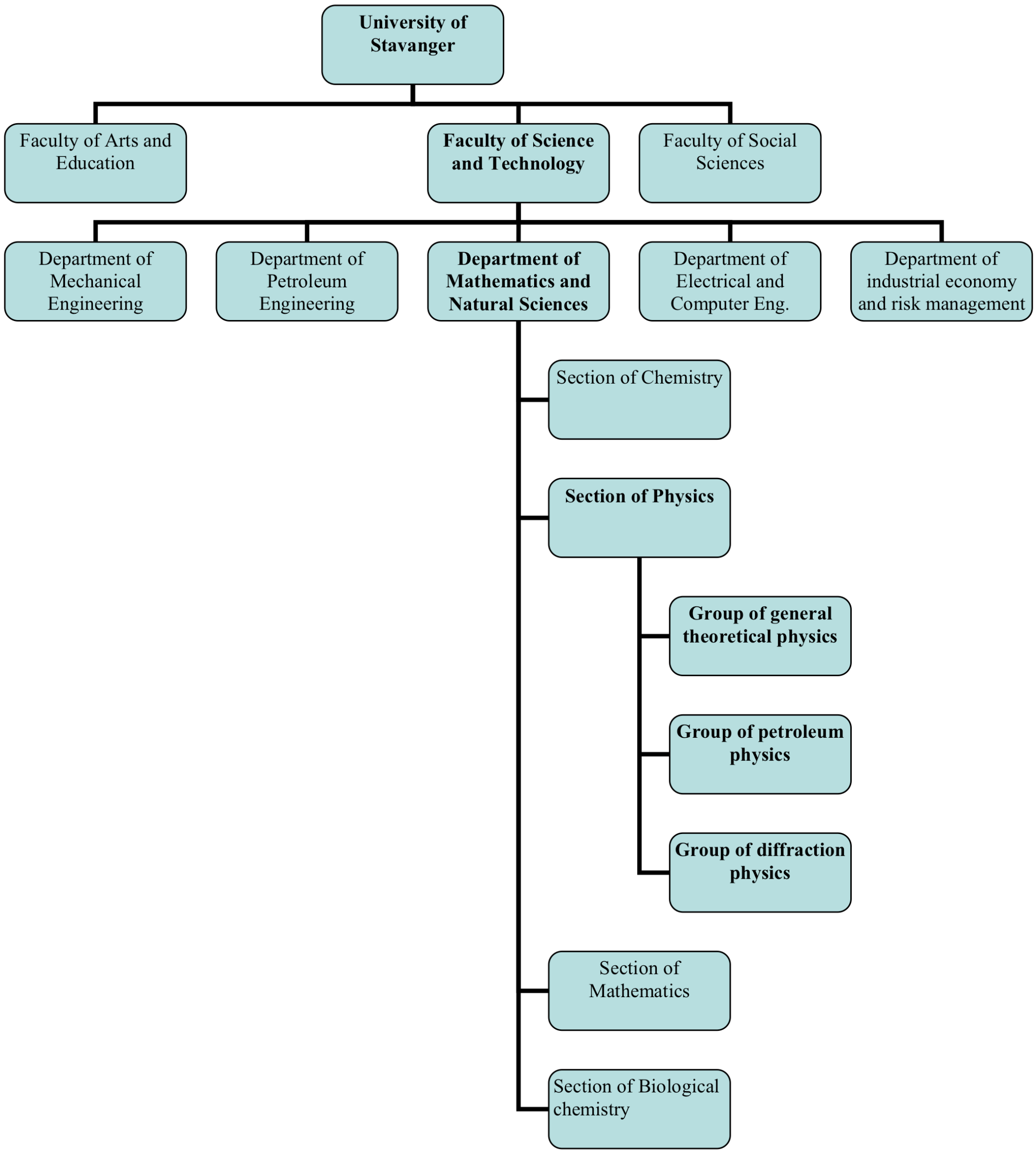
	2006	2007	2008	Total
Dr. ing./Dr. scient./Ph.D. graduated				
Space Physics		1		1
Electrical Engineering		2	1	3
Complex Systems				
Quantum Mechanics				
M.Sc./ M.Tech. graduated				
Space Physics		2	2	4
Electrical Engineering	5	6	5	16
Complex Systems				
Quantum Mechanics				
Total				24

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	2006	2007	2008	Total
University funding*, salaries	20 987	20 695	20 953	62 635
University funding, other costs	2 998	965	450	4 413
University funding, instruments and equipment	1 343	836	599	2 778
University funding, total	25 328	22 496	18 244	66 068
The Research Council, grants	3 455	6 955	7 839	18 249
Other national grants (public or private):	91	1 052	669	1 812
International grants (incl EU)	11	-332	276	-45
External funding, total	3 577	7 675	8 784	20 016
Total expenditures	28 885	30 171	27 028	86 084
External funding as % of total expenditures	12 %	25 %	32 %	23 %

*University funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

Date of form completion: April 14, 2009



University of Stavanger
Faculty of Arts and Education
Faculty of Science and Technology
Faculty of Social Sciences
Department of Mechanical Engineering
Department of Petroleum Engineering
Department of Mathematics and Natural Sciences
Department of Electrical and Computer Eng.
Department of industrial economy and risk management
Section of Chemistry
Section of Physics
Group of general theoretical physics
Group of petroleum physics
Group of diffraction physics
Section of Mathematics
Section of Biological chemistry

Deadline April 15, 2009
e-mail:bg@forskningsradet.no

FACT SHEET
Department of mathematics and natural science – section of physics -- UiS

Organisation – Organisation chart (attached)

Personnel

	Research group/unit Theory		***Research group/unit Petroleum***		***Research group/unit Diffraction***		***Total***	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***
Professor	3.0		1.0		1		5	
Associate professor	1				1		2	
Professor II			1				1	
Associate professor II								
Post-doctoral research fellow								
Doctoral students			0.5**		2.0**		2.5	
Technical/adm. position*								
Total	**4.0**		**2.5**		**4.0**		**10.5**	

"Univ" = persons financed by the university "Extern" = persons financed by external research grants
* Technical/adm.position: Positions supporting research
** Admitted on other doctoral programmes (petroleum and offshore materials science).

Graduates

	2006	***2007***	***2008***	***Total***
Dr. ing./Dr. scient./Ph.D. graduated				0
Research group				
Research group				
Research group				
M.Sc.graduated				0
Research group				
Research group				
Research group				
Total				0

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
University funding*, salaries	3412	3862	4793
University funding, other costs			
University funding, instruments and equipment			
University funding, total	3412	3862	4793
The Research Council, grants	38	34	29
Other national grants (public or private):			
International grants(incl EU)	0	0	0
External funding, total	38	34	29
Total expenditures	3450	3896	4822
External funding as % of total expenditures	1,1	0,87	0,6

* University funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

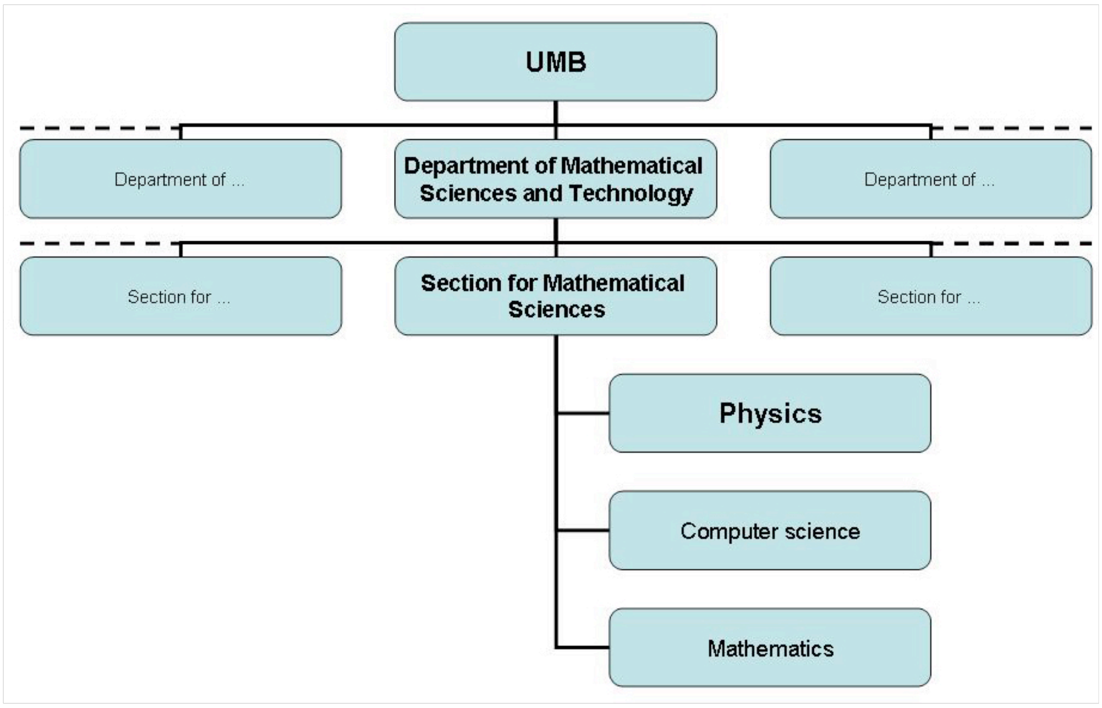
Date of form completion: **3. april 2009**

Deadline April 15, 2009
e-mail:bg@forskningsradet.no

FACT SHEET

Department of Mathematical Sciences and Technology
Norwegian University of Life Sciences, Ås

Organisation – Organisation chart



Personnel

Professors, associate professors, professors II and associate professors II

	Renewable Energy		*Biophysics/ Comp.Biol.*		*Other*		*Total*	
Positions	*Univ*	*Extern*	*Univ*	*Extern*	*Univ*	*Extern*	*Univ*	*Extern*
Professor			1		1		2	
Associate professor	2		1		1		4	
Professor II								
Associate professor II	1						1	
Post-doctoral research fellow			1	1			1	1
Doctoral students		1	3	3			3	4
Technical/adm. position*				1	1		1	1
Total	**3**	**1**	**6**	**5**	**3**		**12**	**6**

”Univ” = persons financed by the university ”Extern” = persons financed by external research grants
* Technical/adm.position: Positions supporting research

Graduates

	2006	*2007*	*2008/09*	*Total*
Dr. ing./Dr. scient./Ph.D. graduated				
Research group: Biophys./Comp. Biol.	0	1	2	3
	2006	*2007*	*2008*	
M.Sc./M.Tech. graduated				
Research group: Renewable Energy	5	8	2	15
Research group: Biophys./Comp. Biol.	0	4	3	7
Research group: Agrometeorology	0	2	1	3
Research group: Hydrodynamics	2	1	1	4
Total *(MSc/MTech)*	7	15	7	29

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
University funding*, salaries	4620	5740	6790
University funding, other costs	80	80	480
University funding, instruments and equipment	0	0	0
University funding, total	4700	4700	4700
The Research Council, grants	1260	2610	2570
Other national grants (public or private):	100	50	100
International grants(incl EU)	100	100	100
External funding, total	1460	2760	2770
Total expenditures	6160	8580	10040
External funding as % of total expenditures	24%	32%	28%

* University funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

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Deadline April 15, 2009
e-mail:bg@forskningsradet.no

FACT SHEET

The University Centre in Svalbard (UNIS) – Arctic Geophysics

Organisation – Organisation chart

Arctic Geophysics is one of four scientific departments at UNIS (the others are Arctic Biology, Arctic Geology and Arctic Technology).

Arctic Geophysics has two research groups: The middle/upper atmosphere, and the air-cryosphere-sea interaction, observation and modelling group (ACSO). According to instructions from Bjørn Jacobsen at the Research Council of Norway (RCN), the ACSO group will be evaluated next year as part of the geosciences. So in the tables below only data for our middle/upper atmosphere group is included.

Personnel

	Middle/Upper atmosphere		*Total*	
Positions	***Univ***	***Extern***	***Univ***	***Extern***
Professor	3		3	
Associate professor				
Professor II	2	1	2	1
Associate professor II				
Post-doctoral research fellow				
Doctoral students	2	2	2	2
Technical/adm. position*				
Total	**7**	**3**	**7**	**3**

”Univ” = persons financed by the university ”Extern” = persons financed by external research grants
* Technical/adm.position: Positions supporting research

Graduates

	2006	***2007***	***2008***	***Total***
Dr. ing./Dr. scient./Ph.D. graduated				
Middle/Upper atm.	0	0	0	0
M.Sc.graduated				
Middle/Upper atm.	2	2	0	4
Total	2	2	0	4

R&D expenditure by main funding source (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
University funding*, salaries	2814	3311	4130
University funding, other costs	1230	1300	1540
University funding, instruments and equipment	750	940	60
University funding, total	**4794**	**5571**	**5730**
The Research Council, grants	20	744	1141
Other national grants (public or private):			
International grants(incl EU)			
External funding, total	20	744	1141
Total expenditures	**4814**	**6315**	**6871**
External funding as % of total expenditures	0,4	12	17

**In addition we get 2500 KNOK/year from the central government to cover the rent of KHO building.

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Deadline April 15, 2009
e-mail:bg@forskningsradet.no

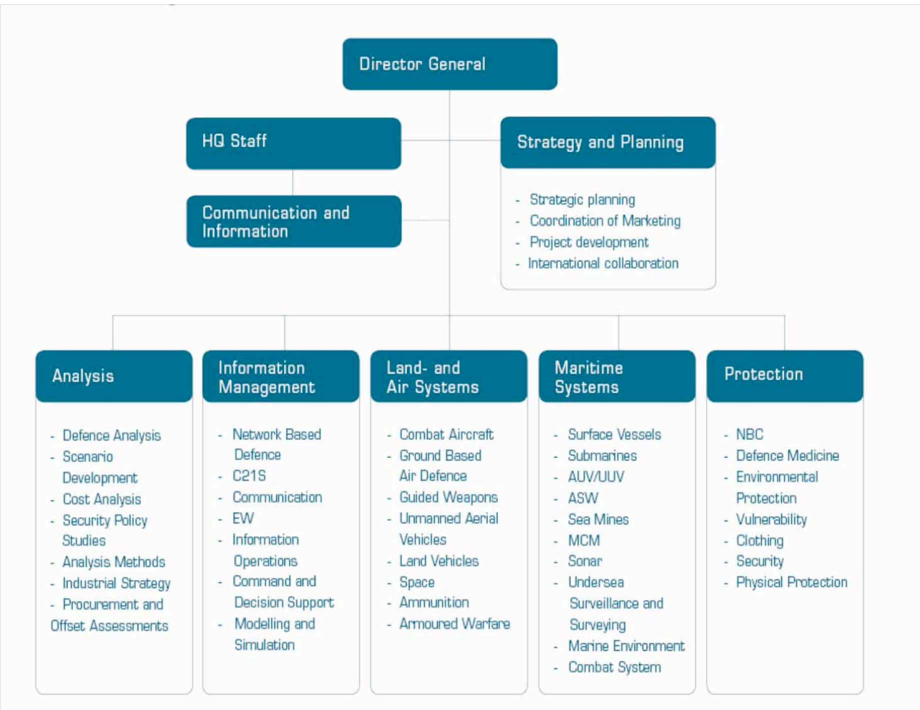
FACT SHEET

Flow Physics and Turbulence Group

Protection Division
Norwegian Defence Research Establishment (FFI)

Organisation – Organisation chart

The Flow Physics and Turbulence Group is a part of the Protection Division, one out of five research divisions at FFI. The Norwegian Defence Research Establishment is subsidiary of the Norwegian Ministry of Defence (MoD). FFI is the major defence R&D organisation in Norway.



<u>Key figures in 2007:</u>

- Annual turnover: 620 MNOK;
- Ministry of Defence block funds: 148.8 MNOK (24 % of the annual turnover)
  The MoD block funds are partly used to fund basic research; the only internal source for basic research funding.
- Staff 666
- 373 Scientists (111 PhD level) 81 research technicians; 6 research fellows

Personnel

	Research group/unit		*Research group/unit*		*Research group/unit*		*Total*	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***
Professor								
Associate professor								
Professor II								
Associate professor II								
Post-doctoral research fellow								
Doctoral students								
*Technical/adm. position**								
Total								

"Univ" = persons financed by the university *"Extern" = persons financed by external research grants*
** Technical/adm.position: Positions supporting research*

Comment

The table above is not applicable to FFI.

The permanent staff consists of 5 scientists. Not listed here are non-permanent staff consisting of one senior scientist (PhD, Nuclear Physics), three MSc-level scientists, and one CAD engineer. These are called upon when required.

Currently there are two post-doctoral fellows and six PhD students.

Funding of the Professor II positions at UiO:
1 University
1 StatoilHydro

Funding of post-doctoral fellows:
1 FFI
1 SFF – Centre for Biomedical Computing

Funding of PhD candidates:
1 NTNU
3 NFR
1 FFI
1 SFF – Centre for Biomedical Computing

Comment

Out of the five non-permanent group members are two from FFI/Protection Division, two from FFI/Land and Air Systems Division, and one from FFI/Staff.

Graduates

	2006	*2007*	*2008*	*Total*
Dr. ing./Dr. scient./Ph.D. graduated				
Flow Physics and Turbulence Group	1		1	2
M.Sc.graduated				
Flow Physics and Turbulence Group	1	4	3	8
Total	2	4	4	10

MSc students:
University of Oslo: 3
University of Bergen: 2
Chalmers University of Technology, Sweden: 3

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	***2006***	***2007***	***2008***
University funding, salaries*			
University funding, other costs			
University funding, instruments and equipment			
University funding, total			
The Research Council, grants			
Other national grants (public or private):			
International grants(incl EU)			
External funding, total			
Total expenditures			
External funding as % of total expenditures			

* *University funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.*

Comment

The table above is not applicable to FFI. Below is instead an overview (excluding PhD students) of over our funding situation divided into two categories:
1) Basic research funding (MoD block funds, SFF, EU)
2) Applied research funding (Defence, Industry)

	2006	*2007*	*2008*
BASIC RESEARCH FUNDING (salaries)			
MoD Block Grants	2000	2000	2691
SFF (Centre of Excellence – CBC)			1070
NFR + EU	570	445	125
FFI (participation in EU project)	452	452	452
Total basic research funding	**3022**	**2897**	**4338**
APPLIED RESEARCH FUNDING (salaries)			
Defence	2402	1423	593
Industry	876	1980	2044
Total applied research funding	**3278**	**3403**	**2637**
TOTAL	**6300**	**6300**	**6975**
Basic research funding as % of total funding	48%	46%	62%

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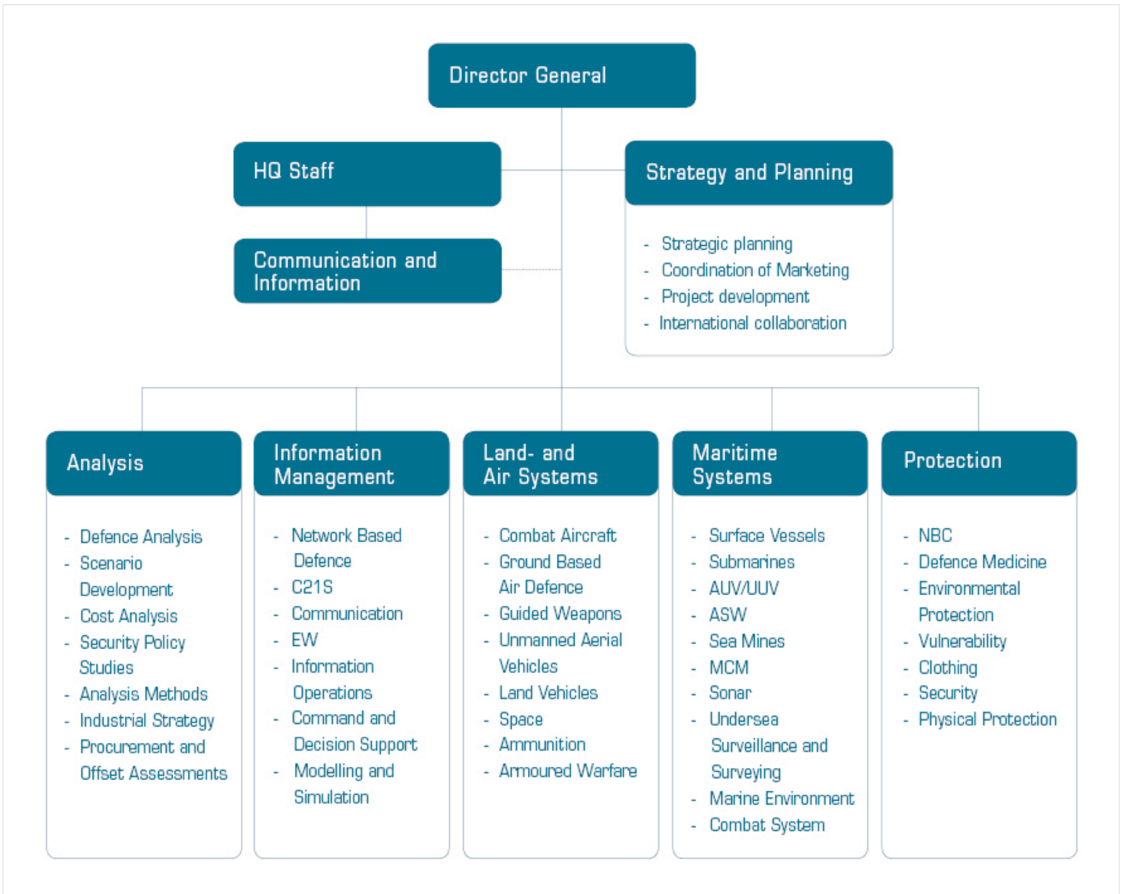
Deadline April 15, 2009
e-mail:bg@forskningsradet.no

FACT SHEET
Department of [Space Physics & Atmosphere Physics at FFI]
Organisation – Organisation chart



This research group “Space Physic & Atmosphere Physics” is one of 30 projects in “Land and Air Systems Division”, one of two projects summarised as “Space” in the organisation chart.

Personnel

	Research group/unit		***Research group/unit***		***Research group/unit***		***Total***	
Positions	***Univ***	***Extern***	***Univ***	***Extern***	***Univ***	***Extern***	***FFI***	***Extern***
Chief Scientist							2	
Principal Scientist							1	
Senior Scientist							1	
Associate professor II								
Post-doctoral research fellow								
Doctoral students								
Technical/adm. position*								
Total							**4**	

”Univ” = persons financed by the university ”Extern” = persons financed by external research grants
* Technical/adm.position: Positions supporting research

Graduates

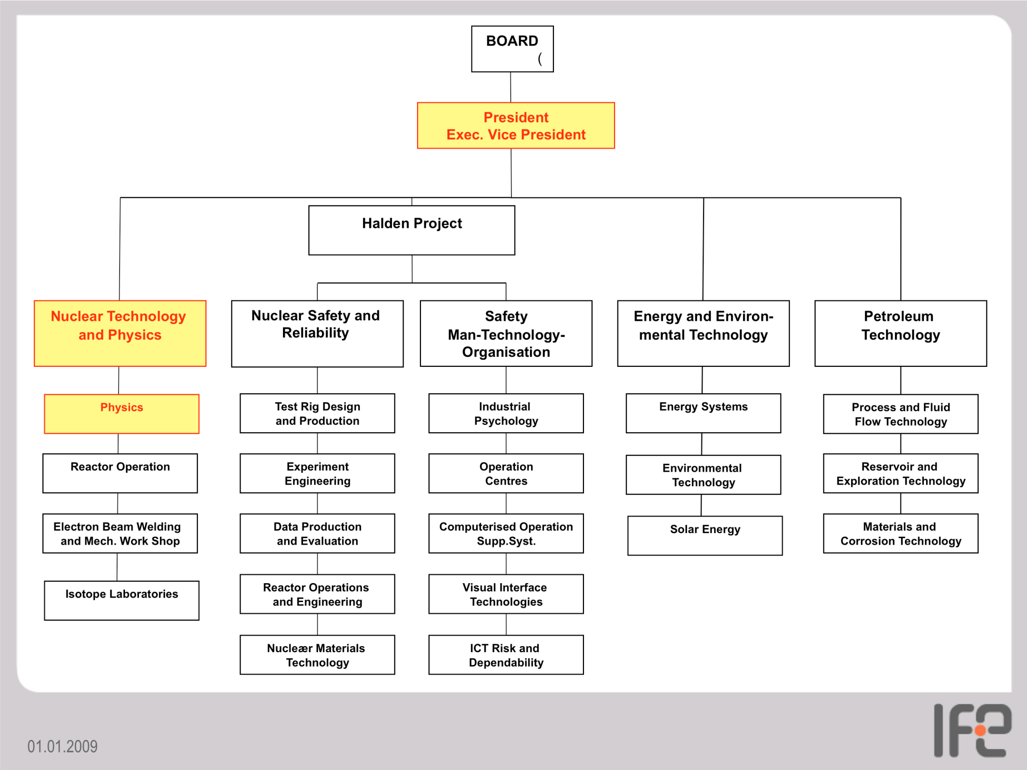
	2006	*2007*	*2008*	*Total*
Dr. ing./Dr. scient./Ph.D. graduated	1	1	2	4
Research group				
Research group				
Research group				
M.Sc.graduated			2	2
Research group				
Research group				
Research group				
Total	1	1	4	6

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
FFI funding*, salaries	6700	6700	6700
University funding, other costs			
University funding, instruments and equipment			
FFI funding, total	6700	6700	6700
The Research Council, grants	2192	610	1072
Other national grants (public or private):	775	2003	2652
International grants(incl EU)	418		236
External funding, total	3385	2613	3960
Total expenditures	10085	9313	10660
External funding as % of total expenditures	34%	28%	37%

* University funding: This refers to the institution's input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

Date of form completion: 03.04.2009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01.01.2009

Deadline April 15, 2009
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FACT SHEET
Physics Department, Institute for Energy Technology, Kjeller
Organisation – Organisation chart 2008

Personnel

	IFE's Physics Department	
Positions	***IFE***	***Extern***
Researchers (5)	4.2	
Professor II (3)	0.4	0.2 (UiO)*
Associate professor II (1)	0.2	
"Inverse professor II" (1)**	0.2	
Researchers (temp.)		2
Post-doctoral research fellows		11
Doctoral students		6
Technical/admin. position***	6	
Total	**11**	**19.2**

"IFE" = persons financed by IFE "Extern" = persons financed by external research grants
* One professor II position financed by Univ. of Oslo
** One professor from Chemistry Dept. at UiO financed by IFE
***Four technical/one adm.position/one instrument scientist: Positions supporting research

Graduates

	2004	*2005*	*2006*	*2007*	*2008*	*Total*
Dr. ing./Dr. scient./Ph.D. graduated	2	3			1	6
M.Sc.graduated	1	3	2	2		8
Total	3	6	2	2	1	14

R&D expenditure by main source of funding (1000 NOK)

Type of expenditure	*2006*	*2007*	*2008*
IFE funding*, salaries	9595	11281	11316
IFE funding, other costs	905	219	984
IFE funding, instruments and equipment			
IFE funding, total	**10500**	**11500**	**12300**
The Research Council, grants	10079	9748	10506
Other national grants (public or private):	2685	2636	2131
International grants(incl EU)	1560	3088	3521
External funding, total	**14324**	**15472**	**16158**
Total expenditures	24824	26972	28458
External funding as % of total expenditures	58	57	57

* IFE funding: This refers to the institutions input of own resources such as salaries for scientific personnel (including social costs), other costs, and infrastructure.

Date of form completion: April 15, 2009

FACT SHEET (the fact sheet has been significantly modified to fit to the structure of Materials Physics)

1. Organisation structure

The SINTEF Group is a non profit polytechnic research foundation, performing contract research and development for industry and the public sector. SINTEF is amongst the largest independent research institutes in Europe. In 2007, SINTEF carried out 6065 projects for 1900 unique customers. By the end of 2008, SINTEF had 2145 employees from 64 nations.

SINTEF Materials and Chemistry is a contract research division within the SINTEF Group offering high competence within materials technology, applied chemistry and applied biology. The institute had 409 employees in 2008.

The main research areas are:

- Materials
- Energy
- Life Science
- Oil and Gas

epartment of Synthesis and properties is one of 8 research departments within INTEF Materials and Chemistry – see organisation structure in Figure 1 below. The epartment had 59 employees in 2008 within the following major competence areas:

ynthesis: Polymers, additives, biodegradable materials, oil field chemicals.

roperties Recyclability, processibility, structural properties, functional properties.

laterials: Polymers, light metals, composites, fine chemicals, particles, films and coatings.

hin Films and Surface technology; Deposition and characterisation, corrosion, electrochemistry, surface treatment of metals, adhesion, micro structuring, surface modification of polymers and particles.

article technology: Manufacturing of emulsions and suspensions, non-magnetic and magnetic particles, encapsulation, characterisation.

haracterisation and testing: Porosity, microstructure, topography, mechanical properties.

lodelling and simulation

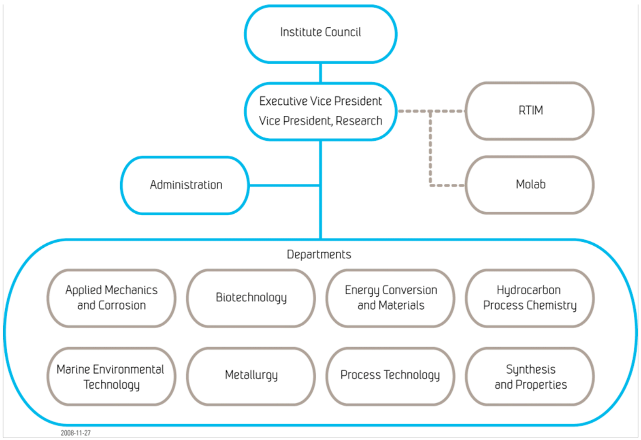

Figure 1: Organisation chart of SINTEF Materials and Chemistry with Department of Synthesis and properties as one of 8 research departments.

The department has a management team consisting of a Research Director, 5 Research Managers, an economy consultancy and a project secretary. The research managers are scientific responsible for five different research teams in the department

Materials Physics is one of the five research teams within Department of Synthesis and Properties – see Figure 2 below. The team has today 11 permanent employees holding positions between 50-100%, of which 10 holds a PhD grade. The team is physically divided between Trondheim (7) and Oslo (4).

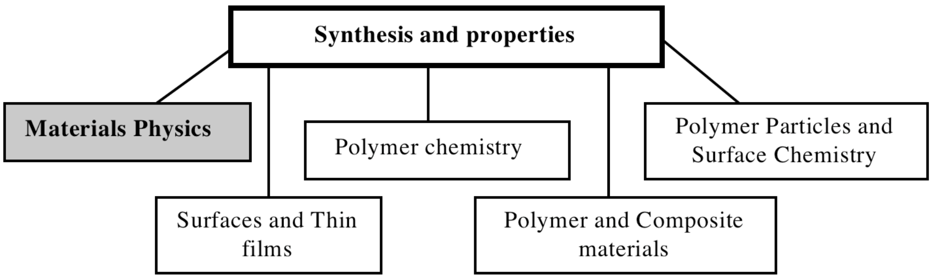

Figure 2: Department of Synthesis and Properties with 5 research teams

Research group: Materials Physics.

Personell (2009)

Title	Research Group
Research scientist	Materials Physics[1]
Research scientist	Materials Physics[2]
Research scientist	Materials Physics
Research scientist	Materials Physics[3]
Research manager	Materials Physics
Research scientist	Materials Physics
Research scientist	Materials Physics[2]
Senior research scientist	Materials Physics
Research scientist	Materials Physics
Cand. Scient.	Materials Physics
Senior research scientist	Materials Physics[4]

[1]Also adjunct associate professor at UiO, Department of Chemistry (20% position)
[2] Also adjunct associate professor at UiO, Department of Physics (20% position)
[3] Also researcher at NTNU, Department of Physics (50% position).
[4] Also adjunct professor at NTNU, Department of Physics (20% position)

Key economic figures Materials Physics 2006-2008 (1000 NOK)

Material Physics has a full-cost model where all expenses are covered by project activities. In general, approximately 50% of the income in projects organised within Materials Physics (i.e. in projects where personnel in Materials Physics are project managers) was financed by the Research Council of Norway in 2006. The rest of the funding came from a wide-scattered Norwegian industry. The international funding is of the total project portfolio increasing, from 2.5% in 2005 to ~ 8% in 2007. This is expected to grow further by involvement in EU-projects.

Key economy figures Materials Physics	2006	2007	2008
Net income (all project activities)	11316	13225	13507
Net costs	9932	12100	12848
Research labour-year	9.0	10.1	9.6
Result	1384	1125	659
Investments*	69 (69)[1]	125 (685)	599(599)

*The first number gives Materials Physics contribution while the number in brackets states the total prize (i.e. the remaining amount of money is raised by co-funders) outside Materials Physics/Department of Synthesis and Properties
[1]In addition to this figure, SINTEF was granted an infrastructure application to the Research Council of Norway for a XPS and an AES instrument, with a total investment level of approximately 11.5 MNOK (including contributions from NTNU and UiO). Materials Physics was heavily involved in the whole process (specifications, negotiation, installation, operation etc) and is managing the labs today (i.e. a significant level of man-hours has been invested to get these advanced instruments up-and running and operated in a sound scientific and financial way.

Date of form completion: 2009-04-30

About the publication

In 2009 an international Committee was commissioned to evaluate research activities within the field of basic physics in Norwegian universities and relevant research institutes. The evaluation has resulted in two publications:

- Basic Physics Research in Norway – Evaluation, report submitted by the Committee.
- Evaluation of Physics Research in Norway - Bibliometric analysis, supplementary report written by Dag W. Aksnes, NIFU STEP.

The publication can be ordered at
www.forskningsradet.no/publikasjoner

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