

Status of beamlines at MAX IV

March 2019



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 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. In addition, 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, 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 in November³ 2018. MAX IV accelerators are performing well, and all three deliver light to beamlines. A major milestone was reached in January when the three accelerators simultaneously supplied light to nine beamlines. Three beamlines (BioMAX, NanoMAX and Hippie) have continued to receive external users during the period since the last report. The MAXPEEM beamline has received permission from the Swedish Radiation Authority (SSM) to take beam and started commissioning in February. Two beamlines, Balder and Bloch, have had first external expert users. In total 167 users (regular as well as experts) have made 175 user visits to MAX IV since 27 November 2018⁴. Users came from 12 different countries and 37 different institutes or companies. The largest fraction of users, 56 %, during this period were from Sweden. Swedish users came from twelve different universities and research facilities. In addition to the three beamlines that already take regular users, FinEstBeAMS will receive its first users from a regular user call in April. A call for proposals for regular beamtime at eight beamlines from September 2019 to February 2020 opened in February. With this call, several new techniques and capabilities are made available to MAX IV users as half of the beamlines in it have not received regular users before.

Two more beamlines (FlexPES & SPECIES) on the 1.5 GeV ring is expected to get their SSM permit application approved soon and thereby be able to receive beam for the first time. The other Phase II beamlines, CoSAXS and SoftiMAX, are focussing on the installation of optics and end station equipment. The more recently funded beamlines DanMAX, ForMAX and MicroMAX, are still in their design phase with upcoming reviews in March for both MicroMAX (optics) and DanMAX (experimental stations).

To strengthen project management at MAX IV, work to implement a central project office at MAX IV has started. As a part of this process, a senior consultant was appointed in January to serve as Central Portfolio Manager. This work includes strengthening processes, governance structures and tools needed for more effective project management including resource-loaded time plans for all MAX IV projects. A position to hire a permanent portfolio manager was opened in February 2019. 19 February 2019, VR performed a second review of MAX IV project management.

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, December 2018, DNR: 2018/777-3, submitted to VR via e-mail to J. Holmberg and N. Ottosson 30 November 2018

⁴ Date for statistics in last report

The beamline office has together with the portfolio manager and PRCC continued the work on refining resource allocation for beamline projects defined in the MAX IV management prioritisation list.

An additional radiation safety expert has been hired and will start in April, in order to strengthen the radiation safety group in their work on the radiological simulations needed for the SSM permit applications.

Appendix 1 lists the current status of individual beamlines and current beamline development priorities with estimated dates to deliver baseline beamline capabilities. This list is based on updated information from each beamline on each's progress, 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 estimations made under the current circumstances. There is some risk that these may change as MAX IV establishes a complete resource-loaded time plan. We will update VR if and as soon as changes appear necessary.

Appendix 1

Current status of individual beamlines

Status of beamlines at MAX IV

March 2019

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MAX IV beamlines

| Beamline | Funding agency* (installation) | Phase | Accelerator |
|-------------|--------------------------------|-----------|-------------|
| Balder | KAW & Swe universities | Phase I | 3 GeV |
| BioMAX | KAW & Swe universities | Phase I | 3 GeV |
| Bloch | KAW & Swe universities | Phase I | 1.5 GeV |
| CoSAXS | VR | Phase II | 3 GeV |
| DanMAX | Denmark & MAX IV | Phase III | 3 GeV |
| FemtoMAX | KAW & Swe universities | Phase I | Linac |
| FinEstBeAMS | Estonia & Finland | Phase I | 1.5 GeV |
| FlexPES | VR | Phase II | 1.5 GeV |
| ForMAX | KAW | Phase III | 3 GeV |
| HIPPIE | KAW & Swe universities | Phase I | 3 GeV |
| MAXPEEM | VR | Phase II | 1.5 GeV |
| MicroMAX | NNF | Phase III | 3 GeV |
| NanoMAX | KAW & Swe universities | Phase I | 3 GeV |
| SoftiMAX | VR | Phase II | 3 GeV |
| SPECIES | VR & KAW | Phase II | 1.5 GeV |
| Veritas | KAW & Swe universities | Phase I | 3 GeV |

*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;

Development priorities for individual beamlines

| Beamline | Status | First Expert Users | First User Call | First Regular Users |
|------------------|----------------|--------------------|-----------------|---------------------|
| SPECIES | Installing | Q2 2019 | Aug 2019 | Q1 2020 |
| FlexPES | Installing | Q2 2019 | Aug 2019 | Q1 2020 |
| FemtoMAX (10 Hz) | Installing | Q2 2019 | Aug 2019 | Q4 2019 |
| CoSAXS | Installing | Q4 2019 | Feb 2020 | Q3 2020 |
| SoftiMAX | Installing | Q1 2020 | May 2020 | Q4 2020 |
| DanMAX | Installing | Q2 2020 | Aug 2020 | Q1 2021 |
| ForMAX | Designing | Q4 2021 | Feb 2022 | Q4 2022 |
| MicroMAX | Designing | Q4 2021 | Feb 2022 | Q4 2022 |
| Veritas | Commissioning | Q1 2019 | Feb 2019 | Q3 2019 |
| MAXPeem | Commissioning | Q1 2019 | Feb 2019 | Q3 2019 |
| Balder | Commissioning | | Feb 2019 | Q3 2019 |
| Bloch | Commissioning | | Feb 2019 | Q2 2019 |
| FinEstBeAMS | Commissioning | | | Apr 2019 |
| FemtoMAX (2 Hz) | Commissioning | | NA | NA |
| NanoMAX | User operation | | | |
| Hippie | User operation | | | |
| BioMAX | User operation | | | |

Current status of individual beamlines

Balder

For the past months, the Balder team has focussed on commissioning of the beamline to make it ready for external users. The first experiments by external expert users were performed 25 February 2019. The first call for regular users at Balder is open. Beamtime from this call will be allocated from September 2019 to February 2020.

- Commissioning: ongoing
- First expert user: 25 February 2019
- First regular users: Q3 2019*

BioMAX

BioMAX is in regular user operation, while some remaining commissioning activities are ongoing in parallel. Commissioning activities include adding remote access to the portfolio. The ISARA sample changer has been added to the available capabilities and has stabilised the operation at low sample loss rates.

Since the last report in December[†] BioMAX has delivered 47 shifts[‡] to 75 users. A call for regular users is now open for beamtime at BioMAX from September 2019 to February 2020. In this call, beamtime at BioMAX is also available for BAG (block allocation group) proposals. In BAG proposals large research groups can apply for beamtime in one single, common proposal in order to permit greater flexibility in beamtime allocation and scheduling. Beamtime for BAG proposals is allocated from September 2019 to August 2020.

Bloch

The Bloch beamline has had its first external expert users performing experiments at the ARPES-endstation. While finalising this endstation for regular users, installation of the SPIN-ARPES endstation is ongoing. The first call for regular users at Bloch is open. Beamtime from this call will be allocated from June 2019 to February 2020.

- Commissioning: ongoing
- First expert users: 6 February 2019
- First regular users: Q2 2019

* Summer shutdown of the 3 GeV-ring 2019 is planned from 1 July to 16 September, which means there will be two weeks of beam delivery to beamlines at the 3 GeV-ring during Q3 2019

[†] Status of beamlines at MAX IV, December 2018, DNR: 2018/777-3, submitted to VR via e-mail to J. Holmberg and N. Ottosson 30 November 2018

[‡] 1 shift = 4 hours

CoSAXS

Beamline installation activities continue, as does development of the sample environment instrumentation.

- SSM permit submission: planned for Q3 2019
- Start of commissioning: Q3 2019*
- First expert users: Q4 2019
- First regular users: Q3 2020

DanMAX

The construction of the conventional infrastructure for DanMAX is progressing well and will be handed over to MAX IV by mid-March. The detailed design of the endstation equipment is being finalised; a review is scheduled for March 2019. The final review of the X-ray optics design is complete, and the production of the components is underway.

The dates below apply for the powder X-ray diffraction station. The imaging station will follow approximately six months behind.

- SSM permit submission: planned for Q1 2020
- Start of commissioning: Q1 2020
- First expert users: Q2 2020
- First regular users: 2021

FemtoMAX

FemtoMAX needs 100 Hz for full scope of user experiments; however, some experiments can be performed at lower repetition rates. For user calls to be published, at least 10 Hz operation needs to be established. Meanwhile, technical commissioning activities and feasibility tests with expert users at 2 Hz continue.

The radiation safety group will start on the SSM permit application for 10 Hz operation of the linac, and thus FemtoMAX, early Q2 2019. However, as the approach for this application differs from that of beamline applications, the radiation safety group currently can not estimate the amount of time needed for the SSM permit application for 10 Hz operation.

- SSM permit 2 Hz: in place
- SSM permit 10 Hz submission: planned for Q2 2019[§]
- Start of commissioning, 10 Hz: Q2 2019[§]
- First expert users, 10 Hz: Q2 2019[§]
- First regular users: Q4 2019

* Summer shutdown of the 3 GeV-ring 2019 is planned from 1 July to 16 September, which means there will be two weeks of beam delivery to beamlines at the 3 GeV-ring during Q3 2019

[§] Amount of work needed for SSM permit application for 10 Hz is currently unknown

FinEstBeAMS

FinEstBeAMS is currently taking expert users who help with the commissioning of the beamline making it ready to take regular user. During November and December 2018, FinEstBeAMS allocated 154 shifts[‡] for beamline commissioning.

The first call for regular users at FinEstBeAMS closed in December 2018. Eight weeks of beamtime will be allocated from April to June 2019. A call for regular users, requesting beamtime from September 2019 to February 2020 is now open.

- First regular users: Q2 2019

FlexPES

The Radiation Safety team is currently preparing the FlexPES SSM permit application. Submission of the application is planned at the beginning of April 2019.

The FlexPES team has continued installation of the beamline as far as they can without synchrotron radiation light.

- SSM permit submission: planned for Q2 2019
- Start of commissioning: Q2 2019
- First expert users: Q2 2019
- First regular users: Q1 2020

ForMAX

Procurements for insertion device and radiation safety hutches are ongoing, and procurements for optics are planned for Q2 2019. The design of the experimental station and infrastructure is ongoing. A review of the detail design for the experimental station is preliminary planned for June 2019.

A small audit of risk management was carried out within the ForMAX project in late 2018. A MAX IV working group will work on an organisation-wide implementation of the suggestion from this audit during the first half of 2019.

- Start installation: Q3 2019
- Start of commissioning: Q2 2021
- First expert users: autumn 2021
- First regular users: autumn 2022

[‡] 1 shift = 4 hours

HIPPIE

HIPPIE has since the last report in December⁺⁺⁺ had regular user operation while taking expert users commissioning the electrochemical/liquid cell. Since December 252 shifts[‡] have been allocated to a total of seven user groups, both regular and expert user groups.

A regular user call is now open for users requesting beamtime at HIPPIE from September 2019 to February 2020.

MAXPEEM

The MAXPEEM SSM permit application was approved at the end of January, and the beamline started commissioning in February.

The first call for regular users at MAXPEEM is open. Beamtime from this call will be allocated from September 2019 to February 2020.

- Start of commissioning: ongoing
- First expert users: Q1 2019
- First regular users: Q3 2019

MicroMAX

The MicroMAX detailed design report (DDR) will be reviewed by external evaluators in March 2019. The design of the infrastructure is ongoing with the aim to have radiation safety hutches and beamline rooms completed during spring 2020. The MicroMAX team has started work on improved risk handling based on the ForMAX risk management audit.

- Start installation: Q4 2019
- Start of commissioning: Q2 2021
- First expert users: autumn 2021
- First regular users: autumn 2022

NanoMAX

The NanoMAX KB-station is partly in regular user operation while work on completing it is going on in parallel. MAX IV Management has decided to delay the development of the second experimental station (the FZP-station). KAW has approved this decision.

Since the last report in December⁺⁺⁺, a total of 180 shifts[‡] have been allocated for experiments, 120 of these have been for regular user experiments, 18 for commissioning experts and 42 for in-house research and test experiments.

A regular user call is now open for users requesting beamtime at NanoMAX from September 2019 to February 2020.

⁺ Status of beamlines at MAX IV, December 2018, DNR: 2018/777-3, submitted to VR via e-mail to J. Holmberg and N. Ottosson 30 November 2018

[‡] 1 shift = 4 hours

SoftiMAX

The undulator for SoftiMAX is installed and cabled in the 3 GeV-ring. The SoftiMAX STXM-station design is finished, and all parts for the endstation have been ordered. The design of the second experimental station, the CXI-station, is starting.

- SSM permit submission: planned for Q4 2019
- Start of commissioning: Q4 2019
- First expert users: Q1 2020
- First regular users: Q4 2020

SPECIES

The SPECIES team has continued installation of the beamline as far as they can without synchrotron radiation light. The beamline will be ready to take light as soon as it has permission from SSM. The SSM permit application for SPECIES was submitted 18 February 2019.

SPECIES beamline has continued to take expert users running APXPS-experiments using an external X-ray source.

- Start of commissioning: Q2 2019
- First expert users: Q2 2019
- First regular users: Q1 2020

VERITAS

At the Veritas A branch line, NEXAFS capabilities are being commissioned. The first NEXAFS results were recorded at the end of 2018. External experts for NEXAFS measurements on various sample environments will be accepted from March 2019. Installation of the spectrometer optics is ongoing.

Installation of the Veritas B branch line is finished, and it is ready to start accept external experts to help with commissioning. When first external users can be accepted depends on MAX IV routines for accepting external equipment since the Veritas B is an open port branch without endstation.

The first call for regular users at Veritas B is open. Beamtime from this call will be allocated from September 2019 to February 2020.

- Commissioning: ongoing
- First expert users: Q1 2019
- First regular users: Q3 2019*

* Summer shutdown of the 3 GeV-ring 2019 is planned from 1 July to 16 September, which means there will be two weeks of beam delivery to beamlines at the 3 GeV-ring during Q3 2019