

Status of beamlines at MAX IV

June 2020



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 financed the construction of the eighth beamline, FinEstBeAMS. These eight beamlines constitute the Phase I beamlines. In 2013, KAW and the Swedish Research Council (VR) funded the Transfer Package, three beamlines (SPECIES, FlexPES and MAXPEEM) consisting of moved and upgraded instruments from MAX-lab. VR also financed two new beamlines, CoSAXS and SoftiMAX. These five beamlines represent the Phase II beamlines. The Danish Agency for Science and Higher Education, the Capital Region of Denmark and the Central Denmark Region fund together with the Technical University of Denmark, Aarhus University and the University of Copenhagen, the DanMAX beamline. In 2017 the Novo Nordisk Foundation (NNF) granted funding for the MicroMAX beamline. By the end of 2018, the complete funding of the ForMAX beamline was settled with KAW funding the construction and the Swedish forest industry funding the operation through the Tree search project and. Currently, MAX IV has sixteen funded beamlines.

Status of MAX IV

MAX IV accelerators are performing well, and all three deliver X-ray light to beamlines. Fourteen beamlines are currently taking light, four of which are in commissioning and ten in general user operation. The SoftiMAX and DanMAX beamlines have received permission from the Swedish Radiation Authority (SSM) to take beam and started commissioning.

The COVID-19 pandemic has had a dramatic impact on research activities globally. MAX IV closely follows Lund University's and Swedish authorities' regulations and guidelines concerning the pandemic and formed a COVID-19 Task Force to develop contingency plans to manage the impact of the pandemic on project execution and operations at MAX IV. Despite this challenging environment, MAX IV accelerators and beamlines continue to operate according to schedule. The principal impact of the pandemic on research at MAX IV is that most users have not been able to come to MAX IV for their scheduled beamtime. About 30 user projects have been cancelled to date, with more projects likely to follow later this spring run cycle. All beamlines are working together with their users to find solutions to serve them under these unprecedented circumstances. Some beamlines, e.g. BioMAX, Balder, MAXPEEM, and NanoMAX, are serving users remotely with mail-in samples. Others are evaluating whether remote user operation could be possible; however, most MAX IV beamlines are not currently compatible with this mode of operation.

MAX IV received approximately 250 proposals requesting beam time in the autumn 2020 run cycle in the spring call for proposals (March 2020 deadline). Because most users could not use their beam time scheduled during the spring 2020 cycle due to the pandemic, MAX IV will reschedule these users' beam time in the upcoming autumn 2020 cycle. In addition, MAX IV will extend this cycle to allocate beam time to highly ranked proposals in the spring call. We have cancelled the standard autumn proposal call (September 2020 deadline) to accommodate these adjustments and to give users who have already submitted proposals the best opportunity for beamtime soon under the present circumstances.

The MAX IV Central Project Office (CPO) is working closely with resource teams to monitor possible project delays due to the COVID-19 pandemic. The MAX IV project portfolio is currently executed

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

with minor delays, but no significant activities are stopped. The CPO is working on various scenarios depending on the impact and timeframe of the pandemic to mitigate the risks and to redirect resources if needed. Activities that rely on external international resources or equipment increase the risk of project delays.

VR conducted the third review of MAX IV project management in November 2019. This review also evaluated MAX IV's transition from the project phase to the operational phase. The review committee's report concluded that significant progress was made regarding both the project management processes and development of the beamlines since the previous review in February 2019. The report also provided a list of ten recommendations focusing on communication to stakeholders about the expected consequences if current funding is not increased to meet budgetary needs, development of a science strategy to exploit the unique characteristics of MAX IV, and specifics concerning handling risks, scope, cost and schedule for effective project management.

This updated version of the May 2020 report replaces the May 2020 report (DNR: STYR 2020/725-1) in full. The report explains deviations in dates from the December 2019 report at certain beamlines. We also clarify the expected dates for first expert users and first general users at some beamlines that in the May 2020 report were left uncommented.

Appendix 1 lists the current status of individual beamlines with estimated dates to deliver baseline beamline capabilities. This list is based on updated status information from each beamline, the anticipated availability of resources for installation and commissioning of the beamlines, and prioritisation by MAX IV Management based on the above and expected user need. The listed dates are based on estimates made under the current circumstances. With the ongoing situation with the COVID-19 pandemic, there is a significant risk that these may change. MAX IV is following the situation carefully to mitigate the risks in the project portfolio.

Appendix 1

Current status of individual beamlines

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June 2020

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MAX IV beamlines

Beamline	Funding agency* (installation)	Phase	Accelerator	Status (2020-04-30)
Balder	KAW & Swe universities	Phase I	3 GeV	User operation
BioMAX	KAW & Swe universities	Phase I	3 GeV	User operation
Bloch	KAW & Swe universities	Phase I	1.5 GeV	User operation
CoSAXS	VR	Phase II	3 GeV	Commissioning
DanMAX	Denmark & MAX IV	Phase III	3 GeV	Installing
FemtoMAX	KAW & Swe universities	Phase I	Linac	Preparing SSM permit 10 Hz, commissioning 2 Hz
FinEstBeAMS	Estonia & Finland	Phase I	1.5 GeV	User operation
FlexPES	VR	Phase II	1.5 GeV	User operation
ForMAX	KAW	Phase III	3 GeV	Procuring, installing
HIPPIE	KAW & Swe universities	Phase I	3 GeV	User operation
MAXPEEM	VR	Phase II	1.5 GeV	User operation
MicroMAX	NNF	Phase III	3 GeV	Procuring, Installing
NanoMAX	KAW & Swe universities	Phase I	3 GeV	User operation
SoftiMAX	VR	Phase II	3 GeV	Commissioning
SPECIES	VR & KAW	Phase II	1.5 GeV	User operation
Veritas	KAW & Swe universities	Phase I	3 GeV	User operation

*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 is in general user operation.

BioMAX

BioMAX is in general user operation.

Bloch

Bloch is in general user operation.

CoSAXS

The first commissioning call for expert users closed in March. Twenty-five proposals were received. Selected proposals will be allocated beamtime as soon as possible, given the current situation.

- First expert users: Q2 2020
- First general users: Q4 2020

Changes made since the December 2019 report:

The dates for first expert and first general users have been delayed from Q4 2019 and Q3 2020 respectively in the December 2019 report. These delays are due to delays in the ordering of equipment and flight tube installations as well as COVID-19 pandemic travel restrictions. CoSAXS has also experienced technical issues during its commissioning, the team is focusing on resolving these, but there is still a high risk for further delays.

DanMAX

First light was delivered to DanMAX and commissioning has started on schedule.

The dates below apply for the powder X-ray diffraction (PXRD) station and assume that there are no delays in the tight schedule. The Imaging station will follow approximately six months behind.

- First expert users: Q3 2020
- First general users: Q1 2021

Change made since the December 2019 report:

The date for first expert users has been delayed from Q2 2020 in the December 2019 report. The beamline will be ready for expert users in Q3 2020. First general users are still scheduled for Q1 2021.

FemtoMAX

Commissioning activities and feasibility tests with expert users at 2 Hz repetition rate continue.

- Commissioning 2 Hz: on-going
- Start of commissioning 10 Hz: Q4 2020
- First general users: Q1 2021

Changes made since the December 2019 report:

Expert users are not needed for commissioning at 10 Hz, so this date was dropped.

The date for first general users has been changed from Q3 2020 in the December 2019 report to Q1 2021. It was determined in spring 2020 that improving the accelerator radiation shielding would reduce the risk for uninterrupted operation at both 2 Hz and higher repetition rates. The first general users' date was delayed to improve the radiation shielding before submitting the radiation safety permit application for 10 Hz operation to SSM.

FinEstBeAMS

FinEstBeAMS is in general user operation.

FlexPES

FlexPES had its first general users beginning of March and is now in general user operation.

ForMAX

ForMAX radiation safety hutches are installed. The detailed design review for the tomography end station is planned for the beginning of May. The ForMAX project is currently on track, but COVID-19 adds a risk of delays to the delivery of essential components such as beamline optics which could delay the installation of the beamline.

- Start of commissioning: Q2 2021
- First expert users: Q4 2021
- First general users: Q4 2022

HIPPIE

HIPPIE is in general user operation.

MAXPEEM

MAXPEEM is in general user operation.

MicroMAX

Installation of MicroMAX started in February, and the radiation safety hutches are complete. Detailed design review of the end station was performed in February. Procurement for optics is underway. The MicroMAX project is currently on track, but COVID-19 adds a risk of delays to the delivery of essential components such as beamline optics which could delay the installation of the beamline.

The first MicroMAX user meeting was held in Copenhagen 2 March.

- Start of commissioning: Q4 2021
- First expert users: Q4 2021
- First general users: Q4 2022

NanoMAX

The NanoMAX KB-station is in general user operation.

The development work of the NanoMAX FZP-end station is on-going, with tests of a prototype sample scanner and finalization of the design for coarse and fine scan stages planned for summer.

- Start of commissioning: Q3 2021
- First expert users: Q3 2021
- First general users: Q4 2022

SoftiMAX

The SoftiMAX beamline started commissioning in March. Installation of the scanning transmission x-ray microscope at SoftiMAX is underway.

- First expert users: Q3 2020
- First general users: Q2 2021

Changes made since the December 2019 report:

The date for first expert users has been changed from Q1 2020 in the December 2019 report.

The date for first general users has been changed from Q4 2020 in the December 2019 report.

The delay is due to wrong planning assumptions, radiation safety permit delay and parts delivery delay. The project is at further risk of delays because experts needed for the commissioning of the beamline may not be able to travel due to COVID-19 restrictions.

SPECIES

The APXPS end station is in general user operation since March. The RIXS end station was included in the last user call.

VERITAS

Veritas B branch line (the open port branch) is in general user operation. The Veritas A branch line is in commissioning.