PROCEEDINGS OF SPIE

Radiation Detectors in Medicine, Industry, and National Security XVIII

Gary P. Grim Lars R. Furenlid H. Bradford Barber Editors

9–10 August 2017 San Diego, California, United States

Sponsored and Published by SPIE

Volume 10393

Proceedings of SPIE 0277-786X, V. 10393

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 SPIEDigitalLibrary.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 Radiation Detectors in Medicine, Industry, and National Security XVIII, edited by Gary P. Grim, Lars R. Furenlid, H. Bradford Barber, Proceedings of SPIE Vol. 10393 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510612433

ISBN: 9781510612440 (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 © 2017, 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/17/\$18.00.

Printed in the United States of America.

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



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

Conference Committee

Authors

vii

10393 0C

10393 0D

10393 OE

10393 OF

_		SAFEGUARDS APPLICATIONS
	10393 02	Threat detection of liquid explosives and precursors from their x-ray scattering pattern using energy dispersive detector technology [10393-1]
	10393 03	Uranyl adsorption kinetics within silica gel: dependence on flow velocity and concentration [10393-2]
	10393 04	Small unmanned aircraft system for remote contour mapping of a nuclear radiation field (Invited Paper) [10393-3]
	10393 05	International Radiation Monitoring and Information System (IRMIS) [10393-4]
_		NOVEL DETECTOR CONCEPTS
	10393 06	Development and deployment of the Collimated Directional Radiation Detection System (Invited Paper) [10393-5]
	10393 07	Neutron detection with plastic scintillators coupled to solid state photomultiplier detectors [10393-6]
	10393 08	High-resolution photon spectroscopy with a microwave-multiplexed 4-pixel transition edge sensor array [10393-7]
_		NOVEL DETECTOR APPLICATIONS
	10393 OA	X-ray backscatter radiography with lower open fraction coded masks (Invited Paper) [10393-9]

Modeling charge collection in x-ray imagers [10393-12]

applications [10393-13]

SIMULATIONS AND DATA ACQUISITION

New results from sub-3 MeV Compton spectrometer experiments (Invited Paper) [10393-11]

3D-printed coded apertures for x-ray backscatter radiography (Invited Paper) [10393-14]

A multi-purpose readout electronics for CdTe and CZT detectors for x-ray imaging

10393 OH	Spectral correction algorithm for multispectral CdTe x-ray detectors [10393-16]
	DIGITAL RADIOGRAPHY AND CT
10393 OJ	Measurement of x-ray spectra using a recent YAP(Ce)-MPPC detector [10393-18]
10393 OM	Scintillator performance considerations for dedicated breast computed tomography (Invited Paper) [10393-21]
	NOVEL DETECTOR APPLICATIONS
10393 OR	A framework for optimizing micro-CT in dual-modality micro-CT/XFCT small-animal imaging system [10393-26]
10393 0\$	A compact energy-independent CZT-based gamma camera (Invited Paper) [10393-27]
10393 OU	Investigation of a high-sensitivity near-infrared-ray computed tomography scanner [10393-29]
	POSTER SESSION
10393 0X	The dual-channel ultraviolet/low light CMOS camera using image fusion technique [10393-32]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abbott, Roy, 04 Adan, Mark, 04 Albinet, Franck, 05 Baciu, Florian, 05 Barzilov, Alexander, 06 Brahmbhatt, Pareshkumar, 04

Cho, Sang Hyun, OR Christensen, Erik D., OH Christian, James F., 07 Croce, Mark, 08 Cui, Yonggang, OS Daniels, Jon, 04 Deng, Z., OE

Doda, Brandon M., 03 Enomoto, Toshiyuki, 0J, 0U Espy, Michelle A., 0C Feidenhans'l, Robert, 0H Fernandez, Daniel E., 07 Fischer, Rick, 04 Frank, Rebecca, 07 Gehring, Amanda E., 0C

Gu, Yun, 0H

Guckes, Amber L., 06 Guss, Paul, 04, 08 Hagiwara, Osahiko, 0J, 0U Haines, Todd J., 0C Han, Jinlu, 04

Healy, Matthew J. F., 0A, 0F

Henderson, Eric, 04
Hoteling, Nathan, 08
Howard, Michael, 04
Huang, Casey, 04
Huang, Justin, 04
Huang, Qiu, 0S
Ishii, Tomotaka, 0J, 0U
James, Ralph B., 0S
Johnson, Erik B., 07
Jupp, Ian, 0A, 0F
Karellas, Andrew, 0M, 0R
Kehres, Jan, 02, 0H
Kenny, Patrick, 05
Klasky, Marc L., 0C
Kong, Xiangyu, 0X

Liu, Y. N., 0E

Lockley, David, 0A, 0F Luke, Tanushree, 04

Lane, David W., 0A, 0F

Kruschwitz, Craig, 08 Kusachi, Shinya, 0J, 0U Lukens, Michael, 04 Lyksborg, Mark, 02 Malchow, Russell, 04 Matsukiyo, Hiroshi, 0J, 0U McCall, Karen, 04 Meehan, B. Timothy, 0C Mitra, Debasis, 0S Mocko, Veronika, 08

Mukhopadhyay, Sanjoy, 04, 05, 08

Muñoz, André A. M., 0A, 0F O'Connor, Paul, 0S Oda, Yasuyuki, 0J, 0U

Oh, Paul, 04
Olsen, Ulrik L., 02, 0H
Palestri, P., 0D
Pan, Hui, 0S
Park, Ki, 04
Pereira, Jorge, 07
Pilotto, A., 0D
Pinaroli, G., 0D
Qian, Yunsheng, 0X
Rabin, Michael, 08
Saluja, Gurdeep, 05
Sato, Eiichi, 0J, 0U
Sato, Yuichi, 0J, 0U
Schwellenbach, David, 08

Selmi, L., 0D Seo, Youngho, 0S Shi, Linxi, 0M Shrestha, Suman, 0R Stapels, Christopher, 07 Stoddard, Graham, 07 Stowisek, Jan, 05 Tang, Xiaodong, 0X Tepper, Gary, 03 Trainham, Clifford P., 04

Vedantham, Srinivasan, OM, OR

Vella, Anna, 0A, 0F Vogel, Samuel, 07 Wagner, Eric, 04

Watanabe, Manabu, 0J, 0U

Wu, Yujing, 0X Xing, Y. X., 0E

Yamaguchi, Satoshi, OJ, OU Yoshida, Sohei, OJ, OU

Yue, X. B., 0E Zegers, Remco, 07 Zhang, Yijun, 0X Zhou, Xiaoyu, 0X

Conference Committee

Program Track Chairs

Ali M. Khounsary, Illinois Institute of Technology (USA)
Ralph B. James, Savannah River National Laboratory (USA)

Conference Chairs

Gary P. Grim, Lawrence Livermore National Laboratory (United States)

Lars R. Furenlid, The University of Arizona (United States)H. Bradford Barber, The University of Arizona (United States)

Conference Program Committee

Stuart A. Baker, National Security Technologies, LLC (United States)
Yonggang Cui, Brookhaven National Laboratory (United States)
F. Patrick Doty, Sandia National Laboratories (United States)
Patrick Feng, Sandia National Laboratories (United States)
Paul P. Guss, National Security Technologies, LLC (United States)
Geoffrey Harding, Morpho Detection (Germany)
Khalid M. Hattar, Sandia National Laboratories (United States)
Ralph B. James, Savannah River National Laboratory (United States)
Edward Steven Jimenez Jr., Sandia National Laboratories (United States)

Will E. Johns, Vanderbilt University (United States)

Michael J. King, Rapiscan Systems Laboratories (United States)

Edward A. McKigney, Los Alamos National Laboratory (United States)

Wondwosen Mengesha, Physical Optics Corporation (United States)

Frank E. Merrill, Los Alamos National Laboratory (United States)

Rex A. Moats, The University of Southern California (United States)

Vivek V. Nagarkar, Radiation Monitoring Devices, Inc. (United States)

Eiichi Sato, Iwate Medical University (Japan)

Michael R. Squillante, Radiation Monitoring Devices, Inc. (United States)

Session Chairs

1 Safeguards Applications

H. Bradford Barber, The University of Arizona (United States)

- 2 Novel Detector Concepts
 Gary P. Grim, Lawrence Livermore National Laboratory (United States)
- 3 Novel Detector Applications Lars R. Furenlid, The University of Arizona (United States) Ling Han, The University of Arizona (United States)
- Simulations and Data Acquisition
 Xin Li, College of Optical Sciences, The University of Arizona (United States)
- 5 Digital Radiography and CT
 H. Bradford Barber, The University of Arizona (United States)
- 6 Radioisotope Imaging
 Edward Steven Jimenez Jr., Sandia National Laboratories
 (United States)
- Novel Detector Applications
 Ling Han, The University of Arizona (United States)
- 8 Other ApplicationsH. Bradford Barber, The University of Arizona (United States)