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**Regarding:** Proposals by MAX IV Laboratory to be submitted in the VR infrastructure initiative in fall 2015

Dear Almut and Stacey,

Below please find initiatives by MAX IV Laboratory suggested for the upcoming Needs Inventory on research infrastructure by Vetenskapsrådet. All of these have extensively been discussed with the scientific community, the MAX IV University Reference Group (URG), our Scientific Advisory Committee (SAC), and the MAX IV Laboratory board.

We would appreciate the support by Lund University and the Natural Science Faculty in bringing them onto the VR-RFI Needs Inventory.

Yours sincerely

A handwritten signature in black ink, appearing to read "Christoph Quitmann", with a long horizontal flourish extending to the right.

Christoph Quitmann, Director

Copy: Hans Hertz (Chair of the board MAX IV Laboratory)  
J. Andersen, T. Lundqvist, M. Eriksson, P. Andersen (Directors MAX IV Laboratory)  
Sverker Werin (Prefekt MAX N-fak)  
Per Johnsson (Chair Steering Committee for Swedish FEL Science)

## **Proposals by MAX IV Laboratory to be submitted in the VR-RFI Needs Inventory in fall 2015.**

### **1) MicroMAX (Contact: Tomas Lundqvist)**

MicroMAX will be a world-leading beamline for the most challenging questions in structural biology. Making use of the extreme brightness of the MAX IV 3GeV ring it will provide x-rays for diffraction experiments on crystals of 1 micron diameter and below. This will open a window of opportunity for solving macromolecular structures like those of membrane proteins, which cannot be crystallized in larger volumes.

MicroMAX has been highly prioritized by the Swedish Molecular Crystallography user community since 2010. It has the full support of the University Reference Group (URG) and was put as the top priority by the Scientific Advisory Committee (SAC) in Dec 2013. At present MAX IV is working on securing the funding for MicroMAX via a private foundation. Together with MedMAX, cryo electron- and x-ray microscopy it would be part of the MAX IV LIFE cluster for life science from the atomic to the anatomic scale.

### **2) MedMAX (Contact: Tomas Lundqvist)**

MedMAX will be a unique beamline for bio-medical research allowing to image cells, organs and small animals in vivo. It is an initiative in collaboration with clinicians and researchers in the medical faculties. Using the brightness and coherence of the MAX IV synchrotron will allow imaging medically relevant samples with unprecedented detail and with much reduced radiation damage (phase contrast) making longitudinal studies possible.

MedMAX has the full support of the University Reference Group (URG) and was put as the second highest priority by the Scientific Advisory Committee (SAC) in Dec 2013. At present MAX IV is working on securing the funding for MedMAX via a private foundation. Together with MicroMAX, cryo electron- and x-ray microscopy it would be part of the MAX IV LIFE cluster for life science from the atomic to the anatomic scale.

### **3) DiffMAX (Contact: Jesper Andersen)**

DiffMAX is a flexible beamline offering diffraction and scattering methods for advanced materials science studies. The extreme brightness of the MAX IV x-rays allows to create a world-leading beamline for powder diffraction, grazing incidence diffraction and scattering, reflectometry, and small molecule diffraction etc. Strong attention will be given to creating a flexible sample environment that allow for variation of temperature, pressure, chemical surroundings in order to facilitate *in-situ* and *in-operando* studies of materials synthesis, film formation, catalysis, surfaces and interfaces, electrochemical cells and batteries, etc. DiffMAX has clear synergy potential for future neutron diffraction and scattering at ESS and could help building up the community already today.

DiffMAX has the full support of the University Reference Group (URG) and in a discussion at the April 29 2015 URG meeting was mentioned again as a clear must for MAX IV and the Swedish community. It was endorsed by the Scientific Advisory Committee (SAC) in Dec 2013.

#### **4) iMAX (Contact: Jesper Andersen)**

iMAX will allow full-field imaging experiment emphasizing multi-modal (absorption, diffraction, phase contrasts), multi-scale (nano-to-mm-scale) of the internal 3D structures of bulk objects. iMAX will explicitly enable extending such capabilities to 4D (time-resolved 3D) allowing to study structural evolution during in-situ/operando experiments. This will allow direct observation and quantification of material responses to external and internal loads, e.g., during mechanical, thermal, hydrological, or chemical loading.

iMAX has the full support of the University Reference Group (URG) and was endorsed by the Scientific Advisory Committee (SAC) in Dec 2013.

#### **5) ForMAX (Contact: Tomas Lundqvist)**

ForMAX is an joint initiative by the Wallenberg Wood Science Centers (WWSC) at KTH and Chalmers, with the Swedish and Finnish forest & paper industry. It shall allow investigation of the raw materials (wood), the processing (pulp), and the final products (paper and laminates). Part of the ForMAX concept is an education program for scientists in academia and industry. The Knut och Alice Wallenberg Stiftelse has promised to fund 25% of investment & 10 years operation (ca. 220-250 MSEK), if industry and the public sector fund the rest.

ForMAX has been discussed with the URG and will be brought up to the SAC in Dec 2015.

#### **6) Endstations at beamlines, sample environments, and cross-beamline laboratory facilities at MAX IV (Contact: Jesper Andersen/Tomas Lundqvist)**

The MAX IV – Phase I investment is secured and will be available to users 2016. The capabilities the funded beamlines can be significantly improved and extended to new user communities by moderate investments (10-30 MSEK) into additional endstations and sample environment. Cross-beamline laboratory facilities for e.g. advanced preparation of samples are critical for expanding support to new scientific areas and user communities and to meet the needs by a now 14 funded beamlines.

What exactly to fund will be decided after close collaboration with users, the University Reference Group (URG), and the Scientific Advisory Committee (SAC). But a starting point will be the items removed from the original KAW application due to financial constraints.

#### **7) Swedish strategy for XFEL science and facilities (Contact: Per Johnsson)**

Sweden has a large and successful community exploiting existing FELs and contributing to their advancement. A Steering Committee for Swedish FEL Science (chair: Per Johnsson) coordinates the



community. New FEL's are being built around the world (European-XFEL: 2017, SwissFEL: 2017, Pohang FEL: 2018, LCLS II: 2019). In addition the MAX IV design allows for expansion to an FEL.

This makes it necessary to take a coordinated approach to FEL science, instrumentation and facilities. We suggest a planning grant to analyse the science done and planned in Sweden, the capacity and development on the international scene, in particular the Swedish co-funded European-XFEL, and the capabilities of a potential XFEL at MAX IV. This proposal is an extension of a planning grant proposal for an XFEL@MAX submitted to KAW, for which 50% of the requested 19.7 MSEK was promised.