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# ***Adaptive X-Ray Optics V***

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*Editors*

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# Introduction

Adaptive x-ray optics is a quite recent branch of optical engineering. Its close relative, i.e., adaptive mirrors for astronomical telescopes, aims at overcoming the disturbance of the atmosphere in astronomical observations by real-time wavefront sensing and correction via rapidly-deformable mirrors. X-ray mirrors, in contrast, operate in high vacuum and so are completely unaffected by air turbulences. Nevertheless, adaptive (or active, or adjustable) x-ray optics has inherited the concept of shape-changing mirrors, in order to correct profile distortions that could not be removed by the manufacturing, integration, or the bearing system. Adaptive x-ray optics furthermore offers the opportunity to actively compensate mirror distortions caused by the thermal load.

This volume encompasses contributions on latest developments of adaptive x-ray optics in two fundamental sectors: space observatories and ground-based light sources (synchrotrons and FEL - free electron lasers). The two domains face the same problem of optimizing the focusing accuracy, but with completely different boundary conditions. The former needs to detect faint signals and therefore has to remove surface defects in thin mirrors, typically densely packed in a large aperture optical module. The latter targets at mirror shape control in beamlines near the diffraction limit, under intense, highly-anisotropic radiation exposure. Consequently, different mirror geometries are usually adopted in the two cases.

Despite the differences, indeed, a common physical frame can be drawn around the two realms. Even to different approximation levels, the same elasticity theory rules the mirror bending. The same wavefront propagation controls the bending of x-rays throughout the optical system. Thermal gradients - on orbit or in a beamline - distort the wavefront and hinder the focusing performances, and sensitive metrology/wavefront sensing techniques have to be developed to characterize and feedback the mirror correction.

This proceeding volume aims at finding a sharing point between the research being carried out in both branches of adaptive x-ray optics. The papers enclosed in the volume cover the following topics:

- FEL applications, with particular regard to surface metrology of mirrors under coherent, high-intensity radiation
- Metrology and optical simulations, modelling of wavefront propagation, and mirror bending
- New device development in lightweight adaptive x-ray optics
- At-wavelength metrology, wavefront sensing, and feedback techniques.

**Daniele Spiga**  
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