

PROCEEDINGS OF SPIE

***UV/Optical/IR Space Telescopes:  
Innovative Technologies and  
Concepts IV***

**Howard A. MacEwen  
James B. Breckinridge**  
*Editors*

**3 August 2009  
San Diego, California, United States**

*Sponsored and Published by*  
SPIE

**Volume 7436**

Proceedings of SPIE, 0277-786X, v. 7436

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

The papers included 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. The papers published in these proceedings 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 this book:

Author(s), "Title of Paper," in *UV/Optical/IR Space Telescopes: Innovative Technologies and Concepts IV*, edited by Howard A. MacEwen, James B. Breckinridge, Proceedings of SPIE Vol. 7436 (SPIE, Bellingham, WA, 2009) Article CID Number.

ISSN 0277-786X

ISBN 9780819477262

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 © 2009, 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 \$18.00 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](http://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/09/\$18.00.

Printed in the United States of America.

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

**SPIE**   
Digital Library

[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

**Paper Numbering:** Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four 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. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

# Contents

vii	<i>Conference Committee</i>
ix	<i>Introduction</i>

---

## SESSION 1 SYSTEMS

---

- 7436 02 **Preliminary cost model for space telescopes** [7436-01]  
H. P. Stahl, F. A. Prince, NASA Marshall Space Flight Ctr. (United States); C. Smart, SAIC (United States); K. Stephens, College of Optical Sciences, Univ. of Arizona (United States); T. Henrichs, Middle Tennessee State Univ. (United States)
- 7436 03 **Observatory conceptual development for the Joint Dark Energy Mission** [7436-02]  
M. J. Sholl, Lawrence Berkeley National Lab. (United States); G. M. Bernstein, Univ. of Pennsylvania (United States); D. A. Content, NASA Goddard Space Flight Ctr. (United States); M. G. Dittman, Ball Aerospace & Technologies Corp. (United States); J. M. Howard, NASA Goddard Space Flight Ctr. (United States); M. L. Lampton, Lawrence Berkeley National Lab. (United States); J. P. Lehan, Univ. of Maryland, Baltimore County (United States); J. E. Mentzell, NASA Goddard Space Flight Ctr. (United States); R. A. Woodruff, Lockheed Martin Space Systems (United States)
- 7436 04 **Euclid Mission: assessment study** [7436-03]  
D. H. Lumb, L. Duvet, R. Laurijs, M. Te Plate, I. Escudero Sanz, G. Saavedra Criado, European Space Agency (Netherlands)
- 7436 05 **Assessment study of the SPICA telescope assembly** [7436-05]  
N. Rando, O. Brunner, D. Doyle, B. Fransen, A. Heras, J. M. Lautier, M. Linder, L. Popken, European Space Agency, ESTEC (Netherlands); T. Nakagawa, JAXA (Japan)
- 7436 06 **The new worlds observer: the astrophysics strategic mission concept study** [7436-06]  
W. Cash, Univ. of Colorado, Boulder (United States); S. Kendrick, C. Noecker, Ball Aerospace & Technologies Corp. (United States); J. Bally, J. DeMarines, J. Green, P. Oakley, A. Shipley, Univ. of Colorado at Boulder (United States); S. Benson, S. Oleson, NASA Glenn Research Ctr. (United States); D. Content, D. Folta, S. Garrison, K. Gendreau, K. Hartman, J. Howard, T. Hyde, D. Lakins, J. Leitner, D. Leviton, R. Luquette, B. Oegerley, K. Richon, A. Roberge, S. Tompkins, J. Tveekrem, B. Woodgate, NASA Goddard Space Flight Ctr. (United States); M. Turnbull, Space Telescope Science Institute (United States); D. Dailey, K. Decker, R. Dehmohseni, B. Gaugh, T. Glassman, M. Haney, R. Hejal, C. Lillie, A. Lo, D. O'Conner, G. Oleas, R. Polidan, S. Shields, J. Shirvanian, D. SooHoo, Northrop Grumman Aerospace Systems (United States); G. Tinetti, Univ. College London (United Kingdom); B. Dorland, R. Dudik, R. Gaume, B. Mason, U.S. Naval Observatory (United States)

---

**SESSION 2 LARGE SYSTEMS**

---

- 7436 07 **Potential astrophysics science missions enabled by NASA's planned Ares V** [7436-07]  
H. P. Stahl, NASA Marshall Space Flight Ctr. (United States); H. Thronson, NASA Goddard Space Flight Ctr. (United States); S. Langhoff, NASA Ames Research Ctr. (United States); M. Postman, Space Telescope Science Institute (United States); D. Lester, The Univ. of Texas at Austin (United States); C. F. Lillie, Northrop Grumman Space Technology (United States); R. J. Brissenden, Smithsonian Astrophysical Observatory (United States)
- 7436 08 **Large segmented UV-optical space telescope using a Hybrid Sensor Active Control (HSAC) architecture** [7436-08]  
L. D. Feinberg, B. Dean, T. Hyde, B. Oegerle, M. R. Bolcar, J. S. Smith, NASA Goddard Space Flight Ctr. (United States)
- 7436 09 **Design for an 8-meter monolithic UV/OIR space telescope** [7436-10]  
H. P. Stahl, NASA Marshall Space Flight Ctr. (United States); M. Postman, Space Telescope Science Institute (United States); W. R. Arnold, Sr., NASA Marshall Space Flight Ctr. (United States); R. Hopkins, NASA Marshall Space Flight Ctr. (United States); L. Hornsby, NASA Marshall Space Flight Ctr. (United States); G. E. Mosier, B. A. Pasquale, NASA Goddard Space Flight Ctr. (United States)
- 7436 0A **Stellar imager (SI): enhancements to the mission enabled by the constellation architecture (Ares I/Ares V)** [7436-09]  
K. G. Carpenter, NASA Goddard Space Flight Ctr. (United States); M. Karovska, SAO (United States); R. G. Lyon, NASA Goddard Space Flight Ctr. (United States); D. Mozurkewich, Seabrook Engineering (United States); C. Schrijver, Lockheed Martin Space Systems Co. (United States)
- 7436 0B **Lightweight optical barrel assembly structures for large deployable space telescopes** [7436-11]  
P. A. Warren, M. J. Silver, B. J. Dobson, QinetiQ North America (United States)

---

**SESSION 3 JWST**

---

- 7436 0C **Optical modeling activities for NASA's James Webb Space Telescope (JWST): VI. secondary mirror figure compensation using primary mirror segment motions** [7436-12]  
J. M. Howard, L. D. Feinberg, NASA Goddard Space Flight Ctr. (United States)
- 7436 0D **Phase retrieval on broadband and under-sampled images for the JWST testbed telescope** [7436-13]  
J. S. Smith, D. L. Aronstein, B. H. Dean, NASA Goddard Space Flight Ctr. (United States); D. S. Acton, Ball Aerospace & Technologies Corp. (United States)
- 7436 0E **Non-invasive optical end-to-end test of a large TMA telescope (JWST) from the intermediate focus** [7436-14]  
T. Whitman, ITT Corp. (United States); J. S. Knight, Ball Aerospace & Technologies Corp. (United States); M. Waldman, Sigma Space Corp. (United States); P. Lightsey, Ball Aerospace & Technologies Corp. (United States)

---

**SESSION 4 NEW CONCEPTS**

---

- 7436 0F **Propellantless precision formation flying with photonic laser thrusters for large space telescopes** [7436-15]  
Y. K. Bae, Y.K. Bae Corp. (United States)
- 7436 0G **Optical pathlength stabilization between formation-flying air-bearing robots** [7436-16]  
E. A. LeMaster, Lockheed Martin Advanced Technology Ctr. (United States)
- 7436 0H **Working model of a gossamer membrane spectrographic space telescope** [7436-17]  
T. D. Ditto, 3DeWitt, LLC (United States); J. Ritter, J. Valliant, Univ. of Hawaii (United States)
- 7436 0I **The lunar radio array (LRA)** [7436-18]  
J. Lazio, Naval Research Lab. (United States); C. Carilli, National Radio Astronomy Observatory (United States); J. Hewitt, Massachusetts Institute of Technology (United States); S. Furlanetto, Univ. of California, Los Angeles (United States); J. Burns, Univ. of Colorado, Boulder (United States) and LUNAR Consortium (United States)

---

**SESSION 5 OPTICAL TECHNOLOGY**

---

- 7436 0L **Vibroacoustic analysis and optimization of lightweight silicon carbide mirrors** [7436-21]  
L. E. Cohan, D. W. Miller, Massachusetts Institute of Technology (United States)
- 7436 0M **Minimizing high spatial frequency residual error in active space telescope mirrors** [7436-22]  
T. L. Gray, M. W. Smith, L. E. Cohan, D. W. Miller, Massachusetts Institute of Technology (United States)
- 7436 0N **Photonic muscle active optics for space telescopes (active optics with  $10^{23}$  actuators)** [7436-23]  
J. Ritter, Univ. of Hawaii (United States)

---

**SESSION 6 POSTER SESSION**

---

- 7436 0O **DMD multi-object spectroscopy in space: the EUCLID study** [7436-04]  
P. Spanò, Osservatorio Astronomico di Brera, INAF (Italy); F. Zamkotsian, Lab. d'Astrophysique de Marseille, CNRS (France); R. Content, Durham Univ. (United Kingdom); R. Grange, Lab. d'Astrophysique de Marseille, CNRS (France); M. Robberto, Space Telescope Science Institute (United States); L. Valenziano, Istituto Astrofisica Spaziale Fisica Cosmica, INAF (Italy); F. M. Zerbi, Osservatorio Astronomico di Brera, INAF (Italy); R. M. Sharples, Durham Univ. (United Kingdom); F. Bortoletto, Osservatorio Astronomico di Padova, INAF (Italy); V. De Caprio, Istituto Astrofisica Spaziale Fisica Cosmica, INAF (Italy); L. Martin, Lab. d'Astrophysique de Marseille, CNRS (France); A. De Rosa, Istituto Astrofisica Spaziale Fisica Cosmica, INAF (Italy); P. Franzetti, Istituto di Astrofisica Spaziale di Milano, INAF (Italy); E. Diolaiti, Osservatorio Astronomico di Brera, INAF (Italy); B. Garilli, Istituto Astrofisica Spaziale Fisica Cosmica, INAF (Italy); L. Guzzo, Osservatorio Astronomico di Brera, INAF (Italy); P. Leutenegger, Thales Alenia Spazio Italia (Italy); M. Scodreggio, Istituto Astrofisica Spaziale Fisica Cosmica, INAF (Italy); R. Vink, TNO Science and Industry (Netherlands); G. Zamorani, Osservatorio Astronomico di Bologna, INAF (Italy); A. Cimatti, Univ. degli Studi di Bologna (Italy)

- 7436 OP **Low dispersion ghost-controlled optical window/combiner component** [7436-24]  
P. Atcheson, Ball Aerospace & Technologies Corp. (United States)
- 7436 OQ **Measurement of vibration environment of 6m-diameter radiometer thermal vacuum chamber in JAXA** [7436-25]  
H. Katayama, Y. Yamamoto, M. Miyamoto, H. Saruwatari, Japan Aerospace Exploration Agency (Japan); H. Kaneda, Nagoya Univ. (Japan); Y. Tange, Japan Aerospace Exploration Agency (Japan)
- 7436 OS **Optical testing of the Kepler Photometer in a thermal vacuum environment at Ball Aerospace** [7436-27]  
M. A. Martella, D. A. Byrd, S. Willis, P. Spuhler, N. Siegel, C. Stewart, Ball Aerospace & Technologies Corp. (United States)
- 7436 OT **Semiconductor laser tracking frequency distance gauge** [7436-32]  
J. D. Phillips, R. D. Reasenberg, Harvard-Smithsonian Ctr. for Astrophysics (United States)

*Author Index*

# Conference Committee

## *Program Track Chair*

**Oswald H. Siegmund**, University of California, Berkeley (United States)

## *Conference Chairs*

**Howard A. MacEwen**, ManTech SRS Technologies (United States)

**James B. Breckinridge**, Jet Propulsion Laboratory (United States)

## *Program Committee*

**Suzanne Casement**, Northrop Grumman Space Technology  
(United States)

**Webster C. Cash, Jr.**, University of Colorado at Boulder (United States)

**Jennifer A. Dooley**, Jet Propulsion Laboratory (United States)

**Lee D. Feinberg**, NASA Goddard Space Flight Center (United States)

**David T. Leisawitz**, NASA Goddard Space Flight Center (United States)

**Daniel F. Lester**, The University of Texas at Austin (United States)

**Gary Matthews**, ITT Industries, Inc. (United States)

**David W. Miller**, Massachusetts Institute of Technology (United States)

**C. Matt Mountain**, Space Telescope Science Institute (United States)

**Ronald S. Polidan**, Northrop Grumman Space Technology  
(United States)

**Stuart B. Shaklan**, Jet Propulsion Laboratory (United States)

**H. Philip Stahl**, NASA Marshall Space Flight Center (United States)

**Mark T. Stier**, Goodrich Corp. (United States)

**Domenick J. Tenerelli**, Lockheed Martin Space Systems Company  
(United States)

## *Session Chairs*

- 1 Systems  
**C. Matt Mountain**, Space Telescope Science Institute (United States)  
**Howard A. MacEwen**, ManTech SRS Technologies (United States)
- 2 Large Systems  
**Ronald S. Polidan**, Northrop Grumman Space Technology  
(United States)
- 3 JWST  
**James B. Breckinridge**, Jet Propulsion Laboratory (United States)

- 4 New Concepts  
**H. Philip Stahl**, NASA Marshall Space Flight Center (United States)
- 5 Optical Technology  
**Gary Matthews**, ITT Corporation (United States)

## Introduction

This conference concentrates on new innovative ideas for astronomical telescopes and technologies. It provides an opportunity for scientists and engineers to come together and communicate revolutionary ideas for the next generation telescopes and their supporting technologies. Astronomers are now preparing material for the National Academy of Sciences 2010 Decadal report supported by NSF, NASA, and DOE. This document sets priorities for the astronomical community in space and ground astronomy for the next 10 years. Many new concepts have been developed recently and some were presented here.

To maximize the science return at minimum cost is critically important to the success of the next astronomy and astrophysics space missions. The development of new technology driven by scientific measurement requirements will enable cost savings in the future.

Phil Stahl presented an important paper on cost models for ground and space telescopes. Reports were given on concepts for the high priority Joint Dark Energy Mission.

New information was provided on the New World's Observer, a very innovative approach to the detection and characterization of exoplanetary systems.

The next generation optical UV telescope may need to be 8-meters aperture in order to achieve high-priority objectives of the scientific community. Several papers were presented on this topic. Ken Carpenter presented the results of his study on the Stellar Imager, which will be a 100 to 1000 meter baseline aperture interferometer with a focal length of 1 to 10 km designed to provide information that will enable the reconstruction of an image across the surface of stars.

In summary this meeting was very successful and we all look forward to the Astronomical Telescopes and Instruments biennial meeting to be held in San Diego, summer 2010.

**James B. Breckinridge**  
**Howard A. MacEwen**

