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A multi-technique setup based on a liquid anode X-ray source for the non-invasive characterization of materials

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In the last decades, a novel technology for X-ray sources based on the use of a liquid anode has been developed, in order to increase the maximum achievable brilliance by at least one order of magnitude compared to conventional microfocus sources [1].

With this innovative equipment, a High-Brilliance X-ray laboratory (HiBriX Lab) is presently under development at the University of Turin, hosted at the NIS inter-departmental Centre. It was designed by integrating different detectors and focusing optics to represent a unique laboratory in Italy and with a handful of comparable examples in the world. The aim is to cover several applications such as:

- material characterization via μ XRD and μ XRF maps;
- investigation of detector performances in terms of charge collection efficiency or as a function of damage effects;
- single cell level radiobiology;
- X-ray imaging (2D radiography and 3D computed tomography - CT) of objects having a wide size range.

Procurement of the different components has been almost completed and their integration is underway, also by means of the development of specifically dedicated software for system control. To date, concerning the microfocused branch of the lab, a minimum spot size of about 25 microns has been achieved by means of a set of twin paraboloidal mirrors, and a maximum flux density of 2.7×10^{10} ph s⁻¹ mm⁻² has been obtained with a polycapillary optics system specifically delivered by INFN X-lab in Frascati. On the other side, where a 30° cone beam is available, a versatile X-ray imaging setup is installed, which allows the acquisition of radiographs and tomographic scans of very different kinds of samples: objects of dimensions in the sub-mm to few tenths of cm range, with wide variability in atomic number and density values, such as the samples of interest in the field of cultural heritage.

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[1] O. Hemberg et al., Liquid-metal-jet anode electron-impact x-ray source, Appl. Phys. Lett. 83, 1483 (2003)