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Manufactuing of Advanced Laue Optics for Gamma ObservationS (LOGOS)

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X- and γ-ray detection is currently a hot topic for a wide scientific community, spanning from astrophysics to nuclear medicine. However, lack of optics capable of focusing photons of energies in the energy range 0.1-1 MeV, leaves their detection to a direct-view approach, resulting in a limited efficiency and resolution. The main scope of the INFN-LOGOS project is the development of technologies that enable manufacturing highly performing optical elements to be employed in the realization of hard X-ray lenses. Such a lenses, typically named "Laue lenses", consist of an ensemble of crystals disposed in concentric rings in order to diffract the incident radiation to the focus of the lens, where a detector is placed.
The possibility to realize an efficient Laue lens is strongly dependent from the quality of its components. In the last years various crystals types were proposed as optical elements for a Laue lens. Nevertheless, their performance have not allowed the construction of an efficient Laue lens so far.
Crystals having curved diffracting planes (CDP) are very promising for high-performance Laue lenses. In fact, they allow the concentration of a large fraction of the incident X-rays. Furthermore, crystalline anisotropy can be exploited to shape the crystal into a focusing element. In fact, for particular lattice orientations, a primary curvature imparted to a crystal slab result in a secondary curvature in a different lying of planes. The phenomenon, known as quasi-mosaicity [3], allows the combination of a high diffraction efficiency, occurring in the interaction with the curved lattice planes, and a focusing effect. This technology enables a diffracting element to have a smaller diffraction spot, thus leading to an increased resolution for a Laue lens employing these objects.
The INFN-LOGOS project aims at the realization of intrinsically bent silicon and germanium crystals exploiting the quasi-mosaic effect for focusing hard X-rays. Crystals manufacturing relies on a proper revisitation of techniques typically employed in silicon micromachining, such as thin film deposition and patterning or ion implantation.

References

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Primary author: MAZZOLARI, Andrea (FE)

Co-authors: SCIAN, Carlo (LNL); PATERNÒ, Gianfranco (FE); Prof. MATTEI, Giovanni (University of Padova); Dr CAMATTARI, Riccardo (INFN Sezione di Ferrara and Dipartimento di Fisica e Scienze della Terra, Via Saragat 1, 44100 Ferrara, Italy); Mr BELLUCCI, Valerio (INFN Sezione di Ferrara and Dipartimento di Fisica e Scienze della Terra, Via Saragat 1, 44100 Ferrara, Italy); GUIDI, Vincenzo (FE)

Presenter: MAZZOLARI, Andrea (FE)

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