

PROCEEDINGS OF SPIE

Ground-based and Airborne Telescopes VIII

**Heather K. Marshall
Jason Spyromilio
Tomonori Usuda**
Editors

**14–22 December 2020
Online Only, United States**

Sponsored and Published by
SPIE

Volume 11445

Part One of Two Parts

Proceedings of SPIE 0277-786X, V. 11445

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

Ground-based and Airborne Telescopes VIII, edited by Heather K. Marshall, Jason Spyromilio,
Tomonori Usuda, Proc. of SPIE Vol. 11445, 1144501 · © 2020 SPIE
CCC code: 0277-786X/20/\$21 · doi: 10.1117/12.2591708

Proc. of SPIE Vol. 11445 1144501-1

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 SPIDigitalLibrary.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 *Ground-based and Airborne Telescopes VIII*, edited by Heather K. Marshall, Jason Spyromilio, Tomonori Usuda, Proceedings of SPIE Vol. 11445 (SPIE, Bellingham, WA, 2020) Seven-digit Article CID Number.

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

ISBN: 9781510636774
ISBN: 9781510636781 (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.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.org

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

SITE CHARACTERIZATION, TESTING, AND DEVELOPMENT

11445 06 **The University of Tokyo Atacama Observatory 6.5m telescope: site development** [11445-2]

ENCLOSURES

11445 08 **GMT site, enclosure, and facilities: 2020 design and construction update** [11445-4]

11445 09 **ELT design progress: The Dome structure** [11445-5]

11445 0A **Thirty Meter Telescope enclosure production readiness overview** [11445-6]

11445 0B **Procurement of the dome and the telescope structure of the ELT: update status report** [11445-7]

TELESCOPE STRUCTURES

11445 0I **Vera C. Rubin Observatory: Telescope and site status** [11445-14]

11445 0J **The SDSS-V local volume mapper telescope system** [11445-15]

11445 0M **Developing the ngVLA Radio Telescope 6m antenna** [11445-16]

PROJECT REVIEWS: ASSEMBLY, INTEGRATION, AND VERIFICATION

11445 0Q **Status of scientific commissioning of the Greenland Telescope** [11445-20]

METROLOGY AND ALIGNMENT

11445 0R **A laser-truss based optical alignment system on LBT** [11445-21]

11445 0T **The GMT Telescope metrology system: Easing the complexity of initial and operational alignment and increasing observing efficiency** [11445-23]

JOINT SESSION WITH CONFERENCES 11445 AND 11450: MODELING AS A DRIVER OF OBSERVATORY DESIGN I

- 11445 0W **Reactivation of the active mass damping system for SOFIA to improve image stability**
[11445-26]
- 11445 0X **The ELT early vibration assessment and for other Giant Telescopes** [11445-27]

GRAVITATIONAL WAVE OBSERVATORIES

- 11445 0Z **Current status of KAGRA (Invited Paper)** [11445-29]
- 11445 11 **Status and plans of the Virgo gravitational wave detector (Invited Paper)** [11445-31]

OBSERVATORIES UNDER CONSTRUCTION

- 11445 12 **The Square Kilometre Array project (Invited Paper)** [11445-243]
- 11445 14 **The University of Tokyo Atacama Observatory 6.5m Telescope: Overview and construction status (Invited Paper)** [11445-245]
- 11445 15 **Eastern Anatolia Observatory (DAG): the status in 2020 (Invited Paper)** [11445-246]

OBSERVATORIES IN DEVELOPMENT AND EARLY CONSTRUCTION

- 11445 19 **Planning of the Maunakea Spectroscopic Explorer preliminary design phase in an evolving astronomy landscape (Invited Paper)** [11445-250]
- 11445 1B **Progress toward improved water vapour radiometry: an overview of the South Africa-Mexico bilateral programme** [11445-193]

PROJECT REVIEWS: EXTREMELY LARGE TELESCOPES

- 11445 1E **The ESO's ELT construction progress (Invited Paper)** [11445-254]
- 11445 1F **Overview and status of the Giant Magellan Telescope project (Invited Paper)** [11445-255]

ELT OPTO-MECHANICAL SYSTEMS

- 11445 1G **The final design for the Extremely Large Telescope prefocal stations** [11445-256]
- 11445 1H **The purpose, plan, and progress of the Giant Magellan Telescope primary mirror off-axis segment test cell** [11445-257]

ELT WAVEFRONT AND PHASING II

- 11445 1N **Wavefront sensor for millimeter/submillimeter-wave adaptive optics based on aperture-plane interferometry** [11445-263]

ELT ENABLING TECHNOLOGIES

- 11445 1P **2216 epoxy bonds for TMT: performance, and precautions** [11445-265]
- 11445 1Q **Production of the world's largest convex ZERODUR mirror blank for the ELT** [11445-266]
- 11445 1R **High precision machining in TMT (Thirty Meter Telescope) structure manufacturing** [11445-267]

ASSEMBLY, INTEGRATION, AND VERIFICATION

- 11445 1T **Seimei 3.8-m Telescope has been commissioned** [11445-269]
- 11445 1U **Vera C. Rubin Observatory system integration, test, and commissioning: strategy and status** [11445-270]
- 11445 1Y **Status of the STUDIO UV balloon mission and platform** [11445-300]

PROJECT REVIEWS / EARLY OPERATIONS

- 11445 21 **Development of the SPECULOOS exoplanet search project (Invited Paper)** [11445-276]
- 11445 22 **The Large Millimeter Telescope (LMT) Alfonso Serrano: current status and telescope performance** [11445-277]

AIRBORNE TELESCOPES

11445 24 **Overview and status of EXCLAIM, the experiment for cryogenic large-aperture intensity mapping** [11445-279]

11445 26 **In-flight performance of the BLAST-TNG telescope platform** [11445-281]

OPTO-MECHANICAL SYSTEMS I

11445 27 **Wide-field ultra-narrow-bandpass imaging with the Dragonfly Telephoto Array** [11445-282]

11445 28 **Rubin Observatory primary tertiary mirror cell assembly: Mirror support system modeling and tuning** [11445-283]

11445 2A **The GMT's acquisition guiding and wavefront sensing system NOVEC-7100 cooling system** [11445-285]

OPTO-MECHANICAL SYSTEMS II

11445 2D **Rubin Observatory active optics system status** [11445-288]

CONCEPTS FOR FUTURE TELESCOPES I

11445 2F **The Atacama Large Aperture Submillimeter Telescope (AtLAST)** [11445-290]

11445 2I **Feasibility of NEO detection with a primary objective grating telescope** [11445-293]

11445 2J **PANOPTES: A citizen science project to discover exoplanets from your backyard using off-the-shelf hardware** [11445-294]

POSTER SESSION: ASSEMBLY, INTEGRATION, AND VERIFICATION

11445 2O **Sustaining mechanical systems of 3.6m optical telescope at Devasthal, India** [11445-32]

11445 2R **The University of Tokyo Atacama Observatory 6.5 m telescope: Development of the telescope and the control system** [11445-35]

11445 2S **LOCNES: A solar telescope to study the stellar activity in the near infrared** [11445-36]

11445 2T **Tor Vergata Synoptic Solar Telescope: spectral characterization of potassium KI D1 MOFs**
[11445-37]

POSTER SESSION: CONCEPTS FOR FUTURE TELESCOPES

11445 3I **Mini-tracker feasibility study results for the Southern African Large Telescope (SALT)** [11445-45]

11445 34 **Mezzocielo: an attempt to redesign the concept of wide field telescopes** [11445-48]

11445 35 **The Atacama Astronomical Park: a place to focus on science** [11445-49]

11445 37 **Study of higher order aberrations of an on-axis three-mirror telescope with an off-axis field of view** [11445-51]

11445 38 **Status of the East Asia ALMA development program: Towards the implementation of the ALMA development roadmap** [11445-52]

11445 39 **The Parkes Radio Telescope as a square kilometre array technology pathfinder** [11445-53]

11445 3B **About the development of the first fly-eye telescope** [11445-55]

11445 3D **The New Robotic Telescope: progress report** [11445-57]

11445 3E **Gearing up the SPEED wavefront shaping strategy** [11445-58]

11445 3I **Front end concept development for a next generation Very Large Array** [11445-62]

11445 3K **A domeless, mobile 2-meter telescope** [11445-64]

11445 3N **Scaling ALMA antenna to 50m and beyond: challenges and solutions** [11445-310]

POSTER SESSION: EXTREMELY LARGE TELESCOPES OPTO-MECHANICAL SYSTEMS

11445 3O **ESO ELT M5 unit: design and manufacturing status** [11445-76]

11445 3V **Mechanism prototyping for the GMT acquisition guiding and wavefront sensing system**
[11445-84]

POSTER SESSION: EXTREMELY LARGE TELESCOPES ENABLING TECHNOLOGIES

11445 3W **Arrayed wide-angle camera system for wide field imaging and spectroscopy on ELTs: proof-of-concept on-sky test results on McDonald Observatory 2.7m telescope** [11445-73]

Part Two

POSTER SESSION: FACILITY INFRASTRUCTURE

- 11445 40 **The University of Tokyo Atacama Observatory 6.5m telescope: Permafrost hazards and the high-altitude infrastructures** [11445-86]
- 11445 41 **Developing an install plan for the DKIST carousel cooling system** [11445-87]

POSTER SESSION: OPTO-MECHANICAL SYSTEMS

- 11445 43 **High dynamic-range observation using a 1.8-m off-axis telescope PLANETS: feasibility study and telescope design** [11445-120]
- 11445 45 **Advances for the 4m DAG Telescope in Flange derotator** [11445-122]
- 11445 47 **A new metrology method for optical fiber position detection** [11445-124]
- 11445 48 **MSE acquisition and guider system focal plane hardware conceptual design** [11445-125]
- 11445 49 **Conceptual design for the optomechanical systems of the New Robotic Telescope** [11445-126]
- 11445 4A **Stray light analysis and control for the Wide Field Survey Telescope (WFST)** [11445-127]
- 11445 4B **Rubin Observatory primary tertiary mirror cell assembly: integration and functional testing** [11445-128]
- 11445 4F **SUNRISE Chromospheric Infrared spectroPolarimeter (SCIP) for SUNRISE III: Scan mirror mechanism** [11445-133]
- 11445 4G **The Cassegrain focal station of the Gran Telescopio Canarias (GTC)** [11445-134]
- 11445 4J **Metrology of Deep Dish Development array (D3A) for precision alignment and surface deformation analysis** [11445-137]
- 11445 4S **New prime focus rotator system for the WHT** [11445-146]
- 11445 4T **Rubin Observatory primary tertiary mirror cell assembly: Optical testing of the fully assembled mirror support** [11445-147]
- 11445 4X **The multiple jet impingement heat rejecter prototype for the GREGOR Solar Telescope** [11445-151]

POSTER SESSION: TELESCOPE CONTROLS

- 11445 50 **Telescopio Nazionale Galileo control system upgrade, new milestone achieved: azimuth axis completed** [11445-205]
- 11445 52 **Towards new servo control algorithms at the TNG telescope** [11445-209]
- 11445 53 **Trajectory generation methods for radio and optical telescopes** [11445-302]
- 11445 54 **The unanticipated states of direct drive system of Extremely Large Telescope in extreme environment** [11445-304]
- 11445 55 **The unanticipated state recognition model of the large telescope drive system** [11445-305]

POSTER SESSION: TELESCOPE STRUCTURES

- 11445 56 **Conceptual design of a fast-slewing mount for the New Robotic Telescope** [11445-214]
- 11445 5A **Correcting primary reflector surface errors produced by excessive thermal dependence on the North American ALMA 12-meter antennas** [11445-218]
- 11445 5B **Development and performance analysis of CSTAR2 Antarctic telescope** [11445-219]
- 11445 5G **ELT design progress: The main structure** [11445-224]
- 11445 5J **Moving towards daytime observing at the Large Millimeter Telescope** [11445-227]

POSTER SESSION: ENCLOSURES AND FACILITIES

- 11445 5Y **Effect of the lack of the windscreen at Subaru Telescope** [11445-69]
- 11445 62 **NEOSTED infrastructures: The fastest dome on Earth!** [11445-311]

POSTER SESSION: FACILITY INFRASTRUCTURE: COATING PLANTS

- 11445 64 **The University of Tokyo Atacama Observatory 6.5m Telescope: Design of mirror coating system and its performances II** [11445-90]
- 11445 65 **Improving the UV reflectance of the aluminum coating of the 4m SOAR Telescope in the Gemini 8-m sputtering coating facility** [11445-91]

POSTER SESSION: FACILITY INFRASTRUCTURE: SAFETY

- 11445 67 **The University of Tokyo Atacama Observatory 6.5m telescope: Safety management at the extremely high Chajnantor site [11445-93]**

POSTER SESSION: METROLOGY AND ALIGNMENT

- 11445 6A **Alignment of the optical system of the 9.7-m prototype Schwarzschild-Couder Telescope [11445-96]**
- 11445 6B **Research on reference fiber for closed-loop measurement of Spectral Survey Telescope [11445-97]**
- 11445 6C **The laser antenna surface scanning instrument [11445-98]**
- 11445 6D **Holographic surface measurement system for the Fred Young Submillimeter Telescope [11445-99]**
- 11445 6E **The structure monitoring of the MST prototype of CTA [11445-100]**
- 11445 6F **Analysis of LAMOST optical fiber positioning units closed-loop operation by dual-telecentric measurement system [11445-101]**
- 11445 6G **Out-of-focus holography at the Sardinia Radio Telescope [11445-102]**
- 11445 6J **Precision alignment and integration of DESI's focal plane using a laser tracker [11445-105]**

POSTER SESSION: MODELING AS A DRIVER OF OBSERVATORY DESIGN

- 11445 6P **The real throughput: Site plus optics plus in-situ cleaning for an optical-IR telescope [11445-111]**
- 11445 6T **Vibration measurements in astronomical observatories toward robust AO and instrument designs [11445-115]**
- 11445 6U **The Herzberg Astronomy and Astrophysics Research Centre's vibration measurement capabilities with applications to astronomical instrumentation [11445-116]**
- 11445 6V **ELT M4 system robustness improvement through the addition of active damping [11445-117]**
- 11445 6Y **The research of intelligentization of control systems for large astronomical optical telescopes [11445-306]**

POSTER SESSION: RADIO/SUBMILLIMETER TELESCOPES

- 11445 71 **The signal processing chain of the Low Frequency Aperture Array** [11445-173]
- 11445 74 **Design and prototyping of the Italian Tile Processing Module 1.6 (ITPM) for the low-frequency aperture array deployment** [11445-176]
- 11445 75 **ALMA front-end and digitizer technical requirements for enabling the ALMA board's 2030 vision roadmap** [11445-177]
- 11445 79 **Sardinia aperture array demonstrator: measurement campaigns of radio frequency interferences** [11445-301]
- 11445 7A **The Balloon-borne Large Aperture Submillimeter Telescope Observatory** [11445-303]
- 11445 7B **Status of the Sardinia Radio Telescope as a receiver of the BIRALET radar for space debris observations** [11445-307]
- 11445 7C **The Baryon Mapping eXperiment: a 21 cm intensity mapping pathfinder** [11445-308]

POSTER SESSION: PROJECT REVIEWS

- 11445 7F **Current status and future plan of Osaka Prefecture University 1.85-m mm-submm telescope project** [11445-156]
- 11445 7G **The Gravitational-wave Optical Transient Observer (GOTO)** [11445-157]
- 11445 7I **Status and performance of Lowell Observatory's Lowell Discovery Telescope's active optical support system** [11445-159]
- 11445 7L **Simons Observatory Small Aperture Telescope overview** [11445-162]
- 11445 7M **Development of the Multi-channel Photometric Survey telescope** [11445-163]
- 11445 7Q **On-site performance of GroundBIRD, a CMB polarization telescope for large angular scale observations** [11445-167]
- 11445 7R **The Tierras Observatory: An ultra-precise photometer to characterize nearby terrestrial exoplanets** [11445-168]
- 11445 7U **SkyLab: Research and development facility for ground-based observations** [11445-309]

POSTER SESSION: SITE CHARACTERIZATION, TESTING, AND DEVELOPMENT

- 11445 80 **Preliminary design of a dual 22/31 GHz single-chip water vapour radiometer** [11445-186]

- 11445 82 **Simulation of atmospheric conditions using a numerical weather prediction model at Dome A, Antarctic: Method and preliminary results** [11445-189]
- 11445 86 **Embedded system upgrade based on Raspberry Pi computer for a 23/31 GHz dual-channel water vapor radiometer** [11445-195]

POSTER SESSION: TELESCOPE ARRAYS

- 11445 89 **A prototype model for evaluating SKA-LOW station calibration** [11445-198]
- 11445 8A **Incoherent clocking for radio telescopes** [11445-199]
- 11445 8B **Panoramic SETI: Overall mechanical system design** [11445-200]

POSTER SESSION: WAVEFRONT, ALIGNMENT, AND PHASING

- 11445 8G **A pentaprism-based opto-mechanical alignment method for Nasmyth telescopes, such as the 4m SOAR telescope and the LSST's 1.2m auxiliary telescope** [11445-236]
- 11445 8L **Upgrading the SOAR telescope calibration wave front sensor system** [11445-241]