KoF/ÖB 2024

Faculty of Science and Technology

Research Program Self-Evaluation

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| Research Program: | Theoretical Physics |
| Department: | Department of Physics and Astronomy |
| Section: | Physics |
| Program Responsible Professor: | Maxim Zabzine |

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| **Goals:*** Maintain and strengthen our **research quality**
	+ Through program and department self-reflection on strengths and weaknesses
	+ Through developing program and department priorities for the next 5 years
	+ Through internal and external feedback on our performance and plans
* Strengthen our **collegial culture**
	+ By involving all research staff in the process and ensuring everyone is aware of the results
	+ By being respectful of everyone’s time at the faculty, department, and program levels
	+ By communicating clearly as to why we are doing this and how we expect everyone to contribute
* Improve our **internal understanding**
	+ By collecting information on the different ways programs and departments are funded and operate
	+ By collecting explanations of why we work that way and how it supports our research
* Improve our **resource usage**
	+ By generating bottom-up prioritized research plans at the program, department, section, and faculty-levels
	+ By allocating and re-allocating resources based our priorities and the potential to significantly improve research
	+ By identifying opportunities for intra- and inter-program/department/section collaboration and re-organization
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**Introduction**

Be sure to regularly [check the faculty KoF24 and ÖB webpage](https://www.uu.se/medarbetare/fakultet/teknisk-naturvetenskapliga/utvardering-av-fakultetens-forskning---kof) for updates, clarifications, details, timelines, and answers to common questions.

**Background on KoF and ÖB**

This evaluation combines two processes: the university-wide Quality and Renewal (KoF) process and the faculty-level Review of Base Financing (ÖB). These are being combined to avoid significant duplication of effort. However, they have different goals which makes combining them a challenge. For example, the first three goals above are KoF-focused while the last is ÖB-focused. Most importantly, KoF is a reflective process where we strive to identify both our strengths and weaknesses, while ÖB is an evaluative process where we strive to identify the best opportunities for using our resources.

This causes an inherent concern: will admitting to weaknesses in KoF make us less likely to get resources from ÖB? While there is no way to completely eliminate this concern, this evaluation has been designed with the ÖB portion focusing on identifying Priorities to improve/strengthen/broaden research while the KoF portion focuses primarily on reflecting on our processes.

This provides the ability to be open about weaknesses while ensuring prioritization of high-quality ideas, as

1. Using Priorities allows us to identify concrete opportunities to improve our research, thereby allowing reflection on not just where we are currently excellent but where we can become better, and,
2. Using an internal, bottom-up prioritization process at the program, department, section, and faculty-levels allows us to identify the most promising and high-quality proposal for potential funding at each level.

**Expectations**

There is understandably a strong focus on the “new” funds that will be allocated as part of the ÖB process. However, these funds are small in comparison to the yearly budget, and the Faculty strongly encourages everyone to look to the four goals listed on the first page for the main value of this process. Please be aware that this report will be a public document and will be placed on the faculty website for all employees to access.

**Time period**

This evaluation pertains to the period since the last evaluation: 2019-2023 inclusive. Descriptions provided by the programs should cover the full evaluation period. However, centrally provided statistics on bibliometrics (2017-2021/2022) and financial data (2022-2023) cover slightly different time periods.

**Responsibility**

The Head of Department (HoD) has the overall responsibility for the department self-evaluations and the Program Responsible Professor (PAP) has the overall responsibility for program self-evaluations. This includes ensuring that the information provided is both sufficiently accurate and not misleading. It is important to be open, even about activities that are not as successful as we may wish.

The HoD/PAP is responsible for coordinating meetings with the appropriate people, collecting input, leading appropriately broad and inclusive discussions, prioritizing among suggestions, and summarizing and producing the final text. Most economic and HR data will be provided centrally, but for the information that needs to be collected locally, the HoD/PAP is responsible for coordinating with the appropriate people. The HoD is responsible for ensuring that the programs provide drafts to the department early enough that the department can use them as input to the department’s self-evaluation.

**Panels**

The panels will provide input on how programs and departments can improve, provide new perspectives on potential organizational changes across programs and departments, help in identifying good examples that can be shared across the faculty, and place our research quality in the international context. While this input is extremely helpful for identifying directions, decisions and prioritization will be done within the faculty using the panel’s feedback as one input.

**Instructions**

**Base data**

Base data such as bibliometrics, HR and financial data will be provided centrally. Details on how the data was collected and how to interpret it will be found in the Base Data Information document on the Faculty KoF webpage.

**Note**

While it is understandable that every program and department will want to look as good as possible, this process is most valuable when everyone is open and honest. In particular:

1. Activities (funding, projects, publications, hires etc.) that ended before the evaluation period or started after it should not be included. If it is extremely important to include such, e.g., very recent recruitments that significantly affect future plans, the text must clearly indicate that the activity falls outside the evaluation period and why it is being included.
2. Cramming in more text by changing the font size, layout, margins, text box sizes, etc. will not be accepted. It is understood that the space limitations will lead to the need for careful prioritization.

The four answer sizes used are:

* Very short – 1.4cm tall box, approximately 250 characters
* Short – 3cm tall box, approximately 600 characters
* Medium – 4.7cm tall box, approximately 950 characters
* Long – 10cm tall box, approximately 2000 characters

Do not change the ordering or labeling of the questions in the document, as the final answers will be extracted from the document based on that ordering and labeling.

**Before submission**

[Check the KoF/ÖB webpage on the employee portal for any important updates](https://www.uu.se/en/staff/faculty/science-and-technology/research).

**Hide instructions**
Modify the “Instructions” style so all colored text is hidden in the submitted document. First, check that you have the “Show/Hide Formatting Marks” turned off then right-click on the style “Instructions” in the ribbon at the top of the window. Then select “Modify” and then “Format” at the bottom left. Choose “Font” and turn on the “Hidden” option and click the OK button.

**Navigation panel**

To quickly navigate through the document, you can use the Navigation panel. To see the Navigation panel, click the “View” tab in the ribbon and then check the “Navigation Panel” checkbox in the “Show” button group or choose “Sidebar🡪Navigation” from the “View” menu. In the Navigation Panel you can view the outline of the document and search for specific words or phrases.

**Submission**

Send this document as **a Word file** to your Head of Department latest April 15, 2024. It is important to submit the document as a Word file as we will be extracting text from the tables to put all answers in a database.

**Updates**

* V4
	+ Clarified in table 3.9 that Top-10 external funding shows the amount spent on each financier during the year.
	+ Corrected data for some programs with regard to “UL, promoted from an adjunct” being included in the category “Other Research”. Those concerned have been informed by e-mail.
	+ Updated data for the Instrumentation Research Program including FREIA.
	+ Added a box where the program can ask questions to the panel.
* V3
	+ Revised bibliometrics table to have only one coverage statistic (3.3.2). This statistic reflects the proportion of DiVA publications used for citation statistics calculations by CWTS Leiden, instead of reporting the Web of Science coverage (WoS coverage). For WoS coverage statistics, see the base data document. The intended goal is to put increased focus on the impact indicators and their validity.
* V2
	+ **3.10 External funding sources** - Changed to include all “active” grants during the evaluation period instead of just grants that “started” during the evaluation period. This change is done to make sure that grants that show up in the financial data for 2022 and 2023 will be listed even if they did not start during the evaluation period
* V1 (initial version)

# General information

Responsibility: PAP to communicate with all program members, discuss, prioritize, and collate. All program members to report and discuss.

## Process for creating this self-evaluation

**Instructions**: Describe the process to generate this self-assessment, how it was collegial, and list which categories of employees (e.g., Professors, ULs, BULs, postdocs, PhDs, researchers, etc.) were significantly involved.

Motivation: To emphasize that this is to be a collegial process and that all members of the program should be included.

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| This form was filled mainly by PAP in consultations with other members of the program. Some specific parts of the form were delegated to other members of the program. After collection all inputs PAP took the final responsibility for the form.  |

## Core of the research program

**Instructions**: Describe what makes the program a coherent research program. For example, shared methods, areas, questions, facilities, etc.

Motivation: To understand the essence of the program so that its plans and activities can be better understood in that context.

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| The program conducts research in theoretical physics, centering on fundamental questions in quantum field theory, string theory and mathematical physics.  |

## Personnel (data provided centrally)

**Instructions**: Postdocs who are on stipend should be listed separately in parentheses. (Example: if there are 4 postdocs on salary and 3 on stipend, please enter “4 (+3)”. )

Motivation: To understand the program’s personnel distribution by career stage and gender. This data shows the number of FTEs (full-time equivalent) employees in each category.

Responsibility: Data provided centrally; PAP to review to ensure no significant mistakes are made. Note that stipend postdocs are not present in the university salary system and will need to be manually accounted for if they are to be included. If this table is changed to add stipend postdocs, please note the changes in the “other important program-specific comments” section below as well.

|  |  |  |
| --- | --- | --- |
|  | **Faculty FTEs** | **Non-Faculty FTEs** |
|  | **Professor** | **Associate (UL)** | **Assistant (BUL)** | **Total** | **PhD** | **Postdoc** | **Researcher** | **Other****Research** | **Other** | **Total** |
| **Female** |  | 3.0 |  | 3.0 | 3.0 | 1.0 | 0.4 |  |  | 4.4 |
| **Male** | 3.0 | 5.0 |  | 8.0 | 8.2 | 5.8 | 6.5 |  |  | 20.6 |

## Finances

### Overall research funding in MSEK (data provided centrally)

Motivation: To understand how a program is funded across the main sources of income. This data shows the long-term internal funding (FFF+SFO) vs. external (grant) research funding.

Responsibility: Data provided centrally; PAP to review to ensure no significant mistakes are made.

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| --- | --- | --- | --- | --- | --- | --- |
|  | **FFF+SFO Internal Research** | **Other Internal Research** | **Total Internal Research** | **External Research** | **Total Research** | **External Research %** |
| **2023** | 6.6  | 4.2  | 10.8  | 17.2  | 28.0  | 61% |
| **2022** | 6.5  | 5.0  | 11.5  | 21.8  | 33.2  | 65% |
| **Average** | 6.6  | 4.6  | 11.1  | 19.5  | 30.6  | 63% |

### Other internal research funding

**Instructions**: If the other internal resources category above is significant, describe where it comes from: e.g., co-funding for various grants, starting packages for Assistant professors, studiestöd, department resources given, special funds from the vice rector, etc.

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| The program also supports joint appointments with the math department. Some of our grants, PhD students, and postdocs are formally based in the math department, although they are de facto part of our program.  |

### Basic funding expectations and policy for using internal resources

**Instructions**: Explain the standard funding distribution between internal research funding (FFFs), external grants, and teaching that faculty (Assistant, Associate, Professor) and non-tenure staff (researchers, adjuncts) receive. Describe the policy for distributing internal resources (FFFs and other 210 funds, including studiestöd, startbidrags, and co-funding). Include a description of how faculty members at each level (Assistant, Associate, Professor) receive research support and are funded. Explain any implicit or explicit policies regarding holding external grants and allocation of internal resources. Include a brief overview of other uses of internal resources, for example: extra support for particular roles (e.g., PAP, FUAP), startup packages (for new faculty), allocation of studiestöd, department policies for FFFs or institution resources, funding of joint facilities/infrastructure, co-funding for grants, paying for PhDs/postdocs, etc.

Motivation: To understand how programs use their internal resources to support members and activities.

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| Within the program we do not have any universal rules about the distributions between external and internal funding among the faculty. We always try to optimize for each given situation. Postdocs are always externally funded, PhD students mainly externally funded with very restrictive partial use of FFF. Among the faculty FFF is distributed according to need. If the faculty member has a large grant then typically a significant fraction of the salary is paid from this grant. We have three faculty members who have had their entire salary paid from external grants plus co-funding since their arrival at Uppsala.  |

### Use of internal research funds in MSEK (data provided centrally)

Motivation: To understand how the program is using internal research funding.

Responsibility: Data provided centrally; PAP to review to ensure no significant mistakes are made.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Faculty Salary | Non-Faculty Salary | Other Personnel Costs | Premises | Equipment Depreciation | Overhead | Running Costs | Total |
| 2023 | 6 (51%)  | 1.9 (16%)  | 0 (0%)  | 1 (9%)  | 0 (0%)  | 2.3 (20%)  | 0.4 (3%)  | 11.6  |
| 2022 | 5.9 (45%)  | 3.3 (25%)  | 0 (0%)  | 0.9 (7%)  | 0 (0%)  | 2.6 (20%)  | 0.4 (3%)  | 13.2  |
| Average | 6 (48%)  | 2.6 (21%)  | 0 (0%)  | 0.9 (8%)  | 0 (0%)  | 2.4 (20%)  | 0.4 (3%)  | 12.4  |

### Personnel funding (data provided centrally)

Motivation: To understand how funding is used across different employment categories and genders. This data shows how staff are funded on average across internal and external research funding as well as teaching.

Responsibility: Data provided centrally; PAP to review to ensure no significant mistakes are made.

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| --- | --- | --- |
|  | Female | Male |
|  | Internal | External | Teaching | Internal | External | Teaching |
| Professor |  |  |  | 73% | 3% | 23% |
| Associate (UL) | 13% | 51% | 36% | 49% | 36% | 15% |
| Assistant (BUL) |  |  |  |  |  |  |
| PhD | 9% | 89% | 2% | 38% | 56% | 6% |
| Postdoc | 0% | 100% | 0% | 10% | 90% | 0% |
| Researcher | 100% | 0% | 0% | 10% | 87% | 3% |

### Major infrastructure usage

**Instructions**: Identify the five most significant research infrastructures used by the program. For this purpose, infrastructures are resources that are too expensive for an individual PI to afford and are therefore organized and funded as shared resources. Specify the level of sharing (program, department, university, national, or international) and whether it is located at Uppsala or elsewhere. Provide the approximate amount spent to pay for development of or access to the infrastructure each year, including both program funds and PI grant expenditures. Infrastructure costs should not include travel to the infrastructure (as travel for research is not infrastructure-specific) nor salary time while using the infrastructure (as research time is not infrastructure-specific), but can include salary costs of engineering staff and explicitly agreed upon in-kind salary contributions. If infrastructure is paid for outside of the program, specify who pays for it instead of the cost. (E.g., write “Faculty” or “VR”.) Note that it is not necessary to provide exact values, but please make an effort to be within ~10%.

Motivation: To understand what important infrastructure is being used and how much it costs and to support the faculty’s ongoing work on developing an infrastructure policy

Responsibility: PAP in discussion with program members, economic administrator for costs.

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| --- | --- | --- | --- |
| Infrastructure | Sharing | Location | Approximate Yearly Cost(MSEK) |
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## Other important comments

**Instructions**: Explain any important issues not addressed above or misrepresented by the above data that need to be clarified for the panel to give valuable feedback. If the program has an important role in supporting the university or department, such as a mandate from the government or university, please describe it here. Please keep these precise and relevant.

Motivation: To bring important and special issues to the view of the panel and department.

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| 6 faculty are also affiliated with the Math Department, mainly through the VR Center for Excellence in Geometry and Physics whose funding from VR passes through the Math Department. Two of these faculty have a further affiliation with math.  |

# Follow up on goals set in the last evaluation

Responsibility: PAP to communicate with all program members, discuss, prioritize, and collate. All program members to report and discuss.

## Reflections on accomplishments and setting goals this time

**Instructions**: Reflect on whether the goals from the last evaluation (ÖB Section D1 for programs and KoF17 Section 1b for departments) were appropriate in retrospect, what has been accomplished towards them since the evaluation, and what we can learn from them about setting effective goals this time. The previous evaluations [are available on the faculty KoF webpage](https://www.uu.se/en/staff/faculty/science-and-technology/the-facultys-research-evaluation---quality-and-renewal---kof24) to support this reflection for the programs, departments, and panels.

Motivation: Try to learn from what we did last time to be able to set more effective goals this time.

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| In retrospect, the goals stated in the previous evaluations were set correctly and remain largely unchanged. The main goals are to keep and improve the present very dynamical research environment, to attract young researchers, and to keep the top researchers who are already here. While we have been successful in the first two goals, in the last 6 years we have already lost one top female researcher and are on our way to losing another. We believe that in order to cure this last problem will require the involvement of both the Physics department and the Teknat faculty. |

# Area 1: Research Quality (evaluation of outcomes and processes)

Responsibility: PAP to communicate with all program members, discuss, prioritize, and collate. All program members to report and discuss.

## Main research areas

**Instructions**: List the largest research areas in the program, including approximately what percent of the program’s total research they cover, the approximate number of FTE faculty (Assistant/Associate/Professor, split according to their approximate activities and not double-counted), and whether the research is mostly Applied, Basic Science, or Mixed. These four areas combined should be broad enough to cover at least 75% of the program’s research activities.

Motivation: To understand the program’s research heterogeneity and how the program sees its own research profile and to help in assigning panel members.

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| --- | --- | --- | --- |
| Main Research Areas | % of program | FTE Faculty | Type |
| 1 | Theoretical and Mathematical Physics | 100 | 11 | Basic sc. |
| 2 |  |  |  |  |
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| 4 |  |  |  |  |

## Research Activities

**Instructions**: Describe the key research activities in the program. This should focus on the types of research done, with the important results described later in the Research Results section. Briefly describe how the research is important for science and society. Describe how the program balances incremental (e.g., safe, easy-to-publish) research with higher-risk projects with more potential for breakthroughs. Note that the limited space will require prioritizing the text based on the main research activities listed above.

Motivation: Provide a more detailed view of the key research directions in the program.

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| The program conducts fundamental research in theoretical and mathematical physics. More specifically the program has deep interests in: 1) scattering amplitudes for gauge theories, gravitational theories and string theory (especially gravitational wave calculations inspired by scattering amplitude techniques); 2)integrability in string and gauge theories; 3) supersymmetric quantum field theories; 4) conformal field theories, including the analytic bootstrap; 5) string phenomenology and cosmology; 6) mathematical physics, including geometrical tools in string and fields theories; 7) and AI-tools in geometry and string theory. While there is occasional collaboration, the research topics of the individual faculty members are largely chosen by themselves and are independent from each other, with the topics often evolving over time. The collaborations are usually small, with an individual faculty part of a group that might include a handful of students and/or post-docs, or with international scholars. Thus, the planning of research and its funding is typically up to the individual faculty member. There is large diversity in our research, but this diversity has also led to meaningful scientific collaboration among the faculty and the non-permanent staff. Despite the individualistic nature of theoretical physics research, the overall scientific environment plays a crucial role in stimulating creativity. Thus, we push for more seminars, journal clubs and discussion groups, while at the same time we try to hire more non-permanent staff whenever funds are available. Over the last 10 years the total size of the program has changed significantly. Five years ago the program had over 50 members, but now it is shrinking as external funding becomes more scarce and is approaching a number closer to 20 members. It is difficult to predict how the shrinking of the program will affect the long-term impact of the program’s research; sometimes small collaborations lead to breakthrough results.  |

## Research Results

### Contributions to the field

**Instructions**: Describe the research results that the program is particularly proud of that indicate the quality and breadth of the research. Explain the importance of the program’s contribution to the field in the international context.

Motivation: Identify the results the program is most proud of and provide the program’s perspective on how important they are. This allows the panel to see how the program sees itself and provide feedback to help the program better understand how it is viewed internationally.

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| The program is responsible for creating new scientific areas in theoretical and mathematical physics. A prime example is the discovery of integrability in gauge theories in the foundational paper by Minahan and Zarembo (2002) , along with many other papers which followed over the last 20 years, with a yearly international conference devoted to the topic. This also includes a highly cited review (+1300 citations), partly written by three members of the program. Another important example is the discovery of the BCJ relations by program member Johansson and others, which has created a whole new subfield in the amplitudes community, including color-kinematics and the double copy formalism. A currently hot research topic is to use these amplitude techniques to analyze gravitational waves. There is also a highly cited prize-winning review in this area written by program members. The program also has highly cited results using equivariant localization to analyze problems in QFT, and is also the subject of a highly cited review. Other sets of results in mathematical physics have been published in top math journals.  |

### Bibliometrics for 2017-2021/2022 (data provided centrally)

Motivation: Provide an overview of how the program is performing that is reasonably comparable to other programs and departments. (See the Base Data definitions file for the meaning of each statistic.)

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| --- | --- | --- |
|  | Type of Indicator | 2017-2022 |
| Number of publications, full publication set (full / fractional counts) | Quantity | 350 / 183 |
| Proportion of publication fractions at the Norwegian model level 2 (%) | Impact | 69% |
|  |  | 2017-2021 |
| Coverage (fractionalized): Proportion of publications from DiVA included in citation statistics, weighted by fractional counts | Coverage | 78% |
| Mean normalized number of citations per publication (MNCS) | Impact | 1.18 |
| Proportion of frequently cited publications (top 10%) (PP(top 10%)) | Impact | 10% |

### Most frequent publishing channels (raw data provided centrally)

**Instructions**: Using the provided raw data of publication frequency per channel (a channel is the name of a conference or journal) for each program, list the most frequent publishing channels with more than two publications during the evaluation period. This data can be found in the Base Data Excel document.

Motivation: To see where the program is most frequently publishing.

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| Channel | Number  | % of Total Publications |
| Journal of High Energy Physics  | 192 | 55 % |
| Physics Review D | 25 | 7 % |
| Journal of Physics A | 18 | 5 % |
| Physics Review Letters  | 13 | 4 % |
| Communications in Mathematical Physics | 12 | 3 % |
| Scipost physics | 10 | 3% |
| Physics Letters B | 9 | 3% |
| Letters in Mathematical Physics | 4 | 1% |
| Journal of Geometry and Physics | 4 | 1% |
|  |  |  |

### Most important publishing channels

**Instructions**: Provide the most important publishing channels (a channel is the name of a conference or journal) according to the program, the number of publications in each channel during the evaluation period, and the % of the total publications based on the centrally provided bibliometrics. For each channel, specify both the total number of publication and the number where a program member was the lead-author. (The lead-author is the primary driver of the particular publication, which is often denoted as the “corresponding” author or the first author in the publication list, and is typically the originator of the core idea of the work and/or the person who wrote the majority of the text in the publication.)

Motivation: Enable the program to indicate what publishing channels they see as most important and how much they publish in them for panel feedback.

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| --- | --- | --- | --- | --- |
| Channel | Number  | % of Total Publications | Lead-author  | Lead-author % of Total  |
| We only publish in top peer-reviewed international journals. As is tradition in our field, author names appear alphabetically. Because of our publishing record our program had the second highest ranking among 67 programs in the TekNat faculty using the level 2Norwegian model. |  |  |  |  |
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### Publishing impact on the field

**Instructions**: Describe the impact of the program’s publishing on the field by elaborating on the provided bibliometrics, the most frequent publishing channels, and the self-identified most important publishing channels. Explain the importance of the program’s contribution to the field in the international context. (See the Base Data definitions file for the meaning of the bilbiometric statistics.)

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| Because program members have founded subareas of theoretical physics and because they remain active in these subareas, we score very high in citations, as evidenced by the bibliometric data. Over last 20 years we have consistently performed well, as can be seen from previous evaluations. When theoretical physics was an independent department it was the top cited department in the 2007 evaluation for the entire university (In subsequent evaluations It was part of a bigger department). Our publishing channels are top within our field, where according to the Norwegian model our program is ranked number two in the TeKNat Faculty. |

### Participation, recognition, and leadership in the field

**Instructions**: Describe how the program interacts with the larger field in terms of its participation (e.g., through collaborations, professional organizations, positions of trust, etc.), recognition (e.g., through awards, keynote presentations, etc.), and leadership (e.g., through steering positions in international organizations, professional bodies, etc.) in the field. Explain the importance of the program’s contribution to the field in the international context.

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| Prof. Danielsson is an Editor for Journal of High Energy Physics, the editor for Journal of Cosmology and Astroparticle Physics and is the secretary of the Nobel Committee in Physics. Prof. Minahan is the Editor-in-Chief for Journal of Physics A. Prof. Zabzine is an Editor for Advances in Theoretical and Mathematical Physics. The different members of the program sit on International Advisory Committees for top conferences (Strings, String-Math, Amplitudes). Several members participate in ERC evaluations, NSF (USA) evaluation panels and many national (EU) research evaluations.  |

## Synergies within the research program

**Instructions**: List up to three examples of synergies (interactions that provide more value than the individual contributions alone) within the research program itself that can be seen through specific on-going collaborations. Synergies can include using similar or complementary methods, facilities, partners, goals, etc. Briefly describe the synergy and extent of the current collaboration. Due to the limited, programs will need to work internally to identify the collaborations that are most important to the program.

Motivation: Identify how the program’s diversity supports its research.

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| 1 | Type of synergy | Scientific collaborations within the program among the faculty |
|  | Specificcollaboration | We have 11 faculty members and there are many examples of short-and long-term collaborations between the members.  |
| 2 | Type of synergy | Joint supervision of PhD students and postdocs |
|  | Specificcollaboration | We have multiple instances where supervised PhD students and postdocs publish their works with the different faculty members.  |
| 3 | Type of synergy |  |
|  | Specificcollaboration |  |

## Synergies across research fields

**Instructions**: List up to three examples of synergies (interactions that provide more value than the individual contributions) the research program has with research fields other than those of the program itself. Synergies can include using similar or complementary methods, facilities, partners, goals, working across theory/experimental, grants together with people in different fields, etc. These synergies can be here in Uppsala or at other universities. Provide the university (cross-field synergies within Uppsala are fine) and the different field, and briefly describe what the synergy is and the extent of the specific current collaboration. Due to the limited space, programs will need to work internally to identify the collaborations that are most important to the program.

Motivation: Identify current activities that are broader than the research programs to promote broader research initiatives and understand what is done across Uppsala vs. externally.

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| --- | --- | --- |
| 1 | University and Field | VR Excellence Centre in Geometry and Physics based at the Math Department  |
| Type of synergy | Common grant to promote mathematical physics |
| Specificcollaboration | Joint hiring of non-permanent stuff, common seminars, common conferences, scientific collaborations |
| 2 | University and Field | Centre for Interdisciplinary Mathematics |
| Type of synergy | Partial funding of several PhD students at theoretical physics |
| Specificcollaboration | We have and had several PhD students in theoretical physics who are or were part of the interdisciplinary math program with co-supervisors in Math and other departments  |
| 3 | University and Field | AI, electrical engineering department  |
| Type of synergy | Co-supervision of one PhD student  |
| Specificcollaboration | Joint PhD student investigating AI applications in geometry and string theory. The co-supervisor is in the department of electrical engineering doing research on AI. |

### Reflections on synergies across research fields

**Instructions**: Reflect on the program’s initiatives and challenges with regards establishing research activities that cross between the program’s field and other fields. Are there particular benefits to such collaborations or particular costs? Describe the formal and informal initiatives the program takes to encourage these and the pros and cons of working within and outside of Uppsala.

Motivation: Understand how the program views its synergies across research fields.

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| As a program we interact often with researchers outside of our department, mainly with the Department of Mathematics via joint appointments, joint grants, joint activities and scientific collaborations. These activities now center around the newly created Centre for Geometry and Physics (supported by a VR Excellence Center grant). Another activity reaching beyond our department is the use of AI-tools in geometry and string theory, a growing activity that features collaboration with the departments of Mathematics, IT and Electrical Engineering. One member of our program has benefited enormously from the University wide program AI4Research, allowing her to establish links outside of our department.  |

## Reflections on ensuring good research ethics

**Instructions**: Reflect on the program’s initiatives and challenges with regards to ensuring good research ethics. Describe the formal and informal initiatives the program takes to teach and promote good research ethics across all research staff, and what particular challenges the program faces in these regards.

Motivation: Understand how the university’s priority for ensuring good research ethics is addressed.

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| We raise the awareness of ethical issue especially with our young researchers. We try to create an open and trusting atmosphere where such issues can be discussed openly.  |

## Reflections on creating and ensuring research freedom

**Instructions**: Reflect on the program’s initiatives and challenges to create and ensure research freedom. Describe the formal and informal initiatives the program takes to create opportunities for research freedom across all research staff, and what particular challenges the program faces in these regards.

Motivation: Understand how the university’s priority for ensuring research freedom is addressed.

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| Our research is highly individualized, and thus to a certain degree research freedom is built in. Research freedom is accepted at all levels, including for PhD students and post-docs. It is not uncommon for PhD students hired under one project to join collaborations on other topics, or even to do their own research. |

## Reflections on research program size

**Instructions**: If the research program has 4 or fewer faculty (Assistant, Associate, Professor), describe the program’s process for ensuring a sufficient critical mass of faculty long-term, current and planned activities in this direction, and discuss whether there are other programs where collaboration could be of assistance. Similarly, if the research program has 10 or more faculty members, describe how the program works to develop a coherent research agenda and collaborations. If the program has between 5 and 9 faculty, describe if increasing or decreasing the size could be beneficial.

Motivation: A reasonable number of faculty members is required for research programs to achieve their purpose of providing a collegial environment that can develop and support diverse ideas and knowledge around a shared core research direction. For research programs with very few faculty, or very many, it is important to reflect on how this can be achieved.

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| The program has 11 faculty, a good number to create a critical mass for creative work within theoretical physics.  |

## Top external funding sources (data provided centrally)

Motivation: To see the amount spent on each financier during the year.

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| --- | --- | --- | --- |
| Funding Agency | 2022 | Funding Agency | 2023 |
| Wallenberg Foundation (KAW) | 11.0  | Wallenberg Foundation (KAW) | 7.5  |
| Swedish Research Council (VR) | 6.1  | Swedish Research Council (VR) | 4.1  |
| European Research Council (H2020) | 3.7  | Olle Engkvist Foundation | 3.4  |
| Ragnar Söderberg Foundation | 0.5  | European Research Council (H2020) | 2.0  |
| Olle Engkvist Foundation | 0.3  | Uppsala University Foundations Management | 0.2  |
| Uppsala University Foundations Management | 0.0  | Private individual (Swedish) | 0.0  |
| Private individual (Swedish) | 0.0  |  |  |
| STINT | 0.0  |  |  |
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## External funding sources

**Instructions**: List the source and number of significant research grants to the program during the evaluation period. Include only grants that awarded at least 3M SEK to a program member and were active (used) during the evaluation period (2019-2023, inclusive). If a program member was awarded at least 3M SEK, but was not the PI on the grant, list the grant on a separate line and state “Co-PI”.

Motivation: This list complements the top external funding sources by providing consistent data for significant (>3M SEK) basic science grants available to all programs and by identifying the number of PIs vs. the total amount of funding. This is important as the absolute amount of money available to different fields varies enormously.

|  |  |
| --- | --- |
| Grant | Number of awards to PIs in the program |
| Basic science grants (available to all fields in the faculty) |
| 2 ERC-StG | Schlotterer (2019-2023), Festuccia (2015-2020) |
| 3 KAW Projects | Johansson-Di Vechia (2019-2024), Minahan-Zarembo (2016-2021), Ekholm-Zabzine (2015-2020) |
| 0 KAW Scholar |  |
| 2 WAF/ 2 WAF continuations | Johansson (2014-2019, 2019-2024), Bissi (2017-2022, 2022-2027)  |
| 4 VR Projects | Festuccia (2019-2023), Chiadarolli (2020-2023), Larfors (2021-2024), Minahan (2021-2024), |
| 1 VR Starting | Bissi (2019-2023) |
| Other grants (may include field-specific grants and Co-PIs) |
| VR excellence centre grant (based in math) | Minahan, Zabzine (2024-2028) |
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## Reflections on external funding

**Instructions**: Reflect on what the program expects from its staff (Assistant, Associate, Professor, postdoc, and researcher levels) in regards to applying for and receiving external funding, how the program communicates those expectations, how the program supports staff in applying for funding through feedback and mentoring, and what opportunities and challenges the program sees in the future for continued and new external funding. Describe initiatives the program takes to form consortia to apply for larger grants.

Motivation: Connect how the program works with external funding to the achieved funding results.

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| Our present well-being depends crucially on external funding. We constantly apply for external funds and have an excellent track record securing such funding. As a program we openly discuss what are our best options are to attract external funding, and how to optimally organize collaborations. We expect all members of the program to apply for applicable external grants.  |

## Reflections on what is working well

**Instructions**: From the above, reflect on what is working well and should be continued over the next 5 years.

Motivation: Require programs to identify where current activities are successful. This will provide the panel with insights into our own self-assessment.

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| We have an excellent track record attracting external funding, both at the national and the EU level. We plan to continue this by coordinating and optimizing our applications, avoiding unnecessary competition within the program. We will also explore new funding tools, such as EU synergy grants (one involving Uppsala, Oxford, Bonn, and Trinity College Dublin has recently reached the second round in the evaluation process) and other collaborations grants.  |

## Reflections on what needs to be improved

**Instructions**: From the above, reflect on what needs to be improved over the next 5 years. Please focus on areas that need improvement and do not list areas that could be improved but where it is not needed.

Motivation: Require programs to identify where they feel that they need to invest. This will both provide the panels with insights into our own self-assessment as well as help us improve.

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| Looking back at our past success, our main concern moving forward is how to organize the long-term planning when it comes to balancing external and internal funding. Some of our past grants were intended to hire personnel at the tenure track/tenured level, and whose appointments were supported by the Rector and/or the vice-Rector of TekNat and/or the Physics department. However, after the grants had ended no internal funding became available to continue support for these young faculty. One difficulty is there is no mechanism to save resources for the future. Some years there can be too many resources and others not enough to support our activities. In our view this is the fundamental problem balancing external and internal funding, and is particularly acute in fundamental theoretical physics research where most resources are spent on personnel costs. |

# Area 2: Career Paths (evaluation of processes)

Responsibility: PAP to communicate with all program members, discuss, prioritize, and collate. All program members to report and discuss.

## Career stage distribution implications and plans for the next 5 years

**Instructions**: Describe the implications of the current distribution of faculty across career stages (e.g., Assistant, Associate, Professor from Section 1) for the program currently and in the next 5 years. In particular, identify up-coming faculty retirements and/or recruitments and discuss and how the program plans to work with those changes to maintain the program’s core strengths as well as evolve in new directions.

Motivation: Provide perspective on the current status and future changes in personnel in the program.

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| At the moment the program has 3 male professors (average age 58 years), 8 UL (average age 42 years)=3 female UL (average age 43 years)+5 male UL (average age 42 years). The average age of the overall faculty is 46 years. All present ULs were hired during last 10 years. We have one retirement in 5 years and one retirement in 9 years. One main goal is to increase number of professors via promotion. Many ULs now qualify for promotion but hesitate to apply. The program will encourage and support these applications for promotion. Due to the present financial situation the only possible way to hire new faculty over the next five year is if their salary is covered by one or more external grants lasting at least five years. |

## Reflections on the process for identifying recruitment needs and focusing areas

**Instructions**: Pick a specific faculty-level recruitment during the evaluation period reflect on how the process of identifying the need for recruitment and focusing the research area worked. First describe the recruitment, e.g., Assistant/Associate/Professor-level and research area. Then discuss how the program worked to identify the need for a recruitment in this area, including discussing how the need was identified, how was it discussed and revised in the program, who was involved in the discussions, etc. For focusing the research area, describe how the balance between continuing existing areas vs. choosing new ones was discussed, who was involved in the discussions, what criteria were discussed to ensure that this direction would strengthen the program, etc. If the program has not done any faculty recruitments during the evaluation period, please reflect on how they would be undertaken.

Motivation: Explain how recruitments are currently motivated and decided

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| The last recruitment of two ULs was in 2021 and was a joint hiring with the math department (presently half of the funding for one UL comes from mathematics). The process was very painful, although we had the moral support of the department and TekNat. The present rules are so rigid that they do not take into account the interdisciplinary nature of the such positions. For example, both subject representatives on the 2021 hiring committee were from physics and only the physics prefekt was sitting at the meeting. Unfortunately, there is no formal mechanism for two departments to collaborate on a joint hiring. These problems were pointed out in previous evaluations and have not yet been addressed by TekNat. |

### Initiatives to recruit and retain top researchers/teachers

**Instructions**: Describe:

* How the program defines what a top researcher/teacher is and how that is used in recruiting (criteria, descriptions, search groups, subject representative, addressing younger recruits who have the potential to become top, etc.),
* How the program balances recruiting external talent vs. promoting internal staff, and who is involved in these discussions and decisions,
* How gender and career stage balance is considered in program planning and recruitment decisions, and,
* What the program does to identify and encourage strong external recruits to join.

Motivation: Provide details as to what efforts are made to recruit and retain the best staff.

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| The main tool we use to recruit is leveraging large excellence grants, such as EU starting grants or Wallenberg Fellows. We have recently slowed this process, despite being constantly contacted by outstanding external candidates who we would love to have but cannot afford. Our priority now is to keep the faculty we have already, who have received offers from elsewhere because of their research success. We previously lost one female UL and we are on our way of losing one more female UL. The main issue is inability to solve their two-body problems. Solving this problem requires help from the university since the partner is usualy in a different field. |

## Career support

### Career support activities for non-tenure-track staff (beyond standard employee dialogs)

**Instructions**: Describe the activities for supporting non-tenure-track (PhDs, postdocs, researchers, adjuncts, etc.) staff in their careers and development. For example: financial support for personal development, mentoring, grant assistance, feedback, career planning, help with job searches, etc.. Explicitly address what support is provided for obtaining the docent and distinguished teacher qualifications for post-PhD staff. Specify if activities are informal (e.g., expected as part of advising/mentoring) or formal (e.g., part of a regular process).

Motivation: Provide details as to how the program works with career development for non-tenured staff and encourage the program to reflect on whether it is providing the right type and amount of support.

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| The main help we provide for our non-permanent staff is information and advice about career and grant possibilities. Many of the faculty have extensive international networks which can be used to help PhD students and postdocs. This has worked reasonably well, where many of our former PhD students and postdocs are able to continue their careers at top universities. This includes postdoc positions at Princeton, the Institute for Advanced Study, Stanford, MIT, Oxford, Paris and London.  |

### Career support activities for tenure-track staff (beyond standard employee dialogs)

**Instructions**: Describe the activities for supporting tenure-track staff (Assistant Professors) in their careers and development. For example: financial support for personal development, startup packages, mentoring, grant assistance, feedback, career planning, co-advising, etc. Include discussions of support for promotion (Assistant to Associate) as well as docent and distinguished teacher qualifications. Specify if activities are informal (e.g., expected as part of advising/mentoring) or formal (e.g., part of a regular process). If there are very few staff in this category, please reflect on why that is and if that is something that should be addressed.

Motivation: Provide details as to how the program works with career development for tenure-track staff and encourage the program to reflect on whether it is providing the right type and amount of support.

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| We do not have any tenure track staff at this time. These positions are no longer useful in our field since they changed the requirement that one must be within 5 years of their PhD in order to be considered. When the requirement was 7 years we hired two people as assistant professors. Hopefully this rule can be modified again to allow more senior people to apply for these positions. |

### Career support activities for tenured staff (beyond standard employee dialogs)

**Instructions**: Describe the activities for supporting tenured staff (Associate Professors and Professors) in their careers and development. For example: financial support for personal development, mentoring, grant assistance, feedback, career planning. Include discussions of support for promotion (Associate to Professor) as well as docent and distinguished teacher qualifications. Specify if activities are informal (e.g., expected as part of advising/mentoring) or formal (e.g., part of a regular process).

Motivation: Provide details as to how the program works with career development for tenured staff and encourage the program to reflect on whether it is providing the right type and amount of support.

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| We have tried to create an open and trusting atmosphere among the faculty in order to allow for the free exchange of ideas and advice. It is especially valuable when the senior staff shares their knowledge and expertise with the younger staff. This advice applies to grant applications, teaching, the supervision of students, and promotion.  |

## Reflections on what is working well

**Instructions**: From the above, reflect on what is working well and should be continued over the next 5 years.

Motivation: Require programs to identify where current activities are successful. This will provide the panel with insights into our own self-assessment.

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| The program is working very well with an open and constructive atmosphere. We support each other via common decisions and have had no conflicts over the last five years. In the coming years we will strive to maintain this atmosphere and will concentrate on keeping our young faculty and in the longer term on replacing our retiring faculty.  |

## Reflections on what needs to be improved

**Instructions**: From the above, reflect on what needs to be improved over the next 5 years. Please focus on areas that need improvement and do not list areas that could be improved but where it is not needed.

Motivation: Require programs to identify where they feel that they need to invest. This will both provide the panels with insights into our own self-assessment as well as help us improve.

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| Our main worry is keeping our top international young faculty. This is a problem that cannot be solved at the program level, but requires the support of the department and the TekNat faculty. We worry that the university is too preoccupied with hiring at the senior level and the burdensome support it requires, and does not pay enough attention to the young excellent staff it already has and the necessary support it requires. We think that this is a misguided strategy for the long-term future of the university as a center for research excellence.  |

# Area 3: Collaboration and Outreach (evaluation of processes)

Responsibility: PAP to communicate with all program members, discuss, prioritize, and collate. All program members to report and discuss.

Collaboration and outreach (“samverkan” in Swedish) should be interpreted to mean activities that reach outside of the university to non-academic partners. Specifically, academic collaborations with other research organizations within academia should be considered part of our research and not collaboration and outreach for this evaluation. To help with this section, here is a partial list of the types of collaboration and outreach that we are striving to achieve:

* Joint research projects, student/PhD/postdoc/researcher/faculty exchanges/sabbaticals, etc.
* Advising/consulting, spreading research results/insights, popular science outreach and publications, press interviews, expert panels, etc.
* Interactions with industry, government, schools, society, media, etc.
* Academic entrepreneurship, including creating, joining, and advising startups and companies, etc.
* Feedback of external ideas, challenges, relevant questions, etc., into program(s) or departments.

## Specific collaboration and outreach examples

**Instructions**: Provide up to three specific examples of collaboration and outreach activities connected to the program’s research. Under “Example and connection” describe the activity and person or organization with whom the collaboration or outreach took place. (e.g., “Expert advice on SUBJECT for COMPANY”, “Popular science book on SUBJECT aimed at AUDENICE”, or “Interview on PROGRAM about SUBJECT”.) Specify the value to the program (e.g., “exposure to new challenges and issues that COMPANY experience on a practical level” or “making the SUBJECT expertise of our researchers visible to the nation”) and the value to the partner (e.g., “insight into how COMPANY can model the physical properties from the chemical composition” or “addressing public concern over the impact of SUBJECT on the environment”). Keep in mind the broad range of collaboration and outreach listed above.

Motivation: Provide a list of specific examples of collaboration and outreach activities to motivate the self-reflection below and to serve as a source of examples for others.

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| 1 | Example and connection | Prof.Danielsson has written seven books on popular science aimed at a general audience. The latest, “Världen själv”, Fri Tanke, 2020, has been translated into several languages, including English (The World Itself, on the relation between physics, mathematics and the rest of science, 2023, Bellevue Literary Press). |
| Value to the program | High visibility for theoretical physics at Uppsala which attracts students  |
| Value to the partner | Outreach activity, the society learns about research in theoretical physics and its challenges  |
| 2 | Example and connection | Prof. Danielsson is the author of a large number of essays on science and its impact on society. He is also a frequent participant on national television and radio in discussions about science and philosophy. He regularly delivers public lectures on popular science. |
| Value to the program | Ability to participate in the public debate about science, education and related issues |
| Value to the partner | Debate with scientists  |
| 3 | Example and connection | Prof. Danielsson: expert advice on artificial intelligence for Swedish prime minister, Sagerska huset, Stockholm, May 8, 2023;Expert advice on artificial intelligence for the Swedish parliament, Riksdagshuset, Stockholm, April 18, 2024 |
| Value to the program | Ability to give expert opinion to politicians and other government officials. |
| Value to the partner | Dialog with scientists on decision making  |

### Reflections on overall aims and strategies for collaboration and outreach

**Instructions**: Use the above examples, as appropriate, to reflect on the program’s overall aims and strategies for collaboration and outreach and discuss what enabled the above examples (e.g., how were they first identified and initiated? How did they fit into the overall aims and strategies? etc.) and what it takes to keep them functioning well (e.g., staff, networking, meetings, equipment/labs/supplies, etc.).

Motivation: Understand what we need to create and maintain collaboration and outreach

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| The program participates very actively in collaboration and outreach activities. Theoretical physics is a very popular subject with the public and our public lectures are very well attended. Prof. Danielsson plays a major role with these activities. This includes the publishing of popular science books and newspaper articles, public lectures (outreach activity in theoretical physics), publishing newspaper articles, TV/radio interviews (participating in public debate about science and society) and advising the government on the relation between science and society.  |

## Support for outreach and collaboration

**Instructions**: Describe the specific support resources and processes available to program members for outreach and collaboration towards non-academic actors, such as collegial discussions, meetings with external actors, etc. Describe whether the activities are formal or informal and whether they are managed by the research program, department, or faculty.

Motivation: Understand what support the program has for outreach and collaboration.

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| We encourage outreach activities and place considerable value on them. The new Center for Geometry and Physics will even allocate resources to public lectures. The program has organized two large conferences and in both cases we also organized public lectures that centered around them and attracted more than 2000 people, completely filling the University Aula. These lectures were in connection with Strings 2011 where Stephen Hawking, Brian Greene, and Andre Linde gave public lectures, and more recently with String-Math 2019 where Cumrun Vafa and Edward Frenkel gave the lectures.  |

## Reflections on what is working well

**Instructions**: From the above, reflect on what is working well and should be continued over the next 5 years.

Motivation: Require programs to identify where current activities are successful. This will provide the panel with insights into our own self-assessment.

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| In our outreach activities we benefit from having a very high profile, thanks in part to the prominence of Prof. Danielsson in the Swedish public sphere. These activities help promote both theoretical physics and Uppsala University. We can also see that these activities attract many good students. This attraction makes us very popular among bachelor and master students when it comes to doing their required research projects.  |

## Reflections on what needs to be improved

**Instructions**: From the above, reflect on what needs to be improved over the next 5 years. Please focus on areas that need improvement and do not list areas that could be improved but where it is not needed.

Motivation: Require programs to identify where they feel that they need to invest. This will both provide the panels with insights into our own self-assessment as well as help us improve.

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|  It would be good if the university could promote outreach activities by establishing one or more prizes to be awarded to young researchers based on their outreach activities. There may be other ways for the university to encourage outreach and should be discussed by the TekNat and university leaderships. Another aspect is that good outreach requires professional tools, for example good graphic design, advanced video etc and this can be done only with the help of professionals. It would be good if University will be able to provide such service to certain extend.  |

# Area 4: Connection between Research and Teaching (evaluation of processes)

Responsibility: PAP to communicate with all program members and the director of studies, discuss, prioritize, and collate. All program members to report and discuss.

The types of connections between research and teaching that we are striving to achieve include, but are not limited to:

* Activities that lead to a scientific approach and student progression in learning how to apply the scientific method within courses and throughout education programs
* Teachers who are active researchers take opportunities to develop their pedagogical skills
* Researchers who are active teachers and take opportunities to develop their pedagogical skills
* Students being trained to find, use, and evaluate research results
* Students being active in on-going research projects
* Integration of research results, methods, and facilities in teaching

## Main teaching areas

**Instructions**: List up to four teaching programs, course packages, or contract/continuing education that the research program’s members contribute to. Specify the level (e.g., bachelor’s or master’s), how much the members of the research program contribute to the teaching program based on the number of full courses taught and whether the teaching program is managed (e.g., the program coordinator/director is in the research program) by members of the research program (yes/no). For the number of courses taught, exact values are not needed. Instead estimate the teachers’ contribution in terms of full courses taught (e.g., 1.0 means the teacher taught the equivalent of one full course) and use the ranges of: <1, 1-5, >6 to simplify accounting.

Motivation: To show what subjects the program primarily teaches in.

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| --- | --- | --- | --- |
| Teaching program, course package, or contract/continuing education | Level | Courses Taught | Managed |
|  Bachelor Physics |  Bachelor  | 9 | no |
| Master Physics (comprises 6 tracks incl. Theoretical Physics)  | Master | 13 | yes |
|  Engineering programs + Upper Secondary School Teacher Education Programme  | Bac/Master | 6 +(1-5) | no |
|  Master in Biophysics, Master in Material Science, Master in Quantum technology  | Master | 4 | no |

## Infrastructure use in teaching

**Instructions**: Please list any major research infrastructures that are used in teaching, the courses that use it, the education level, and the approximate number of students who use it each year.

Motivation: To understand what infrastructure is being used in teaching and to support the faculty’s ongoing work on developing an infrastructure policy

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| --- | --- | --- | --- |
| Infrastructure | Courses | Level | Students |
| Labs | Optics, Quantum Physics, Dynamical Systems, Mechanics I & III  | Bachelor |  |
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## Specific teaching/research connections

**Instructions**: Provide up to four specific examples of how the program’s research has been incorporated into teaching activities or strengthened courses, and/or how teaching activities have been incorporated into the program’s research activities or strengthened the program’s research. Under “Example” describe the connection (e.g., “lab exercise using the facility X that exposes students to research technique Y”). Under “Course Info” specify the course name, program, level (introduction/advanced), and the approximate number of students taking it each year. Describe the value to the teaching experience from the research connection (or vice versa).

Motivation: Provide a list of specific examples of teaching/research connections to motivate the self-reflection below and to serve as a source of examples for others.

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| --- | --- | --- |
| 1 | Example |  Advanced study and research projects for bachelor and master students. Also, some regular courses are taught in the approach of modelling scientific supervision.  |
| Course Info | Projects are optional courses, ranging from 5 to 30 ECTS, taken by about 10-20 students/year. An example of a regular course modelled in this way is Geometrical Methods in Theoretical Physics (1FA153) taken by 6-18 students/year.  |
| Value to teaching/research | One-on-one or one-to-several mentoring gives students an introduction to scientific culture and research practices, such as bibliographic work, the study of original research papers, using computational skills, working in research teams, working on open-end problems, planning long-term research. |
| 2 | Example | Degree projects for master students. |
| Course Info | Degree projects in theoretical physics are taken by about 10 students each year.  |
| Value to teaching/research | Master degree projects can involve original research performed under the direct guidance of a faculty member, potentially leading to a publication in a scientific journal. A high ratio of students taking these projects is successful in securing a PhD position after graduation. |
| 3 | Example | Journal club, common seminar, joint lecture series, research lunch.  |
| Course Info | Informal meetings jointly attended by faculty, research personnel, and students |
| Value to teaching/research | Participation by students is actively encouraged in discussions of current research. Some activities are more informal, thereby allowing students to ask questions and to explore current research directions that they may find interesting for future endeavors. |
| 4 | Example | Student Conference  |
| Course Info | Organized as part of the Master program (not one particular course), the program coordinator is a member of TP. About 30 students are expected to participate (Spring 2024 is the pilot run) |
| Value to teaching/research | 1. Students have a class on how to give scientific presentations (given by the researcher, member of TP division, so direct transfer of knowledge)
2. ½ day conference where each student reports on their ongoing research project, at the end they give feedback to each other and receive feedback from senior members.
 |

### Reflections on overall aims and strategies for connections

**Instructions**: Use the above examples, as appropriate, to reflect on the program’s overall aims and strategies for teaching and research connections and discuss what enabled the above examples (e.g., How were they first identified and initiated? How did they fit into the overall aims and strategies? etc.) and what it takes to keep them functioning well (e.g., staff, networking, meetings, equipment/labs/supplies, etc.).

Motivation: Understand what we need to create and maintain connections

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| Preparation of a student for the research in TP should start early, both skills and the breadth of knowledge are to be trained. An effort is being made to make students aware of this and to provide the necessary teaching. Examples 1-3, and both formal and informal communication of master coordinator with students, target the first goal. All examples target the second, the relevant study plan is being developed together with master/bachelor boards. Members of TP division provide guidance for students while teaching numerous courses through all years of study and through the supervision of projects. |

## Support for integrating teaching and research

**Instructions**: Describe the support resources and processes for integrating teaching and research available to program members such as collegial discussions, meetings with students, course reviews, teaching follow-up, etc. Describe whether the activities are formal or informal and whether they are managed by the research program, department, faculty, or teaching program. If there are no such resources or processes in the research program, then please reflect on whether that is something the research program or department should address under reflections below.

Motivation: Explain what support there is for improving the research and teaching connection.

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| The department conducts student surveys, meetings between education coordinators, program coordinators and other supportive personnel. The Council for Educational Development organizes regular teacher meetings, including the shared experience of integrating teaching and research. Bachelor and Master programs organize research and feedback lunches with students. The master program coordinator and mentors have regular informal meetings with students and faculty to collect feedback and coordinate teaching. Members of the division supervise research projects serving as another useful feedback point.  |

## Reflections on what is working well

**Instructions**: From the above, reflect on what is working well and should be continued over the next 5 years.

Motivation: Require programs to identify where current activities are successful. This will provide the panel with insights into our own self-assessment.

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| The master’s programme in theoretical physics has established fruitful communication with our students. The main channels are through the programme coordinator and the student mentor, both members of the division. The collected input, along with our research vision, is used to shape our future development strategies. Examples 1 and 2, implemented by the division members, already work well and should be retained. Example 3 works for PhD and some master students, but more effort could be made to involve more master students. Recently, we initiated a restructuring of the master programme, both on the level of master board planning and concrete teaching strategies. In particular, we implemented initiatives to enhance students' mathematical skills and modelled a teaching approach in a regular course following the culture of research supervision. The feedback from students has been very positive, indicating that these initiatives should be retained and expanded in the future.  |

## Reflections on what needs to be improved

**Instructions**: From the above, reflect on what needs to be improved over the next 5 years. Please focus on areas that need improvement and do not list areas that could be improved but where it is not needed.

Motivation: Require programs to identify where they feel that they need to invest. This will both provide the panels with insights into our own self-assessment as well as help us improve.

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| An important improvement would be to attract more resources dedicated to student training. Both project supervision and regular teaching are fundamental for integrating teaching and research but are undervalued and underfunded, forcing faculty to borrow from their research resources. A stronger link between research and teaching can be forged through improved coordination among division members. We aim to streamline course content, identify opportunities for synergistic solutions, and collaborate to enhance students' scientific culture. The restructuring of the master's program to achieve these goals is currently underway.   Another objective is to enhance international competitiveness. The key lies in increasing our visibility, which can be accomplished through investment in advertising and the creation of new attractive program offerings. One such option currently under investigation is the creation of a master's program in mathematical physics.  |

# 5-year Priorities

**Instructions**: Identify, describe, and motivate specific Priorities that have a high likelihood of meaningfully strengthening or meaningfully broadening research over the next 5 years. The Priorities should be well-motivated and have sufficiently developed plans that it is clear what needs to be done to accomplish them and how to evaluate if they are successful. The Priorities can cover a wide range of activities with the overall goal of strengthen research, and do not need to require additional expenses. These can include, but are not limited to:

* Strengthening existing areas (e.g., to adapt to future challenges in the field or are necessary to maintain high quality, including by investing in new equipment, facilities, or staff, etc.)
* Investing in new areas (e.g., to adapt to changes in the field or new developments, by including investing in new equipment, facilities, or staff, etc.)
* Changing research organization by splitting, merging, closing, or moving research programs/departments (e.g., to improve collaboration or use of facilities or resources, etc.)
* Changing research policies (e.g., to address funding/co-funding, multi-disciplinary work, or recruiting, etc.)
* Changing research support (e.g., to improve grant success rates, recruiting, management, adoption of new techniques/technologies, etc.)

Building upon existing strategic plans is encouraged and co-funding/support from the program or department is expected to demonstrate commitment to the plan. There will be a yearly lightweight follow up process to see what progress has been made for each Priority with an opportunity to revise/change them as needed. The goals are to both ensure that we follow up on our stated Priorities and that we always have clear Priorities at each level in the faculty.

Each program is allowed to propose 3 Priorities: one that can be fully accomplished within the program, one that may require support at the department level, and one that may require support at the faculty level. This done to ensure that all programs will have at least one Priority they can work on as the very limited faculty funding available means only a few programs will receive additional resources.

Prioritization at the department level: Each department will review the Priorities from all of its programs and consider which to include in the department’s own list of Priorities, along with department’s own Priorities.

Motivation: Identifying Priorities encourages strategic analysis and medium-term planning within the program, and makes it easier for the department and panel to understand the programs’ own assessments of their needs and opportunities. Requiring two of the Priorities to be able to be accomplished within the program and the department emphasizes the need to work locally as well as at the faculty level.

Responsibility: PAP in discussion with program members.

# Priority 1 of 3: An activity that can be accomplished within the program

## Description of the Priority

**Instructions**: Provide the department name (since these will be collected at the section/faculty level) and the program name (if this is a program Priority), the title of the Priority, and whether it may require department support (Yes/No) and/or faculty support (Yes/No).

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| Department: | Physics and Astronomy |
| Program: | Theoretical Physics |
| Title: | Survival of Theoretical Physics program |
| Support: | May require department support: | Maybe | May require faculty support: | Maybe |

### Goal

**Instructions**: Specify the goal of the Priority, for example, to strengthen a specific existing activity or start a new one.

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| Survive in the long run and keep excellent young researchers in the group  |

### Expected meaningful research improvement

**Instructions**: Provide a description of the research that investing in this Priority will accomplish over the next 5 years. Explain how it has the potential to significantly strengthen or broaden the program for program proposals or department for department proposals. Specifically, this should go beyond continuing or slightly enlarging current activities by having a clear description of what change it will accomplish.

Motivation: The overall goal is to strengthen our research. As a result, the Priority should deliver meaningful improvements in research quality and/or breadth.

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| Most UL’s were hired during the last ten years and five of these hires were made possible by large grants (2 St-ERC, 3-KAW-fellow, 2 using KAW project grants). In the peak years (around 2019-2020) the ratio of external funds to internal resources was 5 to 1 and the overall budget of the program quadrupled from 2013 to 2018. During the last three years the trend has been downward, because some large grants ended while newer grants were smaller or restrictive in their usage. This has led to a sharp reduction of non-permanent staff (PhD students and postdocs). Furthermore, we now have three major problems: 1) we cannot cover the costs of all faculty just with internal resources; 2) We have lost at least one faculty and are about to lose another partly because of the university’s inability to help with two body problems; 3) There is no mechanism in place to coordinate joint hires. Long-term discussions with the department and TekNat have led to a modest increase in internal funding, but not enough to resolve all problems. We conclude that we should try our best to sort out these problems, at least partially, within the program itself. |

### Implementation plan

**Instructions**: Provide a brief description of specifically what is planned to be done over the next 5 years to realize the potential of this Priority. For example: new hires, investments in equipment, starting collaborations, closing down existing activities, moving resources from existing activities, etc. Use the limited space provided here to discuss the most important aspects of how this activity will be carried out.

Motivation: For a Priority to be credible, there must be a plausible plan and what needs to be accomplished must have been thought through. It is understood that these plans will change over the next 5 years, however.

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| Besides putting pressure on the department and TekNat to raise our internal funding, we will focus on what we can be done ourselves within the program. The first is to optimize and save resources whereever possible, for example by restricting new hires at the PhD and postdoc level. The second is to aggressively apply for grants at both the national and international levels. We will organize our collaborations to maximze our chances of passing through the university filter for KAW grants and receiving final approval from KAW and other funding agencies. This has proved highly successful in the past. We hope that both efforts will alleviate our problems in the coming two to three years.  |

### What previous accomplishments indicate a high likelihood of success?

**Instructions**: Describe what recent (last 5 years) accomplishments make it clear that the there is a good chance of success in this project. Use specific examples (e.g., grant X, collaboration Y, paper Z) and explain how those recent accomplishments are evidence of having the competencies needed to be successful in this project.

Motivation: For a Priority to be credible, the expertise and track record needed to support it must be present.

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| The program has an excellent track record securing external funding. We believe that the present situation is partly related to the standard fluctuations in grant funding and over the next few years will be resolved. We still are successful getting grants, but not all grants allow us to cover salaries. Furthermore, many individual grants are not allowed to cover the salaries of other researchers. But we are positive that we can resolve the grant situation in the long run because of the continued excellence of the program.  |

## Current status of the area at Uppsala University

Instruction: Describe the current status of the area at Uppsala University as a whole. Include any existing funding, support, staff, and success in this area. Explicitly identify any overlap with other existing activities at the program(s), department, section, faculty, and/or university levels.

Motivation: To avoid duplicating efforts, it is important to understand the local Uppsala context when enhancing existing activities or starting new efforts. As part of the evaluation process, the panel will try to identify synergies between proposed Priorities.

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| The ratio of external funding to internal funding varies drastically within the department and TekNat. Moreover, having too much external resources in theoretical physics creates its own problems. Unfortunately, there is no mechanism to save money for the future with either internal or external funding.  |

### Current and planned contributions to support the initiative

**Instructions**: Describe the current (already in-place and on-going) and planned contributions to this goal from the local level (from the program for program proposals, from the department for department proposals, and from both the program(s) and department, as appropriate, for program proposals selected by the department). For example, co-funding, in-kind support, shared funding of facilities, transfers of FFFs, etc.

Motivation: Evidence of financial commitment from the local environment strongly supports the proposal as being important. Conversely, if the local environment is unable or unwilling to support it, the importance to the environment as a whole is much weaker.

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| In the discussion with the department we try to optimize our budget. The members of the program are actively applying for the external finding.  |

## Strategic value

### Strategic value of the area in the global context

Instruction: Describe the importance of the area in the global context. For example: fundamental challenges in research; new developments in research; societal challenges and priorities; global impact and importance.

Motivation: To ensure consideration of the larger context.

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| Saving the excellent reputation of the theoretical physics group within the international community should be a high priority at all levels of the university. Our group is one of the top groups in theoretical and mathematical physics in all of Europe and has a glowing reputation throughout the world.  |

### Strategic value of the area at the next level

Instruction: Describe the importance of the area to the department (for program proposals) and for the section and faculty (for department proposals). For example: synergies with other activities, connections to teaching and collaboration, both currently and potential for new ones, etc. Explain the value of this activity beyond any overlapping ones identified above.

Motivation: To ensure that there is awareness of where this activity fits in at the next level up in the organization. This is particularly important if support is to be requested at that level.

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| The theory program is one of the top programs at the department. Internationally it is the department’s most visible and well-known program.  |

## Contributions needed for success

**Instructions**: Identify what contributions are needed for success in terms of time, expertise, resources, facilities, staff, etc. Explicitly include estimates of financial resources needed and where they will come from.

Motivation: To ensure the costs and resources required have been thought through, and that they are reasonable given the scope of the benefit.

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| It requires persistence from the program side. When the situation becomes critical (losing a faculty member) we need a help from the university. |

### Success indicators

**Instructions**: Describe specific results that will indicate success in 5 years. For example: increases in publications in top venues X and Y, publications in new field Z, strengthened or new collaborations with university A, new hires in B, new grants from C, etc.

Motivation: To ensure that the local- and faculty-levels will be able to assess whether this Priority was successful at the next evaluation so that we develop a positive cycle of following up on our strategic planning.

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| In 5 years the size and average age of the theoretical physics program will be an excellent indicator of its present state. Another important indicator will be its continued ability to attract external grants.  |

### First steps that can be taken today

**Instructions**: Describe the first concrete steps needed to move in this direction that can be taken today. These should be clear enough that they can be followed up on in a year to see what progress has been made. Identify initial activities that can be started locally to enable progress to help motivate further support for the larger goal. In the exceptional case where no steps can be taken today, explain why a Priority has been chosen that cannot be started.

Motivation: To ensure that there is a clear idea of how to get started and enable easy follow-up of how the Priority is progressing.

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| We are in dialog with the department about budget optimization. Furthermore, we request all faculty within the program to apply for grants which may cover some fraction of their salary.  |

# Priority 2 of 3: An activity that may require department support

## Description of the Priority

**Instructions**: Provide the department name (since these will be collected at the section/faculty level) and the program name (if this is a program Priority), the title of the Priority, and whether it may require department support (Yes/No) and/or faculty support (Yes/No).

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| Department: | Physics and Astronomy (IFA) |
| Program: | Materials Theory, Quantum Matter Theory, and Theoretical Physics (all three programs) |
| Title: | More uniform research salary support for faculty members |
| Support: | May require department support: | yes | May require faculty support: | [Yes/No] |

### Goal

**Instructions**: Specify the goal of the Priority, for example, to strengthen a specific existing activity or start a new one.

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| Strengthen existing research by providing more stable support for research for all faculty members in dept. |

### Expected meaningful research improvement

**Instructions**: Provide a description of the research that investing in this Priority will accomplish over the next 5 years. Explain how it has the potential to significantly strengthen or broaden the program for program proposals or department for department proposals. Specifically, this should go beyond continuing or slightly enlarging current activities by having a clear description of what change it will accomplish.

Motivation: The overall goal is to strengthen our research. As a result, the Priority should deliver meaningful improvements in research quality and/or breadth.

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| The amount of internal research funding available for faculty members at the department depends entirely on the program the faculty member belongs to. Unfortunately, funding for programs varies enormously throughout the department, due primarily to historical reasons that easily stretch back more than 20 years. In fact, faculty members in many new and/or successful programs need to cover a very large part of their own salaries on external grants, or teach the equivalent of a full-time teaching position, while Profs and ULs in other programs, which are typically older, have much more internal research support. This is an impediment to our recruiting and retaining the most talented researchers and hampers the development of new research fields. A stronger, more attractive, and more agile physics department would be possible if the internal research support for the faculty was distributed uniformly over the department. Providing stable and sufficient internal support for faculty research should be a main goal of the department and will help recruit and retain the best international researchers. |

### Implementation plan

**Instructions**: Provide a brief description of specifically what is planned to be done over the next 5 years to realize the potential of this Priority. For example: new hires, investments in equipment, starting collaborations, closing down existing activities, moving resources from existing activities, etc. Use the limited space provided here to discuss the most important aspects of how this activity will be carried out.

Motivation: For a Priority to be credible, there must be a plausible plan and what needs to be accomplished must have been thought through. It is understood that these plans will change over the next 5 years, however.

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| The first step is to recognize the differences and determine the level of research salary support a faculty member should be allowed to have in his/her position. A realistic aim could be 60% FFF support for each Prof, which leaves a possibility for 40% of salary from teaching or other paid university service commitments, if external funding is not available. (It is important to note that teaching is currently underfunded, such that 40% salary on the teaching budget corresponds to much more than 40% time committed to teaching). The exact numbers should be worked out based on the department’s allocation of both internal long-term research (FFFs) and its teaching budget. Implementation will be difficult, but transitioning over a longer period with possible short-term support for those activities most affected should still make it feasible. A more stable and uniform distribution of research salary support will also help to focus the department’s future recruitments to commonly identify needs and opportunities instead of the current process, which is fractured into each individual program. |

### What previous accomplishments indicate a high likelihood of success?

**Instructions**: Describe what recent (last 5 years) accomplishments make it clear that the there is a good chance of success in this project. Use specific examples (e.g., grant X, collaboration Y, paper Z) and explain how those recent accomplishments are evidence of having the competencies needed to be successful in this project.

Motivation: For a Priority to be credible, the expertise and track record needed to support it must be present.

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| Many programs at the department manage to support their faculty on internal resources at a substantially higher level than all three programs in the Theory unit (MT, QMT, TF). Still, most of our current faculty members did not arrive recently (e.g. the last faculty hired in the QMT program was in 2013), so the lack of internal research support for faculty members is not a new issue, but has plagued us for many years. By recently forming units within the department, which groups several programs together, we have been able to identify common issues such as this. Continuing to work for a more uniform department, and hence stronger department, is the goal of this priority. |

## Current status of the area at Uppsala University

Instruction: Describe the current status of the area at Uppsala University as a whole. Include any existing funding, support, staff, and success in this area. Explicitly identify any overlap with other existing activities at the program(s), department, section, faculty, and/or university levels.

Motivation: To avoid duplicating efforts, it is important to understand the local Uppsala context when enhancing existing activities or starting new efforts. As part of the evaluation process, the panel will try to identify synergies between proposed Priorities.

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| Different internal funding is natural in different programs due to the varied nature of the research. But all programs have faculty salaries to cover and doing so at widely different levels is not good for the department; it hampers recruitment and retainment and creates overall unfair work conditions. |

### Current and planned contributions to support the initiative

**Instructions**: Describe the current (already in-place and on-going) and planned contributions to this goal from the local level (from the program for program proposals, from the department for department proposals, and from both the program(s) and department, as appropriate, for program proposals selected by the department). For example, co-funding, in-kind support, shared funding of facilities, transfers of FFFs, etc.

Motivation: Evidence of financial commitment from the local environment strongly supports the proposal as being important. Conversely, if the local environment is unable or unwilling to support it, the importance to the environment as a whole is much weaker.

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| The department should be able to settle on a common funding structure for its faculty based on its existing allocation of internal resources. |

## Strategic value

### Strategic value of the area in the global context

Instruction: Describe the importance of the area in the global context. For example: fundamental challenges in research; new developments in research; societal challenges and priorities; global impact and importance.

Motivation: To ensure consideration of the larger context.

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| Attractive conditions for faculty members are key for future success on an increasingly global talent market. This concerns both being successful in future recruitments and retaining our best researchers. It is also very important for the cohesiveness of the department to provide uniform and fair work conditions. |

### Strategic value of the area at the next level

Instruction: Describe the importance of the area to the department (for program proposals) and for the section and faculty (for department proposals). For example: synergies with other activities, connections to teaching and collaboration, both currently and potential for new ones, etc. Explain the value of this activity beyond any overlapping ones identified above.

Motivation: To ensure that there is awareness of where this activity fits in at the next level up in the organization. This is particularly important if support is to be requested at that level.

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| A more uniform treatment of the faculty in the department will help with future recruitment and retaining of talent, which will overall increase the impact of the department’s research and thus of all physics and astronomy research at UU. |

## Contributions needed for success

**Instructions**: Identify what contributions are needed for success in terms of time, expertise, resources, facilities, staff, etc. Explicitly include estimates of financial resources needed and where they will come from.

Motivation: To ensure the costs and resources required have been thought through, and that they are reasonable given the scope of the benefit.

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| A willingness throughout the department to work for the common good to reduce the fractured current system. Short term extra resources might be needed from TekNat to facilitate a smooth transition. |

### Success indicators

**Instructions**: Describe specific results that will indicate success in 5 years. For example: increases in publications in top venues X and Y, publications in new field Z, strengthened or new collaborations with university A, new hires in B, new grants from C, etc.

Motivation: To ensure that the local- and faculty-levels will be able to assess whether this Priority was successful at the next evaluation so that we develop a positive cycle of following up on our strategic planning.

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| A more uniform distribution of internal research support for all of the department’s faculty members. Better ability to recruit and encourage faculty members to excel in top-notch research areas, which are competitive on the global arena. |

### First steps that can be taken today

**Instructions**: Describe the first concrete steps needed to move in this direction that can be taken today. These should be clear enough that they can be followed up on in a year to see what progress has been made. Identify initial activities that can be started locally to enable progress to help motivate further support for the larger goal. In the exceptional case where no steps can be taken today, explain why a Priority has been chosen that cannot be started.

Motivation: To ensure that there is a clear idea of how to get started and enable easy follow-up of how the Priority is progressing.

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| Determining the level of uniform faculty research that would be possible and then analyzing the changes needed within the department. Identifying the best way to administratively handle the new arrangement, possibly with the department centrally paying salaries. Finding a way of handling the transition. |

# Priority 3 of 3: An activity that may require faculty support

## Description of the Priority

**Instructions**: Provide the department name (since these will be collected at the section/faculty level) and the program name (if this is a program Priority), the title of the Priority, and whether it may require department support (Yes/No) and/or faculty support (Yes/No).

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| Department: | Physics and Astronomy (IFA), Mathematics |
| Program: | Theoretical physics, Algebra and Geometry |
| Title: | Centre for Geometry and Physics |
| Support: | May require department support: | [No] | May require faculty support: | [Yes] |

### Goal

**Instructions**: Specify the goal of the Priority, for example, to strengthen a specific existing activity or start a new one.

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| To strengthen the Center for Geometry and Physics with regular positions and to widen the area of mathematical physics at UU. |

### Expected meaningful research improvement

**Instructions**: Provide a description of the research that investing in this Priority will accomplish over the next 5 years. Explain how it has the potential to significantly strengthen or broaden the program for program proposals or department for department proposals. Specifically, this should go beyond continuing or slightly enlarging current activities by having a clear description of what change it will accomplish.

Motivation: The overall goal is to strengthen our research. As a result, the Priority should deliver meaningful improvements in research quality and/or breadth.

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| The Centre for Geometry and Physics is an interdisciplinary research center with purpose to advance fundamental knowledge in mathematics and theoretical physics, especially in, and on the interface between, geometry and physics. Both fields have seen an immense development over the last decades, largely due to an increased exchange of theories and ideas. We want to maintain and increase the present level of activities, but also, and more important here, we want to widen the scope of the center to other areas of physics and mathematics. We see a very large potential in the use of advanced mathematical tools in physics and also in creating new mathematical ideas from the study of physical systems. This concern for example areas like condensed matter physics (topological phases of matter, categorical symmetries), quantum information theory (tensor networks) and links between number theory and physics (amplitudes, enumerative geometry and number theory). |

### Implementation plan

**Instructions**: Provide a brief description of specifically what is planned to be done over the next 5 years to realize the potential of this Priority. For example: new hires, investments in equipment, starting collaborations, closing down existing activities, moving resources from existing activities, etc. Use the limited space provided here to discuss the most important aspects of how this activity will be carried out.

Motivation: For a Priority to be credible, there must be a plausible plan and what needs to be accomplished must have been thought through. It is understood that these plans will change over the next 5 years, however.

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| The VR Excellence Center in Geometry and Physics operates according to plan with increasing number of activities in coming years and possible tenure track hirings as stated in the project description in the original VR application. Our ambition is to make one tenure-track recruitment in each of the two departments: one more directed to physics and one more directed to mathematics. In order to attract candidates on the highest international level, we need resources for a career-packages at both departments, including PhD students. This requires new resources since the VR Excellence Center funding cannot be used for PhD positions. Furthermore, we will organize our activities across two departments which pose certain challenges both administratively and culturally. We will also identify other activities within physics and mathematics with further potential for interaction. An example is the quantum material theory program with categorical approach to topological phases of matter and to quantum information.  |

### What previous accomplishments indicate a high likelihood of success?

**Instructions**: Describe what recent (last 5 years) accomplishments make it clear that the there is a good chance of success in this project. Use specific examples (e.g., grant X, collaboration Y, paper Z) and explain how those recent accomplishments are evidence of having the competencies needed to be successful in this project.

Motivation: For a Priority to be credible, the expertise and track record needed to support it must be present.

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| Geometry and Physics research was initiated at Uppsala more then 10 years ago between Math Department and the division of Theoretical Physics. It was supported by KAW project grant during 2015-2020 (Ekholm and Zabzine) and since 2024 it is supported by a VR Excellence Centre grant (PI Ekholm, co PIs Dimitroglou-Rizell, Minahan, Zabzine, del Zotto). The area has a strong record in hiring of excellent young researchers, producing top research and organizing top international activities. Apart from being awarded the VR Excellence Center grant other significant accomplishments directly related to the area of Geometry and Physics include the following: The organization of the yearly conference String Math 2019 at Uppsala where three Fields medalists (Yau, Kontsevich, Okuonkov) and two Dirac medalists (Seiberg and Vafa) spoke. The Frontiers of Science Award at the International Congress of Basic Science 2023 for the paper *A complete knot invariant from contact homology,* Inventiones 2018 (Ekhom, Ng, Shende). The one year KAW guest professorship for Ezra Getzler.  |

## Current status of the area at Uppsala University

**Instruction**: Describe the current status of the area at Uppsala University as a whole. Include any existing funding, support, staff, and success in this area. Explicitly identify any overlap with other existing activities at the program(s), department, section, faculty, and/or university levels.

Motivation: To avoid duplicating efforts, it is important to understand the local Uppsala context when enhancing existing activities or starting new efforts. As part of the evaluation process, the panel will try to identify synergies between proposed Priorities.

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| VR Excellence Center in Geometry and Physics (3 Profs, 2 UL) plus affiliated researchers from the departments of Physics and Astronomy and Mathematics. Joint hirings (2 UL based at Math and 1 UL based at Physics) between two departments. The center is also part of the Faculty’s strength area “The universe and mathematical physics”. |

### Current and planned contributions to support the initiative

**Instructions**: Describe the current (already in-place and on-going) and planned contributions to this goal from the local level (from the program for program proposals, from the department for department proposals, and from both the program(s) and department, as appropriate, for program proposals selected by the department). For example, co-funding, in-kind support, shared funding of facilities, transfers of FFFs, etc.

Motivation: Evidence of financial commitment from the local environment strongly supports the proposal as being important. Conversely, if the local environment is unable or unwilling to support it, the importance to the environment as a whole is much weaker.

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| In January 2024 the Centrer for Geometry and Physics was inaugurated and operates scientifically since then. So far, the Department of Mathematics has hired five highly qualified post docs with starting dates during 2024. All will do interdisciplinary research in geometry and mathematical physics. Future hirings and activities are planned. |

## Strategic value

### Strategic value of the area in the global context

**Instruction**: Describe the importance of the area in the global context. For example: fundamental challenges in research; new developments in research; societal challenges and priorities; global impact and importance.

Motivation: To ensure consideration of the larger context.

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| Uppsala University is the strongest institution in geometry and mathematical physics in Scandinavia. It has reached this position through work over more than a decade. It is crucial to maintain and develop it. We believe in particular that it would be strategically valuable to widen the interactions with geometry and mathematical physics to other areas of physics and mathematics, for example Quantum Information and number theory. |

### Strategic value of the area at the next level

**Instruction**: Describe the importance of the area to the department (for program proposals) and for the section and faculty (for department proposals). For example: synergies with other activities, connections to teaching and collaboration, both currently and potential for new ones, etc. Explain the value of this activity beyond any overlapping ones identified above.

Motivation: To ensure that there is awareness of where this activity fits in at the next level up in the organization. This is particularly important if support is to be requested at that level.

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| The synergy between physics and mathematics produces top level research on both sides. Internationally, there are many centers in Geometry and Physics/Mathematical physics. It is crucial for Uppsala to have such a center and to host top level research in this area.  |

## Contributions needed for success

**Instructions**: Identify what contributions are needed for success in terms of time, expertise, resources, facilities, staff, etc. Explicitly include estimates of financial resources needed and where they will come from.

Motivation: To ensure the costs and resources required have been thought through, and that they are reasonable given the scope of the benefit.

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| The Center for Geometry and Physics needs funding (hopefully permanent) that is earmarked for Geometry and Physics and not to specific departments. We believe that the most effective way to achieve this would be to channel resources directly to the research programs in the two departments conditioned to be used for hirings in the broad area of Geometry and Physics/mathematical physics and its applications. |

### Success indicators

**Instructions**: Describe specific results that will indicate success in 5 years. For example: increases in publications in top venues X and Y, publications in new field Z, strengthened or new collaborations with university A, new hires in B, new grants from C, etc.

Motivation: To ensure that the local- and faculty-levels will be able to assess whether this Priority was successful at the next evaluation so that we develop a positive cycle of following up on our strategic planning.

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| Top level scientific publications, attraction of external grants, attractivity of the environment for external hirings at all levels (number and quality of applicants). |

### First steps that can be taken today

**Instructions**: Describe the first concrete steps needed to move in this direction that can be taken today. These should be clear enough that they can be followed up on in a year to see what progress has been made. Identify initial activities that can be started locally to enable progress to help motivate further support for the larger goal. In the exceptional case where no steps can be taken today, explain why a Priority has been chosen that cannot be started.

Motivation: To ensure that there is a clear idea of how to get started and enable easy follow-up of how the Priority is progressing.

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| Dialogue with the Faculty about the joint positions in geometry and physics between the Departments of physics and Astronomy and Mathematics in order to create a proper framework, beyond informal agreements between department chairs. Dialogue with the Faculty about the support of the interdisciplinary activities between different sections. |

# Questions to the panel

The panel will provide feedback on research quality, strengths and opportunities for improvement, and comment and give feedback on staffing, funding, and at least one priority area.

**Instructions**: If you have specific questions for the panel that are not covered by those areas, please list up to three of them here. Please note that due to time constraints during the visit, not all questions may be answered.

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