

## TREX: X-ray diffraction, scattering and spectroscopy experiments

Contact person: Borislav Angelov, [Borislav.Angelov@eli-beams.eu](mailto:Borislav.Angelov@eli-beams.eu)

### Brief description of the available set up:

In the TREX instrument the X-ray diffractometer is available for call 2 experiments. It is based on a custom modification of a commercial STOE STADIVARI goniometer. It has the same functionality as the commercial analog plus in addition an extended range for the detector movement going up to 400 mm sample to detector distance. The main module of the diffractometer is an Euler cradle goniometer capable of simultaneously rotating the investigated sample by 360 degrees and positioning the X-ray detector at desired angle and distance from the sample. It comes with a computer-controlled video microscope and dimmable LED light. Cryo cooling of fragile biological samples is done by a cryo stream cooler from Oxford Cryosystems. Diffracted and scattered X-ray photons are recorded by a single photon counting hybrid pixel detector model Eiger X 1M from Dectris. The main X-ray source module available for call 2 experiments is an X-ray microfocus sealed tube with Montel optics and JJ X-ray pinhole collimation.

The TREX instrument for hard X-ray science is outlined in the figure below.

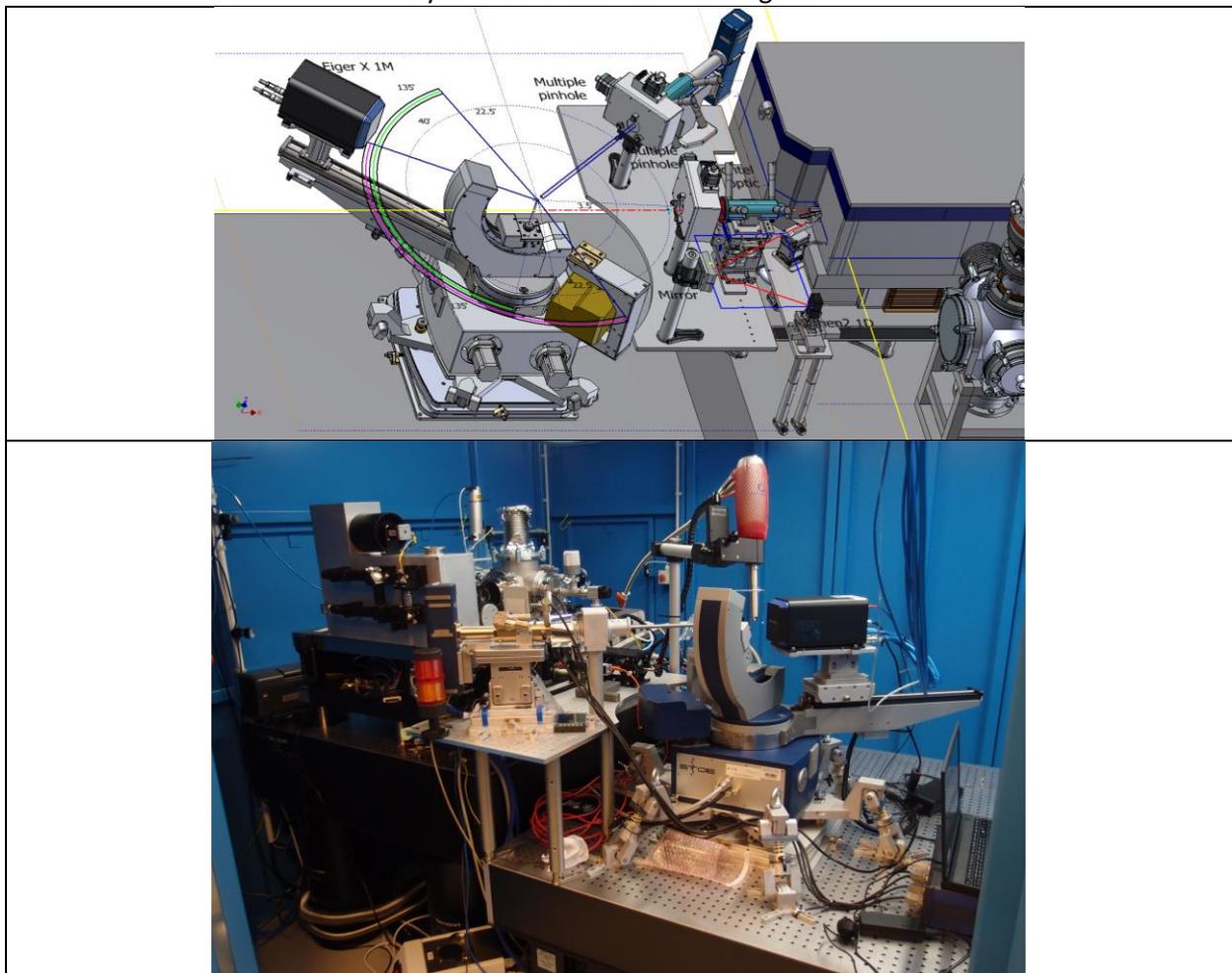




Fig. Top: Hard X-ray experimental station as designed, including the laser driven Plasma X-ray source, a complementary sealed tube Cu-anode X-ray source, diffractometer and von Hamos spectrometer for absorption/emission spectroscopy. Middle: Diffraction station as built (presently available for users with the complementary sealed tube X-ray source). Bottom: detail of the diffractometer sample environment when optimized for protein crystallography with the cryostream cryocooler.

#### Technical Data

<b><i>Sealed tube X-ray beam parameters</i></b>	
Flux on the sample	$10^8$ ph/sec
Beam size	145 micrometers
Beam divergence	4.8 mrad
Beam polarization	40%
Wavelength	CuKa 1.54 Angstroms
<b><i>Detector parameters</i></b>	
Pixel size [ $\mu\text{m}^2$ ]	75 x 75
Sensitive area (width x height) [ $\text{mm}^2$ ]	77.2 x 79.9
Total number of pixels	1030 x 1065 = 1,096,950
Maximum frame rate [Hz]	3000
Frame dead time	3 $\mu\text{s}$
Point-spread function	1 pixel
Sensor thickness [ $\mu\text{m}$ ]	450
Threshold energy [keV]	2.7-18
Maximum count rate [phts/s/ $\text{mm}^2$ ]	$5 \times 10^8$
Counter bit depth [bit]	12
Image bit depth [bit]	16 or 32
Photon processing time per pixel	180 ns
Data format	HDF5
Sample to detector distance	40-400 mm