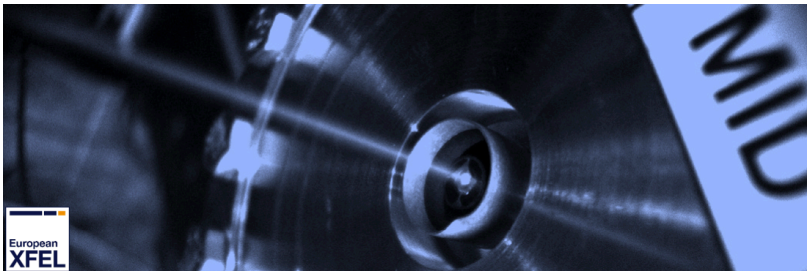

Contribution ID: **24** Type: **Poster**

Considerations for CRL pre-focusing optics at the MID instrument in hard X-ray range above 30 keV

Thursday 19 January 2023 19:10 (7 minutes)

The concept of high-harmonic lasing at X-ray Free-Electron Laser (XFEL) facilities [1] opens new perspectives of generating ultrashort SASE pulses in ultrahard X-ray range up to 100 keV. The European XFEL (EuXFEL) facility is the worldwide unique hard XFEL based on superconducting accelerator operating at an electron energy of up to 17.5 GeV and producing electron bunches at MHz repetition rates distributed to three SASE undulator sections [2]. The EuXFEL linac parameters provide beneficial conditions for high-harmonic lasing as confirmed by simulations [1] and proof-of-principle results obtained at soft X-ray SASE-3 undulator [3]. The Materials Imaging and Dynamics (MID) instrument is located at the hard X-ray SASE-2 undulator section in a straight geometry and enables user experiments in the 5–25 keV X-ray range [4, 5]. When expanding this range to harder X-ray energies the beam transport optics specifications must be revisited. This concerns in particular the offset and distribution X-ray mirrors which block spontaneous and Bremsstrahlung radiations and transmit an XFEL beam to the endstations. MID utilizes M1 and M2 mirrors that transmit photon energies up to 67 keV using Pt-coated stripes [6, 7]. Further X-ray optics crucial for beam transport are compound refractive lenses (CRLs) [8] enabling the beam collimation and pre-focusing at the instrument. CRL-1 and CRL-2 transfocator units equipped with Be CRL stacks of various radii of curvature (ranging from 5.8 mm to 50 μm) are located in SASE-2. Photon tunnel CRLs enable a tunable range of beam sizes in a working X-ray range of the MID instrument [4, 9]. A free slot for the high-energy CRL-3 unit for extended hard X-ray range is available in the XTD6 photon tunnel [4]. This contribution considers possible options for pre-focusing CRL transfocator optics in ultrahard photon energy range based on standard Be, Al lenses, and diamond CRLs.

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Session Classification: Poster Session

Track Classification: Techniques and instrumentation