

Status of beamlines at MAX IV

May 2018



Beamlines at MAX IV

The first seven beamlines¹ at MAX IV were funded by the Knut and Alice Wallenberg Foundation (KAW) together with twelve Swedish Universities² in 2011. In 2012 Estonia and Finland funded the construction of the eighth beamline, FinEstBeAMS. These first eight beamlines constitute the Phase I beamlines. In 2013, KAW and the Swedish Research Council (VR) funded the transfer of the SPECIES, MAXPEEM and FlexPES beamlines from MAX-lab to MAX IV. In addition, VR also funded two new beamlines, CoSAXS and SoftiMAX. These five beamlines represent the Phase II beamlines. Funding for the DanMAX beamline was secured by the Technical University of Denmark, Aarhus University and the University of Copenhagen in 2016. In 2017 two beamlines received funding: KAW granted funding for the construction of the ForMAX beamline, and the Novo Nordisk Foundation (NNF) granted funding for the MicroMAX beamline. Currently MAX IV has sixteen funded beamlines.

Background

Since the start of the beamline programme, MAX IV has grown from a small and informal organisation, to its current form of more than 200 employees divided in different divisions and groups. The original organisation was designed for seven beamlines and is now working on more than the double. Processes, structures, prioritisations and managing roles required in a larger, more complex organisation, have taken time to be identified and to be put into place, and some of this work is still on-going. Original time estimations were ambitious and perhaps also to some extent unrealistic already from the start, leading to some delays already at an early stage in the projects. Compared to these original timelines, buildings, accelerators and beamlines all have had alterations that have affected the entire project time.

Many projects have been run in parallel, requesting the same resources, both at the facility, but also from external manufacturers and suppliers. Instruments as complex as the ones needed at MAX IV are rarely off-the-shelves products and only few suppliers exist worldwide that can deliver to our standards. In some cases, different beamlines at MAX IV have competed for the same resources at external producers. In addition, most of the beamline projects started while Max-lab was still in user operation. Until the closing of Max-lab in December 2015, beamline managers and most resources were needed and used at both facilities.

Originally there was no distinct prioritisation order between the different projects and they were handled on a 'first come first served' basis. At occasions when the same specific resources were requested at the same point in time, there have been uncertainties on how to prioritise. In order to meet the timeline for the inauguration in June 2016, the BioMAX and NanoMAX beamlines were prioritised which led to a halt in basically all work on the other beamlines. Resources at MAX IV are not enough to carry out installation and commissioning of all beamline projects simultaneously. There has been (and still is) a lack of some critical support functions that have been needed simultaneously at the accelerators and beamlines, and now at different beamlines. These areas of expertise have also shown to be difficult to reinforce because of difficulties to recruit the right competence when opportunity for that has occurred. The time needed to recruit new staff within the projects has in general proven to be underestimated. This has in several cases slowed down the progress and the impact can be observed especially on the design phase of many projects.

IT-, engineering and safety have proven to be bottlenecks in pooled resources. The combination of the lack of a mature structure for allocating resources in an efficient way and an underestimation of the safety work needed, is yet another reason for delays. As the same resources

¹ Balder, BioMAX, Bloch, FemtoMAX, HIPPIE, NanoMAX and Veritas

² Chalmers University of Technology, Gothenburg University, Karlstad University, Karolinska Institutet, KTH Royal Institute of Technology in Stockholm, Linköping University, Luleå University of Technology, Lund University, Stockholm University, Swedish University of Agricultural Sciences (SLU), Umeå University and Uppsala University

are used for installation, commissioning and upgrade, and the fact that it is not always well-defined in which state a project is found, resource allocation is made even more difficult.

Due to uncertain long-term financing, MAX IV took a careful approach and imposed an employment freeze until the financial situation for 2019-2023 was clearer. As a result, many beamlines have suffered from being under-staffed.

Way forward

In summary, we can conclude delays of the beamline projects to different extent. We are working on means to reduce the risk of any further delays. The focus is on the following areas:

- Guiding principles for prioritisation
- Improve the process for resource allocation
- Identify and mitigate single point(s) of failure
- Increase bottle neck resources
- Improve communication (users, funders, internal)

In order to facilitate the allocation of resources, the MAX IV management has set up guiding principles for prioritisation projects at MAX IV:

Prio_0: Provide reliable and stable beams

Prio_1: Users today

Prio_2: Users in three months

Prio_3: Long-term development of the MAX IV facility

Following these principles, resources are focused on beamlines and endstations that are most likely to see external users during 2018. As a consequence, work at parts of the phase II beamlines will be significantly slowed down or even postponed. There is also a risk that small changes causing minor alterations in the timelines for prioritised projects, will amplify and have a large impact on projects further down the prioritisation list. However, by finalising a few beamlines, MAX IV will improve knowledge in the organisation. We see that this learning can be transferred to the upcoming beamlines, so that finalising these can be done more efficiently. Hence, the true delay of the full beamline portfolio might not be as severe.

During the past year MAX IV has worked to find a forum for resource allocation. The process for resource allocation is currently being evaluated and at the same time a project to elucidate, map and visualise this process is on-going.

In order to take light, each beamline needs a permit from the Swedish Radiation Safety Authority (SSM). Due to lack of resources in critical positions in the past six months (as a result of an unforeseen and extended sick leave) these permits have been delayed. Recruitments are ongoing, and the position is expected to be filled after summer 2018. In parallel, development of a new and more effective method to make radiological simulations, which form the basis for SSM permits, has been on-going at MAX IV. SSM will evaluate this method at the Balder beamline in June. If approved, this method will accelerate our work to produce the radiological simulations. The timelines for projects that have not yet received their SSM permit are all estimated on the basis that SSM will approve the newly developed method for radiological simulations.

During the last years it has become apparent that MAX IV has relied on a few positions, pieces of equipment and in some cases individuals, for critical resources. At some occasions this vulnerability has had large effects on the organisation. Such “single points of failures” have now been identified and work is on-going to diminish these and thus our vulnerability.

In the first quarter of 2018, MAX IV has identified scarce bottle neck resources. These crucial recruitments have now been approved, as we are more certain on the long-term financial plan.

Finally, we are also working on means on how to communicate the plans and time estimation for beamlines to our user community in the best way.

Appendix 1

Current status of individual beamlines

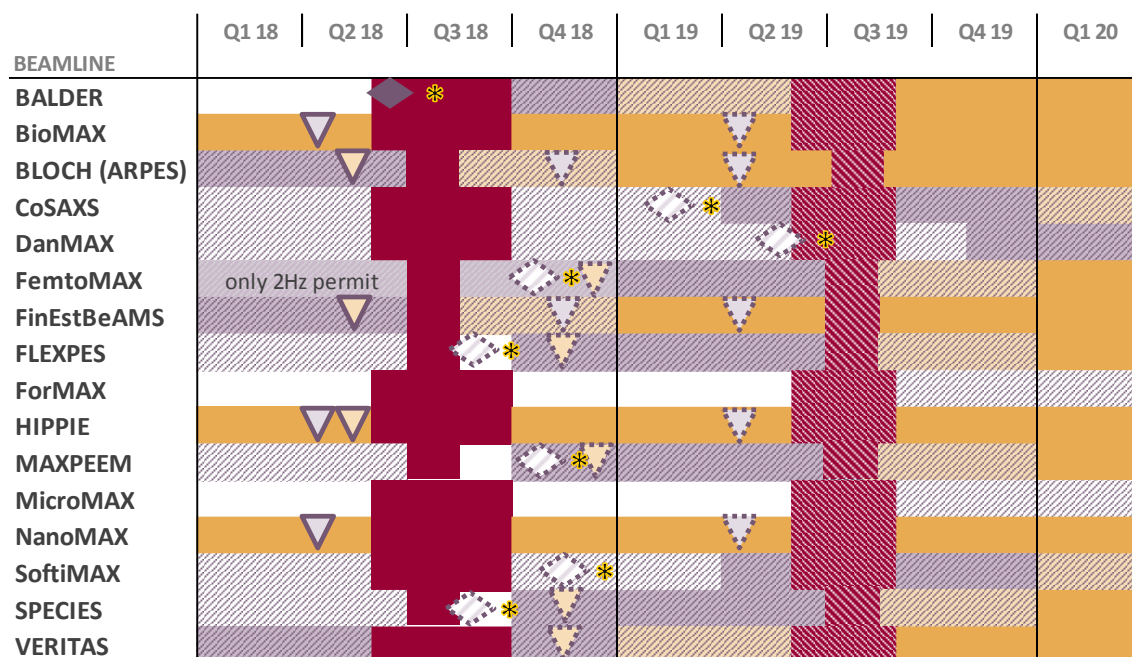
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Timelines for the two coming years

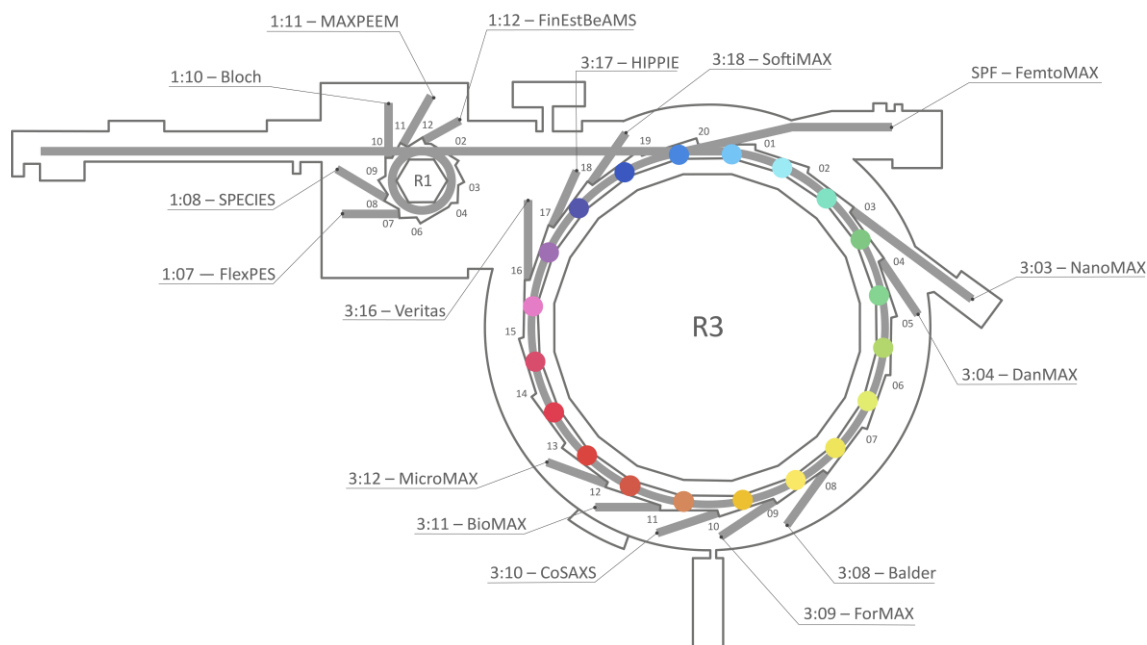


Legend to timelines:



Note: The timelines for projects that have not yet received SSM permit are all estimated on the basis that SSM will approve the newly developed method for radiological simulations.

Location of beamlines at MAX IV



Current status of individual beamlines

Balder

Balder lacks a radiation permit from SSM (Swedish Radiation Safety Authority) for the experimental station, this is scheduled for June 2018. Balder is the first beamline for which the newly developed method for radiological simulations will be tested. Assuming the SSM permit will be in place this summer, Balder could be ready for “simple” EXAFS during 2018. Spectrometer commissioning starts 2019.

- SSM permit submission: June 2018
- Start of commissioning: Q3 2018
- First friendly users: Q1 2019
- First open call users: Q3 2019

BioMAX

BioMAX is one of the beamlines that has started regular user operation in parallel with commissioning activities. Commissioning activities include addition of new sample changer and adding remote access to the portfolio.

Regular user operation has so far led to 114 visits from users, who submitted 36 highly ranked scientific proposals. Altogether BioMAX users have collected 2 999 731 diffraction images from 1 213 crystals, resulting in 943 complete data sets.

The third open user call for beamtime October 2018 – June 2019 closed 27 April 2018. 31 proposals were received, 13 out of these are block allocation group (BAG) proposals.

- Start of commissioning: March 2016
- First friendly users: December 2016
- First open call users: March 2017

BLOCH

BLOCH (formerly known as ARPES) has during 2018 taken first light from the undulator and a first spectrum at the endstation using spectrometer has been collected. The beamline staff is currently working on a machine safety system for the endstation at the same time as commissioning of the beamline, endstation and spectrometer is ongoing.

- SSM permit: in place
- Start of commissioning: on-going
- First friendly users: Q3 2018
- First open call users: Q1 2019

CoSAXS

Front end and insertion device are being installed and will be finalised during summer shut down 2018. Installation of optical elements is on-going. The experiment station is planned to be delivered in autumn 2018.

- SSM permit submission: planned for Q1 2019
- Start of commissioning: Q2 2019
- First friendly users: Q1 2020
- First open call users: Q3 2020

DanMAX

The infrastructure for DanMAX has been designed and the construction is underway, the lead hutch is in place and the conventional buildings will be installed after summer. The undulator and front end have been delivered and are awaiting installation, this is planned for summer shut down 2019. Optics procurement has been initiated.

- SSM permit submission: planned for Q2 2019
- Start of commissioning: Q4 2019
- First friendly users: Q3 2020
- First open call users: 2021

FemtoMAX

Technical commissioning activities are on-going while waiting for the SSM permit for 10 Hz operations of the linac (planned for Q4 2018). FemtoMAX needs 100 Hz for most user experiments, some users can however perform tests at 10 Hz. There can thus not be any user call until at least 10 Hz operations is established.

In October an article based on experiments done at FemtoMAX was published in Structural Dynamics (A. Jarnac, et al, Demonstration of a 20 ps X-ray switch based on a photoacoustic transducer, Structural Dynamics 4, 051102 (2017)).

- SSM permit 2 Hz: in place
- SSM permit 10 Hz submission: planned for Q4 2018
- Start of commissioning: on-going
- First friendly users: Q3 2019
- First open call users: Q1 2020

FinEstBeAMS

FinEstBeAMS is currently in commissioning, it received radiation permit in November 2017.

- SSM permit: in place
- Start of commissioning: on-going
- First friendly users: Q3 2018
- First open call users: Q1 2019

FlexPES

FlexPES front ends and optics are in place and minor installations are remaining. Commissioning can start once the radiation permit is in place. The permit is planned to be submitted Q3 2018.

- SSM permit submission: planned for Q3 2018
- Start of commissioning: Q4 2018
- First friendly users: Q3 2019
- First open call users: Q1 2020

ForMAX

The ForMAX project will not start officially before earliest July 2018. The first part of the detailed technical design will be done during autumn 2018 and will thereafter be sent for external review. If all goes well, first procurements can start end of 2018.

- Start installation: Q3 2019
- Start of commissioning: winter 2020/2021
- First friendly users: autumn 2021
- First open call users: 2022

HIPPIE

Regular user operation at HIPPIE started during autumn 2017 with one out of six cells/experimental setups ready. Commissioning of the cells is on-going in parallel and installation of the remaining cells is planned for 2019.

In the first open user call, 40 proposals for beamtime at HIPPIE were submitted asking for 1 189 shifts*. Five proposals, and 144 shifts, were approved. So far HIPPIE has had eight visits of commissioning experts (one remains) and four visits from open call users (one remains).

The second open user call for beamtime October 2018 – June 2019 closed 27 April 2018 (42 proposals has been received). There will also be a call for commissioning users at HIPPIE for two new cells/functionalities before summer this year.

- Start of commissioning: February 2017
- First friendly users: June 2017
- First open call users: April 2018

MAXPEEM

MAXPEEM front ends and optics are in place and the beamline is basically ready to take light as soon as the SSM permit is in place. Submission of the permit is planned for Q3 2018.

The LEEM instrument at MAXPEEM can work without synchrotron radiation and takes users. Since last year this instrument had 25 user visits.

- SSM permit submission: planned for Q4 2018
- Start of commissioning: Q4 2018
- First friendly users: Q3 2019
- First open call users: Q1 2020

MicroMAX

The MicroMAX beamline was granted funds for construction and for the first ten years of operation by the Novo Nordisk Foundation in November 2017. The project is thus still in its very initial phases. Review of the detail design report (DDR) is scheduled for winter 2018/2019.

- Start installation: Q3 2019
- Start of commissioning: spring 2021
- First friendly users: autumn 2021
- First open call users: spring 2022

* 1 shift = 4 hours

NanoMAX

NanoMAX was one of the first beamlines to take light and users. Currently, NanoMAX takes users at its experimental station 1, the KB-station, while commissioning activities are on-going in parallel. This early focus on start of user operation has however taken resources from project work. It will thus take longer than first anticipated before experimental station 2, the FZP-station, can take light and be open to users.

NanoMAX has so far delivered 78 shifts* to four groups of commissioning users, 108 shifts to four groups doing in-house or collaboration experiments and 180 shifts to twelve user groups from open user calls. The third open user call for beamtime October 2018 – June 2019 closed 27 April 2018. 43 proposals were received.

- Start of commissioning: April 2016
- First friendly users: December 2016
- First open call users: May 2017

SoftiMAX

Front end, optics and insertion device for SoftiMAX are being installed and will be finalised during summer shutdown this year.

SoftiMAX will have two experimental stations, the STXM- and CXI-stations. For the STXM-station purchases are on-going while the CXI-station is put on hold until the STXM-station is up and running.

- SSM permit: planned for Q4 2018
- Start of commissioning: Q2 2019
- First friendly users: Q1 2020
- First open call users: Q3 2020

SPECIES

Minor installations are remaining but commissioning can start once the radiation permit from SSM is in place.

- SSM permit submission: planned for Q3 2018
- Start of commissioning: Q4 2018
- First friendly users: Q3 2019
- First open call users: Q1 2020

VERITAS

Veritas is currently in commissioning. If all goes according to plan Veritas will have light in the experimental chamber within a few weeks. The spectrometer is under construction at the Ångström workshop in Uppsala. The aim is to have all parts by the end of this year and to take first users after it has been commissioned at Veritas. The Veritas B experimental station will be ready to take light within two months as soon as resources for installation are available and to take first friendly users a few months after that.

- SSM permit: in place
- Start of commissioning: on-going
- First friendly users: Q1 2019
- First open call users: Q3 2019

* 1 shift = 4 hours

Appendix 2

Timelines of MAX IV beamlines in funding applications

Status of beamlines at MAX IV

May 2018

Beamlines in KAW application 2011

The application for the phase I beamlines was submitted to Knut and Alice Wallenberg's foundation (KAW) in May 2011. Assuming start date 1 January 2012 for all phase I beamline projects, start of user operation ramp up at Balder and FemtoMAX was planned for Q1 2016, at HIPPIE for Q4 2016 and at BioMAX, BLOCH (ARPES), NanoMAX and Veritas it was planned for Q1 2017.

Phase IIa-beamlines

According to timelines in the application to the Swedish Research Council in May 2013, start of user operation ramp up at SPECIES was planned for Q4 2016, at FlexPES and MAXPEEM for Q1 2017 and at CoSAXS and SoftiMAX it was planned for Q1 2018.

Other beamlines

In the application to the Estonian Research Council there was no date specified for start of user operation ramp up at FinEstBeAMS.

In the timeline indicated for DanMAX in the proposal to the Danish National Committee for Research Infrastructure, start of user operation ramp up was not specified.

There has been no formal application for the ForMAX beamline project and thus no timeline made for a proposal.

According to the application to the Novo Nordisk Foundation, start of user operation ramp up at MicroMAX is planned for Q16 of the project. The official start date of the project has not yet been set.