Publication Year	2018
Acceptance in OA	2020-11-11T16:00:08Z
Title	Adaptive X-Ray Optics V
Authors	SPIGA, Daniele, Mimura, Hidekazu
Publisher's version (DOI)	10.1117/12.2516844
Handle	http://hdl.handle.net/20.500.12386/28262
Serie	PROCEEDINGS OF SPIE
Volume	10761

PROCEEDINGS OF SPIE

SPIEDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 10761

, "Front Matter: Volume 10761," Proc. SPIE 10761, Adaptive X-Ray Optics V, 1076101 (6 November 2018); doi: 10.1117/12.2516844

SPIE.

Event: SPIE Optical Engineering + Applications, 2018, San Diego, California, United States

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PROCEEDINGS OF SPIE

Adaptive X-Ray Optics V

Daniele Spiga
Hidekazu Mimura
Editors

21 August 2018
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 10761

Proceedings of SPIE 0277-786X, V. 10761

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Adaptive X-Ray Optics V, edited by Daniele Spiga, Hidekazu Mimura, Proc. of SPIE Vol. 10761,
1076101 · © 2018 SPIE · CCC code: 0277-786X/18/$18 · doi: 10.1117/12.2516844

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Please use the following format to cite material from these proceedings:
Author(s), "Title of Paper," in *Adaptive X-Ray Optics V*, edited by Daniele Spiga, Hidekazu Mimura, Proceedings of SPIE Vol. 10761 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)

ISBN: 9781510620933
ISBN: 9781510620940 (electronic)

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
SPIE.org
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Printed in the United States of America.

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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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