

The MLS-IDB: A versatile beamline for UV to soft X-ray surface analytics

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The U125 Undulator at the MLS: Emission from the soft X-ray to the Infrared



U125 at the Metrology Light Source

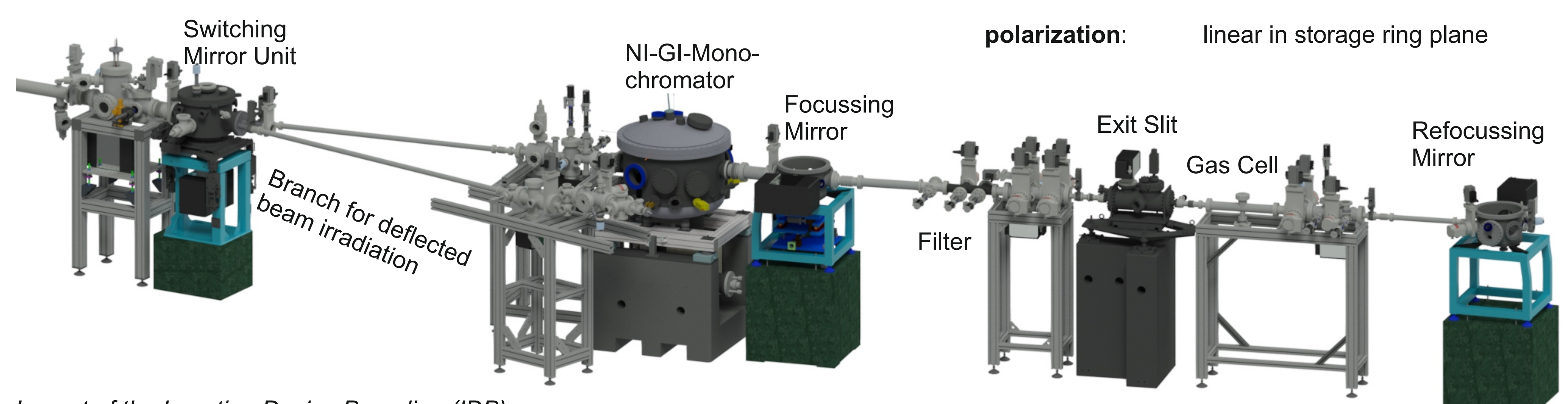
The PTB undulator U125 was taken into operation at the Metrology Light Source (MLS) in the beginning of 2013. The U125 is able to cover a spectral range from soft X-ray to IR due to the high flexibility of the MLS, being able to provide stable electron beams with energies from 100 MeV to 630 MeV.

Specification U125	
type	planar hybrid, quasiperiodical
periode length	125 mm
number of periods	30.5
gap min (B=0.64 T or K = 7.4)	34.5 mm
weight	11 t
l x h x w	4272 mm x 2748 mm x 1726 mm
magnet structure / girder length	4227 mm / 4250 mm
built / upgraded	1998 / 2012

Insertion Device Beamline (IDB) at the MLS for monochromatic radiation

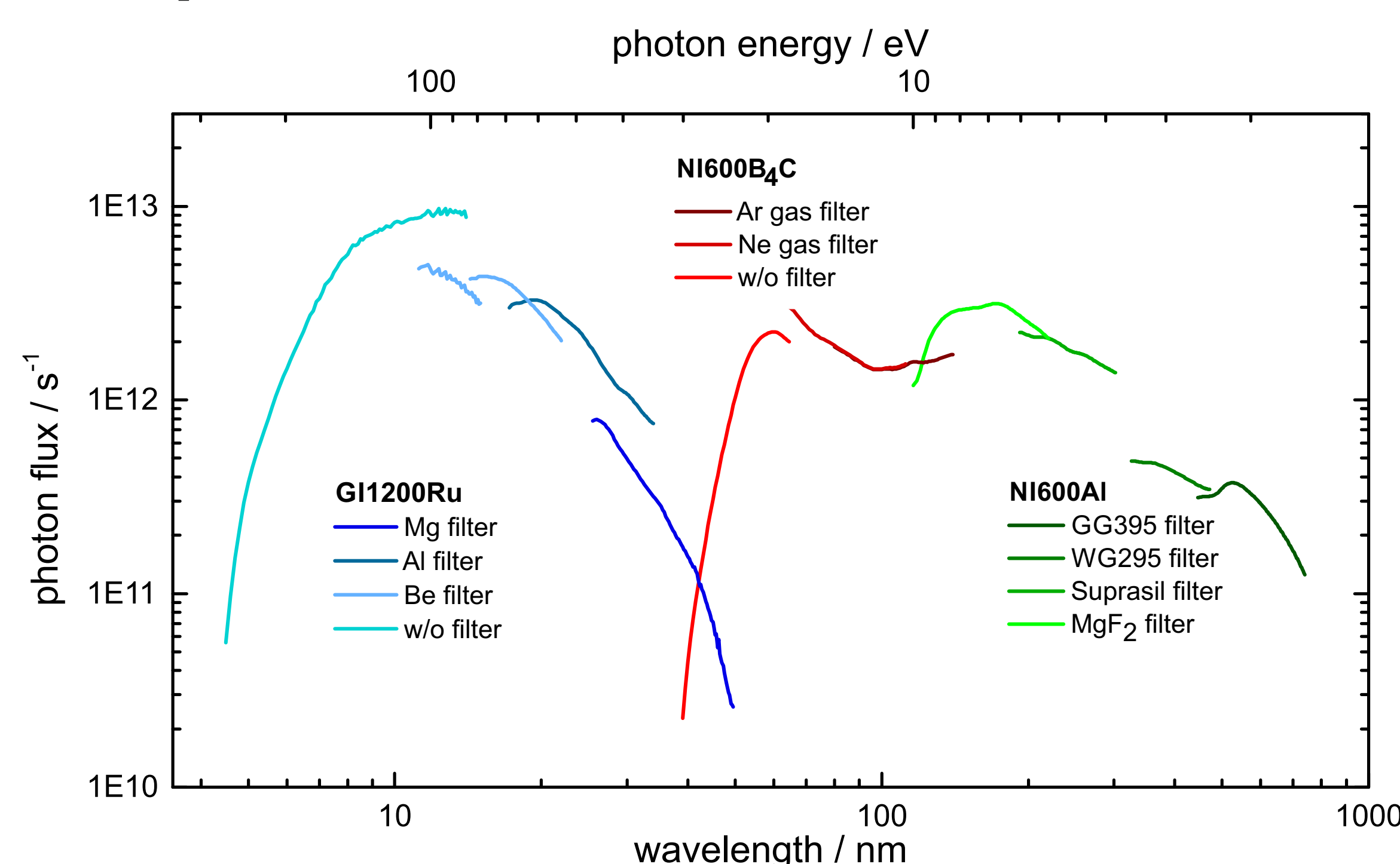
To take advantage of the assets of undulator radiation for advanced applications the insertion device beamline (IDB) provides monochromatic radiation in the wavelength range from about 4 nm to 800 nm. The monochromatized undulator radiation is now employed for advanced materials characterization. Besides, also the direct as well as a deflected beam, is usable, e.g. to irradiate samples for accelerated radiation-induced aging processes.

wavelength range:	4 nm to 800 nm
monochromator:	cPGM/NI hybrid (NIGI)
gratings:	GI: 1200 / mm Ru coating NI: 600 / mm Al/MgF ₂ coating NI: 600 / mm B ₄ C coating
bandwidth:	15 pm to 1.1 nm
typ. photon flux in focus:	10 ¹¹ s ⁻¹ to 10 ¹³ s ⁻¹
typ. spot size in focus:	1.5 mm (hor.) x 0.5 mm (vert.)
polarization:	linear in storage ring plane



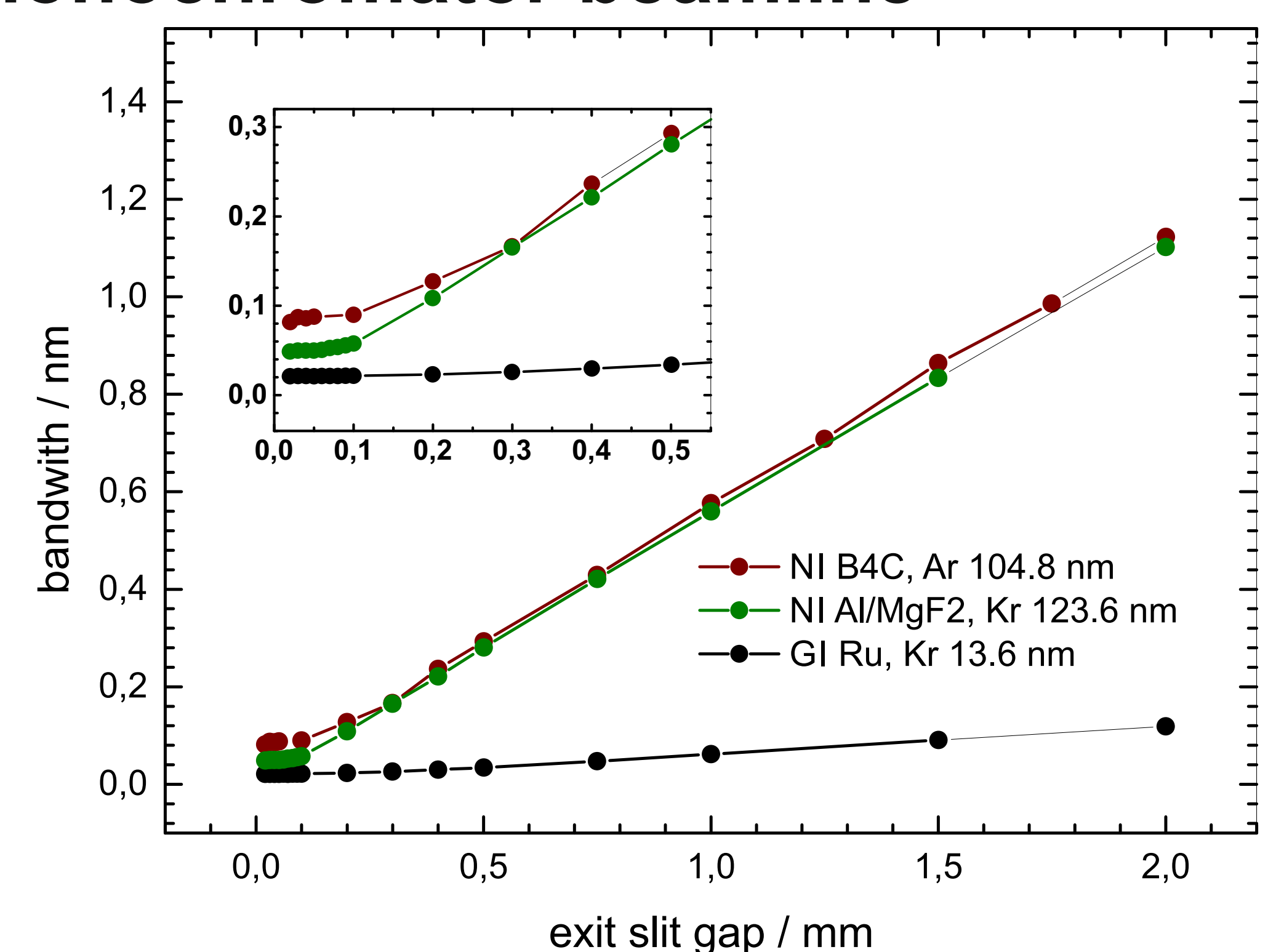
Layout of the Insertion Device Beamline (IDB)

Properties of the combined normal-incidence / grazing-incidence monochromator beamline



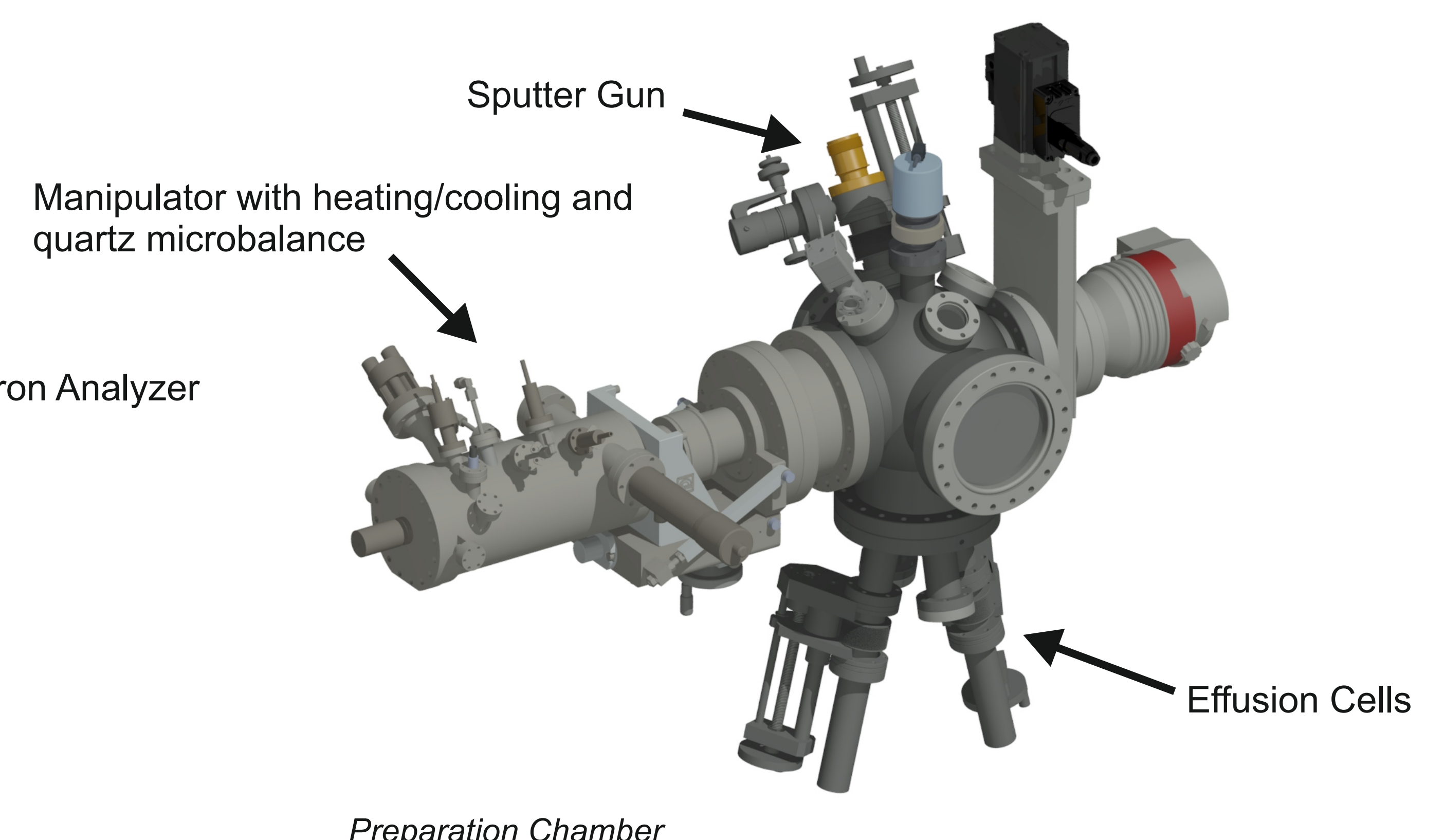
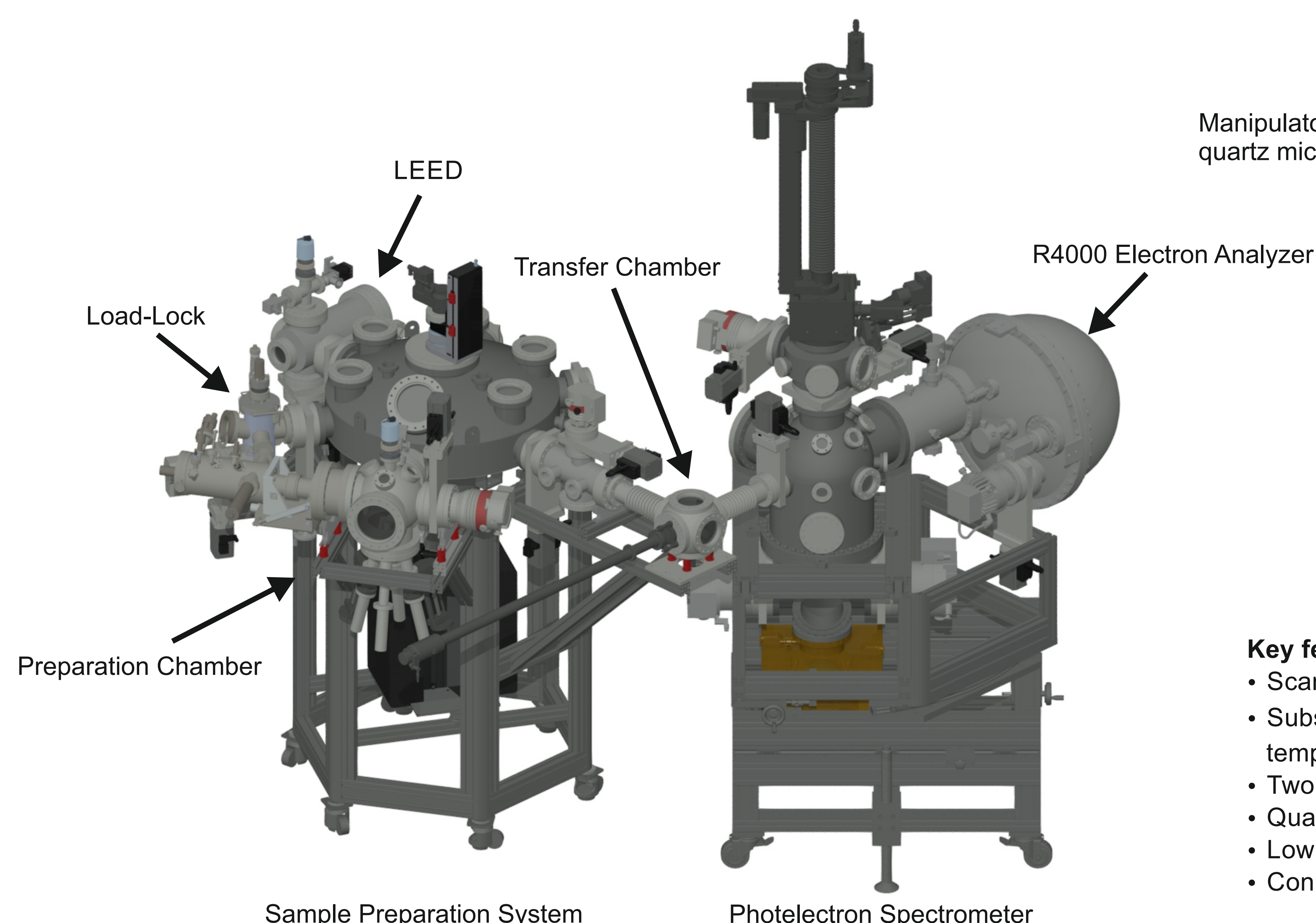
Photon flux measured at ID-Beamline for adapted U125 harmonics and optical configurations normalized to 100 mA stored electron current for a exit slit gap of 0.5 mm

For the applications of the undulator radiation in the context of metrology, the key is the spectral purity and large tunability in combination with the higher radiant power available compared to a typical bending magnet beamline. The beamline is equipped with a Normal Incidence / Grazing-Incidence (NI/GI) plane grating monochromator to provide monochromatized radiation in a broad spectral range. We chose a design combining a collimated Plane Grating Mono-chromator (cPGM) with a normal incidence option, which enables us to perform measurements from the soft X-ray (4 nm) to the NIR (800 nm) spectral range.



Spectral bandwidth determined at different rare gas resonances

Sample preparation and characterisation



Key features

- Scannable sputter gun with beam-focussing for substrat cleaning
- Substrate heating (resistive, up to 1000 °C) and LN₂ cooling for stabilized temperatures during the deposition process
- Two effusion cells up to 1400 °C suitable for organic and anorganic materials
- Quartz microbalance for thickness control of the deposited films
- Low Energy Electron Diffraction (LEED) for sample characterization
- Connectable to a photoelectron spectrometer or an ellipsometer

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