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CALCULATION OF ABERRATION IN A LAUE LENS MADE OF GE AND SI BENT CRYSTALS FOR FUTURE GAMMA-RAY ASTROPHYSICS TELESCOPES

Abstract

Forthcoming hard X-ray (50-700 keV) telescopes designed for high-energy astrophysics will rely on concentrating radiation through diffractive systems utilizing high-Z solid-state detectors at focal plane detector. Our current focus involves exploring the feasibility of employing Laue lenses, made from curved Germanium and Silicon crystals. In this study, we tried to estimate the aberration of a X-ray Laue lens made of bent germanium and silicon crystals disposed on concentric rings on a lens of 2.5 m in diameter. In each ring the crystals are pre-oriented in order to diffract a parallel X-ray beam in a focus positioned at 20 m form the lens. Each crystal is a tile 3x1 cm2, with the longer edge oriented to the centre of the lens, with an expected field of view of 4 arcminutes. Thanks to the 40 m curvature of the crystal tiles each crystal produces a spot of 1x10 mm2 at the focus plane, as already reported [1]. The overlap of diffractions coming from all the tiles produces a spot with a point spread function of a few mm in diameter corresponding to only 30 arcseconds . Examples of imaging of extended X-ray sources as focussed by the lens will be evaluated, permitting to estimate the amount of optical aberration of the X-ray Laue lens made of bent crystals.

[1] “The TRILL project: increasing the technological readiness of Laue lenses”. Lisa Ferro, Enrico Virgilli, Miguel Fernandes Moita, Filippo Frontera, Piero Rosati, Cristiano Guidorzi, Claudio Ferrari, Riccardo Lolli, Ezio Caroli, Natalia Auricchio, John B. Stephen, Stefano Del Sordo, Carmelo Gargano, Stefano Squerzanti, Mauro Pucci, Olivier Limousin, Aline Meuris, Philippe Laurent, and Hugo Allaire https://arxiv.org/pdf/2309.11187.pdf