

PROCEEDINGS OF SPIE

Quantum Optics

Victor N. Zadkov

Thomas Durt

Editors

13–14 April 2010

Brussels, Belgium

Sponsored by

SPIE

Cosponsored by

B-PHOT—Brussels Photonics Team (Belgium) • Brussels-Capital Region (Belgium) • FWO—Fonds Wetenschappelijk Onderzoek (Belgium) • ICO—International Commission for Optics • Ville de Bruxelles (Belgium)

Cooperating Organisations

CBO-BCO (Belgium) • EOS—European Optical Society (Germany) • IET—The Institution of Engineering and Technology (United Kingdom) • IOP—Institute of Physics (United Kingdom) Photonics4Life (Germany) • Photonics@be (Belgium) • Photonics 21 (Germany) • PromOptica (Belgium)

Published by

SPIE

Volume 7727

Proceedings of SPIE, 0277-786X, v. 7727

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 Optics*, edited by Victor N. Zadkov, Thomas Durt, Proceedings of SPIE Vol. 7727 (SPIE, Bellingham, WA, 2010) Article CID Number.

ISSN 0277-786X
ISBN 9780819482006

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.



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

vii *Conference Committee*

SESSION 1 QUANTUM OPTICS I

- 7727 03 **Strong quantum correlations in four wave mixing in ^{85}Rb vapor** [7727-02]
Q. Glorieux, L. Guidoni, S. Guibal, J.-P. Likforman, T. Coudreau, Lab. Matériaux et Phénomènes Quantiques, CNRS, Univ. Paris-Diderot, Paris 7 (France)
- 7727 04 **Spontaneous symmetry breaking as a resource for noncritically squeezed light** [7727-03]
G. J. de Valcárcel, F. V. Garcia-Ferrer, R. M. Höppner, Univ. de València (Spain); I. Pérez-Arjona, Univ. Politècnica de Valencia (Spain); C. Navarrete-Benlloch, E. Roldán, Univ. de València (Spain)
- 7727 06 **Cavity nano-optomechanics: a nanomechanical system in a high finesse optical cavity** [7727-05]
S. Stapsfner, Ludwig-Maximilians-Univ. München (Germany); I. Favero, Lab. Matériaux et Phénomènes Quantiques, CNRS, Univ. Paris-Diderot, Paris 7 (France); D. Hunger, P. Paulitschke, Ludwig-Maximilians-Univ. München (Germany); J. Reichel, Lab. Kastler Brossel (France); K. Karrai, E. M. Weig, Ludwig-Maximilians-Univ. München (Germany)

SESSION 2 QUANTUM OPTICS II

- 7727 08 **Adiabatic passage methods in cooling trapped molecular ions** [7727-07]
C. Lazarou, Sofia Univ. (Bulgaria) and Univ. of Sussex (United Kingdom); M. Keller, B. M. Garraway, Univ. of Sussex (United Kingdom)
- 7727 0A **Phase transition and storage of quantum optical information in spatially periodical atomic structure (Best Student Paper Award)** [7727-09]
I. O. Barinov, E. S. Sedov, A. P. Alodjants, S. M. Arakelian, Vladimir State Univ. (Russian Federation)
- 7727 0B **Ultralong photon storage using an optical locking** [7727-10]
B. S. Ham, Inha Univ. (Korea, Republic of)

SESSION 3 QUANTUM OPTICS III

- 7727 0D **Wave function formalism in quantum optics and generalized Huygens-Fresnel principle for N -photon states: derivation and applications** [7727-12]
E. Brainis, Ph. Emplit, Univ. Libre de Bruxelles (Belgium)

- 7727 0E **Design of a tunable single photon interferometer based on modal engineered tapered optical fibers** [7727-13]
M. Niehus, Instituto de Telecomunicações, Univ. de Santiago (Portugal) and ISEL/DEETC (Portugal); G. G. Martins Fernandes, A. Nolasco Pinto, Instituto de Telecomunicações, Univ. de Santiago (Portugal) and Univ. de Aveiro (Portugal)
- 7727 0F **Frequency-modulation high-precision spectroscopy of coherent dark resonances** [7727-14]
Yu. V. Vladimirova, V. N. Zadkov, Lomonosov Moscow State Univ. (Russian Federation); A. V. Akimov, A. Yu. Samokhin, A. V. Sokolov, V. N. Sorokin, N. N. Kolachevsky, P.N. Lebedev Physical Institute (Russian Federation) and Moscow Institute of Physics and Technology (Russian Federation)

SESSION 4 QUANTUM OPTICS IV

- 7727 0H **Uncertainty, entropy, and non-Gaussianity for mixed states** [7727-16]
A. Mandilara, E. Karpov, N. J. Cerf, Univ. Libre de Bruxelles (Belgium)
- 7727 0I **Spatio-temporal properties of multipartite entanglement** [7727-17]
G. Patera, M. I. Kolobov, Lab. PhLAM, Univ. des Sciences et Technologies de Lille (France)
- 7727 0J **Quantum water-filling solution for the capacity of Gaussian information channels** [7727-18]
J. Schäfer, E. Karpov, N. J. Cerf, Univ. Libre de Bruxelles (Belgium)
- 7727 0K **Quantum radar cross sections** [7727-19]
M. Lanzagorta, ITT Corp. (United States)

SESSION 5 QUANTUM OPTICS V

- 7727 0L **Six-photon entangled Dicke state enabled by a UV enhancement cavity as novel SPDC photon source (Keynote Paper)** [7727-20]
W. Wieczorek, R. Krischek, Max-Planck-Institut für Quantenoptik (Germany) and Ludwig-Maximilians-Univ. München (Germany); A. Ozawa, Max-Planck-Institut für Quantenoptik (Germany); G. Tóth, Univ. del País Vasco (Spain), IKERBASQUE, Basque Foundation for Science (Spain), and Research Institute for Solid State Physics and Optics (Hungary); N. Kiesel, P. Michelberger, Max-Planck-Institut für Quantenoptik (Germany) and Ludwig-Maximilians-Univ. München (Germany); T. Udem, Max-Planck-Institut für Quantenoptik (Germany); H. Weinfurter, Max-Planck-Institut für Quantenoptik (Germany) and Ludwig-Maximilians-Univ. München (Germany)
- 7727 0M **A semiconductor ridge microcavity source of quantum light at room temperature** [7727-21]
A. Orieux, X. Caillet, Lab. Matériaux et Phénomènes Quantiques, CNRS, Univ. Paris-Diderot, Paris 7 (France); A. Lemaître, Lab. de Photonique et de Nanostructures, CNRS (France); P. Filloux, I. Favero, G. Leo, S. Ducci, Lab. Matériaux et Phénomènes Quantiques, CNRS, Univ. Paris-Diderot, Paris 7 (France)
- 7727 0N **DC and pulsed electrical excitation of single quantum dots** [7727-22]
M. Reischle, C. Kessler, W.-M. Schulz, M. Eichfelder, R. Roßbach, M. Jetter, P. Michler, Univ. Stuttgart (Germany)

- 7727 0P **Single-photon emission from Ni-related color centers in CVD diamond** [7727-24]
D. Steinmetz, E. Neu, C. Hepp, R. Albrecht, Univ. des Saarlandes (Germany); W. Bolse, Univ. Stuttgart (Germany); J. Meijer, D. Rogalla, Ruhr-Univ. Bochum (Germany); C. Becher, Univ. des Saarlandes (Germany)

POSTER SESSION

- 7727 0R **Comments on the dual nature of photons** [7727-26]
N. V. Joshi, Univ. of Los Andes (Venezuela)
- 7727 0T **Sympathetic cooling in a multi-isotope Sr⁺ Coulomb crystal** [7727-28]
S. Removille, Q. Glorieux, T. Coudreau, L. Guidoni, J.-P. Likforman, S. Guibal, Lab. Matériaux et Phénomènes Quantiques, CNRS, Univ. Paris-Diderot, Paris 7 (France)
- 7727 0U **Long lifetime of single atom in optical tweezer with laser cooling** [7727-29]
J. Wang, J. He, B. Yang, T. Zhang, K. Peng, Shanxi Univ. (China)

Author Index

Conference Committee

Symposium Chairs

Francis Berghmans, Vrije Universiteit Brussel (Belgium)
Ronan Burgess, European Commission (Belgium)
Jürgen Popp, Institut für Photonische Technologien e.V. (Germany)
Peter Hartmann, SCHOTT AG (Germany)
Hugo Thienpont, Vrije Universiteit Brussel (Belgium)

Conference Chairs

Victor N. Zadkov, Lomonosov Moscow State University (Russian Federation)
Thomas Durt, Vrije Universiteit Brussel (Belgium)

Program Committee

Alain Aspect, Institut d'Optique (France)
Vladimir Buzek, Institute of Physics of the Slovak Academy of Sciences (Slovakia)
Berthold-Georg Englert, National University of Singapore (Singapore)
Gerard J. Milburn, The University of Queensland (Australia)
Arno Rauschenbeutel, Johannes Gutenberg-Universität Mainz (Germany)
Alexander V. Sergienko, Boston University (United States)
Paolo Tombesi, Università degli Studi di Camerino (Italy)
Anton Zeilinger, Universität Wien (Austria)

Session Chairs

- 1 Quantum Optics I
Victor N. Zadkov, Lomonosov Moscow State University (Russian Federation)
- 2 Quantum Optics II
Serge Haroche, Laboratoire Kastler Brossel (France)
- 3 Quantum Optics III
Mikhail I. Kolobov, Université des Sciences et Technologies de Lille (France)

- 4 Quantum Optics IV
Thomas Durt, Vrije Universiteit Brussel (Belgium)
- 5 Quantum Optics V
Nicolas J. Cerf, Université Libre de Bruxelles (Belgium)