Facility Update

13 December 2015 MAX-lab closed down celebrating 30 years of Swedish synchrotron radiation based research. We thank all users and staff for good times and wish you welcome to MAX IV which we inaugurate 21 June 2016. The brightest day of the year for the brightest synchrotron light source in the world.

Accelerators

The first turn of electrons around the ring was achieved on 25 August, without exciting any ring orbit correctors, confirming good alignment of the storage ring magnets and the soundness of the magnet block concept pioneered by MAX IV. First stored beam was achieved 15 September, by 22 October stored current in the ring reached 20 mA, and first light was detected on a diagnostic beamline 2 November. Shortly before Christmas shutdown we are routinely running with 40 mA in top-up mode. BPM offsets have been calibrated with beam-based measurements and first attempts at correcting the linear optics using LOCO have been made. The integer tunes were correct from the beginning, fractional tunes required corrections on the 0.1 level. The slow orbit feedback has been tested and run for some periods of time, otherwise the orbit is corrected manually. Injection into the storage ring presently occurs at 2 Hz using a single dipole kicker according to design. Trains of bunches (300 pC, 15 mm mrad normalized rms emittance, 0.6% fwhm energy spread) are injected into 10 consecutive ring buckets. Capture efficiency during stacking up to 76% has been observed. Since we are so far operating only two of our six main RF cavities (100 MHz), the accelerating voltage is low (~515 kV) which gives only 1.7% RF acceptance and hence limited Touschek lifetime. I*tau has increased with integrated dose and is now ~100 mAh. The next tasks are to further increase the stored current, tune in our passive harmonic cavities (300 MHz), continue with linear optics corrections, and perform an impedance characterization of the storage ring before the first in-vacuum undulator is installed early 2016.

Beamlines

The front ends for five beamlines at the 3 GeV ring are ready for commissioning. Installation of beamline infrastructure and optics for six more beamlines is ongoing. The aim is to have five or six beamlines ready for first experiments by the end of 2016, two more by early 2017 and six more until end of 2018. For the immediate future MAX IV is now working on expand it's beamline portfolio by a micro-focus protein crystallography beamline (MicroMAX), a io-medial imaging beamline (MedMAX), a beamline for bulk and surface diffraction (DiffMAX), and one for imaging of hard materials (iMAX). In parallel discussions with industry from the forestry and paper sector are quite advanced, which shall result in a dedicated industrial beamline (ForMAX) as well as supporting activities for training of industrial staff.

FemtoMAX beamline at the SPF has a first experimental setup ready to take light from a temporary undulator. First X-rays have been observed in the optics hutch early November 2015. The final 10 meters of in-vacuum undulators will be installed in 2016. Due to the emergence of X-ray sources with high peak brilliance, the field of pico-second X-ray diffraction has developed rapidly over the last few years. The key technology behind future breakthroughs in this area is the generation and detection of very short and very intense X-ray pulses. The femtosecond X-ray beamline at the MAX IV short-pulse facility (SPF) will have pulse lengths on the time scale of molecular vibrations (100 fs) at wavelengths matching inter-atomic distances (Å). The FemtoMAX will, also in an international perspective, become a core facility for ultrafast X-ray experiments in physics, chemistry and biology.

NanoMAX is the hard X-ray nanoprobe beamline of MAX IV. It will fully utilize the remarkably high brilliance from the 3 GeV ring to provide focal spot sizes in the 10 – 200 nm range. Two experimental stations are planned: a ZP-based microscope optimized for the best spatial resolution and a diffractometer combined with KB optics for versatile experimental conditions where users sample environments can be accommodated. Available experimental techniques will include scanning X-ray diffraction and imaging based on absorption, phase contrast, X-ray fluorescence and coherent X-rays scattering. The KB-based microscope will be the first to be installed during 2016. The in-vacuum undulator is ready for installation and the beamline optics is ready for commissioning with X-rays in April 2016.

BioMAX is the first beamline at MAX IV dedicated to macromolecular crystallography. The beamline is designed to be a stable and reliable micro-focus beamline offering excellent facilities for most of the demands of the structural biology community. Thanks to the excellent properties of the source the beamline will offer high flux in the wavelength range 0.5 – 2.5 Å with beam divergence of 0.1 x 0.1 $mrad^2$ and beam size down to 20 x 5 μm^2. The in-vacuum undulator has been delivered and will be installed in the 3 GeV ring early 2016. The front-end and optics hutch equipment is installed and under vacuum and will be ready for commissioning with X-rays starting March 2016. The installation of the experiment setup will start in February 2016 in order to be ready for first test experiments in June 2016.

MAX IV