

Status of beamlines at MAX IV

September 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.

Status of MAX IV

The last report on the status of beamlines at MAX IV was submitted to VR beginning of May³ 2018. Due to the planned annual shutdown, light delivery to beamlines was interrupted in the beginning of July. The linac and 1.5 GeV-ring went back into operation, according to plan, in mid-August while the 3 GeV-ring will start up again in September, with delivery of light to beamlines planned for the first of October. Between 1 May and beginning of July the beamlines that are open to users, regular open call users as well friendly users, received a total of 133 users who made 185 user visits. Users came from 13 different countries and 40 different institutions. The vast majority, almost 55 %, of users during this period were from Sweden. Swedish users came from ten different universities and also from industry.

During the annual shut down, maintenance and installation work takes place. The major projects performed this summer were neon venting of vacuum chambers at certain achromats in the 3 GeV-ring, installation of insertion device vacuum chamber for SoftiMAX, installation and tests of CoSAXS insertion device as well as installation and tests of front ends for CoSAXS, SoftiMAX and DanMAX. Annual maintenance, such as personnel safety system (PSS) tests for the whole facility, have also been performed.

Marjolein Thunnissen is replacing Tomas Lundqvist as Life Science director and Ian McNulty has started working full time as Science director. Since July, all directors in MAX IV management team are thus in place.

MAX IV is working towards creating a refined, more detailed priority list for the beamlines going into user operation in 2018 – 2019. The overarching objective is to deliver more beamlines, to more users, sooner. The list of priorities, anchored with MAX IV staff, will guide allocation of resources.

Over summer, the report for the permit from the Swedish Radiation Safety Authority (SSM) for the Balder beamline has been finalised and submitted. In order to take light, each beamline needs a permit from SSM and as a basis for this, radiological risk analyses need to be made. The report for the Balder permit, builds on a new and more effective method to make radiological simulations that has been developed by MAX IV staff during spring and early summer 2018. This method development took longer than anticipated, causing delays in the radiological risk analysis for Balder. In addition, only one member of MAX IV staff has the competence required to perform radiological simulations. Planned date for submission of SSM permits at forthcoming beamlines will

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

³ Status of beamlines at MAX IV, May 2018, DNR: 2018/777, submitted to VR via e-mail to J. Holmberg 2 May 2018

consequently be delayed. A programme to train additional staff members in the methodology for radiological simulations has been initiated, aiming to diminish the foreseen delays.

Sparse resources in support groups remains a major issue. In almost all support groups, there is a lack of critical functions so that they cannot meet the demand from projects at beamlines and accelerators. Many of these key positions have been identified, and recruitments to fill them are ongoing.

The process for resource allocation at MAX IV has been evaluated by Lund University internal consultants, KIA. The evaluation was initiated early spring and the scope quickly expanded to include processes for project management at MAX IV. The processes have been elucidated, mapped and visualised. The KIA evaluation included interviews with the PRCC (pooled resource coordination committee), resource owners, project managers and group managers throughout the organisation. The KIA consultants reported their findings to MAX IV management late August, the final report is expected in September. In many parts, KIA draw the same conclusion as was reported from the audit committee appointed by the Swedish Research Council in their review of MAX IV's project management, performed during summer. Currently, MAX IV is waiting for responses and actions from the MAX IV board, who is meeting 4 September in Lund, in order to implement changes needed to restore confidence in and strengthen project management.

In Appendix 1, the current status of individual beamlines is presented. These statuses are based on updated information from each beamline on their progress, on new information concerning the time needed for SSM permit, the reprioritisation to push forward beamlines that are ready to take users with small(er) demand of resources. MAX IV has not been able to establish a resource-loaded schedule and timelines for beamline projects are thus not present in graphical representation in this report.

Appendix 1

Current status of individual beamlines

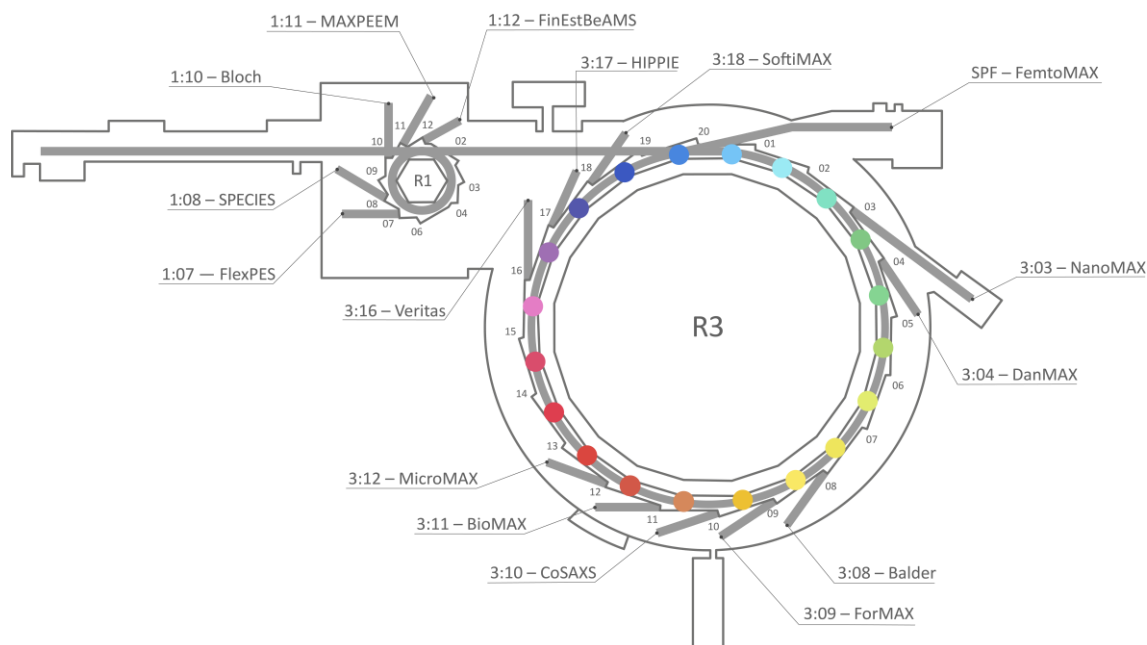
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Location of beamlines at MAX IV



Funding of MAX IV beamlines

Beamline	Funding agency* (installation)	Phase
Balder	KAW & Swe universities	Phase I
BioMAX	KAW & Swe universities	Phase I
BLOCH	KAW & Swe universities	Phase I
CoSAXS	VR	Phase II
DanMAX	Denmark & MAX IV	Phase III
FemtoMAX	KAW & Swe universities	Phase I
FinEstBeAMS	Estonia & Finland	Phase I
FlexPES	VR	Phase II
ForMAX	KAW	Phase III
HIPPIE	KAW & Swe universities	Phase I
MAXPEEM	VR	Phase II
MicroMAX	NNF	Phase III
NanoMAX	KAW & Swe universities	Phase I
SoftiMAX	VR	Phase II
SPECIES	VR & KAW	Phase II
Veritas	KAW & Swe universities	Phase I

*KAW: Knut and Alice Wallenberg Foundation; NNF: the Novo Nordisk Foundation; Swe Universities: 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; VR: Swedish Research Council;

Current status of individual beamlines

Balder

Balder lacks a radiation permit from SSM (Swedish Radiation Safety Authority) for the experimental station. The report to SSM was submitted in the beginning of August and is pending approval. Balder is the first beamline for which the newly developed method for radiological simulations is tested, and the report took longer to finalise than was first anticipated. Assuming the SSM permit will be in place during autumn, Balder could be ready for “simple” EXAFS experiments during 2018. Spectrometer commissioning starts 2019.

- SSM permit submission: 1 August 2018
- Start of commissioning: Q4 2018
- First friendly users from commissioning call: 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 a robotic sample changer and adding remote access to the portfolio.

Since the last report in May* BioMAX has delivered 39 shifts⁺ including first serial crystallography experiments with researchers from Göteborg University and MPIMF-Heidelberg. BioMAX now accepts BAG-proposals. The BioMAX team is assisted by the MicroMAX team in the support of users.

BLOCH

Bloch beamline staff are currently commissioning the beamline, endstation and spectrometer and are at the same time working on a machine safety system for the endstation.

9 July an open call for commissioning users to Bloch closed. Eleven proposals asking for 350 shifts⁺ were submitted. The current plan is to make around 70 shifts available for commissioning users starting end of 2018. This date has been postponed from the one previously reported as the support groups working on machine protection have not had the resources needed to finish the work on time. The date for first regular users from open call has thus been shifted accordingly.

- SSM permit: in place
- Start of commissioning: ongoing
- First friendly users from commissioning call: Q4 2018
- First open call users: Q2 2019

* Status of beamlines at MAX IV, May 2018, DNR: 2018/777, submitted to VR via e-mail to J. Holmberg 2 May 2018

⁺ 1 shift = 4 hours

CoSAXS

Front end and insertion device was installed during summer shut down 2018. Beamline installation activities are ongoing, with among other things alignment of optical elements and final installation of vacuum pipes and valves at the optical hutch. Provided that the SSM permit is submitted and approved as forecasted, commissioning of CoSAXS hutches can start next year.

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

DanMAX

The construction of infrastructure for DanMAX is underway, construction of the conventional buildings are expected to start early autumn 2018. The undulator and front end have been delivered. The front end is partly installed, while the insertion device is planned to be installed during the annual summer shut down 2019. Delivery of optical components are scheduled for October 2019 which is a few months after the initial estimate, thus postponing the planned SSM permit submission proportionally. The detailed design of the endstation equipment is to be finalised during 2018. Recruitment of a mechanical engineer for DanMAX is ongoing; this is a critical position in order to complete the beamline.

- SSM permit submission: planned for Q4 2019
- Start of commissioning: Q1 2020
- First friendly users from commissioning call: Q3 2020
- First open call users: 2021

FemtoMAX

During spring 2018 FemtoMAX had friendly user for commissioning experiments. FemtoMAX needs 100 Hz for most user experiments; some users can however perform limited experiments at lower repetition rates. For user calls to be published, at least 10 Hz operations needs to be established. SSM permit for 10 Hz operations of the linac, and thus FemtoMAX, is planned for Q2 2019. This is a delay from the last report based on the new assessment of the time needed to prepare each SSM permit.

While waiting, technical commissioning activities are ongoing, including commissioning of timing monitor and synchronisation testing.

- SSM permit 2 Hz: in place
- SSM permit 10 Hz submission: planned for Q2 2019
- Start of commissioning: ongoing at 2 Hz
- First friendly users from commissioning call: Q2 2018
- First open call users: Q1 2020

FinEstBeAMS

FinEstBeAMS had its first friendly user in June 2018. The main objective of these commissioning experiments was to enhance the beamline performance and to test the endstation by carrying out experiments. In July, a call for commissioning users at FinEstBeAMS was closed. Eight proposals were received, requiring a total of 288 shifts⁺. First commissioning experts are planned in October, which is a delay as compared to previous timeplan. This delay is due to a unexpected leak in the monochromator grating cooling circuit that was discovered in August, and that will affect the arrival of the first open call user proportionally.

- SSM permit: in place
- Start of commissioning: ongoing
- First friendly users from commissioning call: Q4 2018
- First open call users: Q2 2019

FlexPES

FlexPES front ends and optics are in place and minor installations are remaining, work on this is ongoing while waiting for permission from SSM to take light. During summer there has been a reassessment of the time needed to prepare each such SSM permit, causing a delay as compared to the last report.

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

ForMAX

The ForMAX project was officially started 1 July 2018 and will run for five years. The detailed design report (DDR) for the optics for ForMAX will be ready in September 2018 and will thereafter be sent for external review. Operation costs of ForMAX will be funded through the research platform *Treesearch*. Negotiations concerning the agreement on ForMAX operation is ongoing. Assuming both DDR review and negotiation on operation cost goes according to plan, first procurements can start end of 2018.

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

⁺ 1 shift = 4 hours

HIPPIE

HIPPIE has regular user operation at one out of its six cells/experimental setups (the catalysis cell). While maintaining the beamline and endstation in operational condition and supplying user support for general and expert users, HIPPIE has been working on commissioning the electrochemical/liquid cell. According to recommendation from MAX IV Scientific Advisory Board (SAC), the HT and Bio cells have been put on hold in order to prioritise the cells that are in, or going into, user operation.

Between February and June 2018 HIPPIE has received five open call user groups and six expert, commissioning, user groups.

In the commissioning call for expert users for the PM-IRAS setup and electrochemical/liquid cell, which closed in the beginning of July, fifteen proposals were received.

MAXPEEM

MAXPEEM front ends and optics are in place and work on the control system is ongoing. The beamline is basically ready to take light as soon as the SSM permit is in place. Submission of the permit is planned for Q4 2018. This is a shift as compared to the last report due to a reassessment of the time needed to prepare each SSM permit.

The LEEM instrument at MAXPEEM can work without synchrotron radiation and takes users. Between 1 May until summer shutdown in July this instrument had three user visits.

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

MicroMAX

The MicroMAX project is in its very initial phases. Beamline design with focus on beamline optics is ongoing. Review of the detail design report (DDR) by external evaluators is planned for winter 2018/2019 with the aim to start procurement process in early 2019.

The MicroMAX Scientific and Technical Advisory Panel (STAP) has been appointed and their first meeting is planned for autumn 2018.

A research engineer has been recruited and joined the MicroMAX team mid-August. In order to increase knowledge and prepare for MicroMAX, the MicroMAX team works in close collaboration with the BioMAX team to start development of serial crystallography at MAX IV.

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

NanoMAX

NanoMAX takes users at its experimental station 1, the KB-station, while commissioning activities to finalise it are ongoing in parallel. The aim is to complete the KB-station within the coming nine months. Design and purchases of experimental station 2, the FZP-station are also ongoing. A review of NanoMAX scientific strategy, development and operation is planned for Q4 2018.

Since 1 May, NanoMAX has delivered 48 shifts⁺ to two user groups from open user call and 90 shifts for commissioning and in-house experiments in order to show capability of NanoMAX and improve performance of the beamline. NanoMAX has also had two training days with students, in total five shifts.

SoftiMAX

Front end and parts of the insertion device for SoftiMAX have been successfully installed during summer shutdown. The insertion device will be installed during autumn, the aim is to have it fully in place at the end of the year. There has been an unfortunate delay of approximately four months in the optics installation due to carbon contamination on the grating.

The SoftiMAX STXM-station design is basically finished, and ordering of components has started. The second experimental station at SoftiMAX, the CXI-stations is put on hold until the STXM-station is up and running.

As for many other beamlines, the planned time for SSM permit submission has been changed due to a revision of the estimated time needed to submit the report to SSM for each beamline.

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

SPECIES

There has been a reprioritisation between SPECIES and MAXPEEM in the internal order for which SSM permits are submitted. Start of commissioning of SPECIES is thus pushed forward a few months. While waiting for the SSM permit, the SPECIES team work on installation and initial commissioning activities such as further commissioning of the APXPS endstation and existing cells, and build-up of the RIXS spectrometer. The beamline is ready to start commissioning once the radiation permit from SSM is in place.

The APXPS endstation has been commissioned to 90% using an X-ray source. Since 1 May three friendly users groups have performed preliminary APXPS experiments with the X-ray source.

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

⁺ 1 shift = 4 hours

VERITAS

The Veritas beamline has two branch lines, Veritas A and Veritas B. The spectrometer for the Veritas A experimental station is being built at the Ångström workshop in Uppsala. There are currently no indications of further delays from the workshop, and the experimental station is being built up as parts are delivered. The Veritas team has had light on sample and expect to go forward with NEXAFS measurements during autumn 2018.

The Veritas B branch line 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: ongoing
- First friendly users from commissioning call: Q1 2019
- First open call users: Q3 2019