

PROCEEDINGS OF SPIE

Techniques and Instrumentation for Detection of Exoplanets X

**Stuart B. Shaklan
Garreth J. Ruane**
Editors

**1–5 August 2021
San Diego, California, United States**

Sponsored and Published by
SPIE

Volume 11823

Proceedings of SPIE 0277-786X, V. 11823

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 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 *Techniques and Instrumentation for Detection of Exoplanets X*, edited by Stuart B. Shaklan, Garreth J. Ruane, Proc. of SPIE 11823, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510644847

ISBN: 9781510644854 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2021 Society of Photo-Optical Instrumentation Engineers (SPIE).

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 fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center 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.

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: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE 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

GROUND-BASED INSTRUMENTS

- 11823 02 **High resolution spectroscopy of directly imaged exoplanets with KPIC (Invited Paper)** [11823-1]
- 11823 03 **SCEXAO: a testbed for developing high-contrast imaging technologies for ELTs** [11823-2]
- 11823 04 **A new type of exoplanet direct imaging search: a SCEXAO/CHARIS survey of accelerating stars** [11823-3]
- 11823 06 **Data-driven subspace predictive control: lab demonstration and future outlook** [11823-8]
- 11823 08 **Information content approach to trade studies for SCALES** [11823-7]
- 11823 09 **The Planetary Systems Imager adaptive optics system: an initial optical design and performance analysis tool for the PSI-Red AO system** [11823-9]

IMAGING, SPECTROSCOPY, AND POLARIZATION I

- 11823 0A **Broadband vortex fiber nulling: high-dispersion exoplanet science at the diffraction limit** [11823-12]
- 11823 0B **Design considerations of photonic lanterns for diffraction-limited spectrometry** [11823-13]
- 11823 0C **Very high angular resolution spectro-interferometry with wavefront sensing capabilities on Subaru/SCEXAO using photonics** [11823-11]
- 11823 0D **High-contrast integral field spectropolarimetry of planet-forming disks with SCEXAO/CHARIS** [11823-10]
- 11823 0E **From colors to chemistry: a combined lenslet/slicer IFS for medium-resolution spectroscopy** [11823-14]

MULTI-PLANET SYSTEMS

- 11823 0F **Planet matching and orbit determination in multi-planet systems for exoplanet direct imaging** [11823-15]

IMAGING, SPECTROSCOPY, AND POLARIZATION II

- 11823 OG **Imaging low-mass planets within the habitable zones of nearby stars with ground-based mid-infrared imaging (Invited Paper)** [11823-16]
- 11823 OH **Simulating JWST high contrast observations with PanCAKE** [11823-17]
- 11823 OJ **Testing a 10 micron HgCdTe detector for ground-based exoplanet science** [11823-18]
- 11823 OK **Trade-off study of a high-resolution spectrograph on a CubeSat to study exoplanets** [11823-20]

DEFORMABLE MIRRORS

- 11823 OL **Deriving deformable mirror performance requirements in simulation** [11823-32]
- 11823 OM **Environmental testing of high-actuator-count MEMS deformable mirrors for space-based applications** [11823-33]

CORONAGRAPHS I

- 11823 OO **Results from the laboratory demonstration of a PIAACMC coronagraph with a segmented aperture** [11823-25]
- 11823 OP **New method to achieve the proper polarization state for a vector vortex coronagraph** [11823-26]
- 11823 OQ **High contrast demonstrations of novel scalar vortex coronagraph designs at the high contrast spectroscopy testbed** [11823-80]
- 11823 OR **Model validation of phase-induced amplitude apodization complex mask coronagraph for LUVUOIR-A in vacuum** [11823-24]
- 11823 OS **High contrast imaging with MEMS deformable mirrors in the Decadal Survey testbed** [11823-23]

CORONAGRAPHS II

- 11823 OV **Wavefront control with algorithmic differentiation on the HiCAT testbed** [11823-28]
- 11823 OW **Theoretical performance limits for coronagraphs on obstructed and unobstructed apertures: how much can current designs be improved?** [11823-31]
- 11823 OX **The PICTURE-C exoplanetary direct imaging balloon mission: first flight preparation** [11823-30]

11823 0Y **The Twin decadal survey testbeds in the high contrast imaging testbed facility at NASA's Jet Propulsion Laboratory** [11823-22]

ROMAN CORONAGRAPH INSTRUMENT

11823 10 **The Roman Space Telescope coronagraph technology demonstration: current status and relevance to future missions (Invited Paper)** [11823-79]

11823 11 **Enabling binary stars high-contrast imaging on the Roman Space Telescope coronagraph instrument** [11823-54]

STARSHADES

11823 12 **Optical experiments and model validation of perturbed starshade designs** [11823-56]

11823 13 **Catching the rays: modeling the stray light background of a starshade** [11823-57]

WAVEFRONT SENSING AND CONTROL I

11823 18 **High contrast imaging at the photon noise limit with self-calibrating WFS/C systems** [11823-37]

11823 1A **Wavefront sensing using non-redundant aperture masking interferometry: tests and validation on Subaru/SCEAO** [11823-39]

11823 1B **The bright pyramid wavefront sensor** [11823-41]

11823 1C **Data-driven subspace predictive control: lab demonstration and future outlook** [11823-42]

11823 1D **The Santa Cruz Extreme AO Lab (SEAL): design and first light** [11823-35]

11823 1E **Fast and furious focal-plane wavefront sensing at W.M. Keck Observatory** [11823-36]

11823 1F **Status of predictive wavefront control on Keck II adaptive optics bench: on-sky coronagraphic results** [11823-43]

WAVEFRONT SENSING AND CONTROL II

11823 1H **First experimental results of the fast atmospheric self-coherent camera technique on the Santa Cruz extreme adaptive optics laboratory testbed: demonstration of high speed focal plane wavefront control of residual atmospheric speckles** [11823-76]

- 11823 1J **Strategies for high order wavefront sensing and control (HOWFSC) computation on future space telescopes** [11823-47]
- 11823 1K **Dark zone maintenance results for segmented aperture wavefront error drift in a high contrast space coronagraph** [11823-48]
- 11823 1L **LUVOIR-ECLIPS closed-loop adaptive optics performance and contrast predictions** [11823-50]
- 11823 1M **Experimental validation of active control of low-order aberrations with a Zernike sensor through a Lyot coronagraph** [11823-46]
- 11823 1O **Multi-star wavefront control with SCEAO instrument: demonstration with an internal source** [11823-51]
- 11823 1P **Initial super-Nyquist wavefront control experiments in the Decadal Survey Testbed** [11823-52]

POSTER SESSION

- 11823 1Q **Implementation of a broadband focal plane estimator for high-contrast dark zones** [11823-62]
- 11823 1R **Performance of large-format deformable mirrors constructed with hybrid variable reluctance actuators II: initial lab results from FLASH** [11823-69]
- 11823 1S **Design and commissioning of an in-air coronagraph testbed in the HCIT facility at NASA's Jet Propulsion Laboratory** [11823-78]
- 11823 1T **Dual-polarization electric field conjugation and applications for vector vortex coronagraphs** [11823-64]
- 11823 1U **Confirming transiting exoplanets with the Fraunhofer Telescope Wendelstein** [11823-63]
- 11823 1V **Cold-stop and Lyot stop designs for a new Infrared Exoplanet Imager at Keck Observatory** [11823-66]
- 11823 1W **Cryogenic test results of the SCALES focal plane coronagraph mechanism** [11823-68]
- 11823 1Y **Flight mask designs of the Roman Space Telescope coronagraph instrument** [11823-72]