KoF/ÖB 2024

Faculty of Science and Technology

Research Program Self-Evaluation

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| Research Program: | Physics Education Research |
| Department: | Department of Physics and Astronomy |
| Section: | Physics |
| Program Responsible Professor: | Urban Eriksson |

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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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# General information

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

## Process for creating this self-evaluation

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

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

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| This evaluation was done by the PAP (Prof. Urban Eriksson), with assistance by the head of the division (Dr. Bor Gregorcic). Also, the post doc (Dr. Christopher Robin Samuelsson) and two PhD students assisted in several instances, i.e. the whole division at UU. |

## Core of the research program

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

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

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| The program focuses on investigating and understanding the processes of teaching and learning physics and astronomy. The main theoretical framework we work with is Social Semiotics but also other frameworks are used in the research, such as the Resources framework, Embodied cognition, AI in teaching and learning etc. |

## 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.

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| --- | --- | --- |
|  | **Faculty FTEs** | **Non-Faculty FTEs** |
|  | **Professor** | **Associate (UL)** | **Assistant (BUL)** | **Total** | **PhD** | **Postdoc** | **Researcher** | **Other****Research** | **Other** | **Total** |
| **Female** |  |  |  |  | 0.3 |  |  | 0.9 |  | 1.2 |
| **Male** | 0.6 |  | 0.9 | 1.5 | 0.9 |  |  | 1.2 |  | 2.1 |

## 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** | 3.1  | 0.6  | 3.7  | (0.0) | 3.7  | -1% |
| **2022** | 3.0  | 1.7  | 4.7  | 0.4  | 5.2  | 9% |
| **Average** | 3.0  | 1.2  | 4.2  | 0.2  | 4.4  | 4% |

### 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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| 2019-2023: A starting grant for a BUL position used for salary mostly on total 500 000SEK.2019-2021: A starting grant for hiring a new professor. |

### 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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| The FFF funds are mainly used to finance the salaries of staff and research-related expenses, such as hosting guest researchers, travel, and equipment. The permanent staff is typically financed about 50% from the FFF. The rest comes mostly from teaching and some from other administrative tasks. PhD students are financed partially from the FFF and partially from studiestöd, depending on the amount of studiestöd received in any given year. About 20% of PhD student funding is from teaching. Our postdoc is financed to about 80% from specially allocated funds received from the department and approximately 20% from teaching. |

### 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 | 1.1 (21%)  | 1.9 (36%)  | 0.1 (1%)  | 0.8 (16%)  | 0 (0%)  | 0.9 (18%)  | 0.4 (7%)  | 5.1  |
| 2022 | 1.2 (28%)  | 1.4 (31%)  | 0.1 (2%)  | 0.7 (17%)  | 0 (0%)  | 0.8 (17%)  | 0.3 (6%)  | 4.4  |
| Average | 1.1 (24%)  | 1.6 (34%)  | 0.1 (1%)  | 0.8 (16%)  | 0 (0%)  | 0.8 (18%)  | 0.3 (7%)  | 4.8  |

### 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.

|  |  |  |
| --- | --- | --- |
|  | Female | Male |
|  | Internal | External | Teaching | Internal | External | Teaching |
| Professor |  |  |  | 100% | 0% | 0% |
| Associate (UL) |  |  |  |  |  |  |
| Assistant (BUL) |  |  |  | 55% | 0% | 45% |
| PhD | 100% | 0% | 0% | 100% | 0% | 0% |
| Postdoc |  |  |  |  |  |  |
| Researcher |  |  |  |  |  |  |

### 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) |
| We do not use major infrastructures for our research at all. |  |  | 0 |
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## Other important comments

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

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

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| The PER program focuses on teaching and learning of physics and astronomy. Therefore, we have both different publication records and funding channels, similar to educational sciences. The program has suffered from retirements which has negatively influenced the productivity of the program. |

# 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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| From the ÖB19 we had set goals to further “investigating the role of multimedia in physics teaching and learning” and “developing a new initiative situated in physics teacher education”. We have succeeded in doing the first where in particular focus has been on the importance of embodiment in relation to multimedia of different types, in particular smartboards. The second new initiative is very much ongoing in that we have intensified our involvement in the physics teacher education program. This provided us the arena for researching aspects of physics teacher education, and in particular the use of supportive software and generative AI. Both has influenced our research when building the theoretical frameworks we us.From this we have learned that research interest changes rapidly and in particular the emergence of generative AI has influenced aspects of our research. However, our central focus on building the theoretical framework of Social Semiotics for modelling communication, teaching and learning goes beyond “just” these changing trends, but rather add new knowledge to the Social Semiotic framework, or “pieces to the puzzle”. For us, it is imperative to follow and research the new trends that affects teaching and learning of physics and astronomy. |

# 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.

|  |  |  |  |
| --- | --- | --- | --- |
| Main Research Areas | % of program | FTE Faculty | Type |
| 1 | Social semiotics in university physics education | 30% |  | Basic |
| 2 | Understanding physical phenomena | 20% |  | Basic |
| 3 | Students reasoning on large and small spatio-temporal scales | 30% |  | Basic |
| 4 | AI in teaching and learning | 20% |  | Basic |

## Research Activities

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

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

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| **The role of representations in Physics Education: -Social semiotics (SS) in university physics education**. We examine the roles that semiotic resource-systems such as language, mathematics, gestures, diagrams and sketches play in the teaching and learning of physics. We ask in what ways do physics teachers constitute their practice with respect to the semiotic resources that make up the educational communicative practices for the discipline. **Reasoning and problem solving**. This line of research continues a long-established research agenda within PER and explores how students understand physics phenomena and theory, and how learning experiences can be constructed to facilitate desired learning outcomes. In this line of research, we are pushing the borders of existing scientific knowledge by exploring topics that have previously received little to no attention in physics education research. **Embodiment**. The field of embodiment or embodied cognition explores the roles that students' physical bodies play in the processes of learning physics. The findings from this research allow educators to better adapt their teaching to students' inherent strengths and intuitions for interacting with the physical world. **AI in teaching and learning of physics and astronomy.**This relatively new area for the research program stems from the group's existing experience and interest in researching educational technologies. Research in this area has enormous potential to shape the future of education. The program has already established itself on the international stage as an important player in the field of researching the performance of LLM-based AI on physics tasks. We unpack technical knowledge from the domain of AI and Machine Learning and provided it to our physics education community through physics examples. **Students reasoning on large and small spatio-temporal scales.** We investigate how students communicate and make meaning of large and small spatio-temporal scales, well-known as a threshold concept for coming to understand physics and astronomy on a deeper level. We investigate university students’ communication order to be able to 1) understand how humans think about scales, and 2) inform the teaching and learning of physics and astronomy. We investigate university students’ strategies in building and communicating their understand via different semiotic resources. |

## Research Results

### Contributions to the field

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

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

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| The program has been extremely successful in developing the **SS** framework modelling the teaching and learning of physics and astronomy through communication. It is now used internationally as a good example of how learning physics at university level can be described. It has also been implemented in other neighboring disciplines, such as chemistry, cosmology and particle physics. In the development of the framework, many theoretical pieces have been identified and a recent is *embodiment*. Experiences by the body have shown to be very important; we have shown its importance for learning physics and astronomy. By applying the SS framework, and other theories, we have contributed to and expanded the knowledge on students’ reasoning and problem-solving skills at all levels of university physics education. Lately, AI has become a phenomenon that has great potentials for teaching and learning physics and astronomy, but little to nothing is known on these issues. We investigate this and have made several important and novel contributions to this rapidly growing field.  |

### 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.)

|  |  |  |
| --- | --- | --- |
|  | Type of Indicator | 2017-2022 |
| Number of publications, full publication set (full / fractional counts) | Quantity | 49 / 31 |
| Proportion of publication fractions at the Norwegian model level 2 (%) | Impact | 11% |
|  |  | 2017-2021 |
| Coverage (fractionalized): Proportion of publications from DiVA included in citation statistics, weighted by fractional counts | Coverage | 40% |
| Mean normalized number of citations per publication (MNCS) | Impact | 1.05 |
| Proportion of frequently cited publications (top 10%) (PP(top 10%)) | Impact | 10% |

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

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

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

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| --- | --- | --- |
| Channel | Number  | % of Total Publications |
| European Journal of Physics (EJP) | 5 | 10 |
| Research in Science Education (RISE) | 5 | 10 |
| Designs for Learning (DfL) | 3 | 6 |
| Physical Review Physics Education Research (PRPER) | 3 | 6 |
| Physics Education (PE) | 2 | 4 |
| Physics Teacher (PT) | 2 | 4 |
| Science and Education (S&E) | 2 | 4 |
| Science Education (SE) | 2 | 4 |
| Bridging research and practice in science education: selected papers from the ESERA 2017 conference | 2 | 4 |
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### 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 Physics Education Research (PRPER) | 3 | 6 | 3 | 6 |
| European Journal of Physics (EJP) | 5 | 10 | 5 | 10 |
| Research in Science Education (RISE) | 5 | 10 | 5 | 10 |
| Physics Education (PE) | 2 | 4 | 2 | 4 |
| Science & Education (S&E) | 2 | 4 | 2 | 4 |
| Science Education (SE) | 2 | 4 | 2 | 4 |
| **Conference**s |  |  |  |  |
| American Association of Physics Teachers (AAPT)/PERC |  |  |  |  |
| GIREP/ World Conference on Physics Education (WCPE) |  |  |  |  |
| ESERA |  |  |  |  |

### 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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| The program always aims to publish in the most well-known and respected journals. We prefer to send manuscripts to PRPER and EJP, which are both highly respected. However, publishing in EJP is free of charge for us while publishing in PRPER costs around 20 000SEK/article; a significant cost for our small division. Moreover, RISE is also well respected, and we have sent and send manuscripts here continuously. For conferences, we prioritize to go to well respected conferences, e.g. AAPT and Physics Education Research Conference (PERC) in the USA every year, and GIREP in Europe which often coincide with WCPE. Presentations and proceedings at/from these are considered very important for our research field. |

### 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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| The program has collaborations with many major PER groups around the world. Program members are often invited as keynote speakers at conferences in our fields. The program professor is vice president for the educational Commission C1 in the International Astronomical Union (IAU) and Working Group leader for Astronomy Education Research and Practice in the IAU. He also instigated and is editor for the international Astronomy Education Journal (AEJ, astroedjournal.org) and has instigated and chaired astronomy education conferences (astroeducon.org). Often, he is asked for as SOC member for national and international science education research conferences. Head of Division of PER, Bor Gregorcic, is an editorial board member of EJP. |

## Synergies within the research program

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

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

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| 1 | Type of synergy | Methodologies |
|  | Specificcollaboration | Within the program we all collaborate around a limited number of methodologies and can hence help each other, collaborate, and evaluate each other’s analysis and results. |
| 2 | Type of synergy | Theoretical frameworks |
|  | Specificcollaboration | We are all familiar with the different theoretical frameworks that underly our research and hence have deep scholarly discussions in relation to our research. This makes a huge difference when writing manuscripts and works as a peer review process, increasing the probability for acceptance by journals when submitted. |
| 3 | Type of synergy | Research on physics teacher education |
|  | Specificcollaboration | Both Urban Eriksson and Bor Gregorcic (permanent faculty) have a background in physics teacher education and are engaged the field both through teaching and research. Their international connections on the topic extend beyond the research program and include the National Resource Center for Physics Education in Lund, University of Ljubljana, Slovenia, Leuwen University, Belgium, Deakin University, Melbourne, Australia, and Rutgers University, USA. |

## Synergies across research fields

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

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

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| --- | --- | --- |
| 1 | University and Field | Dept. of physics and astronomy, Uppsala University, Physics and Astronomy |
| Type of synergy | We do research on teaching and learning of university physics and our students at all levels are objects of interest. Our research informs the teaching and learning at the department. |
| Specificcollaboration | Collaborations with faculty at the department in supervising student project in physics didactics and pedagogical development projects. |
| 2 | University and Field | CERN, elementary particle education research |
| Type of synergy | We have a PhD student at CERN doing most of her education there. Synergies are that we get specific access to the PER group at CERN, their knowledge and data collecting opportunities, while we help them with using and implementing our theoretical framework. |
| Specificcollaboration | Prof. Sascha Schmelling (leader of the CERN PER group), Dr. Jeff Weiner and Dr. Julia. Woith, on social semiotics in elementary particle physics, both at formal and informal settings. |
| 3 | University and Field | Cape Town University, Cape Town, South Africa, and Deakin University, Melbourne, Australia  |
| Type of synergy | Collaborations around theory building and data collection, both in physics and astronomy teaching and learning.The collaboration with the Physics and Astronomy Education Research group at UCT is well established and long lasting, and has proven to be very productive over the years. |
| Specificcollaboration | Prof. Saalih Allie and his research group, on social semiotics, reasoning and problem solving, and embodiment in both physics and astronomy education. Prof. Russell Tytler and dr. Saeed Salimpour at Deakin University, Melbourne, Australia. |

### 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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| The driving force for PER is to explore the teaching and learning of physics and astronomy. Therefore, it is of utmost importance for us to be part of a physics and astronomy department, where we are in the disciplinary environment we research. Also, we need to be knowledgeable in the disciplines of physics and astronomy to be able to do the research we do. This is called *discipline-based education research* (DBER). Our collaborations with other univ./inst. provides synergies that our local environment alone cannot provide, and is mutually beneficial for us and our collaborators. We have a very large global network of collaborations which includes many of the most well-known PER groups.  |

## 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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| The program prepared for the implementation of GDPR which was of particular importance for our field of research that often involve personal information, such as audio and video recording, a common practice for data collection, and has since then developed robust routines for the ethics and data management. |

## 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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| The program has the objective to research teaching and learning physics and astronomy and we have a very democratic and informal environment, where individuals are free to suggest, discuss, critique, negotiate and do the research we want as long as it deals with the objective.  |

## 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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| We are presently a small program and division. Over the evaluation period we have had several retirements (3) and PhD students being finished (4). The goal must be for us to grow back to and beyond the size it had before these retirements. This is of great concern for us, since we thus are very vulnerable to loses of staff. |

## 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) | 0.4  |  |  |
| Uppsala University Foundations Management | 0.0  |  |  |
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## External funding sources

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

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

|  |  |
| --- | --- |
| Grant | Number of awards to PIs in the program |
| Basic science grants (available to all fields in the faculty) |
| ERC-StG, ERC-CoG, ERC-AdG, ERC-SyG |  |
| KAW Project |  |
| KAW Scholar |  |
| WAF/WAFx |  |
| VR Project | **1** |
| 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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| The program is special in its nature in that it is situated between physics and education sciences. Historically, this makes it challenging to attract research grant, since we do not “fit in” in the standard classifications. This has a negative impact on the likelihood of attracting funds, which we (and many other similar PER groups around the world) have suffered from. Also, the previous program professor did not have the need to attract more money over the last years before his retirement. However, this does not prevent us from applying and we will intensify our efforts to do so for the future. The program professor will encourage and assist the other staff members to apply for external funding. |

## Reflections on what is working well

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

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

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| The program has been very successful in producing and publishing excellent research internationally, and as such is seen by the international PER community as one of the most important research programs globally. This is something that we aim to continue although the facilitation depends on future commitments and recruitments.Also, the working environment has always been very good, democratic and inclusive, something that allows the program members to grow as individuals and researchers. The social atmosphere allows for everyone to express their thinking and feelings. One consequence of the above is that many scholars want to visit us for shorter or longer periods, something that we see as extremely valuable.So, for the next 5 years we aim to maintain this positive working environment, while at the same time not taking it for granted but work on maintaining it. |

## 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 is critically small by number of faculty members. The program presently only has two permanent faculty, one post doc and four PhD students. This is too little and over the coming years we will need to grow back to and beyond its former size to be able to maintain the excellent quality of the work done by the program and our renowned position internationally. As it is now, the program is vulnerable should we lose a member or two. Therefore, we must recruit more permanent staff to ensure our quality and, indeed, survival. Further, we need to increase our efforts to attract external funding. As presented elsewhere in this evaluation, PER’s unique position between physics/astronomy and education sciences makes it difficult to attract funds in competition with the other disciplines. This is not at all new, but must be prioritized for the future. One approach to this is to increase our collaborations nationally and internationally on grant applications, and we have identified several areas where this could be successful, such as physics teacher education programs and AI in teaching and learning physics and astronomy, etc. |

# 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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| The current personnel makeup is relatively stable, with one professor and one associate professor. One teacher (adjunct) is retiring sometime in the next 5 years. He is not involved in research activities, which will not have a big impact on the research activities. The postdoc position is going to end in 3 years’ time. Three PhD students are expected to also be finished with their studies in approximately 3,5 years’ time. With the resources freed up, the program is expected to employ one or two new PhD students, or a new postdoc in approximately 3,5 years, if the current financing situation is maintained without significant changes. All in all, the personnel makeup is expected to remain relatively stable but low. |

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

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

Motivation: Explain how recruitments are currently motivated and decided

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| The program has recruited a professor in physics education research in 2023. This need was identified because of the special role of PER at the department and the lack of existing expertise among the department faculty. The need emanates mostly from the responsibilities related to the highly specialized PhD-student education and the need for leading a research program in this specialized field. Urban Eriksson was selected as the best candidate and accepted the offered position. The recruitment itself was led by the faculty recruitment board, with representatives of our department. |

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

**Instructions**: Describe:

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

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

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| The program sees as top researchers those who have proved their excellence through the publication of high quality (not only high quantity) publications and presenting high-quality work at international conferences in the field. Top teachers are those who can demonstrate knowledge of and skills in employing research-based approaches to physics teaching. The program balances the promotion of internal staff and recruitment of external candidates by always having the recruitment happen in international competition and let hire the best suited candidate. Gender balance are difficult to keep in a very small group, such as ours, but we have been successful in maintaining a good balance. |

## Career support

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

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

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

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| The program places a lot of focus on academic networking and helping PhD students build international connections and increase their visibility. Career advice is a natural part of supervision at the program, and happens mostly between the supervisor and PhD students, as well as between other staff members, such as postdocs-PhDs and permanent staff and postdocs. For support regarding docentship and distinguished teacher applications, we have a well-functioning system at the department and faculty level. Offering opportunities to give training talks and presentations are one way of supporting docent-candidates, for example. |

### 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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| Due to limited long term secure funding, we only have one employee who was employed as assistant and went from assistant to associate professor during the period, our reflection is based on this person’s experience. The faculty provided the assistant professor with a starting grant of 0,5M SEK and the department offered a pedagogical development dialogue with an experienced teacher, to ensure that the requirement for promotion were being met in good time. The support for obtaining the docent title was more informal and came from the program responsible professor. |

### 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 very little to add here that has not been mentioned above. We have not had any associate to full professor promotions in the period and do not expect to have them for some years to come. The support for distinguished teacher promotions is provided in an organized way by the faculty (TUR). |

## Reflections on what is working well

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

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

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| We have been successful in attracting and employing high-quality researchers, teachers, post-docs and PhD students. We believe that this is due to two main reasons. First, we are a well-established and recognizable group internationally and in Sweden, which gives us visibility and attracts significant talent, both locally and internationally. The recognizability is due to the high quality of our research output in terms of articles and conference presentations in top quality journals and conferences. Second, we have been very focused during the recruitment processes to demonstrate the high quality of the working environment (facilities, friendly colleagues, academic freedom, state provided benefits, work-life balance), which in our experience has a big influence on getting people even from better salaried environments – such as the US – seriously consider and apply for positions with us. |

## 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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| To recruit top talent, tenure track or tenured positions are needed. This is a direction we need to go in, if we want to maintain and grow the group, which is needed to achieve stability of the program. While two permanent staff employees are better than one, we would like to see more permanently employed assistant or associate professors to join us. In case this would be possible, we would like to do our very best to attract a female candidate to improve the gender imbalance among our permanently employed staff. |

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

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

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

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

## Specific collaboration and outreach examples

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

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

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| --- | --- | --- |
| 1 | Example and connection | Public presentation and demonstration at SciFest Uppsala on the topic of infrared cameras in education |
| Value to the program | The researcher in the program got feedback on the designed materials by observing the public interact with them. This is useful for further development of materials. |
| Value to the partner | The public, especially children and youth, were familiarized with IR-camera technology and were allowed to engage in science-like investigation, potentially increasing their interest and motivation to continue their education in natural science. |
| 2 | Example and connection | Workshop at the opening of the Ångström visualization center in Uppsala |
| Value to the program | The program showcased its experience and research on the topic of the use of computer simulation in physics education and engaged with the interested public on the topic. |
| Value to the partner | The public got a glimpse into the use of modern simulation technologies and touch screen interfaces and experienced innovative physics teaching approaches in a hands-on way. The Ångström visualization lab could promote the opening by offering an interactive experience based on latest research. |
| 3 | Example and connection | Public talks, radio interviews and presentations at science festivals outside of Uppsala on astronomy and physics |
| Value to the program | To present our research for a wider audience and get some feedback from them on the value and usefulness of the program |
| Value to the partner | To encourage the public in general and children in particular to be fascinated and engage in science later in life. |

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

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

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

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| The nature of the programs work is such that it is in constant contact with the public through interacting with the public school system at different levels, from kindergarten to university. This is done by supervising teacher students in their practicums, conducting research and developing curriculum materials that impacts education at different levels and participating in outreach activities. For this reason, we feel that our program is naturally integrated into outreach mechanisms.In addition, the PAP is regularly invited to give public lectures, radio interviews and presentations on diverse topics concerning education, physics, and astronomy. |

## 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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| Most of the collaboration with external actors is done on the initiative of individual employees or in response of being invited to contribute by external actors. The program provides informal support for these activities and enables the employees to spend some of their working hours on preparing for these 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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| While the direct impact of our outreach activities has not been measured rigorously, our personal experience of the activities, participant reactions and informal feedback suggest that they are typically well-appreciated by the public and well accepted. We also engage in informal discussion of what worked well and what can be improved in the future. As educators, we enjoy spending time advocating for science and education research to general audiences and support each other in doing so. |

## 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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| There is a need to increase our program’s visibility and collaboration with local educational actors, for example through integrating our research and teaching more closely with surrounding educational institutions, such as the newly relocated gymnasium schools at the Pollacksbacken campus. We are already pursuing some collaboration with upper-secondary school teachers where we expect to establish a working dialogue to see how internationally tested research-based strategies for teaching physics can be productively implemented in the Swedish educational system. |

# 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 |
| Physics education research/physics didactics coursework | G, A | 4 | 4 |
| Upper-division physics coursework | G | 1 | 0 |
| General pedagogical/education coursework | G | 2 | 0 |
| Basår (introductory year) | G | 3 | 2 |

## Infrastructure use in teaching

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

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

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| --- | --- | --- | --- |
| Infrastructure | Courses | Level | Students |
| N/A |  |  |  |
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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 | Research on physics teacher education |
| Course Info | 4 courses for pre-service physics teachers (1FA530, 1FA516, 1FA532, 1FA570) |
| Value to teaching/research | Our explicit focus on researching pre-service physics teacher training informs our teaching and course design. |
| 2 | Example | Student projects in physics education research |
| Course Info | 1FA696, 1FA650 |
| Value to teaching/research | Students engage in physics education research as the basis for their project. We have had several students publish their project findings in international research journals in the field and present at international conferences. |
| 3 | Example | Employing research-based approaches across our teaching |
| Course Info | All courses |
| Value to teaching/research | We employ the findings of physics education research across the courses that we teach. This is reflected in the active learning approach we take in the design and teaching of courses. Student evaluations show that students appreciate this and recognize it as useful. |
| 4 | Example | Helping other faculty apply research-based methods in their teaching, or helping them conduct physics education research |
| Course Info | Diverse courses at the department |
| Value to teaching/research | Faculty from the department consults us informally to help decide appropriate methods and approaches to teaching courses or adjusting them for different populations of students. In some cases, other faculty from the department is also involved in student projects, through which the faculty also learn how to conduct physics education research. |

### 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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| As the program’s research and teaching are closely related by the nature of their content, we see this as a very spontaneous and natural connection. Physics education research is a field that actively bridges the areas of research and teaching. Our collaboration with other faculty at the department (both informal, spontaneous, and formal, through collaborations on projects) is an important part of us being involved and relevant for teaching operations at the department. |

## 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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| There are several formal venues that facilitate this connection (Lärarlunch, MINT, TUR). In addition, our informal interactions with other faculty significantly contribute to helping other faculty see the value and benefits of having the PER group as part of the department. |

## Reflections on what is working well

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

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

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| We believe that we have proven to be a valuable resource for the department. This is especially true ever since we have focused our research efforts on studying the relatively under-researched upper-division physics courses (e.g. statistical mechanics) and the role of AI in physics education. Our research can quite directly inform the teaching and learning of physics. One of our PhD students is also very involved in the organization and leading of the supplemental instruction at the department. This research-based tutoring approach has recently seen an increased uptake and more interest from students and course leaders. The research-based physics teacher education coursework has received excellent student survey feedback.We intend to continue to contribute with our expertise to the quality of education at the department.Our collaboration with other faculty at the department also gives us important access to courses and students for doing our research. We plan to continue pursuing these activities and keeping our program relevant for the teaching at the department. |

## Reflections on what needs to be improved

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

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

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| Our visibility at the department could be further improved by organizing some form of seminar/knowledge exchange similar to *lärarlunch*, or taking more initiative in actively contributing to the ongoing *lärarlunch* seminars by presenting our latest research to interested coworkers outside of our program. |

# 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).

|  |  |
| --- | --- |
| Department: | Physics and astronomy |
| Program: | Physics Education Research (PER) |
| Title: | Re-establishing the PER program via external money |
| Support: | May require department support: | [Yes/No] | May require faculty support: | [Yes/No] |

### Goal

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

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| To strengthen the research program and consolidate it via VR/ERC grants |

### Expected meaningful research improvement

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

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

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| The PER research program has shrinked considerably over the last years and need to grow and be consolidated again. The reason for this is to build the capacity and diversity of the program by increasing the number of permanent faculty members. The PER field is rapidly changing and established areas evolve and new areas are emerging. One such area is generative AI with Large Language Models, something that effectively can be used in teaching and learning physics and astronomy. Here, the program presently is at the front line of research internationally, but due to the growth rate of the field, we risk losing the front-line position and hence would gain very much should we have more research faculty members. Another field is meaning-making of large and small spatio-temporal scales in physics and astronomy, which is identified as a threshold concept for learning physics and astronomy at any deeper level. Here, we are also at the front line of research internationally but again risk losing our unique position due to lack of faculty members. A consolidation grant from ERC or VR would help solve this situation temporary. |

### 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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| We have identified one key component in the consolidation of the research we do; increasing the number of staff members. This can be done in several ways and as priority one - what we can accomplish within the program – is to apply for ERC/VR consolidation grants. This will be done by the program professor with the support by the university services for grant applications. The work will be initiated during 2024 and the applications will be submitted during 2025. If we are fortunate to get grants, we can hire new staff members (a postdoc and PhD student????) or a BUL/UL, to better meet the research capacity we strive for. In mentioning this, the program do not make use of any large infrastructure; our needs are towards increasing the permanent faculty hired by the program/division. However, this is not a long-term solution. In order to achieve the goals, we will need FFF support from our department and faculty, in particular in funding the expansion of the research program in a more sustainable way. |

### 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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| Over the last five years the program has undergone a dramatic change in that many PhD students have finished and staff members have retired. Even under these circumstances the program has maintained a top internationally renowned research group. For example, the program has been successful in attracting resources for two new PhD students and at the same time published top quality articles in the best journals in the world (e.g. Phys.Rev. Physics Education Review, European Journal of Physics, etc). Also, the program has been able to identify and drive the research on AI in physics education. More, the new professor has attracted research grants in collaboration with others and has years of experience in grant applications. |

## 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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| We are already doing research at an excellent level. However, this is now done even if we are fewer than before and currently without any external funding. Since we are a special program, differing from all other programs at the physics department, we have no real overlap with any other program, faculty or sections. However, we do collaborate with faculty at UpCERG and members doing chemistry education research, mostly on methodological issues. |

### 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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| Currently we do not have the financial support for hiring more people but the PAP plan to apply for an ERC grant and has started to take action toward this by the support from the faculty research support units. |

## 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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| To maintain and grow our unique position internationally as a world leading physic education research program. The research by the program has great value for the physics and astronomy education at the department, but also relevant at school levels via our connection to teacher education. |

### 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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| PER is a discipline-based education research (DBER), similar to other DBER groups at the faculty and education sciences. Therefore, our research is important and valuable for many more than the physics faculty. The Centre for STEM education research at the faculty (MINT in Swedish) is a good example of this.  |

## 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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| Help and support in applying for the ERC consolidation grant, for example by the research support unit. |

### 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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| Should we be successful in attracting such grant, the program will have the ability to expand its research both in depth and breadth of PER areas, leading to many more publication, but also allowing us to focus on new emerging areas. In the end it will allow us to maintain our unique international position. |

### 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 PAP has initiated the application process by attending meetings arranged by the research support unit, to be able to tailor the best possible application. Meanwhile, the PAP has also applied for project money for the SCALE project, that will allow the program to focus on increasing the research output and visibility.  |

# 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: | PER and the other 13 programs (whole Physics Section) |
| Title: | AI4Physics |
| 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 all physics research through increased AI literacy, method development, and applications, including educational applications. |

### 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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| Artificial intelligence (AI) has led to an imminent paradigm shift in physics and physics education. New machine learning (ML) methods are already used to reform massive data analysis for experiments at all energy scales. AI’s impact on education is one that will also span all areas of physics, especially via tools that had entered the educational landscape since the end of 2022 (e.g. chatbots such as ChatGPT). IFA has already had many fellows (most outside IT dept) at the university-wide AI4Research initiative, demonstrating early adoption in several fields. But the potential spans all of physics, including PER, with its potential for addressing physics education research in multitude ways. This initiative will dramatically increase AI use and literacy throughout the department, in all fields. Expected research improvement spans from a natural integration of AI/ML methods throughout our research in fields where it is not yet prominent to development of physics-inspired AI methods. The PER program will play a vital role, both by doing research on AI use in teaching and learning, as well as through educational activities aimed at increasing AI literacy. |

### 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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| As a large department with research spanning from theory to large-scale experiments, we have varied needs. Still, we have collegially identified four key components of our AI4Physics initiative: A) Faculty AI courses: 1 course/year for education of faculty members. Here, the PER group will take responsibility for holding courses at the introductory level, specifically those aimed at improving teachers’ AI literacy for the purposes of education. B) Seminar activity with international speakers/visitors (incl industry) for exposure to state-of-the-art use of AI in physics. Here the PER group is among global leaders in research of AI tools’ performance and potential use in physics education. C) AI-focused postdocs (PDs) to drive new research projects using AI. If needs are identified and long-term FFF funding already exists, recruitment can also be at the permanent research engineer or faculty level with explicit AI focus. D) Incorporation of AI within both the department’s teaching and outreach (collaboration) – here the PER group’s expertise is crucial. Educational efforts will primarily be funded through other channels, i.e. TUFF and PUMA projects. |

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

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

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

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| The need for an AI initiative within IFA was identified as a key future priority by all three units already in Spring 2023 within our dept-wide strategy process. IFA has had the most AI4Research fellows beyond IT showing high level of already active AI users. Physicists have generally all the necessary background to be agile AI users: math, programming, and data. The PER group has established itself as an internationally recognized actor in the field of studying AI in physics education, which makes us well-positioned to act as international and local leaders in educational initiatives on the topic. |

## 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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| AI4Research exists, but is only available for already AI users, while our majority faculty members do not yet actively use AI. Further, connections in dept already exists to the IT dept. Our dept teaches the AI courses 1FA370, 1FA006, and the PER group is currently designing an introductory course on AI in education. |

### 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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| Programs: Supervisors time for PDs, plus all other local support. Several faculty members do AI research already on external grants, important for a fast in-house building up of expertise. Dept: approx half of the total cost can be budgeted through dept resources. In the PER group, 1 PhD student is already AI focused. |

## 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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| AI is triggering a transformative change in how research and education is done in physics and astronomy. With this initiative the whole department will be in the forefront of this development and we can also pursue new opportunities for AI, explicitly in physics and physics education. |

### 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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| AI4Physics focuses on the need and opportunities of the whole Physics Section. It is highly complementary to AI4Research and national AI initiatives (WASP, DDLS) due to its dual focus on creating AI literacy and physics aspects of AI. Also, AI4Physics creates a common goal for a very large and diverse department. |

## 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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| Interest and time commitment from faculty members is strong as this is collegially identified top priority.A) 3-day yearly course with internal/external teachers: 560kkr. B) Seminar program: 560kkr. C) PD program: 2500kkr (2 PDs per unit (each unit ~130staff) in 2 rounds). Coordinator: 800kkr. Approx half from dept. |

### 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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| Dramatically increased AI use in all the Section’s research, necessary for future success both in established fields and for AI-developments in physics. Increased grant income throughout department, including excellence grants and through AI-initiatives. Increased AI literacy among teaching faculty is secured.. |

### 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),B), and D) will be implemented during 2024-25 on dept resources. We are asking TekNat to help with half the cost to primarily fund C), which dramatically increase the impact of introducing and developing AI throughout our Section. |

# 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: | PER |
| Title: | Re-establishing the PER program |
| 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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| To have the division to grow to maintain and increase its internationally very high acknowledge research |

### Expected meaningful research improvement

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

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

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| The previous evaluations of the program’s activities clearly confirm the excellent quality and reputation of the program. We must continue and also try to increase, in tough competition both nationally and internationally. To do so under the current circumstances, with only two FTE faculty members seem difficult if not impossible; we need more faculty members, hence more FFFs. From the previous KoF / ÖB the recommendation was to create at least two new positions at the division to maintain the viability and very high standard of the group. This has **not happened** even though we have had three retirements. We therefore ask for more fff-recourses to cover the cost of hiring at least one BUL and one UL. The reason for this is to build the capacity and diversity of the program by increasing the number of permanent faculty members. The PER field is rapidly changing and established areas evolve and new areas are emerging. With more fff we can maintain and increase the research strength for PER at UU, to maintain the very high standard and reputation that the division has internationally, by exploring new areas of physics education. |

### 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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| We need more fff for maintain and increase our position as world leading PER group. To reach this goal we need support from the faculty to announce two new permanent university lecturer (BUL/UL) positions, to better meet the research capacity we strive for. Noticing that the program does not make use of any large infrastructure; our needs are instead towards increasing the permanent faculty hired by the program /division, for us to expand the research program towards more sustainable levels of competencies.Should we get the fffs, the plan would look like this: Announce internationally two positions, one BUL and one UL. During beginning of 2026, the positions should be filled with the best possible candidates, taking gender aspects into account. Depending on background, these will work on increasing the research and output by the program in the program’s profile or create new research fields. Apply for project money for PhD positions withing the program. After five years the BUL will be evaluated to consider being offered a permanent position. |

### 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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| From the previous evaluations done on the programs’ quality, it is very clear that it has world class research, quality and reputation. See previous evaluation from 2017-02-28 by local Gabriella Andersson and Lisa Freyhult at the department of Physics and Astronomy, and international PER experts Noah Finkelstein and Shirley Booth. Although the staff has been reduced and changed, the present faculty members Urban Eriksson and Bor Gregorcic are both very competent and originates from this PER program at an earlier stage. These scholars must be seen to guarantee the programs future quality and excellence in PER locally, nationally, and internationally.  |

## 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 PER program is unique in being a research program for over 20 years, initially initiated and supported by the Rektor at UU. It has positioned itself as world leading in PER and worked as a model for how discipline-based education research can be done at a department such as physics and astronomy.  |

### Current and planned contributions to support the initiative

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

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

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| The new program professor will apply for consolidation grants (ERC/VR) to support the process of acquiring more faculty to temporary (if granted money) can help support the situation. This is not a long-term solution but could serve as start for re-consolidating the program. |

## 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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| Similar to major universities in the world the physics departments has a PER program to increase the quality of their education and reputation. This is since long acknowledge also by UU. Therefore, the PER program is an integrated part at the department today and highly acknowledge for its research also in a global context. See the evaluation from from 2017-02-28 by local Gabriella Andersson and Lisa Freyhult at the department of Physics and Astronomy, and international PER experts Noah Finkelstein and Shirley Booth. |

### 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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| This PER program is well established and works as a role model for other groups wanting to create similar programs at the faculty. Presently, these have not reached the status of programs but are part of our collaborators locally. We include them in MINT, to discuss theoretical frameworks, methodologies, etc. |

## 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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| For us to be able to grow as described above we need fff for two permanent positions from the faculty. We will need more office space (two rooms). No other resources are needed, such as infrastructure or expensive equipment. |

### 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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| Should we get the resources (fffs), the program will have the ability to expand its research both in depth and breadth of PER areas, leading to many more publication, but also allowing us to focus on new emerging areas. it will allow us to maintain our unique international position, and eliminate our present vulnerability. |

### 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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| See Prio 1 above. Meanwhile, the PAP has also applied for project money from VR for the SCALE project and other projects , that will allow the program to focus on increasing the research output and visibility. These efforts will continue in the near future to maintain the research by the program. |

# 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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| (approximately 600 characters)Question 1:Question 2:Question 3: |