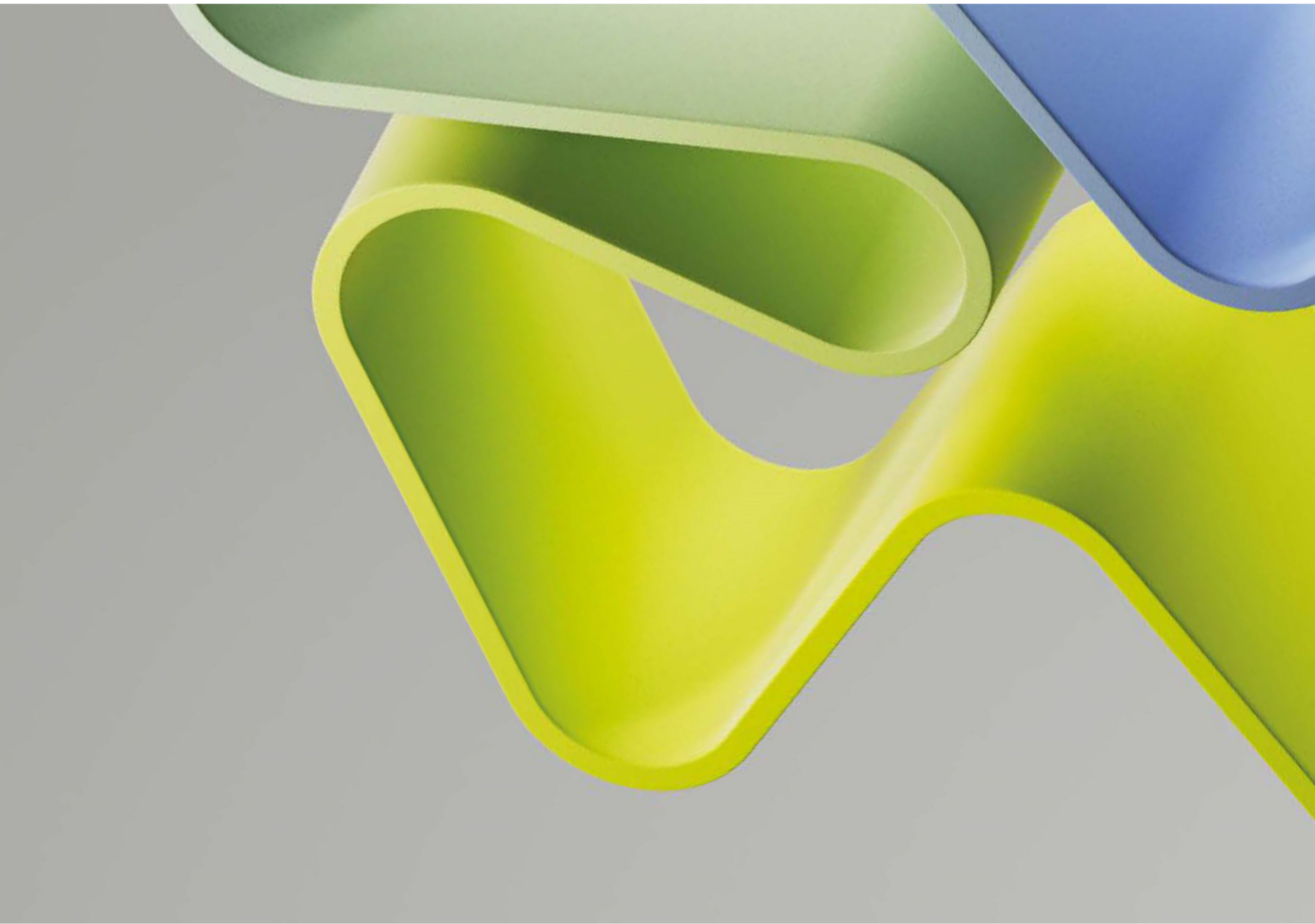
Evaluation of Natural Sciences 2022-2024

Evaluation report

University of Bergen

Department of Physics and Technology (IFT)

January 2024



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Statement from Evaluation Committee I

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 Evaluation Committee members has declared any conflict of interest.

The Evaluation Committee has consisted of the following members:

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Description of the administrative unit

The Department of Physics and Technology (IFT) at the University of Bergen (UiB) is driven by a twofold mission: to pursue fundamental research driven by curiosity and to advance knowledge in applied physics and technology. IFT strives to balance basic and strategic research, seizing funding opportunities to further endeavours. IFT aims to maintaining an equilibrium between fundamental research, applied research, and technology development. IFT researchers participate in in-house scientific investigations, bi- and multilateral projects with external partners, and large-scale collaborations like CERN and EISCAT, ensuring diverse activities. Furthermore, IFT emphasizes maintaining a blend of theoretical and experimental physics.

The composition of the research staff at the institution is skewed towards the higher end of the age distribution, with 27 professors and 16 associate professors. The average age of the professors is 55, and 19% fall within the 65-70 age group. The number of postdocs and students totals 59, comparable to the combined count of faculty and senior scientists at 64. Regarding gender representation, the overall presence of females in the research staff is relatively low. However, it is worth noting that there is a significant proportion of female associate professors, accounting for 44% of the total, but their full-time equivalent (FTE) is relatively small.

UiB ‘s main strategy plan is important for the entire university. The university's priority areas encompass Marine Research, Climate and Energy Transition, and Global Challenges. At IFT, several activities align with UiB's strategic goals, including the SFI Smart Ocean initiative, the research endeavours of the Reservoir Physics and the Energy and Process Technology groups (not evaluated here), and IFT's research training programs aimed at developing countries.

The research conducted at IFT is organised into distinct groups. These include Energy and Process Technology, Microelectronics, Nanophysics, Ocean Technology with its subfields of Acoustics, Measurement Technology and Instrumentation, and Optics. There is also the Reservoir Physics group, Energy Technology and CO_2 Storage (CCUS), Energy and Process Technology, Space Physics represented by the Birkeland Centre for Space Science (BCSS) and the Space Plasma Physics Group (SPPG), Subatomic Physics encompassing Nuclear, Medical, and Particle Physics, and Astrophysics. Each group contributes to the diverse research landscape at IFT.

Subatomic Physics
The area of subatomic physics encompasses a broad range of research, including particle physics, astrophysics, nuclear physics, medical physics, and the microelectronic group. This field is represented by a team of 6 professors, 7 associate professors, 6 researchers, 6 postdocs, and 3 engineers. Notable experiments conducted in this area include ATLAS, ALICE, proton-CT, and others in the field of medical physics.

Theoretical Physics
Theoretical physics is a multidisciplinary area of research that spans atomic, nuclear, and particle physics, molecular dynamics, energy and sustainability, and novel energy sources. The main collaborative contribution of this group is the development of numerical modelling. The group was established in 2019 and currently has no postdocs.

Nano Physics
The Nanophysics group focuses on experimental research within several fields such as renewable energy, material science, medicine, nanotechnology. The research is both in applied science and basic research, often with an interdisciplinary twist. The group is hosting and collaborating in international

and national research projects, and has several projects with industry partners and non-academic institutions. The Nano group was established 7 years ago and comprises 15 members.

Space Physics

The SFF Birkeland Centre has provided strategic partnerships with IFT in space physics over the past decade. It is expanding collaborations with the microelectronic groups and other teams within IFT to extend participation in new space instrumentation projects. The Space Physics group is organised into four teams, each focusing on different research questions. The group plans to continue its involvement in projects with the European Space Agency (ESA).

Ocean Technology

Ocean technology encompasses a multidisciplinary area of research that involves three groups with acoustics, optics, and instrumentation expertise. These groups have an international profile. The area is represented by a team of 3 professors, 2 associate professors, 1 researcher, 4 postdocs and 2 engineers. Notable activities include SFI Smart Ocean, SFI CRIMAC, SFI Michelsen Centre and the 5-year ocean technology integrated master program.

Overall assessment

The Department of Physics and Technology (IFT) has a dual focus: embrace aspects of fundamental curiosity-driven research and enhance expertise in applied physics and technology. IFT aims to maintain an equilibrium between fundamental research, applied research, and technology development, leveraging funding opportunities. Additionally. IFT actively engages in both in-house science and large-scale scientific collaborations such as CERN and EISACT, ensuring a well-distributed range of activities. Moreover, IFT endeavours to seek a harmonious blend of theoretical and experimental physics.

The research conducted at IFT is organised into distinct groups. These include Energy and Process Technology, Microelectronics, Nanophysics, Ocean Technology with its subfields of Acoustics, Measurement Technology and Instrumentation, and Optics. There is also the Reservoir Physics group, Energy Technology and CO2 Storage (CCUS), Space Physics represented by the Birkeland Centre for Space Science (BCSS) and the Space Plasma Physics Group (SPPG), Subatomic Physics encompassing Nuclear, Medical, and Particle Physics, and Astrophysics. Some of these groups are further subdivided. A chair leads the department, and the head of the group leads each group and subgroup. The overall activities and research strategy of IFT is determined by each group interests and funding opportunities.

In the past 10 years, the Birkeland Centre for Space Science has been a driving force in the department enabling active participation in several new space instrumentation projects.

IFT is committed to research and education across various disciplines and fields. The department's main strength lies in its broad science scope but given the limited resources and relatively small size of some research groups the scope needs to be periodically reassessed. The quality of the research groups being achieved is widely different.

Within IFT, several research groups explore innovative concepts with potential commercial outcomes. Some groups have a longstanding tradition of collaboration with industry, demonstrating a good level of engagement. The department is heading the Centre for Research-based Innovation on Ocean Technology, bringing together industry partners, research institutes, and universities on projects relevant to industrial needs.

Furthermore, the success of experimental research at IFT heavily relies on accessible infrastructure. Many newer groups benefit from superb local infrastructures, and others rely strongly on international infrastructures. Both will continue to be indispensable for the future research of IFT and their support should be continued.

In addition, IFT has a relatively large engineering staff working closely with the research groups and a suitable mechanical workshop that engineers and scientific staff work closely together to develop tailored mechanical solutions for research activities. This is a major asset that should be maintained.

IFT hosts an integrated physics master's program and a master's program in Ocean technology. Furthermore, IFT actively contributes to teaching in various programs outside its department.

According to the student survey, IFT students reported the lowest research and development experience level. However, IFT ranked in the middle regarding the knowledge of scientific methods in research acquired by students. Although some concerns, such as gender balance, recruitment and retention of personnel, aging buildings, and lack of research synergy, are shared across all areas, each research group faces unique challenges.

The research groups at IFT are regularly facing negative consequences due to export regulations. This is impacting the recruitment of young scientists, hindering scientific exchange, and potentially diminishing Norway's appeal as a research destination.

The 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 Committee to reach a view.

Recommendations

1. IFT needs a more strategic oversight to create a coherent research plan among the groups for short-, medium-, and long-term planning. Given that that the average age of IFT staff is 55 years and that there are a couple of new hires envisioned, planning towards strengthening weaker areas is strongly recommended.
2. All research groups at IFT are relatively small. Recent consolidation of some groups showed to be beneficial. IFT should consider restructuring the groups around a topic of common expertise.
3. IFT should continue with its strategy to increase the number of ERC proposals submitted. Research in many of the groups is very dependent on external funding. The institute should have contingency plans for how they would handle possible changes in the Norwegian research funding system and be more opportunistic in seeking funding.
4. One of the challenges IFT faces is the declining number of incoming master's students due to a decrease in the overall number of students specializing in physics in upper secondary school. This threatens the department's ability to attract and educate future talents. Maintaining and increasing the level of outreach is imperative as well as continuing to attract talent from around the world.
5. Enhance the research experience among PhD students and postdocs, promoting diversity, organising workshops and conferences, mentoring students, and postdocs for future careers.

The Evaluation Committee agrees with these specific points made by the different Research Panels:

The subatomic field should prioritize the training and education of young researchers. While CERN-related activities are well-established, developing a comprehensive plan that extends beyond the High-Luminosity Large Hadron Collider (HL-LHC) is crucial.

The Theory group currently carries a significant workload in undergraduate and graduate education and outreach activities. However, IFT needs to achieve a better balance in their teaching responsibilities. Additionally, the lack of a sufficient number of postdocs within the group is impeding their overall productivity. The group needs to come together and develop a cohesive research strategy that can enhance their chances of securing external funding.

The Nano group is experiencing significant growth and should proactively define a comprehensive global strategy for the next five years. The group must identify specific areas within the field to make substantial contributions.

The Space group should actively pursue collaborations with microelectronic groups and other relevant teams within the IFT to expand their participation in new space instrumentation projects. The group needs to develop a concrete plan to continue its involvement in projects with the European Space Agency (ESA).

To enhance synergy between the three clusters of expertise in Ocean research, it is crucial to establish a clear and long-term common research problem or goal that can drive collaborative efforts. This shared focus will promote effective collaboration and maximize the impact of research outcomes. While targeting interdisciplinary journals or conference papers is valuable, aiming for publication in top-tier journals is advisable.

1. Strategy, resources and organisation of research

The research and education at IFT encompass a broad range of disciplines and fields, spanning from nanoscale to astrophysics, with a focus on technology-oriented research and innovation. The research at IFT is organised into four main areas: subatomic, theory, nano, and space. While subatomic and space have been longstanding research areas at IFT since 1960, the others were established more recently. Each of these areas is further subdivided into specific research domains.

The relatively small size of most research groups makes them highly susceptible to funding fluctuations, posing a challenge to maintaining stable research activities. Despite this, IFT's strategy is centred around achieving a well-balanced allocation of resources, covering a range of research areas from fundamental to applied physics and from theory to experimental physics. However, this strategy faces obstacles in maintaining resource equilibrium. Funding allocation within IFT exhibits notable disparities across its various domains. European Union proposals enjoy a relatively higher success rate than national funding, which falls within the average spectrum. National funding primarily supports initiatives such as CERN and SFF Birkeland.

Given the expansive scope of research at IFT and the evolving funding landscape, IFT should monitor and reassess the organisation of research activities often.

All research areas at IFT are active and publish their work extensively. They actively participate in international scientific collaborations and engage with other research facilities. While research groups within IFT utilize national and international infrastructures, the latter is utilized more extensively. The institute's well-equipped facilities, including advanced laboratories, mechanical and electronic workshops, and clean rooms, contribute significantly to international initiatives and collaborations.

1.1 Research Strategy

UiB determines the main strategy plan and the priority areas as Marine Research, Climate and Energy Transition, and Global Challenges. Some of the activities at IFT align with UiB's strategic goals, such as SFI Smart Ocean, activities from the Reservoir Physics groups (not evaluated here), and IFT's research training programs in developing countries.

The research strategy for the different areas at IFT is primarily determined by the interests of the principal investigators (PIs) and faculty. While this provides a wide range of opportunities and interests, there is a lack of cohesiveness in the research plans within and across most areas.

The IFT's strategy prioritizes fundamental research driven by curiosity while enhancing expertise in applied physics and technology. The organisation aims to strike a harmonious equilibrium between funding for basic and strategic research and between fundamental research and the development of applied research and technology. The availability of diverse funding sources reflects this endeavour. Moreover, the IFT endeavours to strike a balance between conducting research in-house and collaborating on large-scale projects with entities like CERN and EISACT. It also seeks to find a balance between theoretical and experimental physics.

However, while this strategy is overarching and aspirational, it faces challenges maintaining a well-balanced allocation of resources between theoretical and experimental aspects. There is a noticeable struggle in securing adequate funding for fundamental research despite its significance.

1.2 Organisation of research

The research at IFT is organised into the following groups: Energy and Process Technology, Microelectronics, Nanophysics, Ocean Technology (Acoustics, Measurement Technology and Instrumentation, Optics), Reservoir Physics, Energy Technology and CO2 Storage (CCUS), Space Physics (Birkeland Centre for Space Science (BCSS), Space Plasma Physics Group (SPPG)), Subatomic Physics (Nuclear, Medical, and Particle Physics), and Theoretical Physics. Each group is subdivided into various research areas, as indicated in the parentheses above.

At IFT, a chair oversees the entire department, while a head leads each group, and certain groups may have subgroups with their respective leaders. The overall activities and research strategy of IFT are determined by the interests of each group and the available funding opportunities.

The research areas are diverse, likely reflecting historical strengths. All research areas are functioning well and actively publish their work. They also participate in international science and collaborate with other facilities. There is a consensus in both the self-assessment and expert panel assessment regarding the strengths, weaknesses, opportunities, and threats (SWOT) of IFT. The main strength identified is the broad scope of science, although this is also seen as a weakness due to the relatively small size of most research groups The research becomes highly susceptible to funding fluctuations due to this situation. While some concerns are common across all areas, such as gender balance, recruitment and retention of personnel, aging infrastructure, and lack of synergy across research areas, each area also faces unique challenges.

The research portfolio at IFT is designed to foster internal collaboration within strategic topics and areas of overlapping expertise. However, the current research groups face limitations in fully utilizing this collaboration, likely due to limited resources and small group sizes. Establishing the SFI Smart Ocean initiative has been a recent solution to address this issue, successfully bringing together four research groups and significantly enhancing overall research activities.

IFT's expertise in instrumentation, particularly in radiation sensors and readout electronics, plays a crucial role in supporting the experimental endeavours of diverse research groups, including subatomic physics, space physics, and medical physics. Exploring opportunities for synergistic activities in this domain holds immense potential for further advancement.

On the other hand, the theory group at IFT encompasses a wide range of interests, making it challenging to find a common topic of focus. This can hinder the group's ability to seek funding as a cohesive administrative unit. Given the expansive scope of research at IFT and the evolving funding landscape, it is essential to monitor and reassess the organisation of research activities continuously.

1.3 Research funding

The funding at IFT varies significantly across different areas. The large multi-year projects like SFF Birkeland Centre and SFI Smart Ocean allow IFT to achieve sustainability in terms of external funding.

CERN research and the SFF Birkeland centre has the largest national budgets. Notably, the Trond Mohn Foundation has provided significant support, with four starting grants obtained during the reporting period. The approval rate for NFR proposals has varied, averaging three projects awarded annually. The establishment of the SFF Birkeland Centre in 2013 has positively impacted the overall success rate of NFR projects, including National Research Schools and Young Research Talents (YRT). Additionally, IFT has secured relatively good innovation and industrial funding, with a notable shift towards low-carbon and sustainable energy solutions.

Regarding international funding, IFT has received the largest share from the European Space Agency (ESA). While the success rate for EU proposals is acceptable, the number of submitted proposals remains relatively low. However, IFT is strategically working to increase the number of proposals submitted, as exemplified by the recent achievement of the first ERC starting grant.

Subatomic physics has adequate funding, most of it coming from NFR through competitive funding. The groups' resources are diversified to ensure resilience against changes in the funding landscape. (Outputs for medical physics and astrophysics were not provided.)

The theory group has encountered difficulties obtaining external grants in the past decade. To address this, the group has initiated efforts to foster collaboration within the group. It has shifted its focus towards alternative areas such as energy physics, open quantum systems, and exploring new technologies. Moreover, the group is exploring the potential of transferring concepts from quantum plasma to laser technology.

The nano group has secured external funding through ERC and collaborations with companies. They lead European projects and express a desire to be part of Norfab.

The space group receives impressive funding from various sources, with about one project per year funded by ESA. Institutional support is strong, with two new faculty positions expected. The SFF Birkeland Centre has provided boosted support and resources. However, since the original funding for the centre ends in 2023, UiB has promised an extension in funding, which includes an associate professorship and a technical engineer for IFT.

The institution supports the ocean group well, especially in terms of infrastructure access.

1.4 Use of infrastructures

The research groups utilize some national infrastructures, but the international ones are more extensively employed. The facilities at IFT are well-equipped to contribute to international projects and provide advanced laboratories, mechanical and electronic workshops, and clean rooms. IFT strives to adhere to the FAIR principles.

The subatomic research group relies mainly on CERN as it is involved in the ATLAS and ALICE experiments. Activities in these experiments span from instrumentation and software development to data analysis. In general, CERN-related activities are well established. Space research has profited extensively from the SFF Birkeland Centre, providing strategy partnerships with IFT. The nano groups have very good infrastructure, translating to being at the forefront of their field and leading several European projects. The institution supports the ocean group regarding standard facilities and has generated instrumentation used elsewhere, which has widened its access to infrastructure.

1.5 National and international collaboration

Collaboration with international projects is evident across all areas, whereas the level of collaboration at the national level is less apparent. This distinction is also supported by the NUFI plots, which illustrate the involvement of both international and national co-authors in research publications. Notably, CERN is a central hub for collaboration, while locally, the SFF Birkeland Centre and the Smart Ocean offer unique infrastructure and actively foster collaborative efforts.

IFT is discussing future involvement with CERN beyond LHC. They are currently involved in the upgrade of ALICE (ALICE 3) and have schedules and R&D plans that go up to 2040. However, the current funding ends in 2027, and will need to apply for new funding in the next 4 to 5 years.

Additionally, an extensive list of project-based collaborations with various institutes and companies highlights a strong emphasis on cooperation and partnership.

As a result of the international activities, 86 % of the administrative unit's publications between 2019 and 2021 were co-authored with international collaborators, which is above average for Norwegian universities in the natural sciences (71 %).

While mobility is briefly mentioned, specific numbers are not presented to assess the health of the mobility program at IFT.

IFT faces several challenges in attracting and retaining staff. One prominent challenge is the negative impact of export regulations on certain research groups, which has resulted in adverse consequences. These consequences include difficulties recruiting young scientists, hindering scientific exchange, and potentially diminishing Norway's appeal as a research destination.

1.6 Research staff

The composition of the research staff is skewed towards the higher end of the age distribution, with 27 professors and 16 associate professors. The average age of professors is 55, and more than 20% of professors fall within the 65-70 age group. The number of postdocs and students (59) is comparable to that of faculty and senior scientists (64).

Overall, the representation of females in the research staff is relatively low. It is worth noting, however, that there is a significant proportion (44%) of female associate professors, although their full-time equivalent (FTE) is relatively small.

There is a plan in place to support the careers of postdocs, which includes the mandatory establishment of a career plan in collaboration with their supervisor. This proactive approach helps provide guidance and structure for postdocs' career development.

The most recent national student survey indicates that IFT students have reported the lowest level of research and development experience. However, concerning the knowledge of scientific methods students acquire, IFT ranks in the middle. This situation calls for thoroughly examining and implementing relevant initiatives to address these concerns.

Another challenge is the declining number of incoming master's students, primarily caused by a decrease in the overall number of students specializing in physics in upper secondary school. This decline directly threatens the department's capacity to attract and educate future talents. While the first challenge lies beyond the control of IFT, the second challenge necessitates increased efforts in outreach activities and initiatives to address this issue.

2. Research production, quality and integrity

IFT is a singular institution with much ambition to tackle essential questions from fundamental to applied physics. Space, Subatomic, and theory are considered curiosity-driven and have maintained their reputation and impact. Nano and Ocean are new and have revitalized IFT and added new funding sources. All areas have a strong connection with international collaborations and with companies. Overall, all groups are following a strategy mainly driven by their interests and have been doing well as the research group reports rank them.

The subatomic physics group has leading roles in CERN ATLAS and ALICE experiments, with over 1500 publications in the last ten years. The Space group with SFF Birkeland Centre has produced over 400 publications in the last ten years (Impact case 1). Except for the first one, the most cited publications are with the ATLAS collaboration.

The overall productivity of the publication of IFT has remained stable in the past ten years. The author-share per FTE seems to be decreasing in the past years – and should be monitored. The publications coming from IFT demonstrate a strong international collaboration, with 86% having international co-authors. Additionally, IFT has the highest percentage of publications with national co-authors (63%) compared to the other evaluated administrative units.

Publication statistics show higher than average productivity (author shares per FTE averaged over 2019-2022): 1.23 for women and 1.33 for men, compared to averages of 1.0(W) and 1.13(M) for the administrative units included in this evaluation. However, the impact of publications is somewhat below the average: mean normalized citation score (MNCS) score of 90 and a 7% share of the 10% most cited publications.

2.1 Research quality and integrity

Nano Physics research group overall assessment:

Given its size (15 people all together), the Nanophysics group has a very good research output, good relevance to the institution and good societal impact. The group is very well organised with monthly meetings. They have access to excellent equipment and more important, they are able to develop original characterization techniques and materials deposition systems ensuring to the group a leading position when it comes to applying for funding of publications. On both fronts the group is doing very well. Overall, this group is on a growing trajectory and the expert panel expects that with proper support, they can have very high impact in Norway and worldwide.

Ocean Technology research group overall assessment

The UiB Ocean Technology Group offers a strong and sustainable research environment. The group demonstrates a good balance between theoretical and experimental expertise, while retaining the potential to enhance either side as required by the research projects in their active portfolio.

The main goals and objectives of the group are a close reflection of the institutional benchmark and are aligned well with national strategies. In particular, the group has focused on excellence in research and innovation, as well as impact on society and education advised by their research expertise. The group’s self-assessment indicates substantial success in achieving these goals in terms of quantitative and qualitative indicators.

Compared to other similar national and international players, the group has generated good examples of best practice in the Electronics and Optics area and is a strong contributor to the research landscape in these areas.

Space Physics research group overall assessment

The group is well structured and productive and should be capable of continuation after the coming end of the Birkeland Centre within which it lies. However, it is clear that the group is strengthened by being within the larger organisation and that it contributes to the success of the Centre. Efforts should be extended to continuing this structure. The evidence provided in the self-assessment document could be a strong argument for further research grant and contractual support.

Subatomic Physics research group overall assessment

The Subatomic Physics Group in the Department of Physics and Technology (IFT) at the University of Bergen is playing leadership roles in fundamental nuclear and particle physics with a new research effort is Astro-particle physics. The IFT has a significant role in the ATLAS and ALICE experiments at CERN's LHC. They are responsible for providing detector components, participating in data collection and analysis, and contributing to interdisciplinary applications. The group also offers research-based education and training to young researchers. It encourages them to apply for funding for subatomic, medical, and Astro-particle physics research projects.

The group has successfully applied knowledge and technology from basic research to medical applications. It has presented its research to the public on cancer therapy, nuclear disarmament, and nuclear energy. With a team of six Professors, six Researchers, six Postdocs, seven Associate Professors, and three Engineers, the group is well-equipped to achieve its ambitious research goals. However, in the provided self-assessment, a stronger focus could have been laid on the training and education of PhD students and postdocs and how the group can further the career development of their academic and research staff members.

Theoretical Physic research group overall assessment

The group is adequately organised given its size. The PIs have well-functioning international collaborations and contribute to collective efforts in code-development. The research is of medium to good international quality, which is a non-trivial achievement given the small size of the group.

A serious problem is the absence of postdoc which makes it difficult to have a vibrant training environment for young researchers. The group lacks a plan for future recruitments based on an ambitious, but still realistic, scientific strategy.

Since the group does not specify any specific strategy beyond producing high quality research in the areas of the PIs, it is hard to assess goal achievements.

2.2 Open Science

Open science is well integrated. Policies are set at the UiB level and by funding agencies. Open access is clearly being considered as the fraction of gold OA and green OA has increased in the past 10 years.

While 86% of the publications are OA, the last 3 years show that the not-OA has increased to 13%. This should be monitored.

3. Diversity and equality

The policies in place to ensure and monitor integrity are standard. However, it should be noted that the link to the diversity and inclusion plan for 2019 currently needs to be fixed, which hinders access to critical information.

In the diversity practices section, specific actions are mentioned, such as establishing a committee within the faculty to encourage female applicants for academic positions actively. Additionally, there is an emphasis on having both male and female experts on evaluation committees, such as those responsible for evaluating PhD theses. These actions demonstrate a commitment to promoting diversity and inclusivity within the department.

There have been newly introduced gender balance initiatives in the administrative unit, such as the GenderAct program. Part of this program stipulates that positions can only be announced if a qualified female candidate is included. It was implemented at UiB just two years ago. While there has been an increase in personnel, there is no clear trend in the representation of women. Although the number of female PhDs is above average, there has been a negative trend in female Postdocs since 2016/17, when the university began requiring Postdocs to teach without remuneration. Currently, female Postdocs make up 7.5% of the total. Among the faculty, there is a significant proportion of women working part-time in terms of FTE, primarily influenced by several women in adjunct positions, particularly in the field of medical physics.

Additionally, the process also includes various dimensions of diversity. Given the political situation, recruitment and collaboration with people from outside the EU have been hindered in the past years. Some of the research on IFT is categorized in list 2 (dual use) for developing nuclear weapons. The inability to hire people outside the EU has hampered some of IFT's research, with some projects being three years behind schedule.

4. Relevance to institutional and sectorial purposes

IFT stands out as a unique department that combines the pursuit of scientific curiosity with the goal of finding innovative solutions to society's challenges. This approach is effectively articulated and utilized through the enhancement of fundamental knowledge and the promotion of innovation. Strengthening the theory sector would complement these areas of focus.

The self-assessment description is generic, but there have been excellent contributions in specific areas of great importance for society, such as clean energy and CO_2 capture.

IFT has a well-defined strategy for commercialization, working closely with the technology transfer office at UiB and actively monitoring the progress of projects. The university is proactive in supporting early-phase innovation and closely monitors the outcomes. There have been numerous successful examples of innovation and commercialization.

The Ocean Tech group has reported nine patents (refer to the RG report). In Impact case 2, it is highlighted that the industry has adopted its technologies for carbon-neutral natural gas production and increased CO_2 storage. These achievements demonstrate the tangible impact of their work.

5. Relevance to society

IFT has significantly contributed to training and education, supporting 129 PhD students during the specified period. Their efforts have greatly expanded our understanding of the fundamental nature of the universe, upper atmosphere, and space. Additionally, IFT hosts a new master's program in Ocean Technology and an integrated physics master's program. Furthermore, IFT actively contributes to teaching in various programs outside its department.

In addition to their educational efforts, IFT has played a crucial role in developing technologies to reduce carbon footprint and address climate-related challenges. Their dedication to fully harnessing the potential of PET technology for improving cancer treatment is commendable.

The department has also made numerous contributions to fundamental physics and applied research, particularly in addressing critical societal challenges such as the environment (as evidenced by their involvement in the SFI Smart Ocean initiative) and advancing our knowledge of the upper atmosphere (seen in the Birkland Centre). While several excellent examples are mentioned in self-assessment and impact cases, there is room for improvement in quantifying their impact. For instance, impact case 3 focuses on improving fish abundance measurements, and case 4 centres around flow meters. While the work is outstanding, it remains to be seen what the adoption rate of the technology is and the estimated financial impact for Norway and globally. It is worth noting that the theory group within IFT is also actively engaged in energy research and sustainability, as highlighted in the Theory research group report.

Comments to impact case 1: Birkeland Centre for Space Science

The BCSS (Birkeland Centre for Space Science) was established in 2013 due to a strategic investment by the Institute for Physics and Technology, with significant resources allocated to support the initiative. The centre also benefited from an ERC Advanced Grant and its involvement in the ASIM mission, supported by the Norwegian Space Agency. These activities were instrumental in the successful establishment of BCSS. The centre has demonstrated the value of stable, long-term funding, delivering outstanding scientific results, disseminating them widely, and supporting the national space industry. BCSS has played an international role in space physics, inspiring and supporting large initiatives and projects. The impact of the ASIM mission has been so positive that it has been extended until at least 2025. The collaboration between BCSS and the microelectronics group has helped the Norwegian industry enter international space projects. The centre has also significantly contributed to education, outreach, and dissemination activities, enriching society through popular science publications, online presence, public events, media coverage, and collaborations with organisations such as the European Space Agency and the American Geophysical Union.

Comments to impact case 2: Carbon-neutral society

This impact case is about the global challenge of transitioning to a carbon-neutral society, emphasizing the need for affordable, low-risk technologies with high public acceptance. The work focuses on developing, demonstrating, and verifying technologies that reduce the carbon footprint of fossil fuels, enhance underground CO2 storage, and promote sustainable energy production. They bridge the gap between research, technology development, and demonstration in Carbon Capture, Utilization, and Storage (CCUS). This research has significant impacts on the scientific community, industry, and government officials working on global energy security and climate change. They've successfully demonstrated technologies for carbon-neutral natural gas production, increased CO2 storage in economically viable processes, and contributed to international networks and education. Their current strategy involves conducting large-scale field pilots to encourage industry adoption and mitigate climate change, with a focus on Europe and India. They aim to transfer knowledge for maximizing oil recovery and CO2 storage on the Norwegian Continental Shelf while minimizing costs.

Comments to impact case 3: Fishery industry

Norway's fisheries industry, second only to oil and gas, relies on echosounders for accurate stock assessments and resource management. However, non-linear distortion and finite amplitude sound propagation have introduced errors in fish abundance measurements. The Institute of Marine Research (IMR) and Kongsberg Maritime AS (KM) developed a theoretical framework to manage these errors during echosounder calibration and surveys, improving accuracy and species identification. This framework benefits resource management, quota allocation, and international regulations, keeping Norway at the forefront of fishery research. Ongoing work by the UiB-IMR-KM consortium seeks to enhance echosounder technology. It has significant implications for marine research, national authorities, the fishing industry, and organisations like the International Council for Exploration of the Seas (ICES) in Copenhagen.

List of administrative unit´s research groups

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

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

After the online interview, the 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 added to the summary some details on the individual research groups.

Limitations

The 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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