

Beamline Jockey Days - Challenges in Imaging



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The ANATOMIX beamline at SOLEIL

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ANATOMIX is a beamline for full-field X-ray radiography and tomography currently entering operation at Synchrotron SOLEIL. It uses an undulator as its source and can operate both in monochromatic and white-beam mode. The range of accessible photon energies starts at around 5 keV and goes up to roughly 25 keV with a monochromator and 50 keV or higher with a white beam.

A parallel-beam microtomography station has been open to users for several months; the beam size at the sample position for this modality can be varied between a few mm in each dimension and an extra-wide beam with roughly 40 mm width and 15 mm height. Without X-ray optics, the beam size at sample is around 20 mm (H) × 15 mm (V).

To cover this wide range of beam sizes, several detector optics have been developed in-house at SOLEIL. They are all based on the conventional concept of indirect detection with a single-crystal scintillator, lens optics and a CMOS or CCD sensor.

The scintillators are predominantly LuAG:Ce supplied by Crytur (Turnov, CZ), from which we also bought some YAG:Ce, and some LSO:Tb from the ESRF (Grenoble, FR).

The detector optics for pixel sizes below approximately 5 μm (optical magnification from 2× to 50×) use microscope objectives (Mitutoyo, Kawasaki, JP); two different optics ensembles following this principle have been commissioned and in use for regular beamline operation. For more moderate resolution (optical magnification from 0.28× to 3.6×) and a correspondingly large beam, photo objectives (Hasselblad, Gothenburg, SE) in tandem geometry are used. The corresponding optics units are under commissioning.

A distortion correction of the images for tomography has so far not been necessary with these detection systems. However, our experience shows that careful handling and adjustment of mirrors and lenses is necessary to avoid aberrations and a degradation of spatial resolution even in the 2D images obtained.

Concerning the sensors, the working horse is an Orca Flash 4.0 V2 (Hamamatsu K.K., Hamamatsu, JP), complemented by a pco.dimax HS4 for fast acquisitions and a pco.4000 (PCO AG, Kelheim, DE) for applications requiring a larger pixel array and/or longer exposures.

These indirect detectors are also used with a zone-plate transmission X-ray microscope (TXM) currently under construction at the beamline, using diffractive optics supplied by the Paul Scherrer Institut (Villigen, CH).

The camera control computers are located in cooled racks close to the computer cluster used for tomographic reconstruction. To transport their CameraLink protocol over the large distance thus required, we use fiber-optic extenders (Phrontier Technologies LLC, Lake Forest, Calif., US), in combination with fiber-optic network wall plugs.

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