PROCEEDINGS OF SPIE

Space Telescopes and Instrumentation 2020: Ultraviolet to Gamma Ray

Jan-Willem A. den Herder Shouleh Nikzad Kazuhiro Nakazawa Editors

14–18 December 2020 Online Only, California, United States

Sponsored and Published by SPIE

Volume 11444 Part One of Two Parts

Proceedings of SPIE 0277-786X, V. 11444

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

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in Space Telescopes and Instrumentation 2020: Ultraviolet to Gamma Ray, edited by Jan-Willem A. den Herder, Shouleh Nikzad, Kazuhiro Nakazawa, Proceedings of SPIE Vol. 11444 (SPIE, Bellingham, WA, 2020) Seven-digit Article CID Number.

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

ISBN: 9781510636750 ISBN: 9781510636767 (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 Copyright © 2020, Society of Photo-Optical Instrumentation Engineers.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$21.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/20/\$21.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.



Paper Numbering: Proceedings of SPIE follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

Part One

	ULTRAVIOLET I
11444 04	Ground calibration results of the JUICE ultraviolet spectrograph [11444-1]
11444 05	EUV spectroscopy with the ESCAPE mission: exploring the stellar drivers of exoplanet habitability [11444-2]
11444 06	Optical characterization of the Colorado Ultraviolet Transit Experiment (CUTE) CubeSat [11444-3]
11444 07	Mapping diffuse emission in Lyman UV band [11444-4]
	ULTRAVIOLET II
11444 08	Progress report on the NASA probe mission concept, CETUS [11444-5]
11444 09	INFUSE: a rocket-borne FUV integral field spectrograph [11444-6]
11444 0A	SPARCS payload assembly, integration, and test update [11444-7]
	ULTRAVIOLET IV
11444 01	Development of high technology readiness level, all-reflective spatial heterodyne spectrometers for high resolving power/etendue remote sensing of extended emissions in the NUV to EUV [11444-15]
11444 OK	Microchannel-plate detector development for ultraviolet missions [11444-17]
11444 OL	UVSPEX/WSO-UV for Earth-like exoplanetary oxygen exospheres [11444-336]
	SOLAR
11444 ON	The Solar-C (EUVST) mission: the latest status [11444-19]

	ATHENA I
11444 OT	Development status of the wide field imager instrument for Athena [11444-25]
	X-RAY OPTICS I
11444 1C	Sub-arcseconds to micro-arcsecond x-ray imaging with Multi Image X-ray Interferometer Method (MIXIM): concept and scalabe mission plans [11444-44]
	X-RAY OPTICS II
11444 1D	Sub-arcseconds x-ray imaging with Multi-Image X-ray Interferometer Module (MIXIM): experimental results [11444-152]
11444 1E	An x-ray interferometry concept for the ESA Voyage 2050 programme [11444-153]
11444 1G	Advanced fabrication technologies for ultraprecise replicated mirrors for x-ray telescopes [11444-155]
11444 1H	Towards volume manufacturing of high-performance soft x-ray critical-angle transmission gratings [11444-156]
	SVOM
11444 1K	Calibration of a fully populated lobster eye optic for SVOM [11444-159]
	SPEKTRUM RG
11444 10	SRG/eROSITA in-flight background at L2 [11444-163]
	SMALL/CUBE SATS I
11444 1R	The HERMES-technologic and scientific pathfinder [11444-166]
11444 1S	An innovative architecture for wide band transient monitor on board the HERMES nano-satellite
	constellation [11444-16/]

11444 1V NinjaSat: an agile CubeSat approach for monitoring of bright x-ray compact objects [11444-170]

SMALL/CUBE SATS II

- 11444 1XBurstCube: a CubeSat for gravitational wave counterparts [11444-172]
- 11444 1Z The Mini Astrophysical MeV Background Observatory (MAMBO) CubeSat mission [11444-330]

	XRISM
11444 22	Status of X-ray Imaging and Spectroscopy Mission (XRISM) [11444-176]
11444 23	Soft X-ray Imager (SXI) for Xtend onboard X-Ray Imaging and Spectroscopy Mission (XRISM) [11444-177]
11444 25	On-ground calibration of XRISM/Xtend CCD [11444-179]
11444 26	Planning in-flight calibration for XRISM [11444-180]

NEW

11444 28	GEO-X (GEOspace x-ray imager) [11444-292]
11444 2A	The Colibrì high-resolution x-ray telescope [11444-294]
11444 2C	The Arcus soft x-ray grating spectrometer explorer [11444-326]

	EXTP
11444 2E	Mission analysis and preliminary spacecraft design of the enhanced x-ray timing and polarimetry observatory [11444-298]
11444 21	Investigating the effect of source contamination on eXTP/SFA [11444-199]
	THESEUS

11444 2K The X/Gamma-ray Imaging Spectrometer (XGIS) on-board THESEUS: design, main characteristics, and concept of operation [11444-303]

11444 2L	The soft x-ray imager on THESEUS: the transient high-energy survey and early universe surveyor
	[11444-304]

11444 2M The Infra-Red Telescope (IRT) onboard the THESEUS mission [11444-305]

DETECTORS

11444 2O	Identifying charged particle background events in x-ray imaging detectors with novel machine learning algorithms [11444-308]
11444 2Q	AstroPix: investigating the potential of silicon pixel sensors in the future of gamma-ray astrophysics [11444-310]
11444 2R	A new spectroscopic imager for x-rays from 0.5 keV to 150 keV combining a fully depleted pnCCD coupled to a columnar CsI(TI) scintillator with fano-noise-limited energy resolution and deep subpixel spatial resolution [11444-324]

HUBS 11444 2S HUBS: a dedicated hot circumgalactic medium explorer [11444-311] 11444 2T Development of x-ray focusing telescope for HUBS [11444-312] 11444 2U Preliminary design of a 4K mechanical cooling system for the HUBS mission [11444-313]

POLARIMETER

11444 2V	POLAR-2: a large scale gamma-ray polarimeter for GRBs [11444-314]
11444 2Y	A small satellite version of a broad-band soft x-ray polarimeter [11444-317]

	GAMMA
11444 2Z	High-redshift gamma-ray burst for unraveling the Dark Ages Mission: HiZ-GUNDAM [11444-318]
11444 30	A new tool for MeV astrophysics: the tunable Laue-lens [11444-319]
11444 31	AMEGO: exploring the extreme multimessenger universe [11444-320]
11444 34	Current status of the ComPair silicon tracker [11444-323]

11444 35 **Results from the Advanced Scintillator Compton Telescope (ASCOT) balloon payload** [11444-328]

POSTER SESSION: SVOM

11444 38 Design and validation of onboard observation management software in satellite management unit of SVOM satellite [11444-268]

POSTER SESSION: SOLAR

- 11444 3J A sensitivity analysis of the updated optical design for EUVST on the Solar-C mission [11444-116]
- 11444 3K Thermal design of the Solar-C (EUVST) telescope [11444-117]

POSTERS SESSION: GENERAL

- 11444 3P A comparison of trapped particle models in low Earth orbit [11444-74]
- 11444 3Q Example telescope simulations with the AstroX telescope toolbox for McXtrace [11444-75]

POSTER SESSION: ATHENA

- 11444 3U Warm front end electronic modelization for the X-IFU ATHENA readout chain simulation [11444-45]
- 11444 3W Structural analysis of Athena WFI Large Detector Array [11444-47]
- 11444 3Y Enhanced simulations on the Athena/WFI instrumental background [11444-49]
- 11444 41 ATHENA warm ASIC for the X-IFU electronics [11444-52]
- 11444 42 Reducing the Athena WFI charged particle background: results from Geant4 simulations [11444-53]
- 11444 47 Technology development of Athena WFI frame processor electronics and verification of its real-time performance [11444-58]
- 11444 4A The cryogenic anticoincidence detector for ATHENA X-IFU: advancement in the project [11444-61]

Promtt Tiwkop Part Two

POSTER SESSION: ATHENA OPTICS

11444 4G Upgrade of the x-ray parallel beam facility XPBF 2.0 for characterization of silicon pore optics [11444-67]

- 11444 4J Qualification and performance of the Low-Energy X-ray Reflectometer (LEXR) [11444-70]
- 11444 4K Status of the Ir and Ir/SiC coating development for the Athena optics [11444-71]
- 11444 4L Design of a new long beam x-ray test facility for ATHENA [11444-72]
- 11444 4N Balancing of residual stress in thin film iridium by utilizing chromium as an underlayer [11444-337]

POSTER SESSION: SPECTRUM RG

- 11444 40 The eROSITA camera array on the SRG satellite [11444-260]
- 11444 4Q The calibration of eROSITA on SRG [11444-262]
- 11444 4S SRG/eROSITA early phase and commissioning operations [11444-264]

POSTER SESSION: SMALL/CUBE SATS

- 11444 4U The HERMES-TP/SP background and response simulations [11444-248]
- 11444 4V GRBAlpha: a 1U CubeSat mission for validating timing-based gamma-ray burst localization [11444-249]
- 11444 4W MeVCube: a 6U CubeSat concept for MeV observations [11444-250]
- 11444 4X Timing techniques applied to distributed modular high-energy astronomy: the HERMES project [11444-251]
- 11444 50 The Payload Data Handling Unit (PDHU) on-board the HERMES-TP and HERMES-SP CubeSat Missions [11444-254]
- 11444 54 **Design, implementation, and validation of the electronics for the SPRITE CubeSat** [11444-258]
- 11444 56 A lunar CubeSat mission for high-sensitivity nuclear astrophysics [11444-332]

POSTER SESSION: EINSTEIN

11444 57	X-ray testing of the Einstein Probe follow-up x-ray telescope STM at MPE's PANTER facility [11444-193]
11444 5B	Status of the follow-up x-ray telescope onboard the Einstein Probe satellite [11444-196]
	POSTER SESSION: XRISM
11444 5C	X-ray transmission measurements of the gate valve for the x-ray astronomy satellite XRISM [11444-285]
11444 5D	The XRISM Science Data Center: optimizing the scientific return from a unique x-ray observatory [11444-286]
11444 5E	Detail plans and preparations for the science operations of the XRISM mission [11444-287]
	POSTERS SESSION: NEW
11444 5K	A detection algorithm for faint sources based on 1-d projection for a lobster-eye x-ray imaging system [11444-227]
11444 5L	Development of a fast readout system of a CMOS image sensor for the time-domain astronomy [11444-228]
11444 50	Super DIOS mission for exploring "dark baryon" [11444-231]
	POSTER SESSION: POLARIMETRY
11444 5V	Concept of a CubeSat-based hard x-ray imaging polarimeter: cipher [11444-238]
11444 5X	The back-end electronics for the Imaging X-ray Polarimetry Explorer telescope [11444-240]
11444 5Y	Development and performance verification of a TPC polarimeter for high energy x-rays [11444-241]
11444 5Z	CAT grating alignment and testing for soft x-ray polarimetry [11444-242]
11444 60	Ray-tracing a small orbital mission for soft-x-ray polarimetry [11444-243]
11444 62	The Imaging X-ray Polarimetry Explorer (IXPE): technical overview III [11444-245]

POSTER SESSION: GAMMA

- 11444 67 SMILE-3: sky survey in MeV gamma-ray using the electron-tracking Compton telescope loaded on balloons [11444-211]
- 11444 6A Trigger system for the ComPair instrument [11444-214]
- 11444 6D **Development of a Compton telescope based on single-crystal diamond detectors and fast** scintillators [11444-327]
- 11444 6E GALI: a gamma-ray burst localizing instrument [11444-329]

POSTER SESSION: ULTRAVIOLET

11444 6G	Precision requirements for the POLLUX-LUVOIR spectropolarimeter [11444-123]
11444 61	The detector for the far ultraviolet channel of the imaging instrument on board the Spektr-UF (WSO-UV) space telescope [11444-125]
11444 6Q	Miniaturized UV imager for heliophysics science investigations [11444-133]
11444 6V	GLUV Pathfinder: setting up for rapid cadence UV monitoring of the transient universe [11444-138]
11444 6W	Optical design of the Chromospheric LAyer Spectro-Polarimeter (CLASP2) [11444-139]
11444 6Y	Far-UV multi-object spectroscopy with digital micromirror devices (DMDs) [11444-141]
11444 73	The World Space Observatory: ultraviolet mission: science program and status report [11444-146]
11444 74	Field camera unit of the WSO-UV mission [11444-147]
11444 76	Spectroscopic Investigation Of Nebular Gas (SING): a dedicated NUV spectrograph to study extended objects from a stable space platform [11444-149]
11444 78	Mirrors for improved FUV observations [11444-151]
11444 7A	Qualitative and quantitative test of digital micromirror device for next generation UV multi- object spectroscopy [11444-338]
	POSTER SESSION: OPTICS

11444 7C X-ray performance and simulation study of lobster eye optics [11444-80]

11444 7E	Source position determination method of multiplexing lobster-eye optics [11444-82]
11444 7G	Development of a powerful x-ray generator with a small spot-size option at ISAS x-ray beamline facility [11444-84]
11444 7P	New method to make a smooth surface on Carbon Fiber Reinforced Plastic (CFRP) substrate [11444-93]
11444 7R	Testing of the WXT optics at the University of Leicester [11444-95]
11444 7V	VTXO: the virtual telescope for x-ray observations [11444-99]
11444 7W	The development of a testbed for the x-ray interferometer mission [11444-100]
11444 88	Lynx grating spectrometer design: optimizing chirped transmission gratings [11444-112]
11444 8A	Alignment of the Marshall Grazing Incidence X-ray Spectrometer (MaGIXS) telescope mirror and spectrometer optics assemblies [11444-331]
11444 8B	The 2nd generation of the x-ray multi-foil optical system for rocket experiment [11444-339]

POSTER SESSION: EXTP

- 11444 8E **Optical thermal filters for eXTP: manufacturing and characterization** [11444-200]
- 11444 8FMechanical design and analysis of the eXTP satellite [11444-201]

POSTER SESSION: THESEUS

11444 8P	The XGIS instrument on-board THESEUS: Monte Carlo simulations for response, background, and sensitivity [11444-275]
11444 8Q	Scientific simulations and optimization of the XGIS instrument on board THESEUS [11444-276]
11444 8R	The XGIS instrument on-board THESEUS: the detection plane and on-board electronics [11444-277]
11444 8S	The XGIS imaging system onboard the THESEUS mission [11444-278]
11444 8X	The development of the THESEUS SXI optics [11444-283]
11444 8Y	Development of an imaging system for the THESEUS SXI instrument [11444-284]

POSTER SESSION: DETECTORS

11444 92	A software toolkit to simulate activation background for high energy detectors onboard satellites [11444-184]
11444 93	A summary on an investigation of GAGG:Ce afterglow emission in the context of future space applications within the HERMES nanosatellite mission [11444-185]
11444 94	Progress toward fast, low-noise, low-power CCDs for Lynx and other high-energy astrophysics missions [11444-186]
11444 95	Radiation testing of a small pixel, CMOS compatible CCD [11444-187]
11444 97	A revised model of the temporal behavior of the ACIS contamination layer on the Chandra X-ray Observatory [11444-190]
11444 9A	Preliminary results of the pixel characterization for the Crystal Eye, a new x- and γ -ray satellite detector for multi-messenger astronomy [11444-325]
11444 9B	MCPSim-Py: an open source python-based simulator of the performance of MCP photon- counting detectors [11444-333]

POSTER SESSION: HUBS

- 11444 9C Development of TES-based x-ray microcalorimeters for HUBS [11444-217]
- 11444 9F Making mock HUBS observations with IllustrisTNG [11444-220]
- 11444 9G Development of adiabatic demagnetization refrigerator for HUBS [11444-221]
- 11444 91 Preliminary architecture of integrated cooling system for the HUBS mission [11444-223]
- 11444 9J Developing x-ray microcalorimeters based on TiAu TES for HUBS [11444-224]