

PROCEEDINGS OF SPIE

Infrared Spaceborne Remote Sensing and Instrumentation XV

Marija Strojnik-Scholl
Editor

27–30 August 2007
San Diego, California, USA

Sponsored and Published by
SPIE

Volume 6678

Proceedings of SPIE, 0277-786X, v. 6678

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 *Infrared Spaceborne Remote Sensing and Instrumentation XV*, edited by Marija Strojnik-Scholl, Proceedings of SPIE Vol. 6678 (SPIE, Bellingham, WA, 2007) Article CID Number.

ISSN 0277-786X

ISBN 9780819468260

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 © 2007, 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. 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/07/\$18.00.

Printed in the United States of America.

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

The logo for SPIE Digital Library features the word "SPIE" in a bold, sans-serif font above the words "Digital Library" in a similar font. To the right of the text is a stylized graphic consisting of three vertical bars of increasing height, resembling a bar chart or a signal waveform.

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

ix *Conference Committee*

SESSION 1 FAR INFRARED AND SUBMILLIMETER TECHNOLOGY

- 6678 03 **Noise temperature of a 4.3 THz HEB receiver** [6678-31]
P. Khosropanah, W. M. Laauwen, SRON Netherlands Institute for Space Research, Landleven (Netherlands); J.-R. Gao, M. Hajenius, SRON Netherlands Institute for Space Research, Sorbonnelaan (Netherlands) and Delft Univ. of Technology (Netherlands); J. N. Hovenier, T. M. Klapwijk, Delft Univ. of Technology (Netherlands)
- 6678 04 **Technologies for cooling of large distributed and deployable loads** [6678-33]
A. Kashani, J. R. Maddocks, Atlas Scientific (USA); G. F. Nellis, Univ. of Wisconsin, Madison (USA); Y. B. Gianchandani, Univ. of Michigan, Ann Arbor (USA)
- 6678 05 **The first look at SB349: a 32x32 CTIA readout multiplexer for far IR focal-plane arrays** [6678-34]
J. Farhoomand, TechnoScience Corp. (USA) and NASA Ames Research Ctr. (USA); J. W. Beeman, TechnoScience Corp. (USA) and Lawrence Berkeley National Lab. (USA); D. Hoang, NASA Ames Research Ctr. (USA) and Enterprise Advisory Services, Inc. (USA)
- 6678 06 **Technology developments toward large format long wavelength bolometer arrays** [6678-36]
C. A. Allen, D. J. Benford, T. M. Miller, S. H. Moseley, NASA Goddard Space Flight Ctr. (USA); J. G. Staguhn, NASA Goddard Space Flight Ctr. (USA) and Univ. of Maryland, College Park (USA); E. J. Wollack, NASA Goddard Space Flight Ctr. (USA)
- 6678 07 **Sensitive detectors of terahertz radiation based on $Pb_{1-x}Sn_xTe(In)$** [6678-37]
D. Khokhlov, Moscow State Univ. (Russia)
- 6678 08 **Transients in stressed Ge:Ga photoconductors under high background for PACS** [6678-38]
J. M. Stegmaier, S. M. Birkmann, U. Grözinger, Max-Planck-Institut für Astronomie (Germany); N. Haegel, Naval Postgraduate School (USA); D. Lemke, O. Krause, Max-Planck-Institut für Astronomie (Germany)
- 6678 09 **Far-infrared blocked impurity band detector development** [6678-39]
H. H. Hogue, M. T. Guptill, J. C. Monson, J. W. Stewart, DRS Sensors and Targeting Systems (USA); J. E. Huffman, Lawrence Semiconductor Research Lab. (USA); M. G. Mlynczak, M. N. Abedin, NASA Langley Research Ctr. (USA)

SESSION 2 SOFIA INSTRUMENTATION

- 6678 0A **Stratospheric Observatory for Infrared Astronomy (SOFIA)** [6678-46]
E. E. Becklin, Universities Space Research Association, NASA Ames Research Ctr. (USA)
A. G. G. M. Tielens, NASA Ames Research Ctr. (USA); R. D. Gehrz, Univ. of Minnesota (USA);
H. H. S. Callis, Universities Space Research Association, NASA Ames Research Ctr. (USA)

- 6678 OD **Far-infrared polarimetry from the Stratospheric Observatory for Infrared Astronomy** [6678-48]
 J. E. Vaillancourt, California Institute of Technology (USA); D. T. Chuss, NASA Goddard Space Flight Ctr. (USA); R. M. Crutcher, Univ. of Illinois, Urbana (USA); J. L. Dotson, NASA Ames Research Ctr. (USA); C. D. Dowell, California Institute of Technology (USA) and Jet Propulsion Lab. (USA); D. A. Harper, R. H. Hildebrand, Univ. of Chicago (USA); T. J. Jones, Univ. of Minnesota (USA); A. Lazarian, Univ. of Wisconsin (USA); G. Novak, Northwestern Univ. (USA); M. W. Werner, Jet Propulsion Lab. (USA)
- 6678 OE **THIS: a tuneable heterodyne infrared spectrometer for SOFIA** [6678-49]
 R. Schieder, G. Sonnabend, M. Sornig, P. Kroetz, D. Stupar, Univ. of Cologne (Germany)
- 6678 OF **Mid-IR polarimetry: new vistas for SOFIA** [6678-50]
 C. C. Packham, Univ. of Florida (USA); D. J. Axon, Rochester Institute of Technology (USA); J. H. Hough, Univ. of Hertfordshire (United Kingdom); T. J. Jones, Univ. of Minnesota (USA); P. F. Roche, Oxford Univ. (United Kingdom); M. Tamura, National Astronomical Observatory of Japan (Japan); C. M. Telesco, Univ. of Florida (USA)
- 6678 OH **A far-infrared mapping spectrometer for SOFIA** [6678-52]
 T. Nikola, G. J. Stacey, T. Herter, Cornell Univ. (USA)
- 6678 OJ **AIRES: an airborne infrared echelle spectrometer for SOFIA** [6678-13]
 E. F. Erickson, M. R. Haas, S. J. W. Colgan, J. L. Dotson, NASA Ames Research Ctr. (USA); J. P. Simpson, SETI Institute (USA); E. T. Young, Steward Observatory, Univ. of Arizona (USA)
- 6678 OK **GREAT: the German first light heterodyne instrument for SOFIA** [6678-65]
 U. U. Graf, Univ. zu Köln (Germany); S. Heyminck, R. Güsten, Max-Planck-Institut für Radioastronomie (Germany); P. Hartogh, Max-Planck-Institut für Sonnensystemforschung (Germany); H.-W. Hübers, DLR, Institut für Planetenforschung (Germany); J. Stutzki, Univ. zu Köln (Germany); J. Faist, M. Fischer, ETH, Institut für Quantenelektronik (USA); K. Jacobs, M. Philipp, Univ. zu Köln (Germany); D. Rabanus, Univ. zu Köln (Germany) and European Southern Observatory (Chile); A. Semenov, DLR, Institut für Planetenforschung (Germany); P. van der Wal, Max-Planck-Institut für Radioastronomie (Germany); A. Wagner-Gentner, Univ. zu Köln (Germany); C. Walther, ETH, Institut für Quantenelektronik (Switzerland); M. Wiedner, Univ. zu Köln (Germany)

SESSION 3 IMAGE PROCESSING AND TECHNOLOGIES

- 6678 OL **Shadowed object detection for hyperspectral imagery (Invited Paper)** [6678-40]
 R. Mayer, J. Antoniadis, M. Baumbach, D. Chester, J. Edwards, A. Goldstein, D. Haas, S. Henderson, BAE Systems (USA)
- 6678 OM **Pyroelectric linear arrays and their application** [6678-41]
 V. Norkus, Technische Univ. Dresden (Germany) and DIAS Infrared GmbH (Germany); G. Gerlach, Technische Univ. Dresden (Germany); R. Köhler, G. Hofmann, DIAS Infrared GmbH (Germany)
- 6678 OP **Absolute flux calibrations of stars** [6678-04]
 G. T. Fraser, S. W. Brown, H. W. Yoon, B. C. Johnson, K. R. Lykke, National Institute of Standards and Technology (USA)

SESSION 4 ADVANCED DETECTORS AND TECHNOLOGIES

- 6678 0Q **A microshutter-based field selector for JWST's multi-object near infrared spectrograph** [6678-35]
R. F. Silverberg, NASA Goddard Space Flight Ctr. (USA); R. Arendt, Univ. of Maryland, College Park (USA); D. E. Franz, NASA Goddard Space Flight Ctr. (USA); G. Kletetschka, Catholic Univ. (USA); A. Kuttyrev, Univ. of Maryland, College Park (USA); M. J. Li, S. H. Moseley, NASA Goddard Space Flight Ctr. (USA); D. A. Rapchun, Global Science and Technology (USA); S. Snodgrass, MEI Technologies (USA); D. W. Sohl, L. Sparr, NASA Goddard Space Flight Ctr. (USA)
- 6678 0R **Quantum well and quantum dot based detector arrays for infrared imaging applications (Invited Paper)** [6678-24]
S. D. Gunapala, S. V. Bandara, D. Z. Ting, J. K. Liu, C. J. Hill, J. M. Mumolo, E. Kurth, Jet Propulsion Lab. (USA); J. Woolaway, FLIR Systems Inc. (USA); P. D. LeVan, Air Force Research Lab. (USA); M. Z. Tidrow, Missile Defense Agency/DV (USA)
- 6678 0S **Dual band HEIWP detectors with nitride materials** [6678-25]
A. G. Unil Perera, G. Ariyawansa, R. Jayasinghe, L. Byrum, N. Dietz, Georgia State Univ. (USA); S. G. Matsik, NDP Optronics LLC (USA); I. T. Ferguson, Georgia Institute of Technology (USA); H. Luo, A. Bezinger, H. C. Liu, National Research Council Canada (Canada)
- 6678 0T **Demonstration of a two-color 320 × 256 quantum dots-in-a-well focal plane array** [6678-26]
E. S. Varley, D. Ramirez, J. S. Brown, S. J. Lee, A. Stintz, M. Lenz, S. Krishna, Ctr. for High Technology Materials, Univ. of New Mexico (USA); A. Reisinger, M. Sundaram, QmagiQ LLC (USA)
- 6678 0V **Tunable far-IR detectors/filters based on plasmons in two-dimensional electron gases in InGaAs/InP heterostructures** [6678-32]
W. R. Buchwald, Air Force Research Lab. (USA); H. Saxena, R. E. Peale, Univ. of Central Florida (USA)
- 6678 0X **Characterization of very large format 1K×1K LWIR QWIP focal plane array** [6678-29]
D. Rafol, Diversified Electronics Corp./Infravision (USA); E. Cho, QWIP Technology (USA); W. Lim, Wah Lim and Associates (USA)

SESSION 5 SOFIE GLOBAL WARMING AND CLIMATE CHANGE INSTRUMENT

- 6678 0Y **Sounding the upper mesosphere using broadband solar occultation: initial results from the SOFIE experiment (Invited Paper)** [6678-11]
L. L. Gordley, M. E. Hervig, GATS, Inc. (USA); J. M. Russell, Hampton Univ. (USA); G. J. Paxton, L. E. Deaver, J. C. Burton, R. E. Thompson, C. W. Brown, B. E. Magill, M. McHugh, GATS, Inc. (USA)
- 6678 0Z **SOFIE jitter analysis** [6678-12]
S. R. Wassom, C. Fish, Utah State Univ. (USA); L. Gordley, J. Burton, GATS, Inc. (USA)
- 6678 10 **SOFIE instrument ground calibration update** [6678-14]
S. Hansen, C. Fish, A. Shumway, Utah State Univ. (USA); L. Gordley, M. Hervig, GATS, Inc. (USA)

SESSION 6 GLOBAL WARMING AND CLIMATE CHANGE INSTRUMENTS

- 6678 12 **ACE-FTS instrument: after four years on-orbit** [6678-16]
M.-A. Soucy, H. Buijs, S. Fortin, ABB (Canada); R. Hughes, Univ. of Waterloo (Canada)
- 6678 14 **Design of the SAC-D/NIRST camera module** [6678-18]
J. Gauvin, F. Châteauneuf, L. Marchese, P. Coté, M. Leclerc, C. Chevalier, INO (Canada);
H. Marraco, Comisión Nacional de Actividades Espaciales (Argentina); L. N. Phong,
Canadian Space Agency (Canada)

SESSION 7 GOSAT GLOBAL WARMING & CLIMATE CHANGE PAYLOAD DEVELOPMENT

- 6678 15 **The performance test results for engineering model (EM) of thermal and near infrared sensor for carbon observation (TANSO) on GOSAT** [6678-19]
H. Suto, Japan Aerospace Exploration Agency (Japan); T. Kawashima, NEC TOSHIBA Space Systems, Ltd. (Japan); K. Shiomi, T. Kina, A. Kuze, T. Urabe, S. Kawakami, Y. Kaneko, T. Hamazaki, Japan Aerospace Exploration Agency (Japan)
- 6678 16 **Development of airborne SWIR FTS for GOSAT validation and calibration** [6678-20]
H. Suto, A. Kuze, Y. Kaneko, T. Hamazaki, Japan Aerospace Exploration Agency (Japan);
I. Morino, H. Oguma, T. Yokota, National Institute for Environmental Studies (Japan);
G. Inoue, Nagoya Univ. (Japan)
- 6678 17 **Overview of GOSAT contamination control activity and test results summary** [6678-21]
T. Urabe, A. Kuze, H. Suto, T. Hamazaki, Japan Aerospace Exploration Agency (Japan)

SESSION 8 WEATHER AND CLIMATE CHANGE INSTRUMENTS

- 6678 18 **The performance of the AVHRR, HIRS, and AMSU-A instruments on board Metop-A (Invited Paper)** [6678-22]
A. Pérez Albiñana, EUMETSAT (Germany); D. Battles, D. Monteiro, R. W. Lambeck, Perot Systems Government Services (USA); R. M. Alemán, NASA Goddard Space Flight Ctr. (USA);
C. Jackson, NOAA (USA)
- 6678 19 **In-orbit checkout feedback from the infrared imaging radiometer for the CALIPSO mission** [6678-23]
F. T. Garcia-Moreno, T. Tremas, T. Bret-Dibat, CNES (France); M. C. Arnolfo, SODERN (France)

SESSION 9 CALIBRATION OF INFRARED INSTRUMENTS

- 6678 1A **MWIR imaging spectrometer with digital time delay integration for remote sensing and characterization of solar system objects** [6678-01]
S. E. Kendrick, A. Harwit, M. Kaplan, Ball Aerospace and Technologies Corp. (USA);
W. D. Smythe, Jet Propulsion Lab. (USA)
- 6678 1B **Infrared standards in space** [6678-02]
J. A. Dykema, J. G. Anderson, Harvard Univ. (USA)

- 6678 1E **A tunable filter comparator for the spectral calibration of near-ambient temperature blackbodies** [6678-06]
V. B. Khromchenko, Space Dynamics Lab. (USA) and Joint NIST/USU Program (USA);
S. N. Mekhontsev, L. M. Hanssen, National Institute of Standards and Technology (USA)

SESSION 10 INFRARED INSTRUMENTS

- 6678 1G **Interferometry on stars at mid-infrared wavelengths** [6678-08]
K. Tatebe, D. D. S. Hale, C. H. Townes, Univ. of California, Berkeley (USA)
- 6678 1H **Spectral balancing of a broadband Earth observing radiometer with co-aligned short wave channel to ensure accuracy and stability of broadband daytime outgoing long-wave radiance measurements: application to CERES** [6678-09]
G. Matthews, Analytical Services and Materials (USA); K. Priestley, NASA Langley Research Ctr. (USA); S. Thomas, Science Systems and Applications Inc. (USA)
- 6678 1I **Validation protocol for climate quality CERES measurements** [6678-10]
K. J. Priestley, NASA Langley Research Ctr. (USA); G. L. Smith, National Institute for Aerospace (USA); S. Thomas, Science Systems and Applications, Inc. (USA); G. Matthews, Applied Science and Materials, Inc. (USA)

POSTER SESSION

- 6678 1J **EuTTA fluorescence lifetime and spectral power characterization for its use as an active medium for IR-to-visible conversion** [6678-54]
M. Alfaro, M. Strojnik, G. Paez, Ctr. de Investigaciones en Óptica (Mexico)
- 6678 1K **Development of misalignment condition of a rotational shearing interferometer to detect extra-solar planets** [6678-56]
M. Galan, M. Strojnik, G. Paez, Ctr. de Investigaciones en Óptica (Mexico)
- 6678 1L **Misalignment study for a Dove prism employing exact ray trace** [6678-57]
E. Gutierrez-Herrera, M. Strojnik, Ctr. de Investigaciones en Óptica (Mexico)
- 6678 1M **Wide-field OCT using micro lens arrays** [6678-58]
A. Ortega, M. Strojnik, G. Paez, Ctr. de Investigaciones en Óptica (Mexico)
- 6678 1N **Noise-immune oximetry employing a new expression for oxygen saturation in blood** [6678-59]
C. Vazquez-Jacaud, G. Paez, M. Strojnik, Ctr. de Investigaciones en Óptica (Mexico)
- 6678 1O **Determination of the asphericity degree of a transparent reference sphere with a vectorial shearing interferometer** [6678-60]
C. Ramirez, M. Strojnik, P. Vacas-Jacques, E. Gutierrez Herrera, Ctr. de Investigaciones en Óptica (Mexico)
- 6678 1Q **Geometrical and temporal scale factors for thermal damage studies in a tooth** [6678-62]
M. Strojnik, Ctr. de Investigaciones en Óptica (Mexico)

- 6678 1R **Tunable trans-illumination interferometer and tuned-state identification based on recurrence analysis** [6678-63]
P. Vacas-Jacques, M. Strojnik, Ctr. de Investigaciones en Óptica (Mexico)
- 6678 1S **Prediction of cryogenic temperature impact on the performance of space-borne IR sensors**
[6678-64]
X. Xu, X. Shi, BeiHang Univ. (China)

Author Index

Conference Committee

Conference Chair

Marija Strojnik-Scholl, Centro de Investigaciones en Óptica, A.C.
(Mexico)

Program Committee

John A. Antoniadis, BAE Systems North America (USA)
Gail E. Bingham, Utah State University (USA)
David A. Cardimona, Air Force Research Laboratory (USA)
Catherine J. Cesarsky, European Southern Observatory (Germany)
Jam Farhoomand, TechnoScience Corporation (USA) and NASA Ames
Research Center (USA)
Gerald T. Fraser, National Institute of Standards and Technology (USA)
John C. Gille, National Center for Atmospheric Research (USA)
Dietrich Lemke, Max-Planck-Institut für Astronomie (Germany)
Jan L. Williams, e-Systems Management Consultants (USA)
Juergen Wolf, NASA Ames Research Center (USA)

Session Chairs

- 1 Far Infrared and Submillimeter Technology
Jam Farhoomand, TechnoScience Corporation (USA) and NASA Ames
Research Center (USA)
Juergen Wolf, NASA Ames Research Center (USA)
- 2 SOFIA Instrumentation
Jam Farhoomand, TechnoScience Corporation (USA) and NASA Ames
Research Center (USA)
Juergen Wolf, NASA Ames Research Center (USA)
- 3 Image Processing and Technologies
John A. Antoniadis, BAE Systems North America (USA)
Gonzalo Paez, Centro de Investigaciones en Óptica, A.C. (Mexico)
- 4 Advanced Detectors and Technologies
Paul M. Alsing, Air Force Research Laboratory (USA)
David A. Cardimona, Air Force Research Laboratory (USA)
- 5 SOFIE Global Warming and Climate Change Instrument
Jan L. Williams, e-Systems Management Consultants (USA)

- 6 Global Warming and Climate Change Instruments
Jan L. Williams, e-Systems Management Consultants (USA)
- 7 GOSAT Global Warming & Climate Change Payload Development
Jan L. Williams, e-Systems Management Consultants (USA)
- 8 Weather and Climate Change Instruments
Jan L. Williams, e-Systems Management Consultants (USA)
- 9 Calibration of Infrared Instruments
John A. Antoniades, BAE Systems North America (USA)
- 10 Infrared Instruments
Marija Strojnik-Scholl, Centro de Investigaciones en Óptica, A.C.
(Mexico)