Forskningsrådet

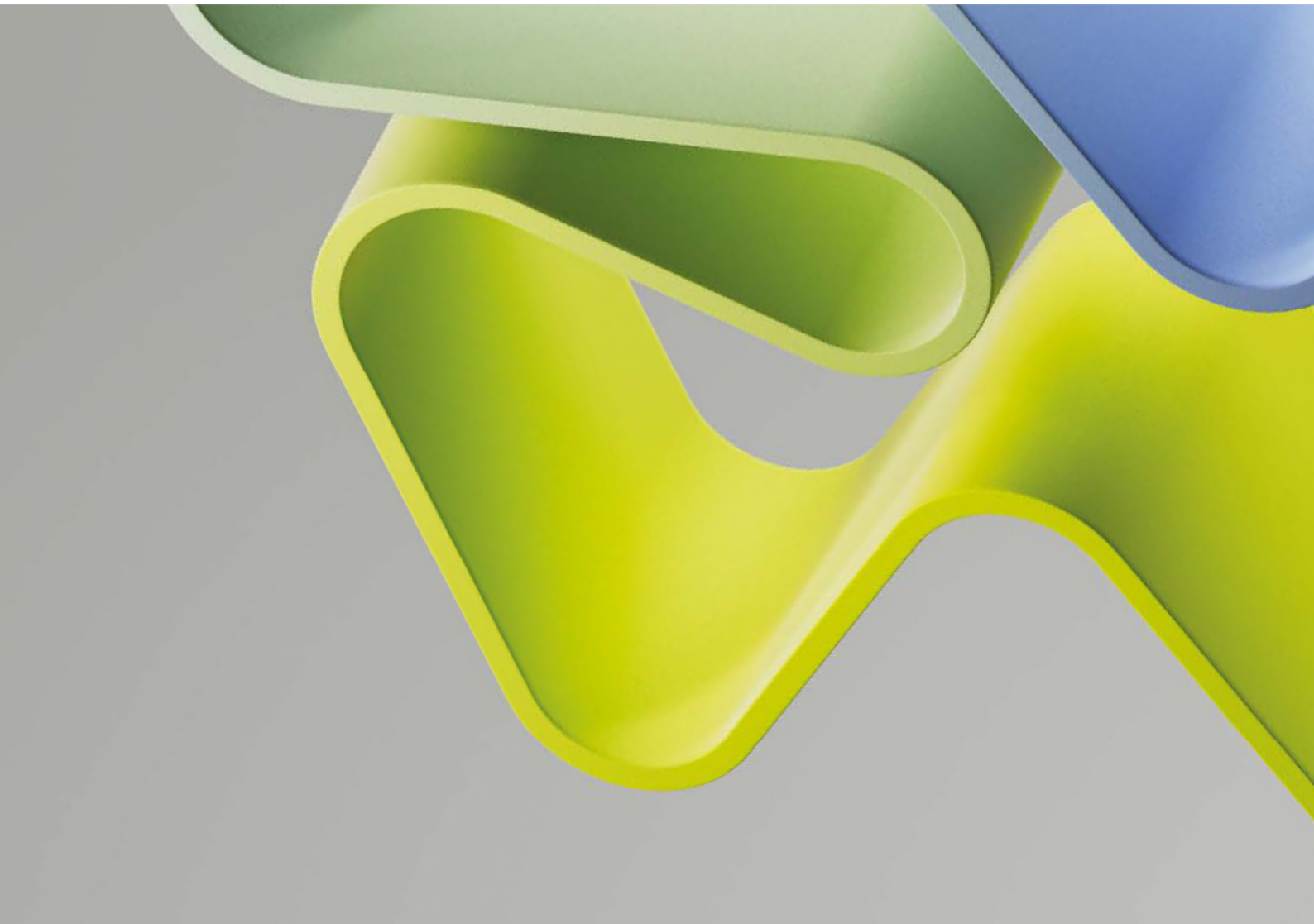
Evaluation of Natural Sciences 2022-2024

Evaluation report

Department of Physics

University of Oslo

January 2024



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Statement from Evaluation Committee I – Higher Education Institutions

The members of this Evaluation Committee have evaluated the following administrative units at the higher education institutions within natural sciences in 2022-2023 and submitted a report for each administrative unit:

- Geophysical Institute, University of Bergen
- Department of Earth Sciences, University of Bergen
- Department of Physics and Technology, University of Bergen
- Department of Chemistry, University of Bergen
- Department of Theoretical Astrophysics, University of Oslo
- Department of Geosciences, University of Oslo
- Department of Physics, University of Oslo
- Department of Chemistry, University of Oslo

The members of the Evaluation Committee are in collective agreement with the assessments, conclusions and recommendations presented in this report. None of the committee members has declared any conflict of interest.

The Evaluation Committee has consisted of the following members:

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Prof. Isobel Hook
University of Lancaster, United Kingdom

Prof. Nicola Hüsing
University of Salzburg, Austria

Prof. Dieter Schinzer
University of Magdeburg, Germany

Description of the administrative unit

In 2021, the administrative unit employed 223 people, of which 171 were in academic positions, 40 as technicians and 12 in administration. Of the academic employees, 43 were professors/associate professors, 16 adjuncts, 53 researchers/postdocs and 59 PhD students. The share of women in these categories were 23, 21 and 51 % respectively, and for technical and administrative staff 10 and 67 per cent, respectively. The average age in the groups of professors, associate professors, researchers/Postdocs and PhD students were 53, 48, 36 and 29 years respectively.

The institute is led by a "leader group" consisting of the head of department, head of education, head of research, and head of administration, advised by the ten group leaders. There is also a board which takes final, larger decisions (strategy, positions etc). The board consists of a head, vice-head, two permanent faculty, one non-permanent faculty (PhD student or Postdoc), two technical/administrative staff, plus students. The composition of the board is not fixed, and the present leadership aims for a clearer majority of elected permanent academic staff, in order to make the board more proactive.

Professors and associate professors nominally have 45% research time, 45% teaching and 10% administration. On average, they can apply for a sabbatical leave every 7th year, and the administrative unit try to accommodate this within the restrictions due to teaching. PhDs and Postdocs either have 100% research time (three years) or 75% research and 25% teaching (four years) depending on the funding source. Researchers hired on external funding normally do 100% research.

The administrative unit hosts 10 Research Groups. The research groups are listed below:

a. The Biophysics and Medical Physics research group is a small research group focused on applied radiation research. After reorganisation, the group in its current shape was established recently (2018) and consists of only two permanent faculty positions. This small group is supported by five adjunct professors (20% position), two postdoctoral fellows, two engineers and four PhD students.
b. The Semiconductor Physics research group is big, 40 – 50 people (including technical and admin staff and around ten master's students), with six professors, and targets application motivated basic research with a focus on Semiconductor Physics at a level which is nationally leading. The group runs the Micro and Nanotechnology Laboratory (MiNaLab), was a co-founder of the Centre for Materials Science and Nanotechnology (SMN) and is strongly involved in Norfab. Therefore, the group occupies a central position in semiconductor physics in Norway.
c. The Structure Physics research group, with three professors, one associate professor and one 20% adjunct professor, was formed in 1968 with a strong focus on material research for industry where TEM methodology was developed and utilised. The group has expertise mainly in TEM and structure analysis. In addition to experimental studies, the group performs code development and theoretical material modelling.
d. The Condensed Matter Physics research group is a fairly large research group with around ten in academic positions. It has a set of local labs and computational resources and is, to a large degree, integrated in the Njord centre. The research profile is mainly within complex material systems/soft matter/condensed matter. This is multiscale physics and includes research on critical phenomena. The research is collaborative and covers the main techniques of experimental, theoretical, and computational physics within the studied areas.
e. The Electronics research group is of modest size, with four academics and five part-time adjunct associate professors from collaborating institutions. The group's research concentrates on instrumentation for CERN research, space physics, bioimpedance and biomedical applications, as well as hydroacoustics.

f. The Nuclear and Energy Physics research group has three professors and a senior researcher who work collaboratively on research projects at the onsite Oslo Cyclotron Laboratory and international accelerator facilities. The group will also be a central actor in the recently formed National Centre for Nuclear Research hosted by the administrative unit. The group's fundamental physics activities are in element synthesis in stars, explosions in the cosmos and probing nuclear structure of unstable and highly excited nuclei using state-of-the-art radiation detection. The fundamental research is complemented by a program in medical applications.
g. The High Energy Physics research group is large, with seven professors and several senior, long-term researchers, and the research is dominated by the work in two large CERN-based collaborations, ATLAS, and ALICE. There are smaller activities in accelerator physics and studies of antihydrogen in the AEGIS collaboration. Other important activities are technology transfer, outreach, and science communication to industry, students at various levels and the public at large.
h. The Plasma and Space Physics research group is rather small with three professors (one of whom is on long-term leave), and several externally funded researchers and postdocs. The main research is on ionospheric dynamics, structuring, and space weather impacts in polar regions. The group operates ground-based instrumentation on Svalbard, in northern Norway, and in Antarctica, and perform rocket experiments and participate in space missions.
i. The Theoretical Physics research group has six professors (two of whom are on long term leave) but has a small number of junior researchers and PhD students. The research is spread over several topics in high energy physics, condensed matter physics, astrophysics, and quantum information. The group is central for the teaching in the department and has a large outreach activity.
j. The Physics Education research group is very small, with one professor, two associate professors and two PhD students. It originally offered outreach to schools and in-service teacher training, and since early 2000´s also contributes to pre-service teacher education and offers master's degrees in physics didactics. It has produced a textbook in physics didactics which is used all over Norway.

The administrative unit is at present working on a new strategy plan, where important components are to critically review the organisation into research groups, and to facilitate a build-up in quantum science and technology.

Overall assessment

The Evaluation Committee finds that overall, the administrative unit performs well on all the evaluation criteria, but that improvements are possible. The scope of research is overall well matched to the resources in funding and staffing, and the plan to develop an activity in quantum science and technology is well motivated and important.

Since the administrative unit hosts ten research groups, there is a large spread both in size, quality, and success rate for securing grants. Here we highlight some points, while details are given in the appropriate sections.

UiO researchers have been rather successful in obtaining grants under RNC's FRIPRO program which funds curiosity driven research, while only two out of 30 ERC applications were funded, a figure that should cause some worry.

Concerning research quality, the groups in Condensed Matter, and Nuclear and Energy physics group are outstanding, while the Theory group is clearly underfinanced and too small given the rather broad spectrum of research. In the Structure physics and Electronics groups, there is a lack of research focus.

The stress on excellent education is commendable, and the presence of a strong research environment as well as a dedicated Physics Education research group, vouch for success.

The Evaluation Committee considered the points raised by the administrative unit in their Terms-of-Reference document and have commented on many of the issues raised in that document. Where no comments are provided, this generally reflects a lack of relevant information in the self-assessment to allow the Evaluation Committee to reach a view.

Recommendations

At the organisational level the Evaluation Committee recommends the administrative unit to consider the following:

1. *Influence of faculty:* It is imperative that the faculty can influence important decisions such as hiring and distribution of funds for PhD student etc. The committee fully supports the present initiatives to secure, a clearer majority of elected permanent academic staff on the board to make it more proactive.
2. *Group structure:* The Theory group is in danger of becoming suboptimal, and the administrative unit should consider different options to strengthen theoretical physics, which, except for its intrinsic value, is of great importance for upholding the standard of teaching and attracting good students. One, unfortunately costly, approach is to plan for the strategic hiring of several theorists in the coming few years. This would preserve a unified theoretical environment which could continue to attract very good students. A less costly alternative would be to dissolve the theory group and assign the members to other groups in the administrative unit, (condensed matter and high energy physics) or at the close by department of theoretical astrophysics. This would split the theory environment but might improve the contacts between theory and experiments. The administrative unit should also consider if any of the smaller groups that run the risk of becoming subcritical could merge with a larger unit, or in the long run be discontinued. The Evaluation Committee notes with

satisfaction that the leadership is fully aware of these important problems and is actively seeking solutions that would, without doubt, require difficult decisions to be taken.

3. *Strategy of the research groups:* The Evaluation Committee points out that the in the Structure physics, Plasma and Space and Electronics groups lack a coherent research strategy, and that the high energy group should already now plan for a life after LHC. It is important the administrative unit makes sure that this criticism is taken seriously. Given the importance of quantum science and technology it is important to develop a detailed and realistic strategic plan for the activities.
4. A key strategic challenge is how to preserve core competencies while exploiting emerging opportunities, all in the context of stagnant or declining base funding. The department will need to make potentially difficult choices about future directions, in recognition of the likely future budgetary constraints.
5. The administrative unit should put more effort in developing a structured support for young faculty, and a plan for increasing diversity, with a stress on identifying top scientists that might not know of or consider a future at UiO.

1. Strategy, resources and organisation of research

The administrative unit is in the process of writing a new strategy plan, and from the interview, and the SWOT analysis, it is clear that they have identified both central goals and important weaknesses that have to be dealt with. Many of the ten research groups are very successful, while others face problems. An important component of the strategy plan will be to re-evaluate the group structure. Another important component will be to make the plans for a build-up in quantum technology concrete and include plans for hiring both faculty and recruiting students and postdocs. Besides exploring new areas of research, it is important that the administrative unit protects the successful activities in Condensed Matter Physics, Nuclear Physics and High Energy physics, which should be able to organically develop within the current group structure. Several other activities are also very good, but it is not clear that they are organised in an optimal way, and some are also lacking strategic plans.

The ratio of technical to academic staff is rather high and might be a matter of concern. The possibility of mobility is good, but discouragingly few make use of the opportunities given. The funding situation is adequate for many groups, but decreased and fluctuating funding is a serious threat to smaller groups doing basic research and might also force a closure of parts of some experimental infrastructure. The groups in the administrative unit make good use of both national and international infrastructure. The faculty members at the administrative unit have a healthy national and international network of collaborators.

1.1 Research Strategy

Although the first of the strategic goals is “to stimulate, foster and protect curiosity-driven basic research” at “a high international level”, societal goals are also stressed. There is more emphasis on physics education than is common in physics departments – this is described by the administrative unit as one of the big assets and considered to be its most important societal impact. In the rather generally formulated strategy document Fi2020 for the period 2014-2020, basic research is very much stressed, but the administrative unit is now working on a new strategy document. Computational methods and the handling of large data sets is stressed as a common theme in five listed research areas: condensed matter, subatomic physics, space science, biological and biomedical physics, and physics education research. There is however no clear cross-disciplinary computational strategy beyond using the national computational infrastructure Sigma2.

The administrative unit stresses the importance of synergy between the research groups and mentions quantum technology and proton therapy as successful examples. Although the importance of a strategy for hiring faculty is emphasised, no plan is presented in the self-evaluation, but reason for this, which was emphasised during the interview, is that “possibilities for permanent hires will be extremely rare in the coming years”. There is also no plan for how to use the university-funded PhD and postdoc positions or the anticipated 20% adjunct professor positions, in a strategic fashion.

In the SWOT analysis, education is listed as a strength, and so is the build-up of a national centre for nuclear physics. Building strong activity in quantum physics and technology is listed as an opportunity. In the interview these plans were made more concrete, and the leadership presented a thought-through strategy for centring activities towards quantum sensing and emphasized that a first hire has been made in quantum technology. Low mobility is listed as a weakness.

1.2 Organisation of research

The research is organised in ten groups that are described in the summary section. The ratio of technical to academic staff is rather high, while the ratio of senior to junior seems adequate. The nominal teaching load for professors is at an acceptable level of 45%. The faculty are offered various career development programs, but the administrative unit does not seem to have any strategy aimed specifically at young researchers in physics. The possibility of sabbaticals secures mobility for the faculty, and supervisors encourage PhD students to spend some time at other institutes. Nevertheless, the fact that there is a hesitation among young researchers to take these opportunities is mentioned as a weakness in the self-assessment. An important part of mobility is to recruit from other countries at all levels, but no data is provided to assess this. One local weakness is the spread of the groups across five different buildings, which damages the cross collaborations among the different groups.

1.3 Research funding

Decreased and fluctuating funding is a major threat, especially to basic research, and might also force a closure of parts of the experimental infrastructure. Still, according to the Evaluation Committee many of the ten research groups in the administrative unit are sufficiently funded. Others face economic difficulties that threaten their functionality and the quality of the research. The theory group seems particularly vulnerable. Many groups are quite successful in obtaining external grants, but again smaller, non-applied activities without connection to large infrastructure, such as the cyclotron lab, or CERN, are at a disadvantage. RCN’s FRIPRO program which funds curiosity driven research has a success rate of only 5%, so even very good smaller projects will remain unfunded. Nevertheless, UiO researchers have been rather successful in obtaining such grants, while only two out of 30 ERC applications were funded. The ERC success of the administrative unit is below average, the funding from RCN is at average level, and the administrative unit is not well-funded from industry or private sector. In the SWOT analysis the low success in obtaining grants is listed as a weakness, which the committee agrees with.

1.4 Use of infrastructures

Many of the research groups are dependent on both national (Sigma2, SIOS, Troll, NorFab, NorTEM), and international (Atlas, Alice and ISOLDE at CERN, ESA, EISCAT and plans for ESS) infrastructure. This is particularly true for subatomic physics and space physics.

It should be noted that the very successful cyclotron laboratory is located on site. So is the centre for CERN activities in Norway and the AU is a node of NordFab for advanced synthesis. The administrative unit also hosts the recently created National Centre for Nuclear Research.

Many groups in the administrative unit are heavily involved in creating and using large data sets, and have data polices in accordance with the FAIR principles. UiO provides courses and support for implementing these principles.

1.5 National and international collaboration

Physics is a collaborative effort, and the administrative unit points out that well over 80% of the papers published by DP authors have international co-authors and over 50% of DP papers have national co-authors. There are also many cross-sector collaborations with other universities and research institutes that are mentioned in other places in this report.

The Evaluation Committee thinks that the faculty at the administrative unit has a healthy network of national and international collaborators.

1.6 Research staff

In 2021, the administrative unit employed 223 people of which 171 are in academic positions, 40 are technicians and 12 are in administration. Of the academic employees, 43 are professors/associate professors, 16 are adjuncts, 53 are researchers/postdocs and 59 are PhD students. The share of women in these categories were 23, 21 and 51% respectively, and for technical and administrative staff 10 and 67%, respectively. The average age in the groups of professors, associate professors, researchers/postdocs, and PhD students were 53, 48, 36 and 29 years.

2. Research production, quality and integrity

The Evaluation Committee reports judge the research in the administrative unit as internationally "outstanding" in terms of originality, significance, and rigour in six of the groups and "excellent" in another three, but reading the reports carefully, a more nuanced picture emerges. In the Structure physics and Electronics groups there is a lack of research focus, and the contributions of the groups are rated lower than that of the overall quality. The same is true for the High Energy group where the overall quality of the research is of course outstanding. However, it is also argued in detail that the contribution of the group is excellent. In the other groups there is no discrepancy between the overall quality of the work and the contribution of the groups at UiO. Of these, the large group in Condensed Matter, and the smaller Nuclear and Energy physics group, are outstanding. Here it should be noted that CM physics is extremely competitive internationally, since there are excellent labs in very many places, while the nuclear physics research is based on an excellent on-site accelerator. The contributions of the Theory group are less clearly understood and viewed by the Evaluation Committee. It is clearly underfinanced and too small given the rather broad spectrum of research. But again, theoretical physics is done in very many groups and the international competition is very hard. The Physics Education group should not be evaluated using the same criteria as the other groups since its subject matter is not natural science. The Evaluation Committee report indicates that it is an important and useful activity in its field, and to have such a group in a physics department is clearly advantageous for the teaching at all levels. The Plasma and Space group runs the risk of becoming subcritical and the Evaluation Committee suggests that they should revise its research strategy. The Biophysics and Medical physics group is small but very active and has been reorganised well in the past year.

From the bibliometric data provided the Evaluation Committee concludes that the quantity of research output is clearly acceptable, and it is good that an increasing number of papers are published as open access. The data is too noisy to allow for any other conclusions about trends. The well cited papers are, as expected, from the large collaborations (all the ten listed are in subatomic physics, mainly from CERN).

The productivity of women and men within the administrative unit, measured as the average number of author shares by FTE, differs slightly: in the period 2019-21, female members of the administrative unit have an average author share of 1.26, whereas their male colleagues have an average of 1.39. Compared to some other administrative units in the evaluation, that difference is rather small.

The administrative unit does not seem to have any specific strategy to ensure research integrity, except for referring to the document describing the UiO policy. Very likely, there are aspects of research integrity that are specific to large international collaborations, such as ATLAS, and these perhaps ought to be targeted more specifically.

2.1 Research quality and integrity

Biophysics and Medical Physics research group overall assessment

The Department of Biophysics and Medical Physics is a small but very active research group that has undergone significant reorganisation in recent years. The group is currently focusing on preclinical research on proton therapy, which is well justified by the qualifications of the scientists, local infrastructure, and the construction of Norway's first proton therapy centre in Oslo.

Despite the problems resulting from the limited size of the group, it manages to obtain competitive financing. The group is well supported at the University and Faculty level.

The group conducts high-quality scientific research, publishing its work in the most prestigious scientific journals. Growing international cooperation with outstanding European partners broadens research perspectives and mobility of young scientists.

The social impact of the group, now mainly expressed through student education, is expected to increase once proton therapy begins in Oslo.

Condensed Matter Physics group overall assessment

The Condensed Matter Section at the University of Oslo produces research outputs that are of very high quality, at a level of outstanding international standing, producing an excellent level of academic impact. The group is very well organised internally and within the host institution and collaborative Centres. They perform top quality, interdisciplinary collaborative research on academically and industrially relevant science. The group is highly successful in obtaining funds from National and European sources supporting an outstanding group of researchers and laboratories. Societal impact is from several sources including the output of well-trained PhDs and interactions with industry. A very minor weakness is that industrial links could be stronger, increasing societal impact with direct impact on current and future technologies, a possible increase in patents, and an important source of external funding.

Electronics group overall assessment

UiO Electronics is an established group, with demonstrated expertise in three distinct areas: acoustics, instrumentation for nuclear physics and space science and biomedical electronic technology. It is notable that the group refers to the umbrella term, “instrumentation and sensor technology”, to encompass their research and research-advised educational activity, where the ambition is to perform on an international level.

The wide range of topics of the research group activities raises the challenge of critical mass to create significant impact in all of them. This however is partly compensated by strong cooperation with a top international institute (CERN) and several industrial partners.

It is encouraging to see the UN Sustainable Development Goals acknowledged in the benchmark used by UiO Electronics. This highlight adds positively onto an already strong research environment.

High Energy Physics group overall assessment

The high energy physics group at the University of Oslo is an internationally recognised leader in experimental particle physics, scientific computing, and instrumentation. As one of Norway's largest particle physics groups, the group plays a significant role in the ATLAS and ALICE experiments at CERN's LHC and contributes to smaller experiments world-wide. The group has accomplished a successful scientific record with well-established connections to industry and contributions to nationally visible outreach and science communication efforts.

The group also offers research-based education and training to young researchers. This training offers visibility at CERN for these early career researchers and supports and encourages in funding applications. Additionally, the group has successfully applied knowledge and technology from basic research to industry applications. With a team of six professors, over eight researchers, three Postdocs, and three engineers, and for the field a balanced contribution of traditionally underrepresented groups in this field, the group is well-equipped to achieve its ambitious research goals and should be looking forward towards studies on future colliders.

Nuclear and Energy Physics group overall assessment

The University of Oslo Department of Physics Nuclear Science and Energy group, and its activities at the Oslo Cyclotron Laboratory, is an exceptionally strong program that deserves full recognition in the national assessment of research in natural sciences for its highest-quality contributions and potential for future excellence.

The group’s leadership in fundamental nuclear science is complemented by its advances in radiation biology and medical applications of nuclear physics at Oslo Cyclotron Laboratory. They are currently leading a new national centre for nuclear research, part of Norway’s commitment to enhancing nuclear science.

The group has a clear strategy that has defined its niche and that is internationally recognised. There is substantial collaboration internationally, with other labs, with other universities, with industry. The scientific impact is high. The group has a well-defined organisational strategy that appears super effective and gives exposure in the university and research administration.

Plasma and Space Physic groups overall assessment

The group is one of the key pillars of the Department of Physics of the University of Oslo (UiO). The main research focus of the group, consisting of only two permanent academics, is the study of ionospheric dynamics, structuring, and space weather impacts in polar regions by means of ground-based (including Svalbord and Antrarctica) and in-situ observations (sounding rockets, ESA space missions, ISS) and modelling. The unique set of research facilities allows the group to be one of the major players in the field. The group's international profile contributes significantly to the international standing of the host institution. The group's research outcomes correspond to the solid international level in the field. The description of the research strategy is rather vague, especially considering the retirement of Professor Moen. The shortage of research active permanent staff is partly compensated by well-developed international research links, in particular, by exploiting mobility opportunities. The group has a successful history in attracting national and international external funding. At the institutional level, the group is supported by the interdepartmental 4DSpace initiative, and the instrument workshop and electronic laboratory. However, it is not clear whether the decrease in the number of academics will be compensated by new permanent academic positions.

Semiconductor Physics group overall assessment

The SPG group is a well stablished team with strong links to the academia and industry in Norway via the facilities that they operate: Micro and Nanotechnology Laboratory (MiNaLab) and their involvement in the Centre for Materials Science and Nanotechnology (SMN), as well as on the Norfab network. The group has an excellent level of competitive funding, and they can attract excellent PhD and master students. They are leading on semiconductors at national level and have a clear strategy to be attractive internationally.

Structure Physics group overall assessment

Many universities run an electron-microscopy facility, which is indispensable for the success in the entire area of material science. The 'STRUCTURE PHYSICS GROUP' is positioned in a similar way, and they perform this task very well. Their success in collaborative publications and acquired third-party funding shows this. The modernisation of infrastructure is an important step forward. However, the group must be careful that the future development does not extend to far in the direction of a service facility. There are some promising starting points, but a unique agenda is not expressed strongly enough. Considering the competition in electron microscopy, only a profile with distinct expertise and possibilities found nowhere else will secure that 'STRUCTURE PHYSICS GROUP' will remain as successful as they are currently.

Theoretical Physics Group overall assessment

The group members play a very important role in teaching, and some of the PIs are highly successful in outreach activities. The group is adequately organised given its size and the PIs have well-functioning international collaborations and contribute to collective efforts to code-development. The research is of medium to good international quality, which is a non-trivial achievement given the small size of the group.

The main challenge for this group is its small and shrinking size. In particular, the very small number of PhD students and postdocs makes it difficult to have a vibrant training environment for young researchers. A structured plan for future recruitments based on an ambitious, but still realistic, scientific strategy will likely be necessary to reverse this downward trend.

2.2 Open Science

Of the papers published by the administrative unit, 80-90% are open access (OA), which is a good number. The fraction of Gold OA and Green OA has increased in the past 10 years. Data from the high energy experiments are released according to the policy of CERN and for the nuclear experiments via the IAEA database. Software is made OA by platforms like GitHub. Educational material is accessible at the site www.viten.no.The administrative unit does not have policies concerning ownership, management, and confidentiality of data beyond those of UiO centrally.

The University of Oslo (UiO) has an open access policy stating that research data shall be made openly available, on equal terms, provided there are no legal, ethical or security reasons not to do so. The University Library regularly gives guidance and holds courses about Open Access publishing and open access to research data.

The educators have access to Canvas commons for making their educational materials openly available and where they can access teaching material.

Projects with Plan S requirements have their publications made openly available immediately when published. An increasing amount of research data is made publicly available, e.g. data from LHC experiments at CERN, which release so-called level 3 data approximately 5 years after collection, or data from nuclear physics experiments at the Oslo Cyclotron which are made publicly available through IAEA databases.

When signing a work contract with UiO, the employee simultaneously accepts the agreement on the acquisition of rights to work results with a commercial agreement. The agreement entitles UiO to acquire all rights (right of ownership) to work results with potential for commercial exploitation produced by the employee, and the employee has a right to remuneration from UiO.

The University of Oslo has a research data management policy that employees are expected to follow. This includes guidelines on open-access, archiving, publication of the data, metadata, data management plans, and licenses.

The university has a data storage guide that informs employees of where they can safely store different types of data. The university has also developed a service for sensitive data (TSD) where researchers can collect, store, and analyse sensitive research data in a secure environment.

3. Diversity and equality

In addition to the UiO documents about gender equality, the faculty of Mathematics and Natural Sciences (MN) had an action plan for equality gender balance and diversity for the period 2019-2020. It is not clear if this has been updated recently, and it is also not clear if the administrative nit has implemented the points in the old action plan. In particular, the plan “proposes a model where the institutes in time will design their own actions based on local needs, in addition to those given in this plan”. It is not clear if the administrative unit has acted on this. Although the UiO’s Action plan for diversity, equality, and inclusion 2021-2024 mentions “gender, ethnicity, functional ability, gender identity, sexual orientation, socio-economic background, age, religion, and other factors relating to the individual” in practice the administrative unit seems to only consider gender equality.

UiO students and employees are encouraged to report any censurable condition or behaviour they experience or witness through the "Speak Up"-system (procedures for notification). UiO offer skill development measures for administrative staff that handle these reports.

4. Relevance to institutional and sectorial purposes

The administrative unit rightly stresses both research, education and outreach and emphasises the importance of basic research for building a strong knowledge base in the Norwegian society. In addition, the administrative unit provides several specific important contributions to the society in areas of radiation therapy, radiation safety, energy research, sustainability, and space weather forecasts.

In 2021, the MN and Medical faculties established an internal innovation unit, UiO Growth House, which will contribute to a stronger innovation culture knowledge transfer. They help researchers and students to mature early-stage ideas, provide tailored counselling, seed funding, meeting places, innovation mentor program, student internships and more. Later stage innovation projects will be supported by the Tech Transfer Office at the University of Oslo – Inven2, for further commercialisation through license agreements and spin-off companies. This support includes patenting process and business development. Adjacent to the university campus is also the Science Park with its incubators for new start-ups; StartupLab – technology start-ups, Aleap for health start-ups and Sharelab, a biotech lab incubator for academics, start-ups, and industry.

The administrative unit presents a nice list of patented innovations in the above areas as well as a method to produce bio-cement and a spin-off company that develop exploration tools for the gas and oil industry.

The administrative unit does not seem to have any coherent approach to commercialisation beyond what is provided by UiO centrally.

The administrative unit encourages several collaborative initiatives such as Njord (with Geoscience), SMN (with chemistry) and CCSE (education). The Norwegian CERN groups are joined in a national centre, and a similar structure is being built in quantum science and technology. There are also many partnerships with research institutes, public health providers and industry in several different areas.

The research in the administrative unit has a healthy collaborative profile both nationally and internationally, and with actors both in the public and the commercial domain.

The master’s and PhD students have good, research integrated education, and according to the young researcher survey students, they are mostly satisfied with the research and knowledge acquired at the AU. It is not far-fetched to assume that this might be related to the extensive research in didactics.

5. Relevance to society

The administrative unit rightly stresses basic research and education as the main societal impact of a university, and that this impact often is felt long after the basic discoveries were made. For example, in the late 1970s a theoretical physicist at UiO discovered that particles moving in two dimensions can have very surprising quantum mechanical properties. This insight has been crucial for many current approaches to robust quantum computing. Today the administrative unit is building

competence in quantum science that might not be applied or commercialised in the coming years, but it is impossible to predict what will happen in 50 years.

The administrative unit presented four "impact cases" (see below) which illustrates recent and current activities with a large societal impact. Of these presented cases, two are related to education and outreach, and two are related to practical applications of physics research done at the administrative unit. That the work of the Physics Education group has impact on education is to be expected, but the committee was impressed by the large outreach effort made by the HEP group.

Perhaps the most impressive of all the cases is the work in the Biological and Medical physics group, working to develop technics for and facilitate implementation of cancer therapy based on proton beams. The societal value of this work is unquestionable.

Another potentially very important area is the research on space weather where the Plasma and Space physics group provides both theoretical and technical experience. Particularly important have been the development of the Langmuir probes that are launched on rockets to measure plasma properties.

Overall, the administrative unit gives important contributions both to short and long-term societal goals.

Comments to impact case 1: Bringing the discovery of the Higgs boson to classrooms and lay audiences worldwide

The members of the HEP group are active in the ATLAS collaboration and one of them played an important role in the discovery of the Higgs particle. The group has used this expertise to engage themselves in the international Masterclasses in particle physics and have taken part in developing the "Z-path" package, which gives the student hands-on experience with particle physics data analysis. The have also taken active part in outreach activities in Oslo and produced a YouTube video about the Higgs particle.

All research groups are supposed to engage in outreach activities, but the Evaluation Committee thinks that what is done in the UiO HEP groups is commendable and "beyond the call of duty".

Comments to impact case 2: Space Weather Products for the Arctic Regions

Space Weather impacts society, as it is highly dependent on satellite-based communication, navigation, and related services. In the Arctic, it the formation of irregularities in ionospheric plasma density and the consequent disturbance of trans-ionospheric radio signals. This can severely impact the performance of systems relying on satellite signals, such as the Global Navigation Satellite Systems (GNSS), which include the commonly used GPS system. When disturbances are strong, the GNSS positioning may become unavailable.

The Plasma and Space physics group at UiO has developed models for the space weather forecasting, and in collaboration with the Electronics group it has developed instrumentation for in-situ measurements of plasma irregularities. Of particular importance has been the multi-needle Langmuir probes that have been flown on many rocket missions from the USA and Japan and are currently being flown on satellites (Norsat-1, Brick-II), mounted on a lunar rover, and will also be installed on the International Space Station in the spring of 2023.

Clearly this is research of large potential benefit to the society. If and/or when reliable predictions about coming disturbances to global communication and positioning services become available, it would make it possible to take preventive measures. This work involves both a collaboration between groups in the administrative unit and with external international partners.

Comments to impact case 3: Developing learning resources, investigating student learning and teacher professional development in modern physics

The Physics Education group gives a description of their work which includes developing online learning resources in relativity and quantum physics as well as research on teaching and development of strategies and resources for teacher training. This must be considered as the core activity of such a group, and as such does not really fit under the title “impact case”, which for the other groups are used to illustrate how their core research in physics also have societal benefits. Nevertheless, this core activity is of course of value to the society and is very likely also very good for the teaching in the administrative unit.

Comments to impact case 4: Introduction of proton therapy in Norway

Researchers in the bio- and medical physics group have been advocates for proton cancer therapy for decades, and today we see how this vision is put into practice.

It is a very impressive story that involves both close collaboration between groups within the administrative unit (bio-med physics, nuclear physics, and HEP), with regional hospitals and with an impact on the national strategy for proton therapy. The societal benefit of improved cancer therapy is obvious, and the administrative unit plays a central role in this technology.

List of administrative unit´s research groups

Institution	Administrative Unit	Research Groups
University of Oslo - Faculty of Mathematics and Natural Sciences	Department of Physics	Biophysics and Medical Physics
		Electronics Research Section
		High Energy Physics
		Nuclear and Energy Physics
		Condensed Matter Physics
		Plasma and Space Physics
		Physics Education Research
		Semiconductor Physics
		Structure Physics
		Theoretical Physics

Methods and limitations

Methods

The evaluation is based on documentary evidence and online interviews with the representatives of administrative unit.

The documentary inputs to the evaluation were:

- Evaluation Protocol (see appendix 3 Evaluation Protocol) that guided the process
- Terms of Reference
- Administrative unit's self-assessment report
- Administrative unit's impact cases
- Administrative unit's research groups evaluation reports
- Bibliometric data
- Personnel and funding data
- Data from Norwegian student and teacher surveys

After the documentary review, the Evaluation Committee held a meeting and discussed an initial assessment against the assessment criteria and defined questions for the interview with the administrative unit. The Evaluation Committee shared the interview questions with the administrative unit two weeks before the interview.

Following the documentary review, the Evaluation Committee interviewed the administrative unit in an hour-long virtual meeting to fact-check the Evaluation Committee's understanding and refine perceptions. The administrative unit presented answers to the Evaluation Committee's questions and addressed other follow-up questions.

After the online interview, the Evaluation Committee attended the final meeting to review the initial assessment in light of the interview and make any final adjustments.

A one-page summary of the administrative unit was developed based on the information from the self-assessment, the research group assessment, and the interview. The administrative unit had the opportunity to fact-check this summary. The administrative unit approved the summary with some adjustments regarding staff and research topics of the various groups.

Limitations

The Evaluation Committee judged the information received through documentary inputs and the interview with the administrative unit generally sufficient to complete the evaluation.

Appendices (link to website)

1. Description of the evaluation of EVALNAT
2. Invitation to the evaluation including address list
3. Evaluation protocol
4. Self-assessment administrative units
5. Grading scale for research groups

Website: https://www.forskningsradet.no/tall-analyse/evalueringer/fag-tema/naturvitenskap/

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Publikasjonen kan lastes ned fra
www.forskningsradet.no/publikasjoner

Design: [design]
Foto/ill. omslagsside: [fotokreditt]

ISBN 978-82-12-04007-6 (PDF)