KoF/ÖB 2024

Faculty of Science and Technology

Research Program Self-Evaluation

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| --- | --- |
| Research Program: | Nuclear Physics |
| Department: | Department of Physics and Astronomy |
| Section: | Physics |
| Program Responsible Professor: |  |

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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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| Leupold (prof), Papenbrock (forsk.), Schönning (prof) and Wolke (UL) were main contributors. Eklund (prof) decided not to contribute. The other division members were asked about feedback early on for the priority projects in sections 8-10, but only in the last stage for the rest (sections 1-6).  |

## 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 focus of our curiosity-driven research program is to investigate the strong interaction that forms the major part of the visible matter of the universe, and generates almost 99% of its mass. We approach this challenging question at experimental facilities world-wide and in collaboration with our theoreticians.  |

## 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** | 1.0 |  |  | 1.0 | 1.5 |  |  |  |  | 1.5 |
| **Male** | 2.4 | 1.0 |  | 3.4 | 2.5 |  | 3.5 | 1.2 | 1.0 | 8.1 |

## 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** | 7.8  | 4.7  | 12.6  | 8.0  | 20.6  | 39% |
| **2022** | 7.7  | 4.3  | 12.0  | 4.5  | 16.5  | 27% |
| **Average** | 7.8  | 4.5  | 12.3  | 6.3  | 18.5  | 33% |

### 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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| Studiestöd from faculty; Calén&Wolke: infrastructure grant for pellet; Eklund: IFA support as recruited prof.; Nyberg: IFA support for Agata; Schönning: 2022-2027: Co-funding of KAW grant (250 kSEK/year); 2022-2023: Support from prefekt as compensation for studiestöd to externally funded PhD students: 700 kSEK/year. |

### 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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| We have not agreed on a policy for how to distribute internal research funding nor for co-funding of external grants, nor for internal resources for researchers; some have all their research paid by internal funding while others have no research paid by internal funding. Studiestöd goes by default to the program, also if the PhD student is paid by third-party funding. The teaching is allocated according to how much money it generates at the GU level, which is typically much smaller than the actual time spent. Furthermore, the documented teaching time does not include supervision of undergraduate students or teaching of PhD courses. There is no policy on how to properly account for teaching or how to allocate teaching between the personnel. |

### 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 | 4.6 (53%)  | 0.9 (10%)  | 0 (0%)  | 0.9 (11%)  | 0 (0%)  | 1.6 (18%)  | 0.7 (8%)  | 8.8  |
| 2022 | 4.4 (41%)  | 2.7 (25%)  | 0 (0%)  | 0.9 (9%)  | 0 (0%)  | 2 (18%)  | 0.7 (7%)  | 10.8  |
| Average | 4.5 (47%)  | 1.8 (18%)  | 0 (0%)  | 0.9 (10%)  | 0 (0%)  | 1.8 (18%)  | 0.7 (7%)  | 9.8  |

### 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 | 95% | 0% | 5% | 83% | 2% | 15% |
| Associate (UL) |  |  |  | 74% | 15% | 11% |
| Assistant (BUL) |  |  |  |  |  |  |
| PhD | 26% | 67% | 7% | 40% | 60% | 0% |
| Postdoc |  |  |  |  |  |  |
| Researcher |  |  |  | 47% | 41% | 13% |

### 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) |
| PANDA / HADES | SFAIR consortium (Chalmers, KTH, Lund, Stockholm, Uppsala) | Germany | 1.1 |
| LHCb | not yet (should become part of Swedish CERN consortium) | CERN | -(financed by IFA and research grant of Kupsc) |
| Belle-II | - | Japan | 0.14(financed by research grant of Schönning) |
| NNBAR @ ESS (not approved yet) | - | Sweden | - |
|  |  |  |  |

## 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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| On top of the large-scale commitment to FAIR, including PANDA (7 active researchers including PhD students), supported by a convention by the Swedish government, hadron physicists in Uppsala are engaged in several facilities: Belle II (4), BESIII (4), NNBAR (ESS) (4), LHCb (3). |

# 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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| A major recruitment (“chair in nuclear physics”) was made shortly after the previous evaluation ÖB19 after which an LHCb activity was initiated. In parallel, a large amount (~34 MSEK) of external funding was acquired to deepen the PANDA/HADES engagement and to join the Belle II experiment, two activities that gained a lot of momentum. However, for different reasons upon which we do not agree with each other, the collaboration within the program and work environment have become problematic. A lack of management has made it difficult to implement procedures that comply with labor laws, collective agreements, and local guidelines. Additional support is crucial for the successful continuation of the program. |

# 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 | Experimental hadron and hypernuclear physics (Schönning) | 45% | 1 | Basic science |
| 2 | Experimental flavor and hadron physics (Eklund, Wolke) | 35% | 2 | Basic science |
| 3 | Experimental nuclear structure physics (Nyberg) (not continued) | 7% | 1 | Basic science |
| 4 | Theoretical hadron physics (Leupold) | 13% | 1 | Basic science |

## 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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| We aim for a quantitative understanding of the strong interaction that binds quarks to protons and neutrons and other hadrons. Additionally we search for physics beyond the standard model by high-precision experiments and corresponding calculations. Our research relates to material physics by exploring the known matter, but at much higher resolution. It also relates to high-energy physics by searching for new types of particles and forces, but at the high-precision, high-intensity frontier. It relates to astronomy and cosmology by exploring the microscopic mechanisms relevant for compact stellar objects (supernovae, neutron stars) and for the evolution of the early universe. Having experiments and theory joined in one program is a key feature of our approach. The main experimental challenge is to identify long-lived particles from their complex decay topology in the detector. This requires tailor-made algorithms and we are exploiting the potential of machine-learning techniques.There is a tendency to invest resources in safe projects, with data already on tape. This puts a challenge to carry out high-risk projects with groundbreaking potential.We carry out curiosity-driven research, i.e. prepare the society for the truly future challenges that have not even been identified yet. This is facilitated by providing the basis for applied sciences, but also by training the analytic skills of the young generation when addressing some of the intellectually most complicated problems.  |

## 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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| Through collaborating experimental and theoretical hadron physicists in Uppsala, several innovative projects have been initiated and conducted with the BESIII experiment in China. These have led to precise hyperon CP tests (Nat. Phys. 15, 631–634 (2019) and Nature 606, 64–69 (2022)) and a pioneering measurement of hyperon structure (Phys. Rev. Lett. 123, 122003 (2019)). These projects have been transformative for the BESIII collaboration.Within PANDA, Uppsala has had the leading role in the read-out electronics and data concentrators for the electromagnetic calorimeter. The backward and forward endcaps are already assembled and are now being taken into operation in PANDA precursor experiments at MAMI in Mainz and, in the future, at ELSA in Bonn.Kupsc and Leupold are co-authors of Phys. Rept. 887, 1 (2020), a report with more than 1200 citations, addressing the magnetic moment of the muon (Muon g-2 Theory Initiative). In 2022 it was the most cited theory paper in particle physics. |

### 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 | 506 / 245 |
| Proportion of publication fractions at the Norwegian model level 2 (%) | Impact | 32% |
|  |  | 2017-2021 |
| Coverage (fractionalized): Proportion of publications from DiVA included in citation statistics, weighted by fractional counts | Coverage | 13% |
| Mean normalized number of citations per publication (MNCS) | Impact | 0.61 |
| Proportion of frequently cited publications (top 10%) (PP(top 10%)) | Impact | 3% |

### 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.

|  |  |  |
| --- | --- | --- |
| Channel | Number  | % of Total Publications |
| Physical Review D: Covering particles, fields, gravitation, and cosmology | 211 | 41.7 |
| Physical Review Letters | 74 | 14.6 |
| Journal of High Energy Physics | 48 | 9.5 |
| Physics Letters B | 47 | 9.3 |
| Chinese Physics C | 17 | 3.4 |
| European Physical Journal A | 15 | 3 |
| Physical Review C: Covering nuclear physics | 15 | 3 |
| European Physical Journal C | 8 | 1.6 |
| Journal of Instrumentation | 7 | 1.4 |
| Nuclear Instruments and Methods in Physics Research A | 6 | 1.2 |

### 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  |
| Physical Review Letters | 74 | 14.6 | NA | NA |
| Physical Review D: Covering particles, fields, gravitation, and cosmology | 211 | 41.7 | NA | NA |
| MESON conference (biannual) | 3 speakers (on average) |  |  |  |
| NSTAR conference (biannual) | 2 speakers (on average) |  |  |  |
| BARYON conference (biannual) | 2 speakers (on average) |  |  |  |
| CHEP conference (18 monthly) | 1 speaker (on average) |  |  |  |
|  |  |  |  |  |
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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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| Our research practice suggests that results are internationally published as quickly as possible, first at the publicly accessible preprint server “arXiv”. This practice collides with the publication rules of journals like Nature. Consequently we regard Physical Review Letters (PRL) as the more important journal in our field. We have a high rate of PRL publications. The concept of a lead author does not make sense for large collaborations and the author list is alphabetical. Even the “corresponding-author” concept is misleading, since students and postdocs often contribute most, but do not have a stable long-time email address. |

### 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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| Collaborations: Belle II, BESIII, NNBAR, KLOE-2, LHCb, PANDA, PANDA@HADES, Muon g-2 Theory Initiative.Recognitions: Thalén award (2018), Bjurzon premium (2019), PANDA PhD prize (2020, 2022), PANDA Outstanding Achievement (2019, 2021), Most Influential Paper by the Chinese Physical Society (BESIII White Paper 2021), several invit. plenary presentations/year and several internat. advisory commit. Leadership: Conveners for hadron physics in the NuPECC Long Range Plan task force, PANDA Physics coordinator 2023-2025, PANDA deputy spokesperson (2016-20, 2020-23), PANDA deputy computing coordinator, Belle II skim coordinator, Belle II publication committee, KLOE-2 analysis board chair, LHCb editorial board. |

## 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.

|  |  |  |
| --- | --- | --- |
| 1 | Type of synergy | Hyperon physics in electron-positron collisions |
|  | Specificcollaboration | Collaboration, on the one hand, between scientists active in BESIII (Adlarson, Johansson, Kupsc, Schönning) and theoreticians (Fäldt, Leupold), on the other hand, between Belle II and theorist Fäldt on Initial State Radiation. |
| 2 | Type of synergy | Pellet tracking |
|  | Specificcollaboration | Synergies between the pellet tracking system (Calén, Wolke) and particle track reconstruction / machine learning (Papenbrock) |
| 3 | Type of synergy | Common papers written by experimentalists and theoreticians |
|  | Specificcollaboration | PhD students (Beijing, Uppsala, Valencia, Warsaw) and Kupsc, Leupold (+ Adlarson, other coauthors) (3 papers since 2019, 1 more in preparation); Fäldt & Schönning |

## 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.

|  |  |  |
| --- | --- | --- |
| 1 | University and Field | Chalmers, KTH, Lund and Stockholm University in nuclear and atomic physics |
| Type of synergy | Research groups in hadron physics, nuclear physics and atomic physics have joined efforts for future physics at FAIR, Germany, within the experimental collaborations APPA, NUSTAR and PANDA. |
| Specificcollaboration | The different research groups have common interests through their engagement in various FAIR projects and experiments. Most prominent are collaborations between the NUSTAR groups and the PANDA groups on projects of common interest and where equipment and expertise from two different research fields (hadron physics and nuclear physics) are used. Uppsala, Chalmers and KTH have also submitted a KAW proposal that includes theory development and the design of a new detector for hypernuclear physics. The latter is a research field that unifies nuclear and hadron physics. |
| 2 | University and Field | Uppsala university, Lawrence Berkeley National Laboratory (US), GSI (Germany) |
| Type of synergy | Particle tracking with machine learning techniques |
| Specificcollaboration | The PANDA group has collaborated with a researcher at the IT department at UU, with the National Energy Research Scientific Computing Center (Berkeley) and with the GSI, on tracking algorithms with Geometric Deep Learning. This collaboration involved a common PhD student. This collaboration is expected to continue, in the form of a guest PhD student in 2024-2025. A common proposal for a CIM grant was written, but could not be submitted since co-funding from the program’s FFF was missing. |
| 3 | University and Field | Valencia University (VU), Spain; particle physics + Warsaw University (NCBJ), Poland; nuclear physics |
| Type of synergy | shared supervision of 3 PhD students theory+experiment (from VU, NCBJ, UU, respectively); one paper published (PhDs: VU+UU), one in preparation (PhDs: VU+NCBJ) |
| Specificcollaboration | Alvarez-Ruso (VU), Kupsc (NCBJ,UU), Leupold (UU) |

### 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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| In hadron physics, cross-disciplinary synergies are a natural consequence of the engagement in multinational experimental collaborations. These evolve around large-scale research facilities that require investments and long-term commitments. Activities within these collaborations include theory/phenomenology development, advanced data analysis and state-of-the-art instrumentation. Hence, they require techniques and technologies from several research fields, and are thus cross-disciplinary at heart. There are formal and informal initiatives to join a large collaboration and informal initiatives to join smaller activities that may be or may not be connected to large-scale facilities. |

## 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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| There are no common initiatives to ensure good research ethics within the program, though individual supervisors take informal initiatives to discuss research ethics with PhD students and post docs. A major challenge is to establish and maintain ethical boundaries in a competitive environment. |

## 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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| There are no initiatives within the program to ensure research freedom nor academic freedom, but up to the PIs to allow their group members to use part of their time for their own projects and grant applications. The program will need support and guidance to implement a good code of conduct for academic freedom. |

## 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 includes 4 faculty and 3 senior researchers. The main challenge is not the size, but the imbalance between senior and junior staff in specific activities. Externally funded activities with mainly junior staff result in a huge workload for the only senior faculty, and would benefit from more seniority. |

## 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 |
| Swedish Research Council (VR) | 3.1  | Swedish Research Council (VR) | 4.2  |
| Wallenberg Foundation (KAW) | 0.8  | Wallenberg Foundation (KAW) | 3.2  |
| Olle Engkvist Foundation | 0.2  | EU commission (H2020) | 0.2  |
| Other private foundations | 0.2  | Carl Trygger Foundation | 0.2  |
| EU commission (H2020) | 0.2  | Uppsala University Foundations Management | 0.1  |
| Uppsala University Foundations Management | 0.0  | Marie Sklodowska-Curie (H2020) | 0.0  |
| STINT | 0.1 | Royal Institute of Technology (KTH) | 0.0  |
| Carl Trygger Foundation | 0.0  | Lunds universitet | 0.0  |
|  |  | Stockholm University | 0.0  |
|  |  | Chalmers Tekniska Högskola AB | 0.0  |

## 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) |
| ERC-StG, ERC-CoG, ERC-AdG, ERC-SyG |  |
| KAW Project |  |
| KAW Scholar | 1 (+ 1 in 2024) |
| WAF/WAFx | 1 |
| VR Project | 3 |
| VR Starting |  |
| Other grants (may include field-specific grants and Co-PIs) |
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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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| There are currently no initiatives to support the staff to apply for external funding and no policy on expectations. Some activities rely completely on external funding while others do not. In 2018-2019, there was an attempt to coordinate funding applications and a strategy to maximize the chance for success. This resulted in two approved applications, which is considerably better than average for the program. KAW project applications were nominated by the university in 2019 and in 2023. |

## 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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| International and national collaborations: **BESIII:** The Uppsala group had a transformative influence on the BESIII physics program, resulting in pioneering hyperon structure measurements and precise symmetry tests. **PANDA:** The Uppsala group has held and hold several leading positions in PANDA and contribute to both physics, software and instrumentation. **Belle II:** Despite being very new in the collaboration, the Uppsala group has high visibility, with several appointments of trust. **LHCb:** The group focuses on searches for new hadrons and measuring their properties, and on measurements of CP violation. Uppsala is leading a new topic, measurements of CP violation in decays of charm hadrons to hyperons. **NNBAR:** Our hardware feasibility studies contribute significantly to the aim of enabling research in fundamental physics at the ESS.There is a well established interaction between experimentalists and theoreticians encompassing spontaneous and organized discussions, common papers, and shared supervision of bachelor, master and PhD students.  |

## 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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| The program would benefit from a policy that i) clarifies the expectations and ensures they are fair and equal, ii) agrees on a system for co-funding of larger grants, iii) identifies a code of conduct to avoid negative interferences, iv) enforces good research practices, in particular that teachers can freely choose research topics, methods and collaborators, and v) counteracts problematic actions that attempt to preventing colleagues from applying for or getting external funding.The LHCb activity (at the moment Lund and UU) needs to be fully established in Sweden (put on VR infrastructure roadmap, becoming member of Swedish LHC consortium).Theory developments do not live from long-term collaborations but from discussions with a variety of international colleagues. Funding for inviting guests, research visits and conference participation should not solely depend on external grants. |

# 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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| Nyberg retired beginning of 2024 which brought number of faculty members back to 4. Schönning started as BUL, got promoted to UL and finally professor. The other two professors and lecturer started already as professors and lecturer, respectively. Next retirement happens only in more than 10 years. When recruiting Eklund, it was envisaged that an additional lectureship could be financed by TekNat faculty. But decision process was rather intransparent and might now be replaced by KOF decisions. |

## 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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| Main activity of program is experimental hadron physics while nuclear structure physics (not continued) and theoretical hadron physics (continued) were side activities when last recruitment took place. The main activity did not have a professor after Johansson retired. Position was internationally announced for the whole breadth of experimental hadron physics, leading to recruitment of LHCb scientist Eklund for “chair in nuclear physics”. |

### 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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| TekNat decides about faculty recruitments. The influence of the program was restricted to formulating scientific requirements for the advertisement, encouraging colleagues to apply, and the final recruitment negotiations. Based on the initiative of individuals a number of potential female candidates was identified and encouraged to apply. The position was internationally announced for all areas of experimental hadron physics. The main activities of the candidates invited for interview were CERN or FAIR, reflecting the largest activities of experimental hadron physics in Europe. The recruitment was already successful for the top candidate. |

## 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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| Currently, there is no common policy on support for career developments for non-tenured staff. However, individual PIs with external funding, or influence over internal funding, often provide support for career-developing activities such as summer schools and conferences, where young staff members get training in presenting their research and have the opportunity to network. The same applies to career development in the form of workshops on e.g. grant application writing, and time spent on grant application writing.Career development should be a part of the paid working time. |

### 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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| There is no system at the program level for tenure-track staff, but the latest tenure track staff (recruited in 2014) received department funding for a PhD student with the agreement that the program paid the remaining part of the PhD. Other career-development activities have relied on funding acquired by the tenure-track staff in the form of external grants. |

### 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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| There is no policy or support for career development of tenured staff. There may be individual initiatives but there is no policy to ensure they apply equally. |

## 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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| Research funding (section 3) and career development (section 4) cannot be seen independently. We have identified the need to establish more transparent decision processes and to develop in a collegial way a clear policy for various aspects related to research directions and the distribution of research funding. But we are by far not there yet to have agreed on such policies in practice. Based on individual initiatives of employees and/or support from individual PIs, it has turned out in practice that PhDs and postdocs leaving our program have obtained good positions as postdocs or in industry or in the public sector.  |

## 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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| In Sweden we are by far the largest hadron physics group. We can be a stepping stone for an international career in hadron physics. But it can be difficult for our employees to find jobs in hadron physics in Sweden. Reaching a more senior non-faculty position in our program can mean a dead-end for a hadron-physics career inside of Sweden. On the other hand, several of our previous employees found academic positions in neighboring fields like applied nuclear physics. In practice, the program runs at the moment a very static system of distributing faculty funding among tills-vidare employees where only retirements and not external funding lead to changes. All these effects together create a system that is too rigid concerning the career perspective of scientists beyond the postdoc level. In addition, it is a general problem that there is no well defined career path for forskare. Even if they carry out tasks beyond their formal qualification, they cannot be promoted to BUL or UL. At the same time, they uphold critical program functions, e.g. teaching and supervision, which would not be possible without them. |

# 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.

|  |  |  |
| --- | --- | --- |
| 1 | Example and connection | Activities at SciFest: The PhD students and postdocs of the program are regularly initiating and conducting activities at SciFest, often in collaboration with Applied Nuclear Physics. In 2023, the SciFest participation included a VR-experience of the Belle II detector, a quark puzzle, and a cloud chamber. The target is school children aged 6-16. |
| Value to the program | Visibility for nuclear physics and ongoing research, possibility to attract future students |
| Value to the partner | Learn about the nuclear physics and the multitude of research opportunities here in Uppsala and world-wide. |
| 2 | Example and connection | Belle II Masterclass, organized by postdocs and PhD students in the hadron and hypernuclear physics group, targeting highschool students. The event is coordinated on a European level and the local students will connect with other groups across Europe during this day. |
| Value to the program | Visibility for our research and possibility to attract future students |
| Value to the partner | Inspiration to study physics at university level, meet young researchers and get new role models. The high-school students also get hands-on experience on how modern research is done. |
| 3 | Example and connection | Several members of the program have given seminars as a part of the popular science lecture series “13X13” in the Humanistiska Teatern, targeting the general public. |
| Value to the program | Visibility and possibility to disseminate one’s research to the public. |
| Value to the partner | Popular adult education (“Folkbildning”) |
| 4 | Example and connection | Chapter on hadron physics (“Protonen – en hundraårig gåta”) in the book Kosmos 2023 by the Swedish Physics Society, about the Standard Model. The book is targeting highschool students in physics and their teachers. |
|  | Value to the program | Visibility and knowledge about hadron physics in Sweden and world-wide, possibility to attract future students. |
|  | Value to the partner | As a whole, the Standard Model edition provides a comprehensive introduction to particle and hadron physics and can in principle be used in teaching. |

### 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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| There is no overall strategy for outreach, but it is up to the PIs to allow their younger staff members to pursue their initiatives. That said, the participation in SciFest has become a tradition and we have a well-established collaboration with the program for applied nuclear physics. Most other outreach-related activities are initiated by engaged and competent individuals, primarily the young researchers. In general, the program is supportive to such events and helps by providing resources, access to equipment, connections to target audiences etc. However, the time spent typically comes from external research funds, since no allocated program funds exist for this purpose. |

## 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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| Outreach activities are primarily supported in the form of access to networks, equipment, lunch and premises. Though not formalized in the work-task plans, senior faculty are allowed to, and encouraged to, use part of their worktime for outreach activities. |

## 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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| Most of the outreach-related projects result from ideas from engaged and creative younger members of the staff. It is crucial to encourage and support such initiatives, both through feedback, access to networks, equipment, lunch, and premises.In general, outreach activities provide an excellent opportunity for young researchers to develop their creative thinking and their leader skills, and to build their own networks. This requires that senior staff are supportive in terms of providing the means to carry out a project, but take a back seat in the planning and implementation and trust the young staff to take the lead. |

## 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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| Since the outreach activities are often initiated by junior members of the staff (PhD students and postdocs), they need support not only for equipment and networks, but also to be able to allocate some work-time to the preparation and implementation. Most of the junior staff are employed on external research grants which in principle means that part of the money intended for research, instead go to outreach. It would be helpful if a part of the program’s budget could be allocated to compensate for the worktime that junior staff put into outreach activities. The connection between outreach and teaching should also be strengthened, in particular in the form of demonstrator equipment and/or software that can be used for both purposes. |

# 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 |
| Master’s Programme in Physics | Master | 5.5 | no |
| Master’s Programme in Engineering Physics | Master | 2.6 | no |
| Bachelor’s Programme in Mechanical Engineering | Bachelor | 0.8 | no |
| Master’s Programme in Electrical Engineering | Master | 0.8 | 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

|  |  |  |  |
| --- | --- | --- | --- |
| Infrastructure | Courses | Level | Students |
| Tandem Laboratory | 1FA348 Accel. And Det. | Master | 9 |
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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 | Use of presently ongoing research activities of the program in the course material, e.g. matter-antimatter asymmetry, hyperon puzzle of neutron stars or measurement of the proton charge radius |
| Course Info | 1FA346 Nuclear Physics and 1FA354 Advanced Nuclear Physics, Bachelor’s Program in Physics, (advanced, 30 students) and Master Program in Physics (advanced, 5-12 students), respectively. |
| Value to teaching/research | Students realize that what they learn is not just textbook physics but closely connected to actual research questions which are being investigated right at the moment. |
| 2 | Example | Master project in hadron experiments |
| Course Info | 1FA195 Project in Physics and Astronomy, Master’s Programme in Physics, advanced, (2-3 students per year) |
| Value to teaching/research | The students learn how to develop strategies for systematic tests of detector components, software development and data analysis. These projects result in actual research contributions to various international collaborations. |
| 3 | Example | Master theses in hadron theory that lead to direct journal publications with master students as leading authors (since 2019: Holmberg, Junker, Vitos, Salone, Mommers, Bertilsson) |
| Course Info | 1FA598 (degree project) or 1FA193 (30 hp project) |
| Value to teaching/research | Learning-by-doing for master students concerning the whole process of performing calculations, presenting them orally, discussing with journal reviewers, and finally publishing results in peer-reviewed journals. |
| 4 | Example | 1. Data analysis examples from contemporary physics experiments 2. Mini-project on application of modern analysis tools on a research problem of choice |
| Course Info | 1FA357 Statistical Methods in Physics, MSc in physics and MSc in engineering physics, |
| Value to teaching/research | Synergies between physics, data analysis and programming, which prepare the students for the methods used in experimental research and data analysis. PhD students who follow the course often learn new methods that they can apply in their own research. One example is a kinematic fitter that has been developed from a hand-in exercise to a full software package and a publication. |

### 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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| Teaching is centered around the Master‘s Programme in Physics, in particular the specialisation Nuclear and Particle Physics. Connecting course content beyond the textbook to actual research done in the programme can make students interested in curiosity driven research. The courses are important as „recruitment“ courses, to attract students to the field to enter into research projects or a master‘s thesis within the research programme. A variety of possible projects is essential to make our programme attractive, from hands-on detector work and software projects to theoretical studies. |

## 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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| To integrate research and teaching in students‘ projects requires knowing what colleagues in the research programme are planning to do. The information flow is mostly supported by collegial discussions without being managed. Also integrating present research results into teaching is mainly supported by collegial discussions, for example during teaching follow-up in connection with course evaluations. The latter organized by the department may contain valuable information of what worked and what did not work. Given the size of the programme, these unmanaged procedures may be considered sufficient. |

## 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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| To a considerable extent our successful research hinges on talented students and the scientific output generated through thesis work leading to publications. Attracting these students to the field is therefore vital and this is reflected in the role members of the program take in teaching in the BSc and MSc in Physics, as well as in Engineering physics. It is therefore also vital to continue this visibility. Part of teaching of exercises and laboratories is done by PhD students in the program. This has proven beneficial given the teaching experience gained, but also due to fresh ideas the PhD students bring into the courses. Therefore teaching by PhD students should be continued in the program, in particular also since PhD students who are involved in actual research can act as a role model. |

## 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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| Teaching both at undergraduate and graduate level can involve different teaching strategies and forms of classroom management and therefore foster the pedagogical skills of the teacher. Presently, undergraduate teaching is underrepresented within the program. This situation should be improved either by adding more undergraduate teaching and/or by a rotation of these teaching instances among the members of the program. Some of our advanced courses are crucial for the education in our field, but generate little GU income because of the small number of students. Thus they are actually cross-financed by internal or external research funding. Interdisciplinary courses with teachers and students from different fields (like 1FA335 Nuclear Astrophysics, given together with Astronomy and Space Physics and High Energy Physics and 1FA357 Statistical Methods in Physics which is given as a faculty-wide course) can be an asset in student education providing the opportunity to connect different disciplinary concepts. The teaching portfolio of the program should contain more such examples. |

# 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: | Nuclear Physics |
| Title: | Femtoscale investigations of matter and antimatter with Belle II and PANDA |
| Support: | May require department support: | No | May require faculty support: | 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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|  • Investigate the electromagnetic structure of strange and charm hyperons with Belle II • Perform high-precision CP tests with polarized charm baryons with Belle II • Outline a roadmap for hyperon and hypernuclear physics with antiproton prior to PANDA |

### 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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| With hyperons as a diagnostic tool, we investigate how the strong interaction forms visible matter, and why the universe consists of more matter than antimatter. The weak, parity-violating hyperon decays provide straight-forward access to spin observables, with far-reaching applications. The ventures we have initiated at the cutting-edge facilities Belle II in Japan and the future antiproton experiment PANDA, enable pioneering measurements of the electromagnetic structure of unstable particles. Furthermore, we exploit hyperon decays as a precision tool to search for CP violation, imperative in the understanding the matter-antimatter imbalance of the universe. In a project, we also investigate hyperon-nucleon interactions which should play a crucial role for the properties of neutron stars. In addition to the aforementioned physics goals, we develop novel techniques for data reconstruction and analysis, including machine-learning techniques. |

### 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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| 2024-2025: Finalizing the low-energy structure studies with PANDA@ HADES. Measure the polarization and structure of charm hyperons in Belle II. Extend the nascent analysis framework for FF measurements. Continue the development of particle track reconstruction algorithms for Belle II and PANDA, with focus on Geometric Deep Learning (GDL). Outline a physics program with antiprotons prior to PANDA.2026-2027: Deploy the FF analysis framework for charm hyperon data from Belle II, aiming for pioneering measurements of the FF phase. Test the GDL pipeline with real data from Belle II. Perform physics simulations of the PANDA precursor and investigate the potential of Belle II and PANDA regarding hyperon interactions. Initialize CP tests exploiting sequential decays of polarized charm hyperons.2028-2029: Continue the CP tests and harvest the world-leading data sample that should be available at this point. Prepare for the launch of a PANDA precursor. |

### 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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| We have initiated and led pioneering measurements of hyperon structure as well as precise baryon CP tests with BESIII, published in Nature, Nature Physics and PRL, and our plan to take these studied to the next level within Belle II are supported by Belle II and by the KAW foundation. Our contributions to the PANDA software led to two PhD prizes. We have leadership positions e.g. physics coordinator and deputy computing coordinator in PANDA, and have quickly established ourselves in Belle II by skim coordination and in the publication committee. We are have active collaboration with theoreticians, internationally and nationally. |

## 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 recognition of expertise of our group members (1 prof., 1 researcher, 2 postdocs, 2+1 PhD students, and 1 senior prof.) at all levels manifest in multiple conference invitations, international leadership positions and ample support from VR, STINT and KAW. Our activities synergize with the planned IFA centre for AI. |

### 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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| Our activities currently receives base funding (FFF) for part of the PI salary, and co-funding of the KAW grant of 500 kSEK from the faculty. The remaining costs are covered by external grants. An FFF distribution matching the group size, would enable the recruitment of a lecturer to reduce the workload for the PI. |

## 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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| Our research provide a unique angle to the question how the strong interaction forms visible matter, and why our universe consist of matter but not antimatter. With applications well beyond subatomic physics, our data reconstruction activities make us an attractive partner inside and potentially outside academia. |

### 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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| Our activities strengthen the fundamental, curiosity-driven research at the department and our method development in data reconstruction synergizes with the planned AI centre. Furthermore, the latter appeal to students within and outside physics and offer a large variety of interesting student projects. |

## 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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| Our current group consists of 6 FTEs but will with the recent KAW Scholar grant grow to about 10 FTEs. This will strengthen our activities and chances for success. However, the group size leads to a huge workload for the PI, hence the recruitment of another lecturer or assistant lecturer to the group is highly motivated. |

### 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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| Conclude the PANDA@HADES activity by publications in PRD. Gain full Belle II authorship. Establish the potential of Belle II in hyperon structure and CP tests, manifested by publications (PRL and PRD), and in 2 PhD projects. Establish a roadmap for antiproton physics. Recruit 2 PhD students and a postdoc. |

### 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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| A paper draft should emerge from our hyperon Dalitz decay study with PANDA@HADES within a year and one from the Geometric Deep Learning project. Our Belle II entry contribution tasks should be completed for full authorship. A memo for internal Belle II review should emerge from the charm polarization project. |

# 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 |
| Program: | Nuclear Physics |
| Title: | Targeting a new era of hyperon physics with deep learning |
| Support: | May require department support: | Yes | 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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| * Cross-section measurements and spin analysis of hyperon-nucleon scattering and possible bound states
* Assembly and operation of pellet tracking system and pellet target
* Implementation of Graph Neural Network-tracking on FPGAs
 |

### 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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| We investigate how massive neutron stars avoid the gravitational collapse into black holes by combining and what role the expected emergence of strange matter, hyperons and hypernuclei, plays in this conundrum. Research on theoretical ab initio frameworks, which connect the fate of these stellar objects to particle interactions on the femtometer scale, is currently held back by data scarcity. While we know of more than 3000 isotopes in the ordinary nuclear sector, only 40 hypernuclei have been discovered so far. The same comparison holds true for elastic baryon-baryon scattering cross sections. By combining our expertise in hyperon physics, pellet target and tracking systems, and geometric deep learning, we will enable a new generation of hyperon scattering experiments at storage rings that can remedy this situation. In parallel, we will plan and carry out hypernuclear experiments at J-PARC. This activity will benefit from the proposed centre for deep learning. |

### 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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| 2024 - 2025: Plan and prepare hypernuclear experiments at J-PARC. Assemble pellet tracking system and start measurements in tabletop setup. Prepare installation of pellet target.2026 - 2027: Collect data with tracking system and analyse with Graph Neural Networks (GNNs). Simulate hyperon scattering yields for different target geometries. Integrate GNN reconstruction algorithms with J-PARC analysis software. Begin assembly of pellet test station. Upgrade pellet tracking read-out system with new FPGAs and implement GNNs on new hardware. Commissioning of pellet target.2028 - 2029: Beam-time for J-PARC experiments and data analysis. Integration of FPGA-based neural network tracking in experimental software frameworks (PANDA, Belle II). Test pellet tracking system in high multiplicity environments of cluster jet targets. Test measurements with pellet target. Mounting of tracking system on pellet target. Pellet beam and vacuum optimisation. Design and construction of secondary target foils. |

### 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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| Our program has the world-leading expertise on pellet targets and the WASA pellet target was in operation for many years. The developments on the pellet tracking system are world-wide unique and have applications also for clusterjet targets. We have a strong collaboration with WWU Muenster, the leading group on clusterjet targets and leader of the CRYOJET project. Furthermore, we have recently developed reconstruction algorithms driven by Graph Neural Networks that yielded outstanding efficiencies when applied to complex hyperon event topologies. Through hardware developments for PANDA and BESIII, we also have the expertise for the implementation of Graph Neural Networks on FPGAs. |

## 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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| Currently, a retired researcher, a researcher, and a PhD student are working with the pellet tracking system on a 5% – 10% level. Occasional student exchanges with WWU Muenster and local technicians support this activity. It is financed through CTS and local infrastructure grants. The program is not offering any support. |

### 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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| There are no current or planned dedicated contributions from the program to this activity. But we regard the activity as a part of the deep-learning initiative of our unit (programs of physics education research, theoretical astrophysics, astronomy, space physics, high-energy physics, nuclear physics). |

## 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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| This activity will lay the ground work for a new generation of hyperon scattering experiments with unprecedented interaction rates. The planned GNN/FPGA developments will be applicable to many experiments in the realm of middle-energy hadron physics and nuclear physics. |

### 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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| Neutron stars are found as a research subject in several programs of the department. The GNN/FPGA developments are applicable to a wide variety of computational problems as they are found in the department. Activity will be strongest connection of nuclear physics program to nuclear physics field. |

## 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 lecturer is required to lead this activity together with at least three FTE. A location and infrastructure for the installation of the pellet target is required as well. Vacuum equipment and read-out electronics will have to be acquired. |

### 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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| Planned experiments will lead to publications with high impact factor and contribute to world data bases (e.g. SAID, hypernuclear database). Hardware developments will be finalized and applied at corresponding experiments. GNN/FPGA developments will find external and in-house applications. |

### 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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| The assembly of the pellet tracking system as well as knowledge transfer is currently ongoing. We applied for external funding to increase the committed person power. Furthermore, we are already establishing the necessary international networks in which these activities will be driven. |

# 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 |
| Program: | Nuclear Physics |
| Title: | High-Precision Searches for the Mechanisms of Baryogenesis in the Early Universe(with BESIII, LHCb, ESS and theory) |
| Support: | May require department support: | Yes | 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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| Strengthen and extend existing activity and reach out to neighboring programs |

### 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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| A fundamental question of our existence concerns the surplus of matter (baryons) over antimatter in our universe. Nobel laureate and physicist A. Sakharov has identified three necessary conditions for dynamical baryogenesis: processes violating (1) baryon number and (2) CP (and C) symmetry. In addition these processes must happen (3) away from equilibrium. Together with members from the FREIA division, we aim at exploring the first two conditions. (Third condition is studied by members of the high-energy division.) We search for CP violation in the quark sector (baryon decays) with BESIII (Beijing) and LHCb (CERN). Using our synergy between experiment and theory, we will develop effective field theories to calculate weak processes, which are relevant for those baryon decays and for neutrino-matter interactions. The latter are instrumental to search for CP violation in the neutrino sector. Finally, we contribute to the instrumentation of NNBAR at the ESS, an experiment that searches for (baryon-number violating) neutron-antineutron oscillations.(approximately 950 characters) |

### 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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| Following up on TekNat’s decision to recruit LHCb physicist Eklund for the “chair in nuclear physics”, our prime objective is to establish a fully functional LHCb activity in Sweden. Program and IFA have invested in our renewal process. Long-term stability calls for TekNat funding of lectureship being envisaged in Eklund’s recruitment process. Present internal and external funding allow for analyses of existing data (BESIII, LHCb), supported by theory calculations to identify the most promising observables. Our key to find new physics is high precision, relating to detector quality. An IFA financed postdoc joint with FREIA would allow to develop instrumentation for LHC upgrades. We are part of the “Sakharov initiative” to support fundamental physics at the ESS. This encompasses our NNBAR and theory activities. TekNat support: (re-)allocate existing funding from strategic area “The universe and mathematical physics” (theory postdoc for neutrino-matter interaction). IFA support: finance postdoc joint with FREIA either for implementation of theory improvements into neutrino-matter simulation software or for instrumentation for NNBAR (or both). |

### 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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| Our developments in experiment and theory for BESIII made us experts in extracting CP-violation observables from baryon decays. This knowledge is transferred to LHCb and the corresponding effective field theory (EFT) for weak processes will be developed. The latter is an extension of our previous VR financed EFT development for electromagnetic processes. Related to fundamental physics that might be studied in the future at the ESS, we assess whether our WASA detector (originally developed for the Celsius accelerator ring in Uppsala) is suitable for the planned NNBAR experiment. Furthermore we develop an EFT for baryon form factors (that can be fitted to lattice QCD results), relevant for neutrino-matter interactions. |

## 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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| After ATLAS, LHCb is the second LHC experiment where UU is taking part. Together with members from the FREIA and high-energy divisions, we are part of the “Sacharov program of the Swedish Consortium for fundamental Physics at ESS”, which also supports the related theory developments. |

### 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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| 2 professors (LHCb+ESS, theory), 1 lecturer (ESS), 1 research engineer (ESS), and 2 researchers (BESIII, LHCb, ESS) contribute to this project; for most (5) it constitutes their main research activity. In addition, we plan to apply for external funding (VR, Carl Tryggers, …). See also 10.3.2(approximately 250 characters) |

## 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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| Within our international collaborations we search for processes that violate the conservation of baryon number and for processes that violate the CP symmetry to a significantly larger extent than the standard model. Finding any of such processes will likely lead to a Nobel Prize in physics. |

### 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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| Students are attracted by our research because of its fundamental nature. It fits to TekNat’s strategic area “The universe and mathematical physics”. Our research has overlap with the activities of members of the FREIA and high-energy divisions. It spurs the renewal process in our own 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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| Support from UU that LHCb becomes recognized by VR as an important infrastructure for Swedish research. LHCb must become part of the Swedish LHC consortium. This requires the commitment for a large enough long-term stable research group, which ties to the envisaged lectureship. |

### 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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| Size of LHCb group at UU can be deduced from number of UU authors on LHCb publications (LHCb publishes more than 170 papers per year). Theory and experiments: Publications, invitations to conferences. ESS: decisions about NNBAR approval. LHCb and NNBAR decisions about instrumentation developed at UU. |

### 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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| BESIII and LHCb: analyses of data that are already on tape (Adlarson, Eklund, Kupsc, IFA postdoc and PhDs);NNBAR: assess suitability of WASA detector (Eklund, Kupsc, Marciniewski, Wolke);theory: calculations of weak processes with master students and/or external collaborators (Kupsc, Leupold). |

# 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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| Question 1: Could we get advice for the following situation? We struggle with the question of a fair distribution of funding having one part of the program that is mostly internally funded with many seniors and another part that is mostly externally funded with a lot of young staff. In addition, the two parts have competing research interests. Question 2:Question 3: |