

PhotonMEADOW 2023

Contribution ID: 34

Type: Poster

Recent developments in Speckle Angular Metrology (SAM) for X-ray mirrors at Diamond Light Source

High precision and accurate metrology plays a pivotal role in the characterization and improvement of X-ray mirrors for synchrotron and X-ray Free Electron Laser (FEL) sources. To meet the stringent requirements of nano-precision metrology for demanding X-ray mirrors, a novel metrology instrument called Speckle Angular Metrology (SAM) has been recently developed at Diamond Light Source [1]. We present the latest experimental results in the form of comparison between measurements performed using SAM, the Diamond- Nanometre Optical Metrology instrument (NOM) [2], and a Fizeau Interferometer [3]. The results are given for three challenging X-ray Mirrors: a 9.3m spherical mirror (also measured by various facilities around Europe as part of the MOONPICS collaboration); a flat grating blank with a radius of curvature > 16 km, and a super-polished JTEC cylindrical, low-reflectivity glass substrate mirror with a radius of ~ 116 m. The study considers systematic errors and assesses the advantages and limitations of SAM. The SAM will extend the capability of the existing metrology instruments and provide an alternative and complementary metrology means for future X-ray mirrors.

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2. Alcock,S.G.et al. The Diamond-NOM: A non-contact profiler capable of characterizing optical figure error with sub-nanometre repeatability. *Nucl. Instruments Methods Phys. Res. Sect. A Accel. Spectrometers, Detect. Assoc. Equip.* 616, 224–228 (2010).
3. da Silva,M.B.,Alcock,S.G.,Nistea,I.T.& Sawhney,K. A Fizeau interferometry stitching system to characterize X-ray mirrors with sub-nanometre errors. *Opt. Lasers Eng.* 161, 107192 (2023).

Journal of Synchrotron Radiation Special Issue: will you submit your contribution?

yes

Primary author: MORICONI, SIMONE

Co-authors: Dr NISTEA, IOANA-THEODORA (Diamond Light Source); Mr BAZAN DA SILVA, MURILO (Diamond Light Source); ALCOCK, SIMON G. (Diamond Light Source); Prof. KORSUNSKY, ALEXANDER M. (University of Oxford); Dr WANG, HONGCHANG (Diamond Light Source Ltd); Dr SAWHNEY, KAWAL (Diamond Light Source Ltd)

Presenter: MORICONI, SIMONE

Session Classification: Poster Session