PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 10118

, "Front Matter: Volume 10118," Proc. SPIE 10118, Advances in Photonics of Quantum Computing, Memory, and Communication X, 1011801 (31 May 2017); doi: 10.1117/12.2276172

SPIE.

Event: SPIE OPTO, 2017, San Francisco, California, United States

PROCEEDINGS OF SPIE

Advances in Photonics of Quantum Computing, Memory, and Communication X

**Zameer UI Hasan
Philip R. Hemmer
Hwang Lee
Alan L. Migdall**
Editors

**31 January–2 February 2017
San Francisco, California, United States**

Sponsored and Published by
SPIE

Volume 10118

Proceedings of SPIE 0277-786X, V. 10118

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Advances in Photonics of Quantum Computing, Memory, and Communication X, edited by Zameer UI Hasan,
Philip R. Hemmer, Hwang Lee, Alan L. Migdall, Proc. of SPIE Vol. 10118, 1011801
© 2017 SPIE · CCC code: 0277-786X/17/\$18 · doi: 10.1117/12.2276172

Proc. of SPIE Vol. 10118 1011801-1

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 *Advances in Photonics of Quantum Computing, Memory, and Communication X*, edited by Zameer Ul Hasan, Philip R. Hemmer, Hwang Lee, Alan L. Migdall, Proceedings of SPIE Vol. 10118 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510606777

ISBN: 9781510606784 (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.

**SPIE. DIGITAL
LIBRARY**

SPIEDigitalLibrary.org

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 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

v	<i>Authors</i>
vii	<i>Conference Committee</i>

NON-BLEACHING AND ULTRA-SMALL FLUORESCENT PROBES: JOINT SESSION WITH CONFERENCES 10079 AND 10118

10118 03	Commercial quantities of ultrasmall fluorescent nanodiamonds containing color centers (Invited Paper) [10118-3]
----------	--

CONTINUOUS-VARIABLE QUANTUM INFORMATION

10118 04	Continuous-variable quantum optical experiments in the time domain using squeezed states and heralded non-Gaussian states (Invited Paper) [10118-4]
----------	--

QUANTUM OPTICAL ENTANGLEMENT FOR COMPUTATIONAL AND COMMUNICATION LINKS I

10118 0B	High-speed continuous-variable quantum key distribution over atmospheric turbulent channels [10118-11]
----------	---

QUANTUM OPTICAL ENTANGLEMENT FOR COMPUTATIONAL AND COMMUNICATION LINKS II

10118 0E	Practical repeaters for ultra-long distance quantum communication (Invited Paper) [10118-14]
10118 0F	Time-optimal quantum control via differential geometry (Invited Paper) [10118-15]

HYPERENTANGLEMENT OF PHOTONS

10118 0G	Multidimensional tomography of an entangled photon-pair source using stimulated emission (Invited Paper) [10118-16]
10118 0I	On chip analysis of path-polarization hyperentangled cluster photon states (Invited Paper) [10118-18]
10118 0J	Non-local correlations in a hyper-entangled circuit [10118-19]

SOLID-STATE QUANTUM MEMORIES I

- 10118 0N **Towards an efficient nanophotonic platform integrating quantum memories and single qubits based on rare-earth ions** [10118-23]

QUANTUM ENTANGLEMENT SENSING

- 10118 0Z **Advantages of interaction-based readout for quantum sensing (Invited Paper)** [10118-35]

POSTER SESSION

- 10118 11 **Plasmonic superradiance of two emitters near metal nanorod** [10118-37]
10118 13 **Integrated optics-based quantum communication devices** [10118-39]
10118 14 **All-fiber photon-pair source at telecom wavelengths** [10118-40]
10118 17 **Spectral correlation and interference in continuous-wave non-degenerate photon pairs at telecom wavelengths** [10118-43]

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.

Allegra, Michele, 0F	Ramakrishnan, Rohit K., 13
Barbieri, M., 0I	Ramponi, R., 0I
Bartholomew, John G., 0N	Reuter, Rolf, 03
Bentsen, Gregory, 0Z	Rochman, Jake, 0N
Chen, Xuewen, 11	Rottwitt, Karsten, 14
Christensen, Erik N., 14	Samad, Shafeek A., 13
Ciampini, M. A., 0I	Schleier-Smith, Monika, 0Z
Cimini, V., 0I	Serikawa, Takahiro, 04
Cohen, Offir, 0G	Shames, Alexander, 03
Corielli, G., 0I	Shenderova, Olga, 03
Craiciu, Ioana, 0N	Shiozawa, Yu, 04
Crespi, A., 0I	Sipe, John E., 0G
Danilov, Evgeny, 03	Smith, Kevin, 03
Das, Partha P., 13	T. R., Yadunath, 13
Davis, Emily, 0Z	Talabattula, Srinivas, 13
Djordjevic, Ivan B., 0B	Torelli, Marco, 03
Erdmann, Reinhard K., 0J	Uskov, Alexander, 11
Fang, Bin, 0G	Usuga Castaneda, Mario A., 14
Faraon, Andrei, 0N	Verma, Varun, 17
Filonova, Daria, 03	Vigliar, C., 0I
Furusawa, Akira, 04	Vinay, Scott, 0E
Gerrits, Thomas, 17	Wang, Xiaoting, 0F
Hashimoto, Yosuke, 04	Wrachtrup, Joerg, 03
Hughes, David H., 0J	Xu, Hongxing, 11
Jacobs, Kurt, 0F	Yokoyama, Shota, 04
K., Archana, 13	Yoshikawa, Jun-ichi, 04
Kindem, Jonathan M., 0N	Zhong, Tian, 0N
Kinev, Alexander, 03	
Kok, Pieter, 0E	
Kuo, Paulina S., 17	
Li, Tracy, 0Z	
Liscidini, Marco, 0G	
Lloyd, Seth, 0F	
Lorenz, Virginia O., 0G	
Lupo, Cosmo, 0F	
Mataloni, P., 0I	
McGuire, Gary, 03	
Miyazono, Evan, 0N	
Mohseni, Masoud, 0F	
Nam, Sae Woo, 17	
Nunn, Nicholas, 03	
Oeckinghaus, Thomas, 03	
Ogawa, Hisashi, 04	
Orieux, A., 0I	
Osellame, R., 0I	
Paesani, S., 0I	
Paternostro, M., 0I	
Protsenko, Igor, 11	
Qu, Zhen, 0B	

Conference Committee

Symposium Chairs

Jean-Emmanuel Broquin, IMEP-LAHC (France)
Shibin Jiang, AdValue Photonics, Inc. (United States)

Symposium Co-chairs

Connie J. Chang-Hasnain, University of California, Berkeley
(United States)
Graham T. Reed, Optoelectronics Research Centre, University of
Southampton (United Kingdom)

Program Track Chair

David L. Andrews, University of East Anglia (United Kingdom)

Conference Chairs

Zameer Ul Hasan, Temple University (United States)
Philip R. Hemmer, Texas A&M University (United States)
Hwang Lee, Louisiana State University (United States)
Alan L. Migdall, National Institute of Standards and Technology
(United States)

Conference Program Committee

Dmitry Budker, University of California, Berkeley (United States)
Alan E. Craig, Montana State University (United States)
Jonathan P. Dowling, Louisiana State University (United States)
Gurudev Dutt, University of Pittsburgh (United States)
Geoff J. Pryde, Griffith University (Australia)
David H. Hughes, Air Force Research Laboratory (United States)
Fedor Jelezko, Universität Stuttgart (Germany)
Marko Loncar, Harvard School of Engineering and Applied Sciences
(United States)
Olivier Pfister, University of Virginia (United States)
Aleksander K. Rebane, Montana State University (United States)
Matthew J. Sellars, The Australian National University (Australia)
Selim M. Shahriar, Northwestern University (United States)
Alan E. Willner, The University of Southern California (United States)
Jörg Wrachtrup, Universität Stuttgart (Germany)
Horace P. Yuen, Northwestern University (United States)
M. Suhail Zubairy, Texas A&M University (United States)

Session Chairs

- 1 Non-bleaching and Ultra-Small Fluorescent Probes:
Joint Session with Conferences 10079 and 10118
Philip R. Hemmer, Texas A&M University (United States)
Ramesh Raghavachari, U.S. Food and Drug Administration
(United States)

Open Discussion on Non-bleaching and Ultra-Small
Fluorescent Probes
Philip R. Hemmer, Texas A&M University (United States)
Ramesh Raghavachari, U.S. Food and Drug Administration
(United States)
- 2 Continuous-Variable Quantum Information
Olivier Pfister, University of Virginia (United States)
- 3 Quantum Optical Entanglement for Computational and
Communication Links I
Pieter Kok, The University of Sheffield (United Kingdom)
Hwang Lee, Louisiana State University (United States)
- 4 Quantum Optical Entanglement for Computational and
Communication Links II
Geoff J. Pryde, Griffith University (Australia)
- 5 Hyperentanglement of Photons
Alan L. Migdall, National Institute of Standards and Technology
(United States)
- 6 Solid-State Quantum Memories I
Philip R. Hemmer, Texas A&M University (United States)
Jörg Wrachtrup, Universität Stuttgart (Germany)
- 7 Solid-State Quantum Memories II
Philip R. Hemmer, Texas A&M University (United States)
Jörg Wrachtrup, Universität Stuttgart (Germany)
- 8 Solid-State Quantum Memories III
Philip R. Hemmer, Texas A&M University (United States)
Jörg Wrachtrup, Universität Stuttgart (Germany)
- 9 Quantum Entanglement Sensing
Alan L. Migdall, National Institute of Standards and Technology
(United States)