

Center for
X-Rays in Swedish Material Science (CeXS)

Briefing on the
Upgrade of PETRA III, Hamburg, Germany
- Impact on Swedish interests and the
Swedish Materials Science Beamline

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Preface

This briefing is for research infrastructure funding stakeholders and concerns DESY's plans to upgrade PETRA III - and how this may impact the Swedish Materials Science beamline (SMS) at PETRA III.

A key risk we see is a possible relocation of the SMS. A relocation would impact returns on previous Swedish investments at the SMS, future costs of re-commissioning a beamline, as well as lengthen the duration of the beamline closure. The duration of the closure is a particular issue for Swedish materials researchers because the MAX IV facilities do not offer needed experimental opportunities.

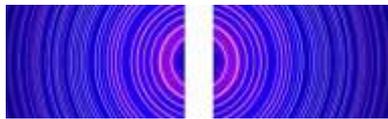
This document contains information about DESY's process to plan the upgrade. It also informs how the Center for X-rays in Swedish Materials Science (CeXS) is acting, in our capacity as academic host of the SMS, to engage the Swedish materials research community in the scientific proposal process that will be one input to PETRA IV's beamline locations and beamline designs.

Recommendations for research infrastructure funding stakeholders are also proposed.

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1. The significance of PETRA III and P21 to Swedish researchers

Primarily through the Swedish Research Council (VR) and Röntgen Ångström Cluster (RÅC), Sweden has invested in PETRA III facilities¹. These investments have built a Swedish Material Science beamline (SMS), P21, to complement MAX IV; and, enable the Swedish research community to gain privileged access to this beamline and other DESY beamlines at PETRA III.

The SMS beamline has two measurement stations, P21.1 and P21.2, which were first available for research in 2019.

The Swedish research community quickly recognised the new opportunity in 2019 to use the P21 beamline as well as make privileged access proposals to PETRA III. 74 Swedish privileged access proposals and 60 regular access proposals were submitted to PETRA III. Proposal success rates increased to 58%. Privileged access proposals to the P21.2 beamline exceeded beamline station capacity by double. At the P21.1 and P21.2 beamline stations, Swedish researchers conducted 17 peer-reviewed granted beamline projects, 6 friendly commissioning projects and 1 paid project. At the PETRA III facility, there were a total of 76 peer-reviewed granted beamline projects and 6 paid projects. That is, in its first year of operation, the SMS accounted for almost 25% of the Swedish use of PETRA III. Furthermore, Swedish researchers are also preparing for future research opportunities e.g., by developing experimental environments for the SMS.

PETRAIII and the Swedish Material Science beamline is in demand

Swedish use of PETRAIII in 2019



and the Swedish Material Science beamline



... and, the number of proposals is double the available access

Figure 1. Use of PETRA III and its Swedish Material Science beamline (SMS) during 2019, when the SMS started operations.

¹ Sweden has also funded use of the PETRA facilities via other research funding organisations e.g. VINNOVA's initiative to encourage industry to undertake trial measurements.

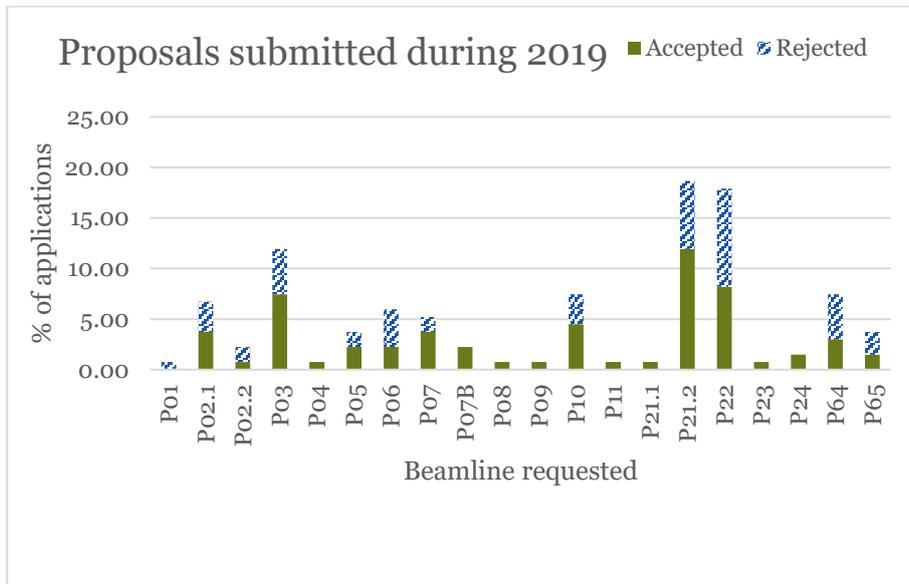
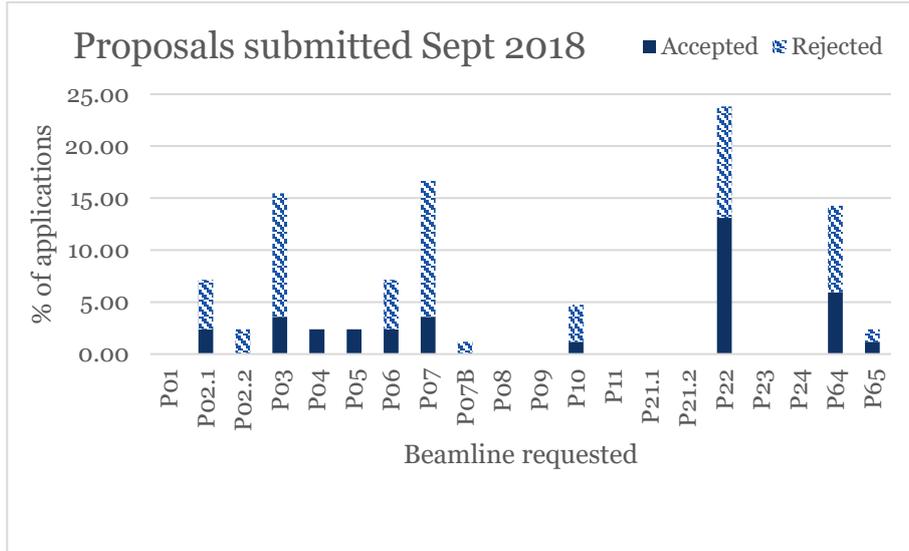
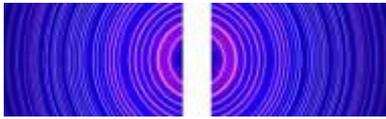
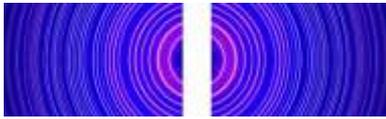


Figure 2. Swedish applications and use of beamlines at PETRA III in 2018 and 2019. Note the Swedish Material Science beamline (P21) were first available 2019 and these immediately affect.



2. Overview of PETRA IV

DESY has made the analogy that PETRA IV will be a “multi-scale hard X-ray microscope”, enabling novel experiments for revealing the dynamic behaviours of structures - from nanometre to millimetre scales at ns time intervals.

In more scientific terms, the upgrade to PETRA IV will enable the production of ultralow-emittance high-energy X-ray beams with unprecedented coherence. The low emittance will allow for diffraction limited experiments with X-ray energies up to ~ 10 keV. The outstanding coherence will allow researchers to efficiently focus nearly the full X-ray beam to nanometre dimensions, opening all X-ray analytical techniques to nanoscopic investigations with high sensitivity.

More information can be found in [DESY's conceptual design report](#).

3. DESY's upgrade planning process

CeXS has discussed the upgrade process with senior management at DESY.

We understand that DESY's process to plan the upgrade has 3 stages, which are shown in Figure 2.

The first stage is to envision Scientific Excellence. DESY has therefore invited researchers to propose novel instruments/experiments for scientifically excellent research using the fourth generation facility. The deadline for proposals is 1 Dec 2020.

The second stage then starts in 2021. This stage involves combining these proposed experiments to optimise the design of beamlines and end stations. Other factors such as funding possibilities will also be considered. That is, the current Swedish privileged access contract, and previous investments in the SMS, are NOT on DESY's upgrade agenda at the present time.

The third stage is to plan the rebuilding process, with primary beamlines that offer novel experimental possibilities being constructed and commissioned first.

The shutdown of PETRA is scheduled from 2025. The shutdown will occur even if the full funding for the *entire* upgrade, including all beamlines, is not yet secured.

It is likely to take at least 2 years to commission the major beamlines. Secondary beamlines will take longer to commission.

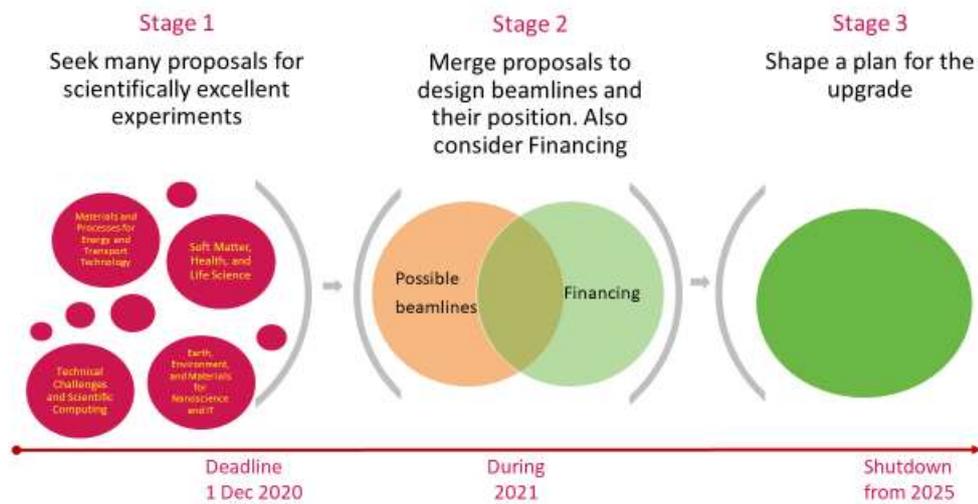
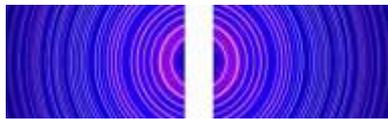


Figure 2. DESY's process for planning the upgrade of PETRA III.

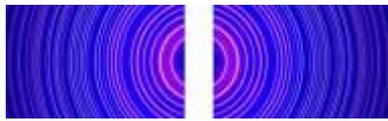
4. The impacts and key issues for Sweden

The SMS faces a relocation risk. The reason for the relocation risk is that the SMS is in a prime location: its long straight section is ideal for forming beams with excellent coherence properties.

Retaining the current location will be hotly contested in DESY's scientific excellence process.

Relocation would impact returns on previous investments and impose additional costs of re-commissioning the beamline. Relocation also increase the down time of the beamline.

A longer duration of beamline closure is a particular issue for the materials research community because the MAX IV synchrotron does NOT have the capabilities to conduct most of the types of material science research experiments offered at PETRA III or IV.



5. How CeXS is influencing the upgrade process

In our capacity as the Swedish academic host for the SMS, CeXS is advocating that the Swedish community actively prepares proposals for scientifically excellent instruments/experiments suitable for PETRA IV. We are engaging the community by:

1. Identifying proposal topics that we consider are relevant for Swedish materials research - initiating proposal writing and engaging Swedish and international researchers to support this.
2. Prompting all researchers in the community to contribute to the above proposals, and/or to initiate complementary proposals for future Swedish research, via
 - a. Direct mails (to approx. 200 users of PETRA III and others) to inform researchers and invite people to be engaged in the proposal writing process
 - b. Briefing meeting to explain the upgrade process on 26 June
 - c. Organising a proposal workshop on 14 September
3. Being active in DESY's workshops² about the upgrade.

CeXS will seek additional funding from RÅC in order to be able to activate more people in the proposal writing process e.g., international experts and leading Swedish scientists who are experienced in synchrotron-based materials science experiments.

² DESY is planning meetings on four topics. These are:
19. - 21.10.20: Materials and Processes for Energy and Transport Technology
28. - 30.10.20: Soft Matter, Health, and Life Science
02. - 04.11.20: Earth, Environment, and Materials for Nanoscience and Information Technology
18. - 20.11.20: Technical Challenges and Scientific Computing

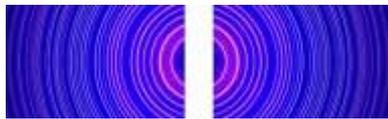


Figure 3. CeXS will act to engage the Swedish community - with the aim of submitting excellent scientific proposals that can benefit Sweden.

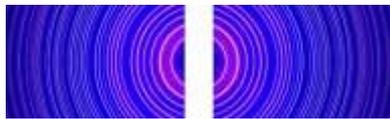
CeXS see the need to also flag to DESY management the noteworthy financial contribution and support that Sweden provides to PETRA III.

6. Recommendations to research infrastructure funding organisations

CeXS recommend that research infrastructure stakeholders *put Swedish financing on DESY's upgrade agenda - at the present time.*

Putting Swedish financing on the agenda could be done, for example, by:

1. Raising concerns about the above impact analysis on Swedish research (see section 4) in appropriate fora with DESY
2. Raising the need for a dialogue with Sweden about the stage 2 process - during stage 1
3. Requesting specific cost estimates for the upgrade costs - with and without a relocation



7. Further information

If you have any queries, please contact us.

You can also see <https://www.cexs.kth.se/> for general high energy X-ray research community news and information.

For specific updates on what's happening relating to the PETRA III upgrade see: <https://www.cexs.kth.se/petraupgrade>