

PROCEEDINGS OF SPIE

Quantum Communications and Quantum Imaging VII

**Ronald E. Meyers
Yanhua Shih
Keith S. Deacon**
Editors

**4–6 August 2009
San Diego, California, United States**

Sponsored and Published by
SPIE

Volume 7465

Proceedings of SPIE, 0277-786X, v. 7465

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 *Quantum Communications and Quantum Imaging VII*, edited by Ronald E. Meyers, Yanhua Shih, Keith S. Deacon, Proceedings of SPIE Vol. 7465 (SPIE, Bellingham, WA, 2009) Article CID Number.

ISSN 0277-786X
ISBN 9780819477552

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. 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.

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 barcode 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

vii *Conference Committee*

SESSION 1 QUANTUM IMAGING I

- 7465 03 **Fluorescence ghost imaging** [7465-02]
G. Scarcelli, S. H. Yun, Harvard Medical School and Wellman Ctr. for Photomedicine,
Massachusetts General Hospital (United States)

SESSION 2 QUANTUM IMAGING II

- 7465 06 **Observation of nontrivial correlation and anti-correlation from pulsed chaotic-thermal light**
[7465-05]
S. Karmakar, Z. Xie, H. Chen, Y. Shih, Univ. of Maryland, Baltimore County (United States)
- 7465 08 **Quantum ghost imaging experiments** [7465-07]
R. E. Meyers, K. S. Deacon, Army Research Lab. (United States)

SESSION 3 QUANTUM COMMUNICATIONS

- 7465 09 **Experiments of 10 Gbit/sec quantum stream cipher applicable to optical Ethernet and optical satellite link (Invited Paper)** [7465-08]
O. Hirota, Tamagawa Univ. (Japan); K. Ohhata, Kagoshima Univ. (Japan); M. Honda, S. Akutsu, Y. Doi, K. Harasawa, Tamagawa Univ. (Japan) and Hitachi Information and Communication Engineering Ltd. (Japan); K. Yamashita, Kagoshima Univ. (Japan)
- 7465 0A **Error performance of intensity modulation-based quantum stream cipher by Yuen 2000 protocol with nonlinear pseudorandom number generator** [7465-09]
K. Kato, National Tsing Hua Univ. (Taiwan) and Tamagawa Univ. (Japan)

SESSION 4 ENTANGLEMENT AND ENTANGLEMENT TECHNOLOGY

- 7465 0E **Higher fidelity source of entangled photon-pairs from a photonic crystal fiber via mode expansion and Bragg filtering** [7465-13]
A. Ling, J. Chen, J. Fan, A. Migdall, National Institute of Standards and Technology (United States) and Univ. of Maryland, College Park (United States)
- 7465 0F **High-efficiency quantum state engineering** [7465-14]
K. T. McCusker, R. Rangarajan, P. G. Kwiat, Univ. of Illinois at Urbana-Champaign (United States)

7465 OH **Nonlocal dispersion cancellation using entangled photons (Invited Paper)** [7465-16]
S.-Y. Baek, Y.-W. Cho, Y.-H. Kim, Pohang Univ. of Science and Technology (Korea, Republic of)

SESSION 5 QUANTUM TECHNOLOGY I

7465 OJ **Pump power dependence of second order correlation in nondegenerate SPDC** [7465-18]
C. Kim, G. Kanner, Northrop Grumman Electronic Systems (United States)

7465 OK **Optimization of photon pair generation in dual-element PPKTP waveguide** [7465-19]
O. Slattery, L. Ma, X. Tang, National Institute of Standards and Technology (United States)

SESSION 6 QUANTUM TECHNOLOGY II

7465 OL **Waveguide source of correlated photon-pairs for chip-scale quantum information processing (Invited Paper)** [7465-20]
J. Chen, National Institute of Standards and Technology (United States) and Univ. of Maryland, College Park (United States); A. J. Pearlman, National Institute of Standards and Technology (United States); A. Ling, J. Fan, A. Migdall, National Institute of Standards and Technology (United States) and Univ. of Maryland, College Park (United States)

7465 ON **Chirped-pulse interferometry with finite frequency correlations** [7465-22]
K. J. Resch, R. Kaltenbaek, J. Lavoie, D. N. Biggerstaff, Institute for Quantum Computing (Canada)

SESSION 7 QUANTUM INFORMATION TECHNOLOGY

7465 OQ **Quantum private data sampling** [7465-25]
D. Fattal, M. Fiorentino, R. G. Beausoleil, Hewlett-Packard Labs. (United States)

SESSION 8 QUANTUM TECHNOLOGY III

7465 OU **Factorization in a single run with an optical interferometer** [7465-29]
V. Tamma, H. Zhang, X. He, Univ. of Maryland, Baltimore County (United States); A. Garuccio, Univ. degli Studi di Bari (Italy); Y. Shih, Univ. of Maryland, Baltimore County (United States)

7465 OW **Low noise up-conversion single photon detector and its applications in quantum information systems** [7465-31]
L. Ma, O. Slattery, A. Mink, X. Tang, National Institute of Standards and Technology (United States)

SESSION 9 QUANTUM TECHNOLOGY IV

7465 OZ **Birefringence compensation in Sagnac and its quantum communication applications** [7465-34]
J. Bogdanski, J. Ahrens, M. Bourennane, Stockholm Univ. (Sweden)

SESSION 10 QUANTUM TECHNOLOGY V

- 7465 13 **Analysis of errors in an optical controlled-NOT gate** [7465-38]
T. Nagata, R. Okamoto, Hokkaido Univ. (Japan) and Osaka Univ. (Japan); K. Sasaki,
Hokkaido Univ. (Japan); S. Takeuchi, Hokkaido Univ. (Japan) and Osaka Univ. (Japan)

Author Index

Conference Committee

Conference Chairs

Ronald E. Meyers, Army Research Laboratory (United States)
Yanhua Shih, University of Maryland, Baltimore County (United States)
Keith S. Deacon, Army Research Laboratory (United States)

Program Track Chairs

Stephen M. Hammel, Space and Naval Warfare Systems Center, San Diego (United States)
Alexander M. J. van Eijk, TNO Defense, Security and Safety (Netherlands)

Program Committee

Stefania A. Castelletto, The University of Melbourne (Australia)
Milena D'Angelo, Università degli Studi di Bari (Italy)
Richard J. Hughes, Los Alamos National Laboratory (United States)
Yoon-Ho Kim, Pohang University of Science and Technology (Korea, Republic of)
Todd B. Pittman, University of Maryland, Baltimore County (United States)
Barry C. Sanders, University of Calgary (Canada)
Alexander V. Sergienko, Boston University (United States)
Dmitry V. Strekalov, Jet Propulsion Laboratory (United States)
Shigeki Takeuchi, Hokkaido University (Japan)
Zhi Zhao, Oak Ridge National Laboratory (United States)

Session Chairs

- 1 Quantum Imaging I
Keith S. Deacon, Army Research Laboratory (United States)
- 2 Quantum Imaging II
Keith S. Deacon, Army Research Laboratory (United States)
- 3 Quantum Communications
Keith S. Deacon, Army Research Laboratory (United States)
- 4 Entanglement and Entanglement Technology
Ronald E. Meyers, Army Research Laboratory (United States)
Keith S. Deacon, Army Research Laboratory (United States)

- 5 Quantum Technology I
Keith S. Deacon, Army Research Laboratory (United States)
- 6 Quantum Technology II
Keith S. Deacon, Army Research Laboratory (United States)
- 7 Quantum Information Technology
Ronald E. Meyers, Army Research Laboratory (United States)
Keith S. Deacon, Army Research Laboratory (United States)
- 8 Quantum Technology III
Ronald E. Meyers, Army Research Laboratory (United States)
- 9 Quantum Technology IV
Ronald E. Meyers, Army Research Laboratory (United States)
- 10 Quantum Technology V
Keith S. Deacon, Army Research Laboratory (United States)