

PROCEEDINGS OF SPIE

Medical Applications of Radiation Detectors

**H. Bradford Barber
Hans Roehrig
Douglas J. Wagenaar**
Editors

**24–25 August 2011
San Diego, California, United States**

Sponsored and Published by
SPIE

Volume 8143

Proceedings of SPIE, 0277-786X, v. 8143

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 *Medical Applications of Radiation Detectors*, edited by H. Bradford Barber, Hans Roehrig, Douglas J. Wagenaar, Proceedings of SPIE Vol. 8143 (SPIE, Bellingham, WA, 2011) Article CID Number.

ISSN 0277-786X
ISBN 9780819487537

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 © 2011, 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/11/\$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 smaller, lighter 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 as 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

- v *Conference Committee*
vii *Introduction*

PLENARY SESSION

- 8143 02 **Biomedical spectral x-ray imaging: promises and challenges (Plenary Paper)** [8143-100]
S. M. Jorgensen, D. R. Eaker, E. L. Ritman, Mayo Clinic College of Medicine (United States)

CLINICAL IMAGING

- 8143 05 **A novel SPECT camera for molecular imaging of the prostate (Invited Paper)** [8143-02]
A. Cebula, D. Gilland, L.-M. Su, Univ. of Florida (United States); D. Wagenaar, Children's Hospital of Los Angeles (United States); A. Bahadori, Univ. of Florida (United States)
- 8143 07 **Dose reduction in molecular breast imaging** [8143-04]
D. J. Wagenaar, Children's Hospital of Los Angeles (United States) and Univ. of Southern California (United States); S. Chowdhury, J. W. Hugg, Gamma Medica, Inc. (United States); R. A. Moats, Children's Hospital of Los Angeles (United States) and The Univ. of Southern California (United States); B. E. Patt, Gamma Medica, Inc. (United States)

RADIOTHERAPY

- 8143 09 **Computer simulations to demonstrate new inversion methods for Compton camera data** [8143-06]
B. Smith, The Univ. of Texas at San Antonio (United States)
- 8143 0A **Properties and spectroscopic performance of semiconductor detectors under high-flux irradiation (Invited Paper)** [8143-07]
M. L. Rodrigues, Z. He, Univ. of Michigan (United States)

DETECTORS AND APPLICATIONS

- 8143 0F **High-performance imaging of stem cells using single-photon emissions** [8143-12]
D. J. Wagenaar, R. A. Moats, Children's Hospital of Los Angeles (United States) and Univ. of Southern California (United States); N. E. Hartsough, DxRay, Inc. (United States); D. Meier, J. W. Hugg, Gamma Medica, Inc. (United States); T. Yang, Children's Hospital of Los Angeles (United States) and Univ. of Southern California (United States); D. Gazit, G. Pelled, Cedars-Sinai Medical Ctr. (United States); B. E. Patt, Gamma Medica, Inc. (United States)

- 8143 0G **High-resolution, anamorphic, adaptive small-animal SPECT imaging with silicon double-sided strip detectors** [8143-13]
H. L. Durko, College of Optical Sciences, The Univ. of Arizona (United States); T. E. Peterson, Vanderbilt Univ. (United States); H. H. Barrett, L. R. Furenlid, College of Optical Sciences, The Univ. of Arizona (United States)

DIGITAL RADIOGRAPHY AND OTHER

- 8143 0J **Optimizing CdTe detectors and ASIC readouts for high-flux x-ray imaging (Invited Paper)** [8143-16]
W. C. Barber, DxRay, Inc. (United States); E. Nygard, J. C. Wessel, N. Malakhov, Interon AS (Norway); N. E. Hartsough, T. Ghandi, DxRay, Inc. (United States); G. Wawrzyniak, Interon AS (Norway); J. S. Iwanczyk, DxRay, Inc. (United States)
- 8143 0K **Mcps-range photon-counting x-ray computed tomography system (Invited Paper)** [8143-17]
E. Sato, Y. Oda, Iwate Medical Univ. (Japan); A. Abudurexiti, Toreck, Inc. (Japan); O. Hagiwara, T. Enomoto, The Toho Univ. (Japan); S. Sugimura, Tokyo Denpa Co. Ltd. (Japan); H. Endo, Iwate Industrial Research Institute (Japan); S. Sato, A. Ogawa, Iwate Medical Univ. (Japan); J. Onagawa, Tohoku Gakuin Univ. (Japan)
- 8143 0L **Cancer diagnosis using a conventional x-ray fluorescence camera with a cadmium-telluride detector** [8143-18]
E. Sato, Iwate Medical Univ. (Japan); T. Enomoto, O. Hagiwara, The Toho Univ. (Japan); A. Abudurexiti, K. Sato, Toreck, Inc. (Japan); S. Sato, A. Ogawa, Iwate Medical Univ. (Japan); J. Onagawa, Tohoku Gakuin Univ. (Japan)
- 8143 0M **Color management and calibration techniques at the University of Arizona** [8143-19]
S. F. Hashmi, H. Roehrig, E. A. Krupinski, The Univ. of Arizona (United States)
- 8143 0N **Calibration and verification of DICOM software at the U-of-A** [8143-20]
S. F. Hashmi, H. Roehrig, M. Arthur, The Univ. of Arizona (United States)
- 8143 0O **An x-ray tube based room-temperature Compton spectrometer, with application to material characterization** [8143-21]
S. Olesinski, G. Harding, Morpho Detection Germany GmbH (Germany)

POSTER SESSION

- 8143 0P **Test apparatus to monitor time-domain signals from semiconductor-detector pixel arrays** [8143-22]
K. Haston, H. B. Barber, L. R. Furenlid, E. Salçin, V. Bora, The Univ. of Arizona (United States)
- 8143 0Q **Design considerations for the next-generation MAPMT-based monolithic scintillation camera** [8143-23]
E. Salçin, H. B. Barber, L. R. Furenlid, College of Optical Sciences, The Univ. of Arizona (United States)

Author Index

Conference Committee

Program Track Chair

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

Conference Chairs

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

Hans Roehrig, Health Sciences Center, The University of Arizona (United
States)

Douglas J. Wagenaar, Consultant (United States)

Program Committee

F. Patrick Doty, Sandia National Laboratories (United States)

Geoffrey Harding, Morpho Detection (Germany)

Ralph B. James, Brookhaven National Laboratory (United States)

Denny L. Lee, DxRay, Inc. (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 Clinical Imaging
H. Bradford Barber, Health Sciences Center, The University of Arizona
(United States)
- 2 Radiotherapy
Douglas J. Wagenaar, Consultant (United States)
- 3 Detectors and Applications
Hans Roehrig, Health Sciences Center, The University of Arizona (United
States)
- 4 Digital Radiography and Other
Heather L. Durko, College of Optical Sciences, The University of Arizona
(United States)

Introduction

At first look, this conference, Medical Applications of Radiation Detectors, might appear to be a new conference. Actually it has been around for a long time with different names. In 1999, the conference "Medical Applications of Penetrating Radiation" was initiated at the SPIE Optics and Photonics meeting in Denver with co-chairmen: H. Bradford Barber and Hans Roehrig. The conference was intended as a sister conference to "Hard X-Ray, Gamma-Ray, and Neutron Detector Physics" and "Penetrating Radiation Systems and Applications." In subsequent years, the medical conference was merged with "Penetrating Radiation Systems and Applications" where it flourished for a decade as about half of that conference. This year, the medical conference again goes it alone with a new name and the addition of a new co-chair, Douglas J. Wagenaar.

Research on new Medical Applications concentrated on the two traditional radiation imaging fields of x-ray radiography and nuclear medicine. Photon-counting x-ray radiography and computed tomography is closer to fulfilling its promise of dose reduction, contrast enhancement of soft tissues, and identification of specific, low-atomic number materials. Exploitation of superior energy resolution in semiconductor radiation detectors was reported for a Compton spectrometer. Nuclear Medicine techniques ranged from densely-pitched silicon detectors for gamma-ray microscopy, new designs for dedicated prostate SPECT imaging, and an innovative robotic SPECT imaging system for the radiation therapy suite. The field of Molecular Breast Imaging (MBI), highlighted in the plenary session, uses nuclear medicine with dedicated breast scanners to detect small, early-stage breast cancer with high diagnostic accuracy (sensitivity, specificity). Unlike mammography, the diagnostic performance of MBI is unaffected by radiographically-dense breast tissue. In mammography, detection sensitivity is less than 50 percent in women with dense breasts, and to compound the problem dense breast tissue is a leading risk factor in the development of breast cancer. This presents a significant opportunity for MBI to emerge as a new modality to impact the early detection and successful treatment of breast cancer.

An intriguing addition to this conference was a presentation on the use of micro- and nano-particles for drug delivery; it described an impressive use of techniques from electronic circuit production for direct medical engineering.

**H. Bradford Barber
Hans Roehrig
Douglas J. Wagenaar**

