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MEtrology, Astronomy, Diagnostics and Beamline Design Workshop

Updates on the optical design and initial characterization activity of the MOST beamline in view of Elettra 2.0

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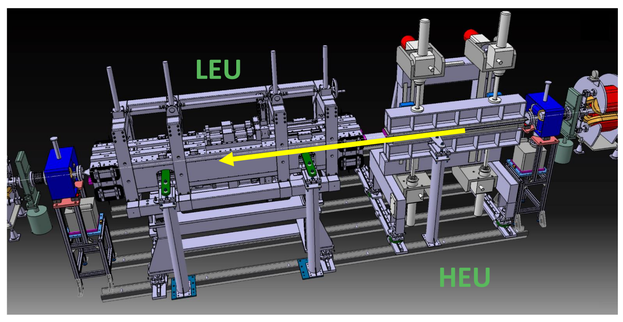
[3]CNR-ISM, [4]CNR – IOM, [5]ELETTRA SINCROTRONE TRIESTE

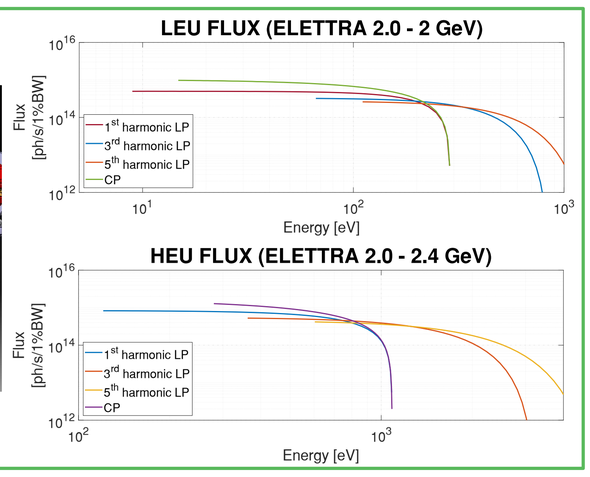
PHOTON SOURCES:

We report on the latest developments regarding the design and initial operations of the Molecular and Optical Science Technology beamline (MOST), the new beamline specifically dedicated to the atomic and molecular physics community at Elettra 2.0. MOST will address studies of isolated species (atoms, molecules, clusters, ions and nanoparticles), chirality, liquids and adsorbate systems, meeting the scientific interests currently investigated at the GasPhase Photoemission beamline [1] (GasPhase) and the Circular Polarization beamline [2] (CiPo). The optical layout of MOST is in the final stages of its design and its present status will be described. Two novel undulator sources were recently installed in place of the old wiggler and they are presently being operated with some limitation, to avoid heat load issues of the CiPo beamline front end and optics. A test campaign for a preliminary characterization of the new ID is scheduled for the next semester.

The beamline will receive light from two new insertion devices (IDs) adopting an in-line configuration. One low-energy undulator (LEU) will cover the low-to-intermediate photon energy range (10-300 eV), while a second high-energy undulator (HEU) the intermediate-to-high photon energy range (80-3000 eV).

The HEU is an APPLE-II, with a period length of 50.36 mm and 28 periods. The LEU is a variable phase fixed gap undulator, with a period length of 132 mm and 18 periods. Both undulators provide full polarization control of the emitted radiation. With the Elettra 2.0 upgrade, the spectral flux for both sources is expected to be on the order of 10^{14} - 10^{15} photons/s/0.1%BW.





BEAMLINE OPTICAL LAYOUT:

The beamline optical layout has been designed with the ray-tracing software SHADOW [3], within the OASYS [4] environment.

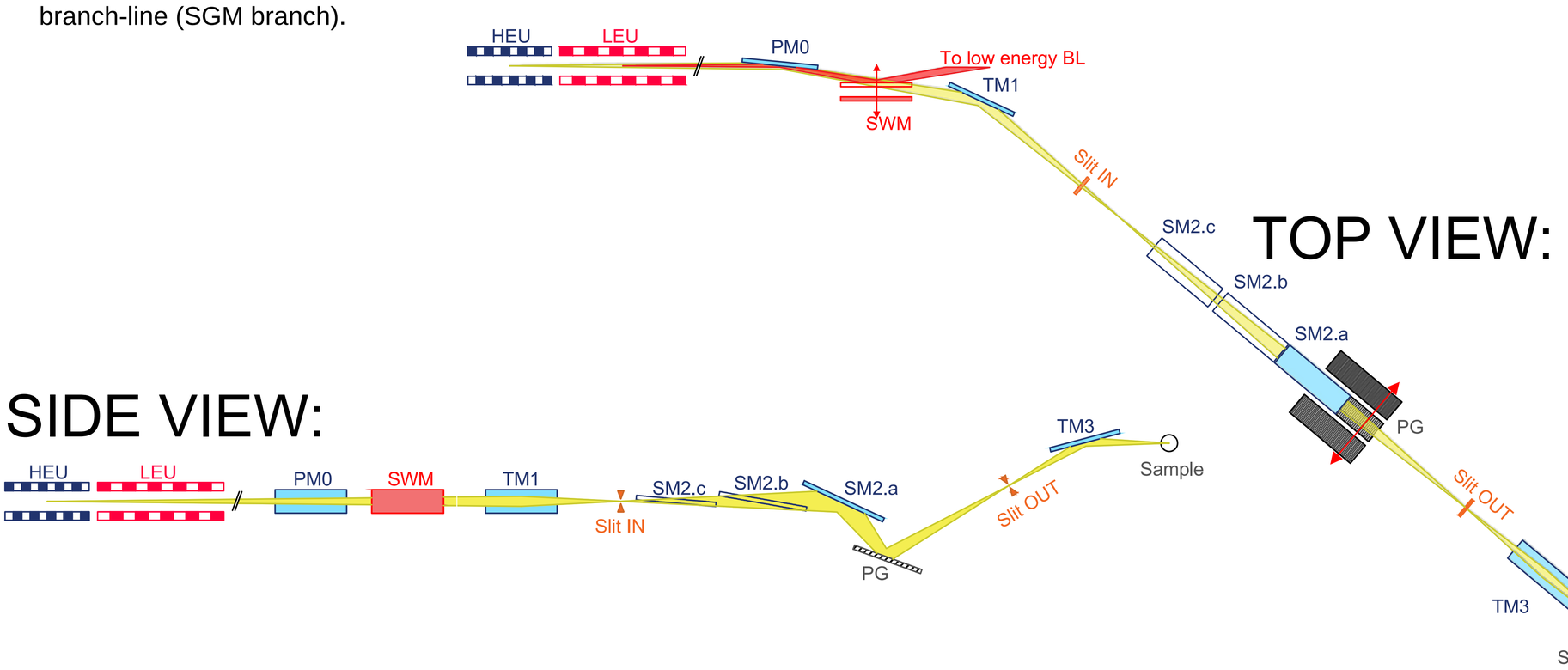
MOST will consist of a central main line which will allow for the intermediate-to-high photon energy range, and it will be complemented by two branches, one for the intermediate XUV range equipped with the spherical grating monochromator (SGM, currently at the GasPhase beamline at Elettra) and a second one for low-energy equipped with a normal incidence monochromator (NIM, currently at the CiPo beamline of Elettra). All optical elements will be Au coated.

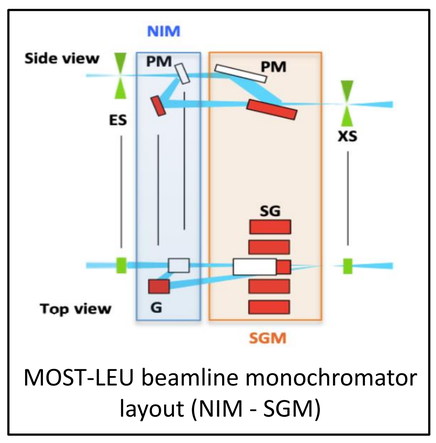
High energy beamline:

- The **first optical element (PM0)** is a plane mirror at 0.75° grazing incidence. PM0 is meant to absorb most of the high heat load and to aid radiation protection measures.
- The **pre-focusing mirror (TM1)**, is a toroidal mirror at 1° grazing incidence designed to astigmatically focus the beam so to achieve the sagittal focus on the entrance plane in the vertical direction and tangential focus inside the monochromator in the horizontal direction.
- The **monochromator** design employs **spherical mirrors (SM2a-c)** and **plane gratings (PG)** (600 gr/mm, 1200 gr/mm, 1800 gr/mm) each with variable line spacing configuration.
- The **refocusing mirror (TM3)**, is a toroidal mirror at 1° grazing incidence with 2500 mm focal distance to focus the beam at the sample position.

Low energy beamline:

- A movable **switching mirror (SWM)** at 3° grazing incidence will be installed between PM0 and TM1 to direct the radiation along the low energy beamline.
- The low energy beamline will use the existing GasPhase optical elements in their current layout. The GasPhase **SGM monochromator** is going to be refurbished and improved with the addition of the **NIM** currently at CiPo. After the monochromator, the beam will be further split into a low energy branch-line (NIM branch) and an intermediate energy branch-line (SGM branch).





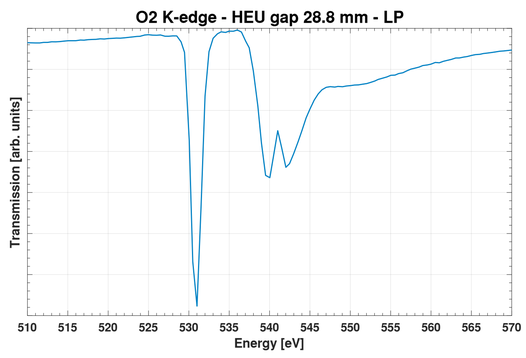
MOST-LEU beamline monochromator layout (NIM - SGM)

SHORT TERM OUTLOOK:

Both HEU and LEU are now available to provide light, down to 20 eV photon energy, to the existing CiPo beamline with all polarisatior degrees. In the current semester (Run198) initial characterisation of the IDs performance is planned. In particular:

- Calibration of the energy and undulator parameters.
- Flux measurements.
- Polarimetric measurements.

Additionally, thermal load effects on the first optical element (PM0) will be simulated to optimize its cooling system.



[1] K.C. Prince, et al J. Synch. Rad. 5, 565-568 (1998); see also www.elettra.eu/elettra-beamlines/gasphase.html
[2] A. De Rossi, F. Lama, M. Piacentini, T. Prosperi, and N. Zema, Rev. Sci. Instrum. 66, 1718 (1995); see also www.elettra.eu/elettra-beamlines/cipo.html
[3] F. Cerrina and M. Sanchez del Rio, Ch. 35 in Handbook of Optics (volume V, 3rd edition), edited by M. Bass, Mc Graw Hill, New York, 2009
[4] L. Rebuffi, M. Sanchez del Rio, Proc. SPIE 10388, 103880S (2017)