

The BEAR beamline at Elettra 2.0

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The beamline BEAR was open to users from 2003 till July 2025, and it is expected to reopen in 2028 after the upgrade to Elettra 2.0. BEAR is a IOM-CNR bending magnet beamline, working in the spectral region 2.8-1600 eV (443-0.775 nm) [1].

Elettra is the Italian synchrotron radiation facility and it is currently upgrading to Elettra 2.0, a new light source with a significant enhancement of the brilliance and the coherence of the radiation: the critical energy will increase from 3.2 to 5.55 keV, the electron energy from 2.0 to 2.4 GeV, the ring current from 300 (160 in case of 2.4 GeV) to 400 mA.

The new beamline BEAR, which will be moved from exit 8.1 to the dipole exit 3.1, will take advantage of the improved characteristics of the light source: the intensity will increase of a factor 2.5, and the linear power density will increase from present 13.5 W/mrad to 34 W/mrad. Moreover, the electron beam size will reduce from 113x33 μm^2 to 9.5x8.5 μm^2 (HxV), and consequently the light source will reduce in particular in the horizontal plane. The improvement in brilliance and coherence will allow in particular to enhance the signal to noise ratio, reduce the acquisition time, and enable the analysis of samples at micrometer scale.

The beamline layout, based on the Plane Mirror Plane Grating (PMPG) configuration, with a very high flux, important energy resolution and a small spot size [2], will be maintained, but also adapted to exploit the properties of the new light source. The main improvement on the monochromator will consist in the enhancement of the UV-EUV spectral range by replacing the low energy grating of the NIM (Normal Incidence Mirror) channel with a new one optimized in the FUV spectral range and by adding a second grating in the grazing incidence channel optimized for the EUV range.

The existing end station, conceived mainly for surface science, will be flanked by a second scattering chamber, dedicated to the calibration activity, in particular to the characterization of larger optical elements and instrumentation. For this purpose, the refocusing section must be redesigned, mounting, beside the actual ellipsoidal mirror, a new toroidal mirror with a much longer focal distance and a lower divergence of the beam, preserving the order of magnitude of the size spot, thanks to the lower emittance of Elettra2.0.

All the optics of the beamline will be cleaned with ultraviolet/ozone treatment to reduce the surface carbon contamination due to more 20 years of synchrotron life, and enhance the beamline transmission in particular in the spectral region of C K edge at 4.35 nm.

[1] S. Nannarone et al., 2004, AIP Conf. SYNCHROTRON RADIATION INSTRUMENTATION **705**, 450-453.

[2] G. Naletto, M.G. Pelizzo, G. Tondello, S. Nannarone, A. Giglia, 2001, Proc. SPIE **4145**, 105-113.