PROCEEDINGS OF SPIE

Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XII

Arnold Burger
Larry A. Franks
Ralph B. James
Editors

2–4 August 2010
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 7805

Proceedings of SPIE, 0277-786X, v. 7805

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 *Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XII*, edited by Arnold Burger, Larry A. Franks, Ralph B. James, Proceedings of SPIE Vol. 7805 (SPIE, Bellingham, WA, 2010) Article CID Number.

ISSN 0277-786X
ISBN 9780819483010

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 © 2010, 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/10/$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

SPIEDigitalLibrary.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 CZT DETECTORS AND CHARACTERIZATION I

7805 02 **Macro- and microscopic growth interface study of CdZnTe ingots by THM technique (Invited Paper)** [7805-01]
U. N. Roy, S. Weiler, J. Stein, ICx Radiation Inc. (United States)

7805 03 **Characterization of secondary phases and other defects in CdZnTe (Invited Paper)** [7805-02]
M. C. Duff, Savannah River National Lab. (United States); K. G. Lynn, K. Jones, R. Soundararajan, Washington State Univ. (United States); J. P. Bradley, H. Ishii, J. Aguiar, P. Wozniakiewicz, Lawrence Livermore National Lab. (United States)

7805 04 **Array of virtual Frisch-grid CZT detectors with common cathode readout and pulse-height correction** [7805-03]
A. E. Bolotnikov, G. S. Camarda, Y. Cui, Brookhaven National Lab. (United States); S. U. Egarievwe, Alabama A&M Univ. (United States); P. M. Fochuk, Brookhaven National Lab. (United States) and Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); M. Fuerstnau, R. Gul, A. Hossain, F. Jones, K. Kim, Brookhaven National Lab. (United States); O. V. Kopach, Brookhaven National Lab. (United States) and Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); R. Taggart, G. Yang, Z. Ye, Brookhaven National Lab. (United States); L. Xu, Brookhaven National Lab. (United States) and Northwestern Polytechnic Univ. (China); R. B. James, Brookhaven National Lab. (United States)

7805 07 **Study on thermal annealing of cadmium zinc telluride (CZT) crystals** [7805-06]
G. Yang, A. E. Bolotnikov, Brookhaven National Lab. (United States); P. M. Fochuk, Brookhaven National Lab. (United States) and Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); G. S. Camarda, Y. Cui, A. Hossain, K. Kim, Brookhaven National Lab. (United States); J. Horace, B. McCall, Brookhaven National Lab. (United States) and Alabama A&M Univ. (United States); R. Gul, Brookhaven National Lab. (United States); L. Xu, Brookhaven National Lab. (United States) and Northwestern Polytechnical Univ. (China); O. V. Kopach, Brookhaven National Lab. (United States) and Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); R. B. James, Brookhaven National Lab. (United States)

SESSION 2 CZT DETECTORS AND CHARACTERIZATION II

7805 0A **Reduction of leakage currents in CdZnTe-based x-ray and γ-ray detectors: a II-VI semiconductor superlattice approach** [7805-09]
Y. Chang, C. H. Grein, C. R. Becker, X. J. Wang, S. Sivananthan, Univ. of Illinois at Chicago (United States)

SESSION 3 CDTE AND OTHER NOVEL SEMICONDUCTORS I

7805 0D **Silicon photomultiplier and radiation detection: follow-up study and the path forward (Invited Paper)** [7805-12]
A. Osovizky, D. Ginzburg, Rotem Industries Ltd. (Israel); N. S. Kopeika, Ben-Gurion Univ. of the Negev (Israel); M. Ghelman, E. Marcus, Nuclear Research Ctr. Negev (Israel); A. Manor, V. Pushkarsky, I. Cohen-Zada, Rotem Industries Ltd. (Israel); E. Gonen, T. Mazor, Y. Kadmon, Y. Cohen, Nuclear Research Ctr. Negev (Israel)

SESSION 4 SCINTILLATORS

7805 0I **Transparent ceramic scintillators for gamma spectroscopy and radiography (Invited Paper)** [7805-17]
N. J. Cherepy, J. D. Kuntz, Z. M. Seeley, S. E. Fisher, O. B. Drury, B. W. Sturm, T. A. Hurst, R. D. Sanner, J. J. Roberts, S. A. Payne, Lawrence Livermore National Lab. (United States)

7805 0K **Role of carrier diffusion and picosecond exciton kinetics in nonproportionality of scintillator light yield (Invited Paper)** [7805-19]
R. T. Williams, Q. Li, J. Q. Grim, K. B. Ucer, Wake Forest Univ. (United States); G. A. Bizarri, W. W. Moses, Lawrence Berkeley National Lab. (United States)

7805 0L **Comparison of $CeBr_3$ with $LaBr_3$:Ce, $LaCl_3$:Ce, and NaI:Tl detectors** [7805-20]
P. Guss, M. Reed, D. Yuan, Remote Sensing Lab. (United States); M. Cutler, C. Contreras, D. Beller, Univ. of Nevada, Las Vegas (United States)

SESSION 5 NEUTRON DETECTORS AND SILICON DETECTORS

7805 0N **Characteristics of the stacked microstructured solid state neutron detector (Invited Paper)** [7805-22]
S. L. Bellinger, R. G. Fronk, W. J. McNeil, J. K. Shultis, T. J. Sobering, D. S. McGregor, Kansas State Univ. (United States)

7805 0O **Nine element Si-based pillar structured thermal neutron detector (Invited Paper)** [7805-23]
R. J. Nikolic, A. M. Conway, R. Radev, Q. Shao, L. Voss, T. F. Wang, Lawrence Livermore National Lab. (United States); J. R. Brewer, C. L. Cheung, Univ. of Nebraska-Lincoln (United States); L. Fabris, C. L. Britton, M. N. Ericson, Oak Ridge National Lab. (United States)

7805 0P **Fast time correlation detection in associated particle spectrometry of spontaneous fission neutrons and cosmic-ray backgrounds** [7805-24]
L. Forman, Ion Focus Technology, Inc. (United States); I. Dioszegi, P. E. Vanier, Brookhaven National Lab. (United States)

SESSION 6 CDTE AND OTHER NOVEL SEMICONDUCTORS II

7805 0Q **Characterization of gallium telluride crystals grown from graphite crucible (Invited Paper)** [7805-25]
K. C. Mandal, T. Hayes, P. G. Muzykov, R. Krishna, S. Das, T. S. Sudarshan, S. Ma, Univ. of South Carolina (United States)

7805 0U **Radiation detectors based on 4H semi-insulating silicon carbide** [7805-29]
K. C. Mandal, R. Krishna, P. G. Muzykov, Z. Laney, S. Das, T. S. Sudarshan, Univ. of South Carolina (United States)

SESSION 7 ELECTRONICS

7805 0V **Efficient readout electronics for multi-anode photomultiplier** [7805-30]
C. W. Lerche, V. Herrero-Bosch, N. Ferrando-Jodar, R. Gadea-Girones, Univ. Politecnica de Valencia (Spain); F. Sanchez-Martinez, Instituto de Física Corpuscular (Spain); F. J. Mora-Más, Univ. Politecnica de Valencia (Spain)

7805 0W **Pixel electronics for a hybrid x/gamma-ray imager** [7805-31]
C. P. Lambropoulos, E. G. Zervakis, A. Nikologiannis, G. Theodoratos, D. S. Hatzistratis, Technological Educational Institute of Chalkida (Greece); I. Papadakis, A. Papadimitriou, D. Loukas, National Ctr. for Scientific Research Demokritos (Greece)

7805 0X **Radiation damage studies on a 5T sCMOS image sensor with integrated readout electronics** [7805-32]
B. Rodricks, B. Fowler, J. Lowes, P. Vu, Fairchild Imaging (United States)

SESSION 8 APPLICATIONS

7805 0Z **Study of charge transport mechanisms in ZnO-ZnTe nanojunctions** [7805-66]
J. Xu, S. H. Lee, Z. W. Bell, B. Smith, X.-G. Zhang, T. Ju, Oak Ridge National Lab. (United States); A.-J. Chen, Univ. of Minnesota (United States); Z. Pan, The Univ. of Georgia (United States)

7805 11 **Automatic detection of high-Z materials in cargo** [7805-34]
D. Perticone, R. Eilbert, N. Gillett, R. S. McNabb, Jr., A. Ozcandarli, J. Stillson, L-3 Communications Security & Detection Systems (United States)

7805 12 **Cameras shapes for medical imaging Compton cameras** [7805-36]
B. Smith, L. J. Denbina, The Univ. of Texas at San Antonio (United States)

7805 13 **First results from the Daresbury Compton backscattering x-ray source (COBALD)** [7805-37]
G. Priebe, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); D. Laundy, STFC Daresbury Lab. (United Kingdom); P. J. Phillips, STFC Rutherford Appleton Lab. (United Kingdom); D. M. Graham, S. P. Jamison, STFC Daresbury Lab. (United Kingdom); S. Vassilev, The Univ. of Nottingham (United Kingdom); E. A. Seddon, Univ. of Manchester (United Kingdom); J. B. Rosenzweig, Univ. of California, Los Angeles (United States); G. A. Krafft, Thomas Jefferson National Accelerator Facility (United States); T. Heinzl, Univ. of Plymouth (United Kingdom); D. Filippetto, Instituto Nazionale di Fisica Nucleare (Italy); O. Williams, Univ. of California, Los Angeles (United States); K. M. Spohr, Univ. of the West of Scotland (United Kingdom); S. Ter-Avetisyan, Queen's Univ. Belfast (United Kingdom); U. Schramm, Forschungszentrum Dresden-Rossendorf e.V. (Germany); Y. M. Saveliev, L. B. Jones, S. L. Smith, STFC Daresbury Lab. (United Kingdom)

7805 14 **Preliminary results from the Spring 2010 balloon campaign of the Nuclear Compton Telescope** [7805-38]
J.-L. Chiu, National Tsing Hua Univ. (Taiwan); E. C. Bellm, S. E. Boggs, Univ. of California, Berkeley (United States); H.-K. Chang, National Tsing Hua Univ. (Taiwan); Y.-H. Chang, National Central Univ. (Taiwan); M. A. Huang, National United Univ. (Taiwan); M. Amman, Lawrence Berkeley National Lab. (United States); M. S. Bandstra, Univ. of California, Berkeley (United States); W.-C. Hung, National Central Univ. (Taiwan); J.-S. Liang, National Tsing Hua Univ. (Taiwan); C.-H. Lin, Institute of Physics, Academia Sinica (Taiwan); Z.-K. Liu, National Central Univ. (Taiwan); P. N. Luke, Lawrence Berkeley National Lab. (United States); D. Perez-Becker, Univ. of California, Berkeley (United States); R.-S. Run, National United Univ. (Taiwan); C. B. Wunderer, Deutsches Elektronen-Synchrotron (Germany); A. Zoglauer, Univ. of California, Berkeley (United States)

7805 15 **Millimeter-order imaging technique from 100 keV to MeV based on germanium Compton camera** [7805-39]
S. Takeda, T. Fukuchi, Y. Kanayama, S. Motomura, M. Hiromura, RIKEN Ctr. for Molecular Imaging Science (Japan); T. Takahashi, Institute of Space and Astronautical Science (Japan); S. Enomoto, RIKEN Ctr. for Molecular Imaging Science (Japan)

7805 16 **Detector dead time in particle counting detectors** [7805-67]
D. Laundy, STFC Daresbury Lab. (United Kingdom)

POSTER SESSION

7805 17 **Charge transport mechanism in CdTe-based *p-n* junction detectors formed by laser irradiation** [7805-16]
T. Aoki, Shizuoka Univ. (Japan); V. A. Gnatyuk, Shizuoka Univ. (Japan) and V. Lashkaryov Institute of Semiconductor Physics (Ukraine); L. A. Kosyachenko, O. L. Maslyanchuk, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); E. V. Grushko, Shizuoka Univ. (Japan) and Yuriy Fedkovych Chernivtsi National Univ. (Ukraine)

7805 18 **Feasibility study of CCD-based gamma camera** [7805-35]
H. Lee, Y.-J. Jeong, Korea Univ. (Korea, Republic of); J. Yoon, Pacific Islands Univ. (United States); J. Kang, S. Lee, H. Shin, Dankook Univ. (Korea, Republic of); K. Lee, Korea Univ. (Korea, Republic of)

7805 1B **Thermographic analyses of the grwth of $Cd_{1-x}Zn_xTe$ single crystals** [7805-42]
L. P. Shcherbak, O. V. Kopach, P. M. Fochuk, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); A. E. Bolotnikov, R. B. James, Brookhaven National Lab. (United States)

7805 1C **Synthetic software γ-ray spectra generation of SNM masking scenarios for homeland security application** [7805-43]
B. Sarusi, S. Levinson, Nuclear Research Ctr. Negev (Israel); A. Osovizky, V. Pushkarsky, Rotem Industries Ltd. (Israel); U. German, Z. Mazor, Y. Cohen, I. Belaish, Nuclear Research Ctr. Negev (Israel)

7805 1D **X-ray detection method for the direct-conversion plasma detector** [7805-44]
J. Kang, H. Shin, S. Lee, Dankook Univ. (Korea, Republic of); K. Lee, H. Lee, Korea Univ. (Korea, Republic of)

7805 1H **Diffusion studies on Si-PIN x-ray detectors with guard-rings for single photon counting sensors** [7805-48]
K. Lee, Korea Univ. (Korea, Republic of); J. C. Yoon, Pacific Islands Univ. (United States); Y. J. Jung, Korea Univ. (Korea, Republic of); S. Jeon, B. Kim, Korea Electrotechnology Research Institute (Korea, Republic of); J. Kim, Imperial College London (United Kingdom)

7805 1I **Special features of conductivity of semi-intrinsic CdTe and CdZnTe single crystals used in x- and γ-ray detectors** [7805-49]
L. A. Kosyachenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); E. Diequez, Univ. Autónoma de Madrid (Spain); T. Aoki, Shizuoka Univ. (Japan); C. P. Lambropoulos, Technological Educational Institute of Chalkida (Greece); V. A. Gnatyuk, Shizuoka Univ. (Japan) and V.E. Lashkaryov Institute of Semiconductor Physics (Ukraine); M. Fiederle, Albert-Ludwigs-Univ. Freiburg (Germany); S. V. Melnychuk, O. L. Maslyanchuk, O. F. Sklyarchuk, O. V. Sklyarchuk, E. V. Grushko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine)

7805 1L **Neutron detection with Gd/CdTe semiconductor detector** [7805-52]
A. Miyake, T. Nishioka, S. Singh, H. Morii, Y. Neo, H. Mimura, T. Aoki, Shizuoka Univ. (Japan)

7805 1M **Improvement of analysis precision upon the atomic number and electron density measurement by the dual x-ray CT** [7805-53]
Y. Imura, H. Morii, A. Koike, T. Okunoyama, Y. Neo, H. Mimura, T. Aoki, Shizuoka Univ. (Japan)

7805 1O **Extended defects in As-grown CdZnTe** [7805-55]
L. Xu, Brookhaven National Lab. (United States) and Northwestern Polytechnical Univ. (China); A. E. Bolotnikov, A. Hossain, K.-H. Kim, R. Gul, G. Yang, G. S. Camarda, Brookhaven National Lab. (United States); L. Marchini, Brookhaven National Lab. (United States) and Istituto dei Materiali per l' Elettronica ed il Magnetismo, CNR (Italy); Y. Cui, R. B. James, Brookhaven National Lab. (United States); Y. Xu, T. Wang, W. Jie, Northwestern Polytechnical Univ. (China)

7805 1P **A multi-energy method of nondestructive testing by determination of the effective atomic number of different materials** [7805-56]
V. D. Ryzhikov, O. D. Opolonin, S. M. Galkin, Y. F. Voronkin, O. K. Lysetska, Institute for Single Crystals (Ukraine); S. A. Kostioukevitch, Institute of Semiconductor Physics (Ukraine)

7805 1R **Development of an ultra-low-power x-ray-photon-resolving imaging detector array** [7805-58]
S. Sun, S. Downey, S. Gaalema, J. L. Gates, Black Forest Engineering, LLC (United States); J. G. Jernigan, Univ. of California, Berkeley (United States); P. Kaaret, The Univ. of Iowa (United States); S. MacIntosh, Black Forest Engineering, LLC (United States); B. Ramsey, NASA Marshall Space Flight Ctr. (United States); B. Wall, Black Forest Engineering, LLC (United States)

7805 1T **Performance of CdZnTe pixellated radiation detectors assembled by a new attachment method** [7805-60]
P. Lu, H. Chen, S. Awadalla, K. Iniewski, G. Bindley, Redlen Technologies (Canada)

7805 1U **Detector performance of ammonium-sulfide-passivated CdZnTe and CdMnTe materials** [7805-61]
K. H. Kim, A. E. Bolotnikov, G. S. Camarda, Brookhaven National Lab. (United States); L. Marchini, Brookhaven National Lab. (United States) and Istituto dei Materiali per l' Elettronica ed il Magnetismo, CNR (Italy); (Italy); G. Yang, A. Hossain, Y. Cui, Brookhaven National Lab. (United States); L. Xu, Brookhaven National Lab. (United States) and Northwestern Polytechnical Univ. (China); R. B. James, Brookhaven National Lab. (United States)

7805 1V **Design of a coded aperture Compton telescope imaging system (CACTIS)** [7805-63]
A. Volkovskii, M. Clajus, Nova R&D, Inc. (United States); S. R. Gottesman, H. Malik, K. Schwartz, Northrop Grumman Electronic Systems (United States); E. Tumer, T. Tumer, S. Yin, Nova R&D, Inc. (United States)

7805 1W **Measurements with coplanar grid (Cd,Zn)Te detectors and development of the GMCA (Gamma-ray analysis digital filter Multi Channel Analyzer)** [7805-64]
M. Dambacher, A. Zwerger, A. Fauler, C. Disch, Freiburger Materialforschungszentrum (Germany); U. Stöhlker, Bundesamt für Strahlenschutz (Germany); M. Fiederle, Freiburger Materialforschungszentrum (Germany)

7805 1X **Simulations of a monolithic lanthanum bromide gamma-ray detector** [7805-65]
C. Ertley, C. Bancroft, P. Bloser, T. Connor, J. Legere, M. McConnell, J. Ryan, The Univ. of New Hampshire (United States)

Author Index

Conference Committee

Program Track Chair

Carolyn A. MacDonald, University at Albany (United States)

Conference Chairs

Arnold Burger, Fisk University (United States)
Larry A. Franks, U.S. Department of Energy (United States)
Ralph B. James, Brookhaven National Laboratory (United States)

Program Committee

Toru Aoki, Shizuoka University (Japan)
James E. Baciak, Jr., University of Florida (United States)
Zane W. Bell, Oak Ridge National Laboratory (United States)
Lynn A. Boatner, Oak Ridge National Laboratory (United States)
Aleksey E. Bolotnikov, Brookhaven National Laboratory (United States)
Bill Cardoso, Creative Electron (United States)
Henry Chen, Redlen Technologies (Canada)
Nerine J. Cherepy, Lawrence Livermore National Laboratory (United States)
Jeffrey J. Derby, University of Minnesota (United States)
Martine C. Duff, Savannah River National Laboratory (United States)
Michael Fiederle, Albert-Ludwigs-Universität Freiburg (Germany)
Jan Franc, Charles University in Prague (Czech Republic)
Yoshinori Hatanaka, Aichi University of Technology (Japan)
Zhong He, University of Michigan (United States)
Keitaro Hitomi, Tohoku Institute of Technology (Japan)
Alan Janos, U.S. Department of Homeland Security (United States)
Warnick J. Kernan, Pacific Northwest National Laboratory (United States)
Glenn F. Knoll, University of Michigan (United States)
Henric S. Krawczynski, Washington University in St. Louis (United States)
Patty Lee, Brookhaven National Laboratory (United States)
Longxia Li, Yinnel Tech, Inc. (United States)
Kelvin G. Lynn, Washington State University (United States)
Manoj Mahajan, Brookhaven National Laboratory (United States)
Krishna C. Mandal, University of South Carolina (United States)
Jim L. Matteson, University of California, San Diego (United States)
Douglas Scott McGregor, Kansas State University (United States)
Robert D. McLaren, Consultant (United States)
Raulf M. Polichar, SAIC (United States)

Utpal N. Roy, ICx Technologies Inc. (United States)
Michael M. Schieber, The Hebrew University of Jerusalem (Israel)
Carolyn E. Seifert, Pacific Northwest National Laboratory (United States)
Paul J. Sellin, University of Surrey (United Kingdom)
Michael R. Squillante, Radiation Monitoring Devices, Inc. (United States)
Csaba Szeles, eV Microelectronics (United States)
Tumay O. Tumer, Nova R&D, Inc. (United States)
Sergey E. Ulin, Moscow Engineering Physics Institute (Russian Federation)
Lodewijk van den Berg, Constellation Technology Corporation (United States)
Peter E. Vanier, Brookhaven National Laboratory (United States)

Session Chairs

1 CZT Detectors and Characterization I
Krishna C. Mandal, University of South Carolina (United States)

2 CZT Detectors and Characterization II
Aleksey E. Bolotnikov, Brookhaven National Laboratory (United States)

3 CdTe and Other Novel Semiconductors I
Utpal N. Roy, ICx Technologies Inc. (United States)

4 Scintillators
Richard T. Williams, Wake Forest University (United States)
Nerine J. Cherepy, Lawrence Livermore National Laboratory (United States)

5 Neutron Detectors and Silicon Detectors
Robert D. McLaren, Consultant (United States)

6 CdTe and Other Novel Semiconductors II
Michael Fiederle, Albert-Ludwigs-Universität Freiburg (Germany)

7 Electronics
Raulf M. Polichar, SAIC (United States)

8 Applications
Feng Zhang, University of Michigan (United States)