Dnr: STYR 2021/908

Annual Report of MAX IV Laboratory

2020

Contents

1 2020 in brief

MAX IV has a linear accelerator, a 1.5 GeV storage ring, a 3 GeV storage ring, and 16 funded beamline projects at present. The MAX IV accelerator facility performed well in 2020 and delivered X-ray light on schedule and per specification to 14 beamlines, of which 11 received general users and 3 received expert users as part of commissioning activities by year-end. First general users are expected on the latter 3 beamlines by autumn 2021. Construction of the last 2 funded beamlines, ForMAX and MicroMAX, was well along by end of 2020. MAX IV anticipates serving general users on these beamlines by the end of 2022.

MAX IV registered 107 articles published by users and staff in 2020, adding significantly to the science portfolio of the Laboratory. These primarily include peer-reviewed journal papers and also PhD dissertations. For the first time, yearly publications on work at MAX IV dramatically outpaced those on work carried out at MAX-lab before it closed in 2015. Citations of MAX IV publications grew similarly, with approximately 30% of the publications appearing in journals with an impact factor greater than 5. Notable publications in 2020 appeared in top journals such as *Nature Communications, Advanced Science, Nano Research, Physical Review Letters*, and the *International Journal of Molecular Sciences*.

Two user proposal calls were held in 2020 in synchrony with the twice-yearly maintenance/installation shutdown schedule. The quality of the 328 proposals received as rated by the PAC was high, making allocation of beamtime competitive on the more heavily subscribed beamlines. Between 1 March 2020 and 28 February 2021, MAX IV hosted 1036 user visits and 560 individual users (many virtual – see below), 56% of which were from Swedish institutions. The rest were predominantly from the Nordic region.

The SARS-CoV-2 pandemic significantly impacted MAX IV beamline operations in 2020, mainly because many users were unable to come to MAX IV for their scheduled beamtime due to travel restrictions. Nevertheless, MAX IV supported experiments by users who could travel to MAX IV as well as a substantial number of user experiments by mail-in services and remote operations. Users who could not use their beamtime were rescheduled as far as possible to future run cycles. To make room for rescheduled experiments, the autumn 2020 proposal call only included new capabilities and beamlines delivered since the spring 2020 call, and the rest of the autumn call was merged with the spring 2021 call.

MAX IV's policy regarding working on-site during the pandemic closely followed Lund University's and the Swedish authorities' regulations and guidelines. In keeping with these, and personnel safety overall, MAX IV advised staff to work from home when possible, beginning in March. User teams were limited to 5 people per user group per visit from May 2020. MAX IV also did not allow study visits, collaboration visits, training activities or other external meetings or workshops on its premises from May. MAX IV updated the user community periodically on these developments and actions taken, including restrictions on visiting, as the Laboratory adapted to the evolving pandemic.

Despite these conditions and with many staff working from home, MAX IV made substantial progress in 2020 on its portfolio of accelerator, beamline and other projects, keeping most of them close to schedule. The CPO coordinated project activities overall, working closely with both project managers and resource teams to track progress, monitor critical paths, identify

project risks, and mitigate potential delays. While there were some delays, no significant installation activities were stopped due to the pandemic.

Of note, MAX IV completed a long-standing project in 2020 to operate the accelerator facility with a 10 Hz injection rate. The Swedish Radiation Safety Authority granted a permit for MAX IV to operate the accelerator facility in this mode in autumn. Commissioning and a radiation survey of the linac and two rings in 10 Hz mode was completed soon afterward, enabling routine delivery of X-rays to the SPF and FemtoMAX beamline with a 10 Hz pulse repetition rate by late 2020. FemtoMAX obtained promising early commissioning results demonstrating improved signal-to-noise in diffraction measurements, and the beamline expects to start general user operations at 10 Hz in mid-2021. This outstanding achievement involved the concerted effort of many people and areas of expertise across the Laboratory.

The amount and complexity of data produced by MAX IV is growing as the user programme gathers momentum. MAX IV continued development of the KAW-funded DataSTaMP project, which started in July 2019 and runs until July 2024, to implement long-term data storage and data management services at MAX IV.

VR conducted a fourth project review of MAX IV in November 2020 to evaluate how MAX IV is progressing toward operations from a project management perspective, how the recommendations from previous reviews are being implemented, and to give MAX IV principle advice on how to deal with any potential problems identified during the reviews. The report written by the review committee contained findings and comments per the review terms of reference, a summary of MAX IV's progress toward previous review recommendations, and a list of recommendations. These focused on strengthening project governance and planning, prioritising completion of beamlines that exploit the unique characteristics of MAX IV, providing a clear plan (finances, personnel, upgrade projects, etc.) for each beamline's operational phase, ensuring that up-to-date information on beamline capabilities and performance parameters are provided to the community, and as the highest priority, completing a 10-year strategic plan. The review committee commended MAX IV on its progress since the 2019 review despite the pandemic, especially on-time completion of many beamline projects, and the fast ramp-up of remote and mail-in access on several beamlines.

MAX IV began a process in 2019 of developing a new strategic plan with a decadal outlook to define scientific priorities for the Laboratory through 2030. At the request of the Swedish Research Council, MAX IV began preparing a first-draft strategic plan and operations budget for the period 2023-2030 in autumn 2020, due in March 2021. This effort, launched by the MAX IV Science Division, is a major step forward in the strategic development process. Looking ahead toward completing the strategy in late 2022, active participation by the MAX IV community as well as staff, review by advisory bodies such as the MAX IV Scientific Advisory Committee and Machine Advisory Committee, coordination with funding agencies, and approval by the MAX IV Board, are crucial to the process. Hosting and co-organizing community workshops on scientific areas and techniques relevant for MAX IV are also essential; the interactions enabled by these workshops and resulting reports will play an instrumental role in informing the strategy. The goal of this strategic planning effort is to develop a roadmap for developing major new technical capabilities at MAX IV through 2030, driven by compelling science cases, to enable the research community to exploit MAX IV to the fullest extent possible. These could include enhancements to the existing accelerators and beamlines, several new beamlines, and a soft X-ray laser.

2 Scientific output

MAX IV adopted a strategy of early engagement with the community, aiming to serve as many users in parallel as possible initially with baseline capabilities on its funded beamlines, then adding the full planned scope over time. MAX IV anticipated that this approach would be more likely to deliver impactful science sooner than completing the full scope on just a few beamlines.

This strategy is now showing results. Appendix 5 lists 2020 publications from MAX IV and MAX-lab beamlines that have been registered to date in MAX IV Digital User Office system. Although the list is incomplete (not all publications have been registered yet), the number of publications in 2020 from MAX IV is now much larger than that from MAX-lab. This growth is healthy and in line with the maturation of the facility. More importantly, the number of high impact papers produced by MAX IV is also increasing. For example, papers produced from results obtained at BioMAX this year were published in journals such as *ACS Catalysis* and *Nature Communications.* Papers produced from results obtained at NanoMAX appeared in A*dvanced Science, Nano Research* and *Physical Review Letters*. The fast access call MAX IV opened to encourage research related to the SARS-CoV-2 virus as well as other urgent medical research delivered its first publication, appearing in the *International Journal of Molecular Sciences*. Registered MAX IV and MAX-lab publications are available at

https://www.maxiv.lu.se/science/publications/

Highlights on noteworthy results are featured on the MAX IV homepage, and are archived at

https://www.maxiv.lu.se/news/category/science-highlights/

3 User programme

This report covers MAX IV user programme statistics for the period 1 March 2020 to 28 February 2021. By the end of this period, eleven beamlines were in operation and received general users (see Appendix 2 for capabilities available to users).

This reporting period coincides with the beginning of pandemic in Europe. MAX IV was fortunate to be able to continue operating the accelerators and beamlines throughout all of 2020, but the pandemic prevented many users from coming to MAX IV for their scheduled beamtime. MAX IV strived to ensure that as few users as possible lost beamtime due to pandemic issues, and either switched them to some form of remote, mail-in or virtual access where possible, or rebooked their experiments. Apart from on BioMAX where automated remote operations became standard, other access modes, such as at MAXPEEM, BALDER and NanoMAX, were flexible and sometimes improvised in a short time (with tremendous staff effort) to give users the best chance of success with their experiments. Whereas some of these services were clearly an emergency response and can not be sustained after the pandemic, others could become permanent operational features in future. The long-term impact of the pandemic is difficult to assess because the situation is still changing. More than 80 proposals that normally would have received beamtime during the 2020 reporting period were carried over into the next period.

Thus, many user experiments were performed in 2020 without the users being physically present at MAX IV. All user groups registered project participants for each individual experiment session, comparable to a physical "visit". This counted as the same individual several times for separate visits (e.g. in different projects).

User statistics for 2020 are, therefore, not comparable to previous years, in none of the key indicators. The number of submitted and accepted proposals, as well as completed projects was heavily skewed by cancellations, rebooking and carry-over of proposals. The number of on-site visitors was considerably lower than normally expected, but also doesn't reflect the actual activities. In line with reporting requirements, users receiving remote access and/or data from remote and mail-in experiments - a much higher number compared to on-site visits - are reported here.

Given these caveats, MAX IV hosted 1036 user visits by 560 individual users during this period (Table 1). The average user gender distribution was 33% women and 67% men. The majority of users (56%) were from Sweden, with most of the rest from other Nordic countries (Figure 1). Other European countries represented 16% and non-European countries represented 14% of the total.

There were two main proposal calls in 2020. The spring call (opened 20 February, closed 17 March) was for the period September 2020 to February 2021. 260 proposals were submitted in this call, which included Balder, BioMAX, Bloch, FinEstBeAMS, FlexPES, HIPPIE, MAXPEEM, NanoMAX, SPECIES-XPS, and Veritas. The autumn call (opened 17 September, closed 13 October) was for the period March to August 2021. 68 proposals were submitted in this call, which included only BioMAX, CoSAXS, DanMAX, SoftiMAX, SPECIES-RIXS, and Veritas, i.e., mainly new beamlines unaffected by a large pandemic backlog. Proposals for the other beamlines in operation (Balder, Bloch, FinestBeAMS, FlexPES, HIPPIE, MAXPEEM, NanoMAX, and SPECIES-APXPS), and FemtoMAX which is ready to begin general user operations with 10 Hz repetition rate, were merged into the next call, with a deadline outside this reporting period (2021-02-15). This call offers some opportunities for scheduling beamtime early in 2021.

Table 2 shows the PAC research areas, associated beamlines, and numbers of proposals in the 2020 calls. Submitted proposals were sent to the PAC, which included 40 international experts, for scientific review and allocation. Beamline staff reviewed the proposals for feasibility and safety specialists evaluated them for experimental safety in parallel with PAC review.

Figures 2 and 3 show there were far more requests for beamtime than most beamlines could support. The highest-ranked proposals were allocated beamtime and next-ranked proposals were put on a waiting list in case more beamtime became available. Only BioMAX met this high demand due to the short turnover time for typical protein crystallography experiments and routine availability of remote access mode on this beamline. BioMAX was also the only beamline open for BAG proposals in 2020. In BAG proposals, researchers in well-established groups combine their beamtime requests into a single, common proposal for greater allocation and scheduling flexibility. Accepted BAG proposals are valid for four beamtime cycles (two years). Out of the 20 submitted proposals to BioMAX in the 2020 call, 10 were BAG proposals.

Beamline	User visits
Balder	123
BioMAX	464
Bloch	43
CoSAXS	23
DanMAX*	0
FemtoMAX*	0
FinEstBeAMS	21
FlexPES	106
HIPPIE	59
MAXPEEM	48
NanoMAX	82
SoftiMAX*	0
SPECIES-APXPS	57
SPECIES-RIXS	10
Veritas	0
Total	**1036**

* Beamlines still being commissioned

Table 1. Number of user visits to beamlines at MAX IV between 1 March 2020 and 28 February 2021.

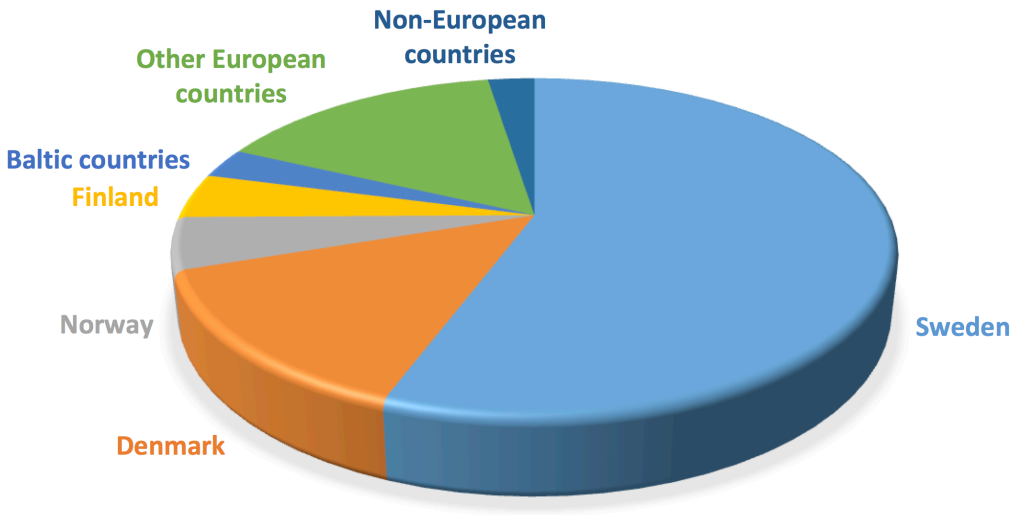

Figure 1. Distribution of users' home institutions between 1 March 2020 and 28 February 2021.

PAC research area	Beamline	Number of proposals spring call*	Number of proposals autumn call^
Chemistry & Soft Matter	Balder	46	not in call
	CoSAXS	25	28
Structural biology	BioMAX°	20 (10 BAGs)	0
Nanoscience Material sciences with hard X-rays	NanoMAX	38	not in call
	DanMAX	not in call	17
Spectroscopy	FinEstBeAMS	16	not in call
	Bloch	16	not in call
	FlexPES	33	not in call
	HIPPIE	28	not in call
	MAXPEEM	17	not in call
	SoftiMAX	not in call	12
	SPECIES-APXPS	14	not in call
	SPECIES-RIXS	7	3
	Veritas	not in call	8
	Total	**260**	**68**

Table 2. Numbers of submitted proposals per beamline and call in 2020.

* spring call (closed 17 March)
^ autumn call (closed 13 October)
° includes BAG proposals

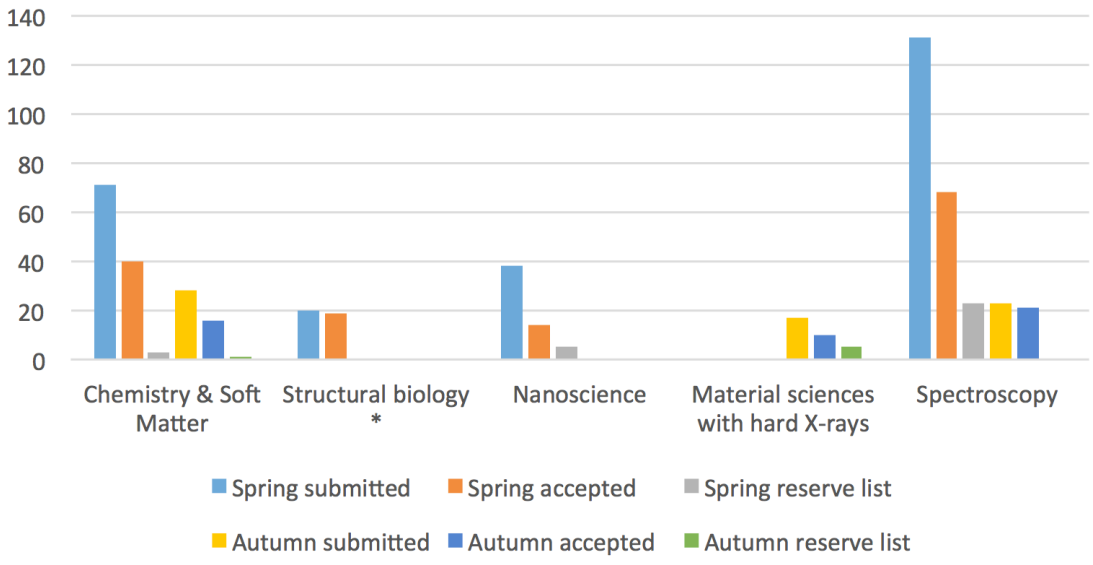

Figure 2. Number of submitted, accepted, and reserve shifts (four hours each) for beamtime in the 2020 calls.
*Proposals for BioMAX include BAG proposals.

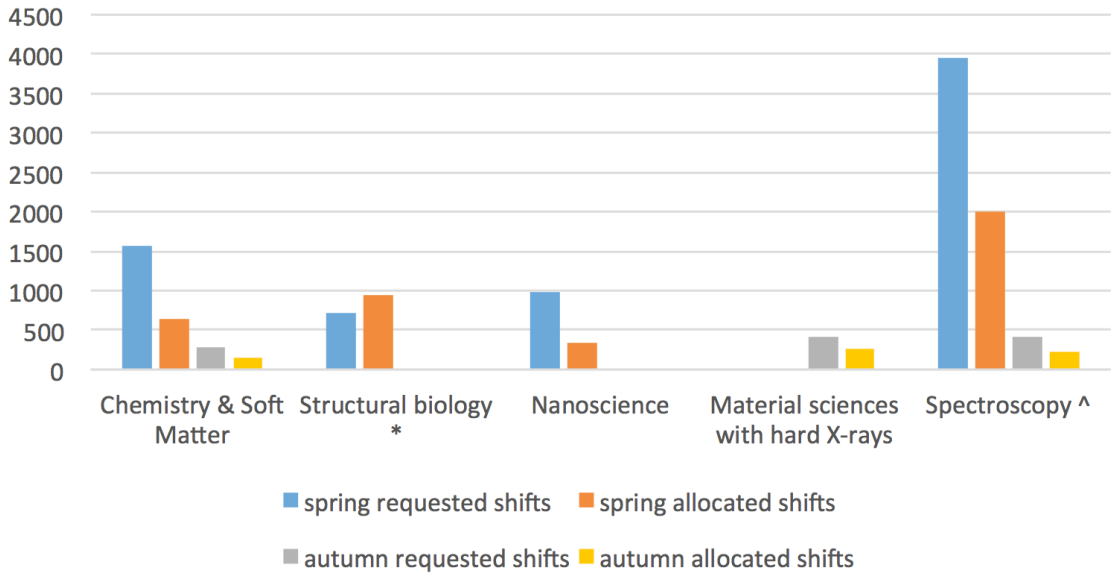

Figure 3. Number of requested and allocated shifts (four hours each) for beamtime in the 2020 calls.

4 Industry engagement

Allocation of proprietary beamtime at MAX IV increased during 2020 compared to 2019, in terms of hours sold, number of user organisations involved, and numbers of new beamlines used. In total, 313 hours of proprietary beamtime were sold to 11 different organisations on 43 occasions during 2020 (Table 3). Two new industrial user groups came in through the Vinnova pilot programme to buy beamtime, and some other groups successfully used the general user programme to access beamtime. Industry engagement through the this access mode, together with academic or institute research collaborations, continued to be the major route for industrial utilisation of MAX IV. The level of academic/industrial collaboration is the same as for 2019, however the actual number of experiments in 2020 was much lower due to the effect of pandemic-related travel restrictions on many research groups.

The pandemic also affected industrial engagement at MAX IV with cancelled meetings and events, but also in some in unexpectedly positive ways. With most other synchrotrons in the world shutting down or reducing their user programmes, MAX IV was one of the few synchrotrons to turn to experiments. This led to several new industry contacts, particularly within the pharmaceutical industry. With establishment of remote operations capability at the BioMAX beamline during fall 2019, the BioMAX team switched completely to remote operation for all users. BioMAX continues to serve both the academic and industrial user communities at nearly full capacity.

Industrial outreach activities started out strong in early 2020 with a couple of events and meetings. One such meeting was a joint facility outreach to life science industry between MAX IV, DESY, EuXFEL, ESRF and ILL in connection with the DESY user meeting. This event was attended by about 50 participants and included presentations from the different facilities as well as from industry. Almost all physical meetings and events abruptly stopped in mid-March

due to the pandemic. However, MAX IV hosted a Master Class in the summer on new synchrotron and neutron techniques for the food and packaging sector, through the Northern Lights on Food initiative. The three-day event was hosted at LINXS and included 10 on-site participants as well as 25 digital participants from industry and academia.

The MAXESS Industry Arena project got traction in 2020 and a website was developed with support funding from Region Skåne. This was launched in the end of October on www.maxess.se. The first functionality of the web arena is a "find research partner" function, where companies can find research groups, projects, beamlines and other resources to help them better utilize neutron and synchrotron-based tools. The project group also applied for funding to continue working on the arena and develop new services and functions for industry.

Collaborations between MAX IV, ESS and SciLifeLab in the life sciences intensified during the year, leading to formation of a project team involving MAX IV IRO, ESS Host State Relations, and the SciLifeLab External Relations Office. The team applied for, and received funding from, the VR "Tillgängliggörande av forskningsinfrastruktur" open call. This project, InfraLife, will build a joint hub between the three large-scale research infrastructures to become more accessible to the life science industry and health care sector in Sweden. The project starts in 2021 and runs four years.

Alfa Laval, Lund University and the MAX IV IRO developed a collaboration over the past year to strengthen Swedish and Nordic metal industry connections to MAX IV. Alfa Laval assigned a full time position for two years to work closely with the MAX IV IRO. The recruitment process for this position took place during autumn 2020. The new position starts in January 2021.

At the request of the MAX IV Board, MAX IV developed an industry strategy in 2020 with a mission to increase industrial engagement of and access to MAX IV. The strategy set goals for broadening the industrial user community, increasing industrial use of MAX IV, and including industry in development of the facility. It also set goals for strengthening beamline and IRO staffing, opening a new open access mode for industrial beamtime, and strengthening academic-industrial collaborations.

Industrial users	**Technique (Beamline)**	**2018**	**2019**	**2020**
Total industry users		4	8	11
New industry users		4	5	6
Customer retention		0	-1	-3
Proprietary beamtime (h)				
	MX (BioMAX)	43	132	218
	Spectroscopy (HIPPIE, Balder)		60	35
	Imaging (NanoMAX, MAXPEEM)		24	37
	Scattering (CoSAXS)			24
	Total	**43**	**216**	**314**

Table 3. Proprietary industry utilisation (in hours) of MAX IV in 2020.

5 Beamline development

MAX IV made substantial progress on the beamline project portfolio in 2020, not only on construction and installation but also on commissioning tasks in preparation to receive general users. Major accomplishments include readying 10 beamlines for general user operations for the spring 2020 cycle, “first light” and rapid commissioning of SoftiMAX and DanMAX, and opening CoSAXS to general and proprietary users by the end of 2020. Installation of the optics at ForMAX began in autumn, and the MicroMAX hutches and interior infrastructure are largely complete.

The CPO was instrumental in coordinating these activities. Appendix 3 lists the main functionalities (project scope) planned for all 16 funded beamlines, the percentage completed by the end of 2020, and the timeline showing current and expected future availability of these functionalities for general users.

Several projects were completed and many progressed according to schedule, but there also were challenges advancing the project portfolio. Communication and coordination concerning projects suffered somewhat because of the many people working from home during the pandemic. MAX IV developed systems for addressing some of these issues as experience with digital tools increased. Other delays developed due to manufacturing, shipping or vendor travel restrictions, and in some cases procurement legal issues. Most of these were resolved, but a legal delay in the MicroMAX optics procurement and a manufacturer error delaying delivery of the ForMAX and MicroMAX undulators added risk to the schedules for those projects.

One unexpected setback was the discovery of mirror water-cooling system leaks in the Veritas and SoftiMAX beamlines during the summer and autumn. Both beamlines were taken offline to address the causes of, and develop solutions to, the leaks. Extensive analysis of the water quality, including oxygen and mineralisation content, materials used in the cooling systems and fittings, the nature of the corrosion, and consequent failure modes was carried out.

The first leak found, in the Veritas beamline monochromator, occurred because of corrosion in an M2 mirror water connection. Similar damage was found in the M1 mirror cooling system. Spare parts for the M1 mirror were ordered from the manufacturer with estimated delivery in early February 2021. The beamline expects to resume operation in spring if installation of the spares resolves the problems. Procurement of a new mirror (18 months lead time) was also started in parallel to mitigate risk of lost beamtime due to another failure. A leak found in the SoftiMAX monochromator mirror bears some similarities to the Veritas leaks but does not appear to be identical in nature. The SoftiMAX team implemented a temporary fix in consultation with the manufacturer and began baking the monochromator. Procurement of a new mirror (which is not the same as for Veritas) was also started. As with user operations at Veritas, SoftiMAX plans to resume commissioning and expert user activities in spring 2021.

Clearly, these cooling system leaks in key optical components of two beamlines raise concerns for the other soft X-ray beamlines because of the potential severity of the consequences. However, as of the end of 2020, no other leaks or impending leaks were found elsewhere. In addition to analysing the local water quality, other actions taken include implementing a program to monitor cooling water quality lab-wide and development of an alternative cooling system.

6 Accelerator operations and development

Accelerator operation statistics for 2020 indicate that all operational goals for the year were achieved or surpassed: in the 3 GeV ring, 4872 hours of beamtime were scheduled for delivery to beamlines and the availability was 97.4%. The corresponding numbers for the 1.5 GeV ring and SPF (delivering to the FemtoMAX beamline) were 5104 hours/98.1% and 4584 hours/95.7%. For comparison, the 2020 goals for the three accelerators were 4800 hours/97%, 4900 hours/97% and 4300 hours/95%, respectively, for the 3 GeV ring, 1.5 GeV ring and injector.

Operating under pandemic restrictions proved to be a challenge in several respects. Significant effort was devoted to making accelerator operations, troubleshooting and studies as much as possible remotely. This involved administrative measures such as limiting the number of people in the control rooms, as well as implementing efficient mechanisms for remote operation of accelerator subsystems. Even if operations for beam delivery to the beamlines succeeded in remaining largely unaffected by the situation, as indicated by the statistics shown above, new accelerator developments suffered significantly from reduced efficiency due to the constraints of remote-only access for an accelerator physicist during studies shifts.

10 Hz operations

After being granted a radiation safety permit for 10 Hz operation by the Swedish Radiation Safety Authority, MAX IV commissioned the accelerator systems at this repetition rate during the first few days of week 47. This fast commissioning process was a result of detailed preparatory work done in advance with many of the required features being tested during maintenance periods all along the year (without beam) to identify and fix (mostly software-related) issues. Initial problems with overheating of chopper systems in the pre-injector when running at 10 Hz were quickly sorted out. Detailed radiation surveying at 10 Hz was carried out and 10 Hz delivery to the FemtoMAX beamline was in routine operation since week 49. Ring injections at 10 Hz were also successfully demonstrated with injection rates reaching the expected ~100 mA/min in the 3 GeV ring and ~500 mA/min in the 1.5 GeV ring. One concern raised by the first few months of running the accelerator systems at 10 Hz was an increased rate of IGBT switch failures in the linac modulators. Investigation is on-going to identify the root cause and to define appropriate mitigation measures.

Transparent top-up injection into the 3 GeV ring

Following the successful installation (in 2019) of a MIK developed in collaboration with Synchrotron SOLEIL, further trimming of the injection process carried out in spring 2020 allowed reaching record sub-micrometer stored beam perturbation levels (Figure 4). Moreover, since early 2020, top-up injections are performed every 10 min (instead of the previous 30 min intervals) with a resulting improved thermal stability of the beamlines.

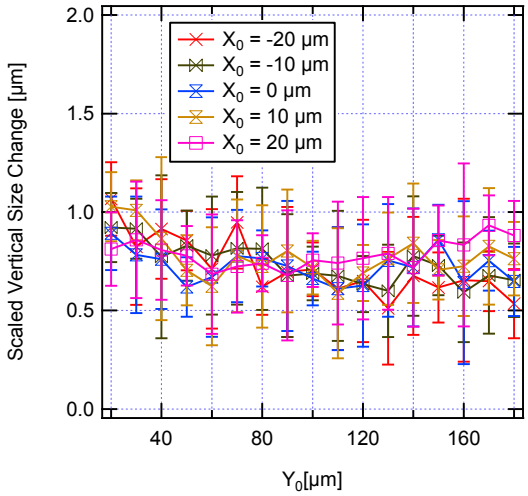

Figure 4. Sub-micrometer changes to the vertical stored beam size.

Fast-orbit feedback in the 3 GeV ring

A FOFB system was put in routine operation in the 3 GeV ring. Even though the ring shows outstanding passive stability (i.e. even without FOFB), transient perturbations produced by gap and phase motions of the insertion devices require FOFB (Figure 5).

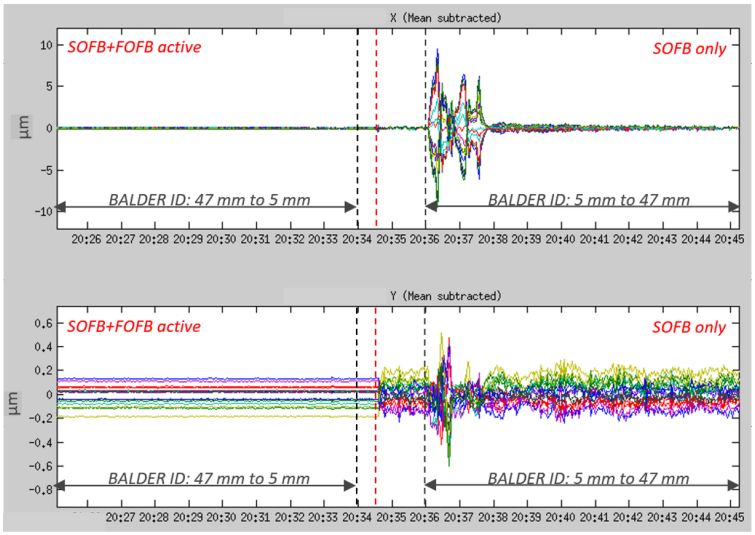

Figure 5. FOFB and slow orbit feedback (SOFB) reduce transient perturbations during Balder ID gap motion. Balder is the strongest ID in the 3 GeV ring.

BAM and pulse-to-pulse energy jitter measurements

The first prototype BAM was installed in the linear accelerator (Figure 6). This device will allow accurate (down to ~10 fs) determination of the arrival time of electron bunches delivered to the FemtoMAX beamline. Arrival time jitter is a critical parameter for the pump-probe experiments conducted at FemtoMAX. Pulse-to-pulse energy jitter measurements performed

in 2020 indicate an outstanding stability (0.01% rms), which confirms the inherent stability of the MAX IV achromat bunch compressors.

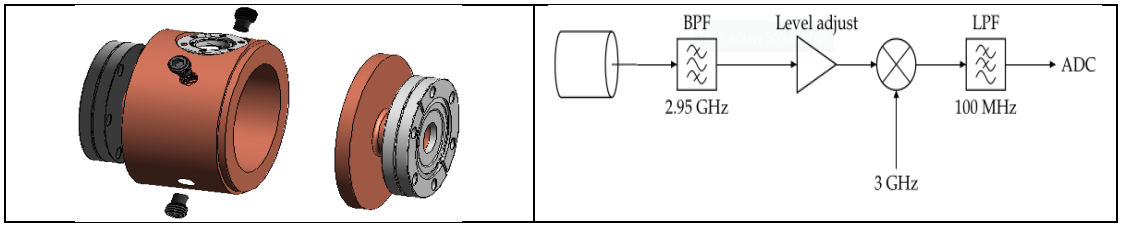

Figure 6. Mechanical design (left) and electronics schematic (right) of the beam arrival monitor.

SXL conceptual design report

The bulk of the work for the conceptual design report of an SXL driven by the MAX IV linac was completed in 2020, with final editing taking place in early 2021. The main features of the proposed design are shown in Table 4. The SXL will enable exploration of ultrafast science on a scale not accessible by any other beamline at MAX IV

Electron beam energy	3 GeV
Charge per bunch	10 – 100 pC
Wavelength range	1 – 5 nm
Photon pulse duration (FWHM)	0.8 – 26 fs
Photon energy per pulse	0.015 – 1.5 mJ
Maximum repetition rate	100 Hz
Maximum peak brightness	4×10^{33} photons/s/mm^2/mrad^2/0.1%BW
Full polarization control with Apple-X undulators.	
Extensive range of pump lasers, from IR to XUV.	
Two-pulse/Two-colour, delays from few fs to few tens of ns	
Prepared for future expansions: Echo-Enabled Harmonic Generation, High Brightness SASE, Self-Seeding	

Table 4. Design parameters of the SXL proposed for MAX IV.

7 Collaborations and partnerships

MAX IV collaborated with external partners on several grant applications to various funding agencies in 2020. Some of the major proposals awarded funding, were:

(i) MAX4MINT, a VR-funded training and education initiative by the User Office and Communications teams to raise the interest of young people in science at MAX IV.

(ii) Four projects (out of nine funded) involving MAX IV through a VR Grant for Accessibility to Research Infrastructure call. The B-branch project, led by Andrey Shivorskiy, is a collaboration involving MAX IV, two Swedish companies, Scienta Omicron and Batteries Sweden, Swerim, and researchers at UU, and LU. B-branch

aims to establish a second endstation at HIPPIE dedicated to research on electrochemistry, batteries, energy materials, and corrosion.

(iii) A project titled, "Dynamics of proteins in crowded environments on multiple length and time scales," involving the CoSAXS team and researchers at LU, SU and the universities of Siegen and Tübingen in Germany, funded within the Röntgen-Ångström-Cluster. Its aim is to exploit the coherence of the light at CoSAXS in X-ray photon correlation spectroscopy experiments to study protein dynamics.

MAX IV also participated in two major grant proposals within the European landscape that were awarded funding. The first, EC (H2020) – LEAPSINNOV, is a LEAPS pilot project to foster open innovation for accelerator-based light sources in Europe. MAX IV's main contributions to this are leading a networking/co-creation work package and efforts within insertion device development. The second, EC (H2020) – NEP, is a Nanoscience Foundries and Fine Analysis – Europe PILOT project on which MAX IV collaborates with Nanolund. Transnational access to MAX IV facilities is offered through this project. MAX IV is also involved with the Lund Protein Production Platform in a project funded through the European University Alliance for Global Health (EUGLOH) to study the function and structure of SARS-Cov-2 antibodies.

8 Communication and outreach

MAX IV operates an extensive outreach programme through the annual user meeting, hosting scientific conferences and workshops, study visits, a periodic newsletter, a website, and social media.

The annual user meeting is the largest event held by MAX IV each year to bring the users and staff together. For safety as well as travel restrictions during the pandemic, MAX IV organised the 2020 meeting as an online hybrid format with both live and pre-recorded presentations. Held during 28-29 September in Lund, the meeting featured several sessions covering the facility status, beamline updates, user science highlights, and a PhD award presentation. There also were four parallel breakout sessions on opportunities for exploiting coherent X-rays at MAX IV, the FragMAX fragment screening facility and other programmes planned for BioMAX and MicroMAX, utilisation of the MAXESS Industry Arena for industrial collaborations, and what new users need to know about tools available at MAX IV. The meeting ended with a strategic outlook into the future of MAX IV. Six short student clip presentations opened this session, followed by keynote lectures by Alexander Balatsky (NORDITA/UConn) and Harald Reichert (ESRF). These speakers were then joined by Aleksandar Matic (CTH), Stacey Sörensen (LU), Lars Kloo (KTH & VR) and Ian McNulty (MAX IV) for a panel discussion and open forum. The meeting attracted many online participants from Sweden and abroad, from both academia and industry.

The pandemic negatively impacted most other outreach activities in 2020 involving in-person interactions. MAX IV did not hold an Open Day in 2020, its largest outreach activity for the general public. Visits from the general public to the MAXESS visitor centre and to the facility itself were halted. The contract concerning the MAXESS centre was terminated 2020 because the owner, SVS, is looking into ways of using the facility for other purposes. MAX IV also did not host an annual summer school as usual, or study visits by secondary schools to encourage

careers in science, technology, engineering and mathematics fields (normally led every year by Lund University natural science students serving as tour guides).

MAX IV sent a newsletter to the community approximately quarterly to update it about current events, beamtime proposal calls, and other news items of general interest. A major focus of the newsletters in the latter part of 2020 was to inform users about restrictions on in-person visits to MAX IV and adjustments to proposal calls on account of the pandemic.

The MAX IV website (http://www.maxiv.se), the primary channel for information and news about MAX IV, took on greater prominence in 2020 in informing the community about recent research, publications, available beamline capabilities, and the status of the beamlines and accelerator systems. In particular, MAX IV prioritised writing short on news articles to highlight ground-breaking scientific results (mainly, though not exclusively on published work) on the website. A new Science Communications Officer was recruited in 2020 to support the growing importance of this effort, as reflected by the growing number of publications from work at MAX IV.

Table 5 shows the number of visits to the website over the past three and a half years. The stagnation in 2020 is most likely due to the decrease in user visits to the lab, i.e., fewer opportunities to apply for and come for beamtime, therefore less interest in news and information from MAX IV. Construction of a modern and accessible (Lag (2018:1937) om tillgänglighet till digital offentlig service) was started.

Visits				**Unique visitors**				**Pageviews**			
2020	*2019*	*2018*	*2017*	*2020*	*2019*	*2018*	*2017*	*2020*	*2019*	*2018*	*2017*
157	156	136	100	63	69	55	41	499	541	482	422

Table 5. Visits to www.maxiv.se (thousands).

Table 6 gives an overview of MAX IV's activities on different social media channels from 2017 to 2020. Notable is that the activity on LinkedIn increased a lot, most likely due to an increase in the number of recruitments at MAX IV.

	Followers				**Impressions (thousands)**			
	2020	*2019*	*2018*	*2017*	*2020*	*2019*	*2018*	*2017*
Twitter	3 782	3 400	2 870	2 400	337	341	473	321
Facebook	2 803	2 770	2 574	2 400	65	100	188	
LinkedIn	5 623	4 400	3 441	2 700	258	159	164	229
Instagram	1 207	1 040	839	625	40			

Table 6. Development of MAX IV social media channels over time. Empty cells indicate statistics are not available or applicable.

9 Organisation and staffing

The MAX IV organisation as of 31 December 2020 is shown in Figure 7. At the end of 2020, MAX IV had 257 employees (Figure 8). Parts of the organisation strengthened by new recruitments included KITS and beamlines, as more beamlines became operational. About one-third of MAX IV employees are from countries other than Sweden. MAX IV advertises most of its open positions internationally to seek the strongest possible candidates.

Recruitment of a permanent Physical Science Director was initiated in autumn 2020 to fill the position temporarily held by the Interim Physical Science Director, Conny Såthe. A search committee composed of four Swedish university faculty members and two MAX IV Board members was charged with identifying highly qualified candidates, evaluating their suitability for the position, and making recommendations (along with others including MAX IV staff and the Board) to the MAX IV Director as to the top candidates. The position was widely advertised and the application portal opened from mid-November 2020 to mid-January 2021. It is anticipated that opportunities holding in-person interviews and a laboratory visit by candidates will become feasible by spring 2021. The goal is to complete the recruitment process and hire a Physical Science Director into the permanent position by September 2021.

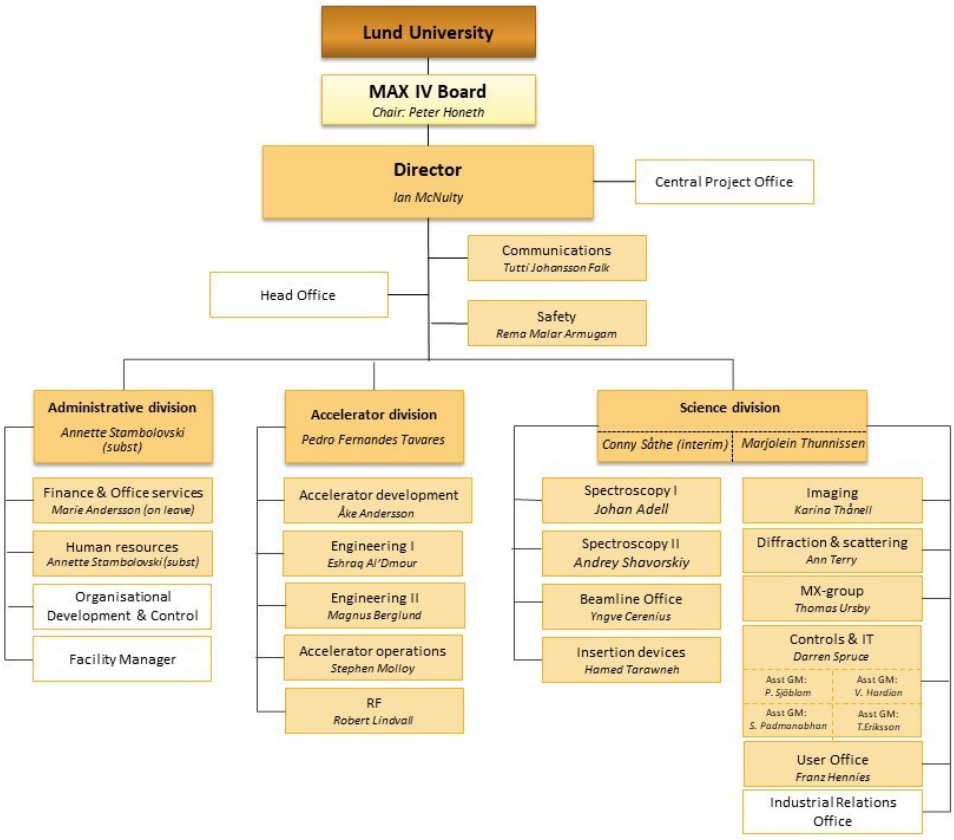

Figure 7. MAX IV organisation (31 December 2020).

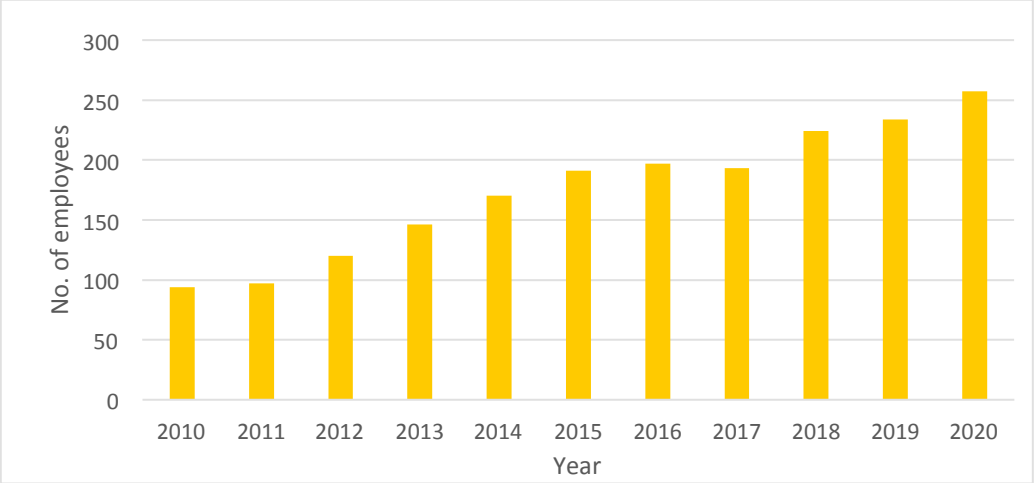

Figure 8. Number of employees at MAX IV from 2010 through 2020.

10 Financial report

In 2020, VR, Vinnova, E-mynd, Formas, and 14 Swedish universities including LU[1] funded the MAX IV operations budget. The Academy of Finland, DanMAX Consortium, and Vilnius University also contributed. As a condition for their grants, MAX IV submits an annual report to the Swedish funding agencies with emphasis on its operations activities.

The MAX IV Board decided at its November 2019 meeting that the operations budget for 2020-2023 must be balanced upon review of the increasing deficit according to the 2019 MAX IV economic LTP for 2020-2023. Balancing the operations budget per the Board's decision required cost-reduction measures applied to 2020 through 2023. Steps to balance the budget for 2020 included pausing the MAX IV in-house postdoctoral programme, discontinuing employment of temporary staff, reducing hiring of operations staff, and significantly reducing funds earmarked for upkeep of beamlines and accelerators. The expected long-term consequences of these measures are (i) slower delivery of planned and future capabilities and reduced user operations, (ii) more rapid aging and increased exposure to the risk of component failure, (iii) decreased ability to maintain the facility at the state of the art. The 2020 funding, costs, and result for operations of MAX IV are shown in Appendix 4.

Comments on the outcome in MAX IV operations

MAX IV delivered a result of +20,3 MSEK and hence a corresponding increase in agency capital. The outgoing agency capital in 2020 was 52,1 MSEK.

[1] CTH, GU, KI, KTH, KU, LiU, LnU, LTU, LU, MU, SLU, SU, UmU, and UU.

The budget decrease in undepreciated funds (17,6 MSEK) was reduced to 2 MSEK as a result of lower spending overall in all groups, mainly due to the pandemic.

Funding

The main deviations in contributions from funders are due to the fact that E-mynd decided to pay out its entire contribution in 2020 (+5 MSEK) and that MAX IV received additional funding for three post docs from LU (+4 MSEK).

Funding according to the agreement with Swedish universities resulted in a cash contribution of 42 MSEK as income and 8 MSEK in-kind as budgeted.

The total income for proprietary beamtime sales resulted in 1,6 MSEK, with Astra Zeneca accounting for 32% of a total of 10 companies/universities. This industrial engagement is accounted for in more detail above.

As other income, MAX IV accounts for revenue from recycled heat, hosted conferences and guesthouse revenue, some of which was underestimated (+1,2 MSEK).

Costs

Recruitments progressed according to the reduced staffing plan. All budgeted positions are underway to be filled except for a few positions resulting in a slight budgetary deviation. However, a number of positions filled will start their first day of employment in early 2021. In general, it can be stated that all groups spent less than budget, mainly due to the pandemic. Conferences, travel, etc. were cancelled, and meetings such as the annual user meeting and board meetings were held digitally, thus they became less expensive.

The electricity price and the STIBOR interest rate were two external factors that affected the outcome for 2020. The electricity cost was 17% lower due to lower electricity prices (-3.9 MSEK) and the rental cost for the facility based on STIBOR 3M was slightly lower (-2MSEK).

Realignment of the time plan for beamline, accelerator, and other facility related projects due to the pandemic contributed to delays in budgeted investments, procurements, investments and deliveries, including lower depreciation. In total, this resulted in an expenditure deviation of 30,5 MSEK. The overall cost impact in 2020 was minor. The future cost of the delays, particularly for long lead-time projects, is not yet known.

11 Financial outlook 2021

The Council for Research Infrastructure (RFI) of the Swedish Research Council requested MAX IV to provide RFI with a report with background material to prepare a decision to close the funding gap for MAX IV within the current funding period, i.e. 2021 and 2022. This report was submitted in November 2020. The proposal addresses how additional funding of 50 MSEK in 2021 and 55 MSEK in 2022 from the Council will secure full operations of its 16 funded beamlines, as well as abridge and mitigate risks of under-funding.

The Research Bill (prop. 2020/21:60), published on 17 December 2020, states that within the framework of the Swedish Research Council's funding for research, 50 MSEK will be set aside in 2021, 55 MSEK in 2022, 70 MSEK in 2023, and 80 MSEK in 2024 for investment in MAX IV.

The primary target for the additional funding in 2021 and 2022 is to hire more permanent as well as temporary staff to support MAX IV users through the beamline science programmes. Specifically: (1) The floor coordinator function will be strengthened by several new positions with the aim of sufficient staffing to provide 24/7 on-call service to beamlines. (2) Technical support of the beamlines will be enhanced in several areas, especially for controls and software development. (3) The MAX IV in-house postdoctoral programme will be resumed. While training and career development are major thrusts of the postdoctoral programme, engagement with and support of MAX IV users on the beamlines are similarly important.

The operations budget for 2021, approved by the Board of MAX IV, is therefore based on an assumed additional grant of 50 MSEK for 2021 from VR. The total funding for 2021 amounts to 490 MSEK assuming funding from VR, Vinnova, E-mynd, Formas, Swedish universities, et al. MAX IV aims to consume the surplus from 2020 (agency capital) by planning a deficit of 20,5 MSEK in the budget for 2021.

Staff paid by operations funding in 2021 is budgeted to increase by 56 employees by year-end. To support the organisation and minimise delays within projects, consultancy costs will be significantly higher for the KITS group compared to previous years.

The accelerator project portfolio includes items required to maintain high reliability and performance of the MAX IV accelerators. For 2021, the largest investment items are spare parts of accelerator subsystems. 63% of the total investment goes to projects focusing on maintaining high accelerator reliability, 26% goes to projects aiming at maintain high stability of the photon beams and 11% goes to projects aiming at securing high performance. 68% of the investment goes to projects that will benefit the 3 GeV ring and 1.5 GeV ring beamlines, whereas 17% goes to projects that will benefit beamlines connected to the SPF, 15% goes to projects befitting all existing beamlines, and 1% benefits future beamlines.

Rent cost is assumed to remain stable through the period as the interest rate level remains close to zero (0% STIBOR 3M). As the number of staff is increasing, an estimated cost connected to office space is included in the budget. The variable cost of electricity is partially fixed (70%) throughout 2021.

An AFF-procurement for property management, maintenance services and related systems is planned for 2021 as the current agreement with the landlord expires in 2021. As MAX IV is responsible for all building related costs after the warranty periods have expired, a long-term maintenance plan has been established and is currently being updated to cover all relevant areas of the facility. A first allocation, similar to upkeep, of 2 MSEK is allocated in the budget to cover future needs for maintenance and exchanges of equipment related to the buildings and its infrastructures. The plan is to annually allocate a relevant amount based on the long-term maintenance plan mentioned above.

Allocation of funding towards beamline upkeep, which has been in effect for several years, will continue. MAX IV allocates 4% of its operations cost for this purpose. An example is the urgent

need at SoftiMAX to change the existing M2 mirrors experiencing water leaks. Other large cost items are the on-going projects within MAX IV Engineering for the gas system and the cryo-systems needed in the facility to run the beamlines.

Appendix 1. List of Abbreviations

APXPS	ambient pressure x-ray photoemission spectroscopy
ARPES	ngle resolved photoelectron spectroscopy
BAG	block allocation group
BAM	beam arrival monitor
CPO	Central Project Office
CTH	Chalmers University of Technology
DataSTaMP	data storage and management project
DDR	detailed design report
DESY	Deutsches Elektronen-Synchrotron
ESRF	European Synchrotron Radiation Facility
ESS	European Spallation Source
EuXFEL	European XFEL
E-mynd	Swedish Energy Agency
EXAFS	extended x-ray absorption fine structure
FEL	free electron laser
FOFB	fast orbit feedback system
GU	Gothenburg University
IGBT	insulated-gate bipolar transistor
ILL	Institut Laue Langevin
IRO	Industrial Relations Office
KAW	Knut and Alice Wallenberg Foundation
KI	Karolinska Institutet
KITS	Controls and IT group
KTH	KTH Royal Institute of Technology, Stockholm
KU	Karlstad University
LEAPS	League of European Accelerator-based Photon Sources
linac	linear accelerator
LINXS	Lund Institute of Advanced Neutron and X-ray Science
LiU	Linköping University
LnU	Linnæus University
LTP	long term financial plan
LTU	Luleå University of Technology
LU	Lund University
MIK	multipole injection kicker
MU	Malmö University
NLF	Northern Lights on Food
PAC	Programme Allocation Committee
RF	radio frequency
RISE	Research Institutes of Sweden
RIXS	resonant inelastic X-ray scattering
SAXS	small angle x-ray scattering
SIP	Strategic Innovation Programmes
SLU	Swedish University of Agricultural Sciences
SPELEEM	spectroscopic photoemission and low energy electron microscopy
SPF	Short Pulse Facility
SU	Stockholm University
SVS	Science Village Scandinavia
STM	scanning tunneling microscopy
SXL	soft x-ray laser
UmU	Umeå University
UU	Uppsala University
Vinnova	Swedish Governmental Agency for Innovation Systems
VR	Swedish Research Council
WAXS	wide angle x-ray scattering
XANES	X-ray absorption near edge structure
XMCD	X-ray magnetic circular dichroism
XPCS	X-ray photon correlation spectroscopy

Appendix 2. Beamline capabilities available to users

Beamline	Techniques	Energy	Capabilities available to users
Balder	XANES, EXAFS	2.4-40 keV	XANES and EXAFS in transmission, continuous scanning to 30 s/EXAFS XANES and EXAFS in fluorescence with 7 element SDD, continuous scanning to 30 s/EXAFS
BioMAX	MX at fixed energy, MAD, SAD	6-24 keV	Remote data collection Automated sample mounting and dismounting from UniPucks, 29 puck positions in dewar Beam focus of 20x5 µm, 50x50 µm or 100x100 µm and defining aperture of 5, 10, 20, 50 and 100 µm Element identification by X-ray fluorescence Fragment-based drug screening Serial crystallography using HVE-injector (high viscosity extrusion injector), fixed target scan using MD3
Bloch	ARPES	15-200 eV (10-1000 eV with less flux /resolution)	High-resolution ARPES with deflection based analyser or 6-axis manipulator Linear vertical or horizontal polarised light, with energy range 10-1000 eV (peak flux and resolution 15-200 eV) Online STM, 50K - 300K
CoSAXS	SAXS	12.4 keV (fixed energy)	SAXS, q-range 1×10-3 to 0.5 Å-1 Laser triggered, temperature jump time-resolved SAXS (2 ms time-resolution), q-range 1 x 10-3 to 0.5 Å-1 and ca. 1.5 to 2.3 Å-1 Solution and bio-SAXS, with pipetting autoloader from 96 well plates, flow-through quartz capillary, in-line HPLC
FinEstBeAMS	XPS, NEXAFS, Ion TOF, PEPICO/NIPICO, photoluminescence, UPS, ARPES	4.6-1300 eV	High-resolution photoelectron, TOF and coincidence spectroscopy of gaseous samples Time-resolved photoluminescence spectroscopy XPS, NEXAFS, UPS & ARPES of solid samples
FlexPES	PES, XAS or NEXAFS, Multi-coincidence	40-1500 eV	PES and NEXAFS on solid samples, NEXAFS in partial electron and partial fluorescence yield

			PES on low-density matter samples using liquid jet setup, molecular jet source, gas cell or magnetron-based source for metal particle beams COLTRIMS/multi-coincidence spectroscopy (in expert commissioning mode)
HIPPIE	APXPS	250-2200 eV	Catalysis cell: APXPS of solid-gas interfaces, up to 30 mbar, for catalysis and surface science experiments Liquid/electrochemistry cell: APXPS of solid-liquid (dip-and-pull setup) and gas-liquid (liquid jet setup) interfaces up to 30 mbar, for electrochemistry, energy, environmental, and atmospheric science Polarization modulated infrared reflection absorption spectrometer for detection of reaction intermediate species on surfaces simultaneously with APXPS in catalysis cell
MAXPEEM	SPELEEM	30-1500 eV	SPELEEM (micro-LEED, PED, micro-ARPES, XMCD)
NanoMAX	Scanning X-ray microscopy, coherent imaging	6-28 keV	Scanning X-ray diffraction and coherent imaging in Bragg geometry Forward-scatter ptychography and CDI XRF mapping in 2D
SPECIES	APXPS / RIXS	30-1500 eV	Standard cell: APXPS up to 20 mbar, for catalysis, redox studies, and surface science ALD cell: APXPS for in-situ and operando ALD experiments at pressures up to 20 mbar RIXS using GRACE spectrometer (emission energy range 50-650 eV, only linear polarization horizontally and vertically). Solid samples only. LN2-sample cooling available, 4-axis manipulator.
Veritas	RIXS	275-1500 eV	Mid-range performance RIXS, solid samples, LN2 cooled samples, linear polarization (horizontal and vertical), XAS (MCP and photodiode), sample scanning Veritas B (open port)

Appendix 3. Beamline scope completion and availability for users

Beamline	Functionality	% Complete	Available
Balder	Simple XANES, EXAFS	100%	Yes
	Cryostat	70%	Yes
	XES spectrometer	95%	Q3 2021
	XRD	20%	Q3 2022
BioMAX	MX Automated sample changing Remote data collection Fragment-based drug screening SAD and MAD	100%	Yes
Bloch	ARPES Linear vertical or horizontal polarisation STM	100%	Yes
	Spin-ARPES	90%	Q1 2021
CoSAXS	SAXS & bio-SAXS	100%	Yes
	WAXS, time resolved	5%	Q4 2021
	XPCS	0%	Q3 2022
DanMAX	PXRD, time resolved studies Low temperature studies In situ battery set up	90%	Q3 2021
	Imaging	5%	Q1 2022
FemtoMAX	Diffraction (10 Hz)	100%	Q1 2021
	Scattering	90%	Q3 2021
	EXAFS	20%	Q3 2021
FinEstBeAMS	LDM endstation GPES, PLES, SSES	95%	Yes
	Solid state endstation	100%	Q1 2021
FlexPES	Solid state endstation	100%	Yes
	LDM endstation	95%	Yes
	ICE endstation	95%	Q1 2022
ForMAX	SAXS	46%	Q4 2022
	Tomography	10%	Q4 2022
HIPPIE	APXPS PM-IRRAS Liquid/electrochemistry cell	100%	Yes
	Additional cells (new B branch project)	0%	Q4 2023
MAXPEEM	SPELEEM (micro-LEED, PED, micro-ARPES, XMCD)	100%	Yes
MicroMAX	MX	7%	Q4 2022

NanoMAX	KB station Scanning X-ray diffraction and coherent imaging in Bragg geometry Forward ptychography and CDI XRF mapping in 2D	100%	Yes
	FZP station	31%	Q4 2022
SoftiMAX	STXM Forward ptychography (basic) XMCD microscopy (basic) XRF mapping	95%	Q3 2021
	CXI (second branch)	0%	Q3 2023
SPECIES	APXPS	100%	Yes
	RIXS	76%	Q1 2021
Veritas	Open port	100%	Yes
	Spectrometer	95%	Q3 2021

Appendix 4. 2020 funding, costs and results

FUNDING SOURCE	Result 2020 (MSEK)	Budget 2020 (MSEK)	Diff (MSEK)
VR	310,0	310,0	
LU	59,5	55,5	4,0
Lunarc	-2,0	-2,0	
Swedish universities cash contribution	42,0	42,0	
Vinnova	15,0	15,0	
E-mynd	10,0	5,0	5,0
Formas	5,0	5,0	
LP3	-,5	-,5	
Academy of Finland	3,6	3,7	-,1
Vilnius University	,0	,6	-,6
Industrial beamtime and services	1,6	1,5	,1
Other income	5,4	4,2	1,2
TOTAL FUNDING	**449,7**	**440,1**	**9,6**

COST	Result 2020 (MSEK)	Budget 2020 (MSEK)	Diff (MSEK)
Staff	-183,1	-182,7	-,4
CPO	-4,7	-4,4	-,3
Accelerators (AFSG, RF, AccDev, Op)	-6,9	-8,1	1,1
Accelerator portfolio projects	-10,8	-15,0	4,1
Life science beamlines	-4,1	-7,0	2,9
Physical science beamlines	-5,4	-6,1	,7
Beamline office & insertion devices	-2,5	-4,2	1,7
KITS	-5,7	-6,0	,4
Engineering I & II	-20,4	-23,6	3,2
Safety	-7,9	-8,6	,8
Admin support (FIOS, HR, RC, Procur, Legal)	-6,2	-7,7	1,5
User Office, IRO, COM, HO	-1,0	-3,9	2,8
DanMAX	-3,9	-3,1	-,8
Rent	-72,2	-74,2	2
Electricity	-20,1	-24,0	3,9
Facility cost	-18,3	-18,6	,2
Ph 1 project (NLF funding gap)	-1,6	-1,6	
DM Ex contingency	-1,2	-3,3	2,1
Beamline upkeep cost	-,3	-,7	
Investments (excl. upkeep)	-10,4	-13,5	3,1
Decommissioning MAX IV	-1,0	-1,0	
Lund University overhead	-22,8	-22,8	
TOTAL COST	**-410,5**	**-440,0**	**29,5**

Result (Funding-Cost)	**39,2**	**,1**	**39,1**
MAX IV co-funding research grants	-6,1	-2,1	
Indirect cost research grants	5,2	3,9	
RESULT INCL EXTERNAL PROJECTS	**38,3**	**1,9**	**39,1**
Upkeep - allocations VR grant	-20,2	-20,2	
Upkeep - use of VR allocated grant	,3	,7	
Decrease in undepreciated funds	2,0	17,6	
TOTAL RESULT	**20,3**	**,0**	**20,3**

Appendix 5. 2020 publications

BEAMLINE(S)	AUTHORLIST	TITLE	JOURNAL	DOI
Balder	Persson Ingmar, Lundberg Daniel, Bajnoczi Eva G., Klementiev Konstantin, Just Justus, Clauss Kajsa G. V. Sigfridsson	EXAFS Study on the Coordination Chemistry of the Solvated Copper(II) Ion in a Series of Oxygen Donor Solvents	INORGANIC CHEMISTRY	10.1021/acs.inorgchem.0c00403
Balder	Simonarson Gunnar, Calcagno Giulio, Lotsari Antiope, Palmqvist Anders E. C.	Electrochemical and structural characterization of lithiation in spray deposited ordered mesoporous titania as an anode for Li ion batteries	RSC ADVANCES	10.1039/d0ra02687e
Balder	Rissler J, Klementiev K, Dahl J, Steenari BM, Edo M	Identification and Quantification of Chemical Forms of Cu and Zn in MSWI Ashes Using XANES	ENERGY & FUELS	10.1021/acs.energyfuels.0c02226
Balder	Magnuson M, Näslund L-Å	Local chemical bonding and structural properties in Ti3AlC2 MAX phase and Ti3C2Tx MXene probed by Ti 1s x-ray absorption spectroscopy	PHYSICAL REVIEW RESEARCH	10.1103/PhysRevResearch.2.033516
Balder, FinEstBeAMS	Kozlova Anna P., Kasimova Valentina M., Buzanov Oleg A., Chernenko Kirill, Klementiev Konstantin, Pankratov Vladimir	Luminescence and vacuum ultraviolet excitation spectroscopy of cerium doped Gd3Ga3Al2O12 single crystalline scintillators under synchrotron radiation excitations	RESULTS IN PHYSICS	10.1016/j.rinp.2020.103002
* BioMAX	Ernst HA, Mosbech C, Langkilde AE, Westh P, Meyer AS, Agger JW, Larsen S	The structural basis of fungal glucuronoyl esterase activity on natural substrates	NATURE COMMUNICATIONS	10.1038/s41467-020-14833-9
* BioMAX	Labourel Aurore, Frandsen Kristian E. H., Zhang Feng, Brouilly Nicolas, Grisel Sacha, Haon Mireille, Ciano Luisa, Ropartz David, Fanuel Mathieu, Martin Francis, Navarro David, Rosso Marie-Noelle, Tandrup Tobias, Bissaro Bastien, Johansen Katja S., Zerva Anastasia,	A fungal family of lytic polysaccharide monooxygenase-like copper proteins	NATURE CHEMICAL BIOLOGY	10.1038/s41589-019-0438-8

BEAMLINE(S)	AUTHORLIST	TITLE	JOURNAL	DOI
	Walton Paul H., Henrissat Bernard, Lo Leggio Leila, Berrin Jean-Guy			
* BioMAX	Lima GMA, Talibov VO, Jagudin E, Sele C, Nyblom M, Knecht W, Logan DT, Sjögren T, Mueller U	FragMAX: the fragment-screening platform at the MAX IV Laboratory	ACTA CRYSTALLOGRAPHICA SECTION D	10.1107/S205979832000889X
* BioMAX	Teze D, Shuoker , Chaberski K E, Kunstmann S, Fredslund F, Nielsen S T, Stender G P E, Peters H J G, Karlsson Nordberg E, Welner D H, Hachem Abou M	The Catalytic Acid-Base in GH109 Resides in a Conserved GGHGG Loop and Allows for Comparable alpha-Retaining and beta-Inverting Activity in an N-Acetylgalactosaminidase from Akkermansia muciniphila	ACS CATALYSIS	10.1021/acscatal.9b04474
* BioMAX	Vilstrup Joachim, Simonsen Amanda, Birkefeldt Thea, Strandbygard Dorthe, Lyngso Jeppe, Pedersen Jan Skov, Thirup Soren	Crystal and solution structures of fragments of the human leucocyte common antigen-related protein	ACTA CRYSTALLOGRAPHICA SECTION D	10.1107/S2059798320003885
BioMAX	Ursby T, Åhnberg K, Appio R, Aurelius O, Barczyk A, Bartalesi A, Bjelčić M, Bolmsten F, Cerenius Y, B Doak R, Eguiraun M, Eriksson T, J Friel R, Gorgisyan I, Gross A, Haghighat V, Hennies F, Jagudin E, Norsk Jensen B, Jeppsson T, Kloos M, Lidon-Simon J, M A de Lima G, Lizatovic R, Lundin M, Milan-Otero A, Milas M, Nan J, Nardella A, Rosborg A, Shilova A, L Shoeman R, Siewert F, Sondhauss P, O Talibov V, Tarawneh H, Thånell J, Thunnissen M, Unge J, Ward C, Gonzalez A,	BioMAX – the first macromolecular crystallography beamline at MAX IV Laboratory	J. SYNCHROTRON RADIATION	10.1107/S1600577520008723

BEAMLINE(S)	AUTHORLIST	TITLE	JOURNAL	DOI
	Mueller U			
BioMAX	Shilova A, Lebrette H, Aurelius O, Nan J, Welin M, Kovacic R, Ghosh S, Safari C, Friel RJ, Milas M, Matej Z, Hogbom M, Branden G, Kloos M, Shoeman RL, Doak B, Ursby T, Hakansson M, Logan DT, Mueller U	Current status and future opportunities for serial crystallography at MAX IV Laboratory	J. SYNCHROTRON RADIATION	10.1107/S1600577520008735
* BioMAX	Lima GMA, Talibov VO, Jagudin E, Sele C, Nyblom M, Knecht W, Logan DT, Sjögren T, Mueller U	FragMAX: the fragment-screening platform at the MAX IV Laboratory	ACTA CRYSTALLOGRAPHICA SECTION D	10.1107/S205979832000889X
BioMAX	Wollenhaupt Jan, Metz Alexander, Barthel Tatjana, Lima Gustavo M. A., Heine Andreas, Mueller Uwe, Klebe Gerhard, Weiss Manfred S.	F2X-Universal and F2X-Entry: Structurally Diverse Compound Libraries for Crystallographic Fragment Screening	STRUCTURE	10.1016/j.str.2020.04.019
BioMAX	Rogstam Annika, Nyblom Maria, Christensen Signe, Sele Celeste, Talibov Vladimir O., Lindvall Therese, Rasmussen Anna Andersson, Andre Ingemar, Fisher Zoe, Knecht Wolfgang, Kozielski Frank	Crystal Structure of Non-Structural Protein 10 from Severe Acute Respiratory Syndrome Coronavirus-2	INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES	10.3390/ijms21197375
* BioMAX	Schmitt Andreas, Hirt Helmut, Jarva Michael A., Sun Wei-Sheng, ter Beek Josy, Dunny Gary M., Berntsson Ronnie P-A	Enterococcal PrgA Extends Far Outside the Cell and Provides Surface Exclusion to Protect against Unwanted Conjugation	JOURNAL OF MOLECULAR BIOLOGY	10.1016/j.jmb.2020.08.018
* BioMAX	Starkholm Allan, Kloo Lars, Svensson Per H.	Implicit Tandem Organic-Inorganic Hybrid Perovskite Solar Cells Based on Internal Dye Sensitization: Robotized Screening, Synthesis, Device Implementation, and	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY	10.1021/jacs.0c06698

BEAMLINE(S)	AUTHORLIST	TITLE	JOURNAL	DOI
		Theoretical Insights		
BioMAX	Hansen Sabine, Hall Michael, Grundstrom Christin, Brannstrom Kristoffer, Sauer-Eriksson A. Elisabeth, Johansson Jorgen	A Novel Growth-Based Selection Strategy Identifies New Constitutively Active Variants of the Major Virulence Regulator PrfA in Listeria monocytogenes	JOURNAL OF BACTERIOLOGY	10.1128/JB.00115-20
*BioMAX	Rumnieks Janis, Lieknina Ilva, Kalnins Gints, Sisovs Mihails, Akopjana Inara, Bogans Janis, Tars Kaspars	Three-dimensional structure of 22 uncultured ssRNA bacteriophages: Flexibility of the coat protein fold and variations in particle shapes	SCIENCE ADVANCES	10.1126/sciadv.abc0023
BioMAX	Remeeva Alina, Nazarenko Vera V., Goncharov Ivan M., Yudenko Anna, Smolentseva Anastasia, Semenov Oleg, Kovalev Kirill, Guelbahar Cansu, Schwaneberg Ulrich, Davari Mehdi D., Gordeliy Valentin, Gushchin Ivan	Effects of Proline Substitutions on the Thermostable LOV Domain from Chloroflexus aggregans	CRYSTALS	10.3390/cryst10040256
BioMAX	Ásgeirsson B, Markússon S, Hlynsdóttir SS, Helland R, Hjörleifsson JG	X-ray crystal structure of Vibrio alkaline phosphatase with the non-competitive inhibitor cyclohexylamine	BIOCHEMISTRY AND BIOPHYSICS REPORTS	10.1016/j.bbrep.2020.100830
BioMAX	Vella P, Rudraraju R, Lundback T, Axelsson H, Almqvist H, Vallin M, Schneider G, Schnell R	A FabG inhibitor targeting an allosteric binding site inhibits several orthologs from Gram-negative ESKAPE pathogens.	BIOORGANIC & MEDICINAL CHEMISTRY	
BioMAX	Hammerstad M, Gudim I, Hersleth HP	The Crystal Structures of Bacillithiol Disulfide Reductase Bdr (YpdA) Provide Structural and Functional Insight into a New Type of FAD-Containing NADPH-Dependent Oxidoreductase.	BIOCHEMISTRY	10.1021/acs.biochem.0c00745
BioMAX	Brangulis Kalvis, Akopjana Inara,	Structural analysis of the outer surface	JOURNAL OF STRUCTURAL	0.1016/j.jsb.2020.107490

BEAMLINE(S)	AUTHORLIST	TITLE	JOURNAL	DOI
	Petrovskis Ivars, Kazaks Andris, Tars Kaspars	proteins from Borrelia burgdorferi paralogous gene family 54 that are thought to be the key players in the pathogenesis of Lyme disease	BIOLOGY	
* BioMAX	Wang Huabing, Logan Derek T., Danielsson Jens, Oliveberg Mikael	Exposing the distinctive modular behavior of beta-strands and alpha-helices in folded proteins	PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA	10.1073/pnas.1920455117
* Bloch	Shah J, Wang W, Sohail H, Uhrberg R	Experimental evidence of monolayer arsenene: an exotic 2D semiconducting material	2D MATERIALS	10.1088/2053-1583/ab64fb
Bloch	Yang X, Cochran TA, Chapai R, Tristant D, Yin JX, Belopolski I, Cheng Z, Multer D, Zhang SS, Shumiya N, Litskevich M, Jiang Y, Chang G, Zhang Q, Vekhter I, Shelton WA, Jin R, Xu SY, Hasan MZ	Observation of sixfold degenerate fermions in PdSb2	PHYSICAL REVIEW B	10.1103/PhysRevB.101.201105
* Bloch	Igor Marković, Matthew D. Watson, Oliver J. Clark, Federico Mazzola, Edgar Abarca Morales, Chris A. Hooley, Helge Rosner, Craig M. Polley, Thiagarajan Balasubramanian , Saumya Mukherjee, Naoki Kikugawa, Dmitry A. Sokolov, Andrew P. Mackenzie, and Phil D. C. King	Electronically driven spin-reorientation transition of the correlated polar metal Ca3Ru2O7	PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES	10.1073/pnas.2003671117
Bloch	D. A. Chareev, P. Evstigneeva, D. Phuyal, G.J. Man, H. Rensmo, A.N. Vasiliev, M. Abdel-Hafiez	Growth of Transition Metal Dichalcogenides by Solvent Evaporation Technique	CRYSTAL GROWTH & DESIGN	10.1021/acs.cgd.0c00980
Bloch	Tian, S., Gao, S., Nie, S., Qian, Y., Gong, C., Fu, Y., Li, H., Fan, W., Zhang, P., Kondo, T., Shin, S., Adell, J., Fedderwitz, H., Ding, H., Wang,	Magnetic topological insulator MnBi6Te10 with a zero-field ferromagnetic state and gapped Dirac surface states	PHYSICAL REVIEW B	10.1103/PhysRevB.102.035144

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	Z., Qian, T. & Lei, H.			
Bloch	Chareev Dmitriy A., Evstigneeva Polina, Phuyal Dibya, Man Gabriel J., Rensmo Hakan, Vasiliev Alexander N., Abdel-Hafiez Mahmoud	Growth of Transition-Metal Dichalcogenides by Solvent Evaporation Technique	CRYSTAL GROWTH & DESIGN	10.1021/acs.cgd.0c00980
* Bloch, MAXPEEM	Karakachian Hrag, Nguyen T. T. Nhung, Aprojanz Johannes, Zakharov Alexei A., Yakimova Rositsa, Rosenzweig Philipp, Polley Craig M., Balasubramanian Thiagarajan, Tegenkamp Christoph, Power Stephen R., Starke Ulrich	One-dimensional confinement and width-dependent bandgap formation in epitaxial graphene nanoribbons	NATURE COMMUNICATIONS	10.1038/s41467-020-19051-x
Bloch, FinEstBeAMS, HIPPIE, SPECIES, SoftiMAX, Veritas	Sjöblom P, Todorescu G, Urpelainen S	Understanding the mechanical limitations of the performance of soft X-ray monochromators at MAX IV laboratory	J SYNCHROTRON RADIATION	10.1107/S1600577520000843
BLOCH I311-PEEM MAXPEEM STM-Laboratory	Shi Yuchen, Zakharov Alexei A., Ivanov Ivan G., Vinogradov Nikolay A., Yazdi G. Reza, Syvajarvi Mikael, Yakimova Rositsa, Sun Jianwu	A patterning-free approach for growth of free-standing graphene nanoribbons using step-bunched facets of off-oriented 4H-SiC(0001) epilayers	JOURNAL OF PHYSICS D-APPLIED PHYSICS	10.1088/1361-6463/ab6149
* FemtoMAX	Wang Xiaocui, Ekstrom J. C., Bengtsson A. U. J., Jarnac A., Jurgilaitis A., Van-Thai Pham, Kroon D., Enquist H., Larsson J.	Role of Thermal Equilibrium Dynamics in Atomic Motion during Nonthermal Laser-Induced Melting	PHYSICAL REVIEW LETTERS	10.1103/PhysRevLett.124.105701
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FemtoMAX, FinEstBeAMS	Kamenskikh I, Tishchenko E, Kirm M, Omelkov S, Belsky A, Vasil'ev A	Decay Kinetics of CeF3 under VUV and X-ray Synchrotron Radiation	SYMMETRY	10.3390/sym12060914
FinEstBeAMS	Dendebera M., Chornodolskyy Ya, Gamernyk R., Antonyak O., Pashuk I., Myagkota S., Gnilitskyi I., Pankratov V., Vistovskyy V., Mykhaylyk V., Grinberg M., Voloshinovskii A.	Time resolved luminescence spectroscopy of CsPbBr 3 single crystal	JOURNAL OF LUMINESCENCE	10.1016/j.jlumin.2020.117346
FinEstBeAMS	Pankratova Viktorija, Purans Juris, Pankratov Vladimir	Low-temperature luminescence of ScF3 single crystals under excitation by VUV synchrotron radiation	LOW TEMPERATURE PHYSICS	10.1063/10.0002473
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FinEstBeAMS	Pankratov Vladimir, Kotlov Aleksei	Luminescence spectroscopy under synchrotron radiation: From SUPERLUMI to FINESTLUMI	NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS	10.1016/j.nimb.2020.04.015
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FinEstBeAMS	Abid Abdul Rahman, Pelimanni Eetu, Reinhardt Maximilian, Boudjemia Nacer, Kivimaki Antti, Huttula Marko, Bjorneholm Olle, Patanen Minna	Electron-ion coincidence spectroscopy of a large organic molecule: photofragmentation of avobenzone after valence and core ionisation	JOURNAL OF PHYSICS B-ATOMIC MOLECULAR AND OPTICAL PHYSICS	10.1088/1361-6455/abc228
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FinEstBeAMS	Shalaev A, Shendrik R, Rusakov A, Bogdanov A, Pankratovs V, Chernenko K, Myasnikova A	Luminescence of divalent lanthanide doped BaBrI single crystal under synchrotron radiation excitations	NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS	10.1016/j.nimb.2020.01.023
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FlexPES	Marcel J. S. Abb, Tim Weber, Daniel Langsdorf, Volkmar Koller, Sabrina M. Gericke, Sebastian Pfaff, Michael Busch, Johan Zetterberg, Alexei	Thermal Stability of Single-Crystalline IrO2(110) Layers: Spectroscopic and Adsorption Studies	J. PHYS. CHEM. C	10.1021/acs.jpcc.0c04373

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HIPPIE	Hohner Chantal, Kettner Miroslav, Stumm Corinna, Blaumeiser Dominik, Wittkaemper Haiko, Grabau Mathias, Schwarz Matthias, Schuschke Christian, Lykhach Yaroslava, Papp Christian, Steinrueck Hans-Peter, Libuda Jorg	Pt-Ga Model SCALMS on Modified HOPG: Thermal Behavior and Stability in UHV and under Near-Ambient Conditions	JOURNAL OF PHYSICAL CHEMISTRY C	10.1021/acs.jpcc.9b10944
* HIPPIE	Weststrate CJ, Sharma D, Garcia Rodriguez D, Gleeson MA, Fredriksson HOA, Niemantsverdriet JW	Mechanistic insight into Carbon-Carbon bond formation on Cobalt under simulated Fischer-Tropsch Synthesis conditions	NATURE COMMUNICATIONS	10.1038/s41467-020-14613-5
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MAXPEEM	Kim Kyung Ho, He Hans, Rodner Marius, Yakimova Rositsa, Larsson Karin, Piantek Marten, Serrate David, Zakharov Alexei, Kubatkin Sergey, Eriksson Jens, Lara-Avila Samuel	Chemical Sensing with Atomically Thin Platinum Templated by a 2D Insulator	ADVANCED MATERIALS INTERFACES	10.1002/admi.201902104
* MAXPEEM	Li Hao, Shi Yuchen, Shang Huan, Wang Weimin, Lu Jun, Zakharov Alexei A., Hultman Lars, Uhrberg Roger I. G., Syvaejaervi Mikael, Yakimova Rositsa, Zhang Lizhi, Sun Jianwu	Atomic-Scale Tuning of Graphene/Cubic SiC Schottky Junction for Stable Low-Bias Photoelectrochemical Solar-to-Fuel Conversion	ACS NANO	10.1021/acsnano.0c00986

BEAMLINE(S)	AUTHORLIST	TITLE	JOURNAL	DOI
MAXPEEM	Shi Yuchen, Zakharov Alexei A., Ivanov Ivan G., Vinogradov Nikolay A., Yazdi G. Reza, Syvajarvi Mikael, Yakimova Rositsa, Sun Jianwu	A patterning-free approach for growth of free-standing graphene nanoribbons using step-bunched facets of off-oriented 4H-SiC(0001) epilayers	JOURNAL OF PHYSICS D-APPLIED PHYSICS	10.1088/1361-6463/ab6149
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* MAXPEEM	Aprojanz J., Rosenzweig Ph, Nguyen T. T. Nhung, Karakachian H., Kuester K., Starke U., Lukosius M., Lippert G., Sinterhauf A., Wenderoth M., Zakharov A. A., Tegenkamp C.	High-Mobility Epitaxial Graphene on Ge/Si(100) Substrates	ACS APPLIED MATERIALS & INTERFACES	10.1021/acsami.0c10725
* MAXPEEM	Pakdehi Davood Momeni, Schaedlich Philip, Thi Thuy Nhung Nguyen, Zakharov Alexei A., Wundrack Stefan, Najafidehaghani Emad, Speck Florian, Pierz Klaus, Seyller Thomas, Tegenkamp Christoph, Schumacher Hans Werner	Silicon Carbide Stacking-Order-Induced Doping Variation in Epitaxial Graphene	ADVANCED FUNCTIONAL MATERIALS	10.1002/adfm.202004695
* MAXPEEM	Karakachian Hrag, Nguyen T. T. Nhung, Aprojanz Johannes, Zakharov Alexei A., Yakimova Rositsa, Rosenzweig Philipp, Polley Craig M., Balasubramanian Thiagarajan, Tegenkamp Christoph, Power Stephen R.,	One-dimensional confinement and width-dependent bandgap formation in epitaxial graphene nanoribbons	NATURE COMMUNICATIONS	10.1038/s41467-020-19051-x

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	Starke Ulrich			
* MAXPEEM I3 I311-PEEM I4	Forti S, Link S, Stöhr A, Niu Y, Zakharov AA, Coletti C, Starke U	Semiconductor to metal transition in two dimensional gold and its van der Waals heterostack with graphene	NATURE COMMUNICATIONS	10.1038/s41467-020-15683-1
MAXPEEM I311-XPS	Kim Kyung Ho, He Hans, Struzzi Claudia, Zakharov Alexei, Giusca Cristina E., Tzalenchuk Alexander, Park Yung Woo, Yakimova Rositsa, Kubatkin Sergey, Lara-Avila Samuel	Ambipolar charge transport in quasi-free-standing monolayer graphene on SiC obtained by gold intercalation	PHYSICAL REVIEW B	10.1103/PhysRevB.102.165403
NanoMAX	Akan Rabia, Frisk Thomas, Lundberg Fabian, Ohlin Hanna, Johansson Ulf, Li Kenan, Sakdinawat Anne, Vogt Ulrich	Metal-Assisted Chemical Etching and Electroless Deposition for Fabrication of Hard X-ray Pd/Si Zone Plates	MICROMACHINES	10.3390/mi11030301
NanoMAX	Björling A, Kalbfleisch S, Kahnt M, Sala S, Parfeniukas K, Vogt U, Carbone D, Johansson U	Ptychographic characterization of a coherent nanofocused X-ray beam	OPTICS EXPRESS	10.1364/OE.386068
* NanoMAX	Hammarberg S, Dagytė V, Chayanun L, Hill MO, Wyke A, Bjorling A, Johansson U, Kalbfleisch S, Heurlin M, Lauhon LJ, Borgström MT, Wallentin J	High resolution strain mapping of a single axially heterostructured nanowire using scanning X-ray diffraction	NANO RESEARCH	10.1007/s12274-020-2878-6
NanoMAX	Ji Cheng, Li Bing, Liu Wenjun, Smith Jesse S., Bjorling Alexander, Majumdar Arnab, Luo Wei, Ahuja Rajeev, Shu Jinfu, Wang Junyue, Sinogeikin Stanislav, Meng Yue, Prakapenka Vitali B., Greenberg Eran, Xu Ruqing, Huang Xianrong, Ding Yang, Soldatov Alexander, Yang Wenge, Shen	Crystallography of low Z material at ultrahigh pressure: Case study on solid hydrogen	MATTER AND RADIATION AT EXTREMES	10.1063/5.0003288

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* NanoMAX	Björling A, Marcal L, Solla-Gullon J, Wallentin J, Carbone G, Maia F	Three-Dimensional Coherent Bragg Imaging of Rotating Nanoparticles	PHYSICAL REVIEW LETTERS	10.1103/PhysRevLett.125.246101
NanoMAX	Kahnt Maik, Sala Simone, Johansson Ulf, Bjorling Alexander, Jiang Zhimin, Kalbfleisch Sebastian, Lenrick Filip, Pikul James H., Thanell Karina	First ptychographic X-ray computed tomography experiment on the NanoMAX beamline.	JOURNAL OF APPLIED CRYSTALLOGRAPHY	10.1107/S160057672001211X
* NanoMAX	Chayanun Lert, Hrachowina Lukas, Bjorling Alexander, Borgstrom Magnus T., Wallentin Jesper	Direct Three-Dimensional Imaging of an X-ray Nanofocus Using a Single 60 nm Diameter Nanowire Device	NANO LETTERS	10.1021/acs.nanolett.0c03477
* NanoMAX	Marcal L, Oksenberg E, Dzhigaev D, Hammarberg S, Rothman A, Björling A, Unger E, Mikkelsen A, Joselevich E, Wallentin J	In Situ Imaging of Ferroelastic Domain Dynamics in CsPbBr3 Perovskite Nanowires by Nanofocused Scanning X-ray Diffraction	ACS NANO	10.1021/acsnano.0c07426
* NanoMAX	Silva Barreto Isabella, Le Cann Sophie, Ahmed Saima, Sotiriou Vivien, Turunen Mikael J., Johansson Ulf, Rodriguez-Fernandez Angel, Grunewald Tilman A., Liebi Marianne, Nowlan Niamh C., Isaksson Hanna	Multiscale Characterization of Embryonic Long Bone Mineralization in Mice	ADVANCED SCIENCE	10.1002/advs.202002524
* NanoMAX	Dzhigaev D, Svensson J, Krishnaraja A, Zhu Z, Ren Z, Liu Y, Kalbfleisch S, Björling A, Lenrick F, Balogh ZI, Hammarberg S, Wallentin J, Timm R,	Strain mapping inside an individual processed vertical nanowire transistor using scanning X-ray nanodiffraction	NANOSCALE	10.1039/D0NR02260H

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Veritas, HIPPIE, SoftiMAX, FinEstBeAMS, MAXPEEM, Bloch and FlexPES	Agaker, M., Mueller, F., Norsk Jensen, B., Ahnberg, K., Sjoblom, P., Deiwiks, J., Henniger, H., Parna, R., Knudsen, J., Thiagarajan, B. & Sathe, C.	A five-axis parallel kinematic mirror unit for soft X-ray beamlines at MAX IV	J SYNCHROTRON RADIATION	10.1107/S160057751901693X
Accelerator	Jonas Björklund Svensson, Tessa K. Charles, Olle Lundh, and Sara Thorin	Third-order double-achromat bunch compressors for broadband beams	PHYS REV ACCEL BEAMS	10.1103/PhysRevAccelBeams.22.104401
Accelerator	F. J. Cullinan, Å. Andersson, and P. F. Tavares	Harmonic-cavity stabilization of longitudinal coupled-bunch instabilities with a nonuniform fill	PHYS REV ACCEL BEAMS	10.1103/PhysRevAccelBeams.23.074402
Accelerator	Olsson DK, Andersson Å, Sjöström M	Nonlinear optics from off-energy closed orbits	PHYSICAL REVIEW ACCELERATORS AND BEAMS	10.1103/PhysRevAccelBeams.23.102803
Accelerator	Aleksandre P, Fekih RBE, Letresor A, Thoraud S, Castro J, Bouvet F, Breunlin J, Andersson Å, Tavares PF	Transparent top-up injection into a fourth-generation storage ring	NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT	10.1016/j.nima.2020.164739
Accelerator	Williams Peter H., Perez-Segurana Gustavo, Bailey Ian R., Thorin Sara, Kyle Bill, Svensson Jonas Bjorklund	Arclike variable bunch compressors	PHYSICAL REVIEW ACCELERATORS AND BEAMS	0.1103/PhysRevAccelBeams.23.100701
BL73	Andersen J., Larsen R. Wugt, Ceponkus J., Uvdal P., Nelander B.	Far-Infrared Investigation of the Benzene-Water Complex: The Identification of Large-Amplitude Motion and Tunneling Pathways	JOURNAL OF PHYSICAL CHEMISTRY A	10.1021/acs.jpca.9b01497
I1011	Magnuson Martin, Mattesini Maurizio	Magnetic anisotropy in Cr2GeC investigated by X-ray magnetic circular dichroism and ab initio calculations	JOURNAL OF MAGNETISM AND MAGNETIC MATERIALS	10.1016/j.jmmm.2020.166470

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* I311-XPS	Garcia-Martinez Fernando, Garcia-Fernandez Carlos, Simonovis Juan Pablo, Hunt Adrian, Walter Andrew, Waluyo Iradwikanari, Bertram Florian, Merte Lindsay R., Shipilin Mikhail, Pfaff Sebastian, Blomberg Sara, Zetterberg Johan, Gustafson Johan, Lundgren Edvin, Sanchez-Portal Daniel, Schiller Frederik, Enrique Ortega J.	Catalytic Oxidation of CO on a Curved Pt(111) Surface: Simultaneous Ignition at All Facets through a Transient CO-O Complex	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION	10.1002/anie.202007195
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I311-XPS	Emanuelsson C., Johansson L. S. O., Zhang H. M.	Photoelectron spectroscopy studies of PTCDI on Sn/Si(111)-2 root 3 x 2 root 3	CHEMICAL PHYSICS	10.1016/j.chemphys.2020.110973
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* I4	J. Shah, H. M. Sohail, R. I. G. Uhrberg, and W. Wang	Two-Dimensional Binary Honeycomb Layer Formed by Ag and Te on Ag(111)	THE JOURNAL OF PHYSICAL CHEMISTRY LETTERS	10.1021/acs.jpclett.0c00123
I411	Sankari Anna, Strahlman Christian, Sankari Rami, Partanen Leena, Laksman Joakim, Kettunen J. Antti, Galvan Ignacio Fdez., Lindh Roland,	Non-radiative decay and fragmentation in water molecules after 1a(1)(-1)4a(1) excitation and core ionization studied by electron-energy-resolved electron-ion coincidence	JOURNAL OF CHEMICAL PHYSICS	10.1063/1.5141414

BEAMLINE(S)	AUTHORLIST	TITLE	JOURNAL	DOI
	Malmqvist Per-Ake, Sorensen Stacey L.	spectroscopy		
I511-3	Magnuson M, Olovsson W, Ghafoor N, Odén M, Hultman L	Interface bonding of Zr1−xAlxN nanocomposites investigated by x-ray spectroscopies and first principles calculations	PHYSICAL REVIEW RESEARCH	10.1103/PhysRevResearch.2.013328
* I811	Tiberg C, Sjöstedt C, Eriksson AK, Klysubun W, Gustafsson JP	Phosphate competition with arsenate on poorly crystalline iron and aluminum (hydr)oxide mixtures	CHEMOSPHERE	10.1016/j.chemosphere.2020.126937
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I911-4	Johansson Eva, Nielsen Anders D., Demuth Helle, Wiberg Charlotte, Schjodt Christine B., Huang Tao, Chen Jianhe, Jensen Sanne, Petersen Jorgen, Thygesen Peter	Identification of Binding Sites on Human Serum Albumin for Somapacitan, a Long-Acting Growth Hormone Derivative	BIOCHEMISTRY	10.1021/acs.biochem.0c00019
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