

PROCEEDINGS OF SPIE

Nonlinear Optics and its Applications IV

Benjamin J. Eggleton
Neil G. R. Broderick
Alexander L. Gaeta
Editors

4–6 April 2016
Brussels, Belgium

Sponsored by
SPIE

Cosponsored by
B-PHOT—Brussels Photonics Team (Belgium)
Research Foundation Flanders (Belgium)
Visit Brussels (Belgium)

Cooperating Organisations
Photonics 21 (Germany)
EOS—European Optical Society (Germany)
KTN—the Knowledge Transfer Network (United Kingdom)
Graphene Flagship (Belgium)
Photonics Public Private Partnership (Belgium)

Published by
SPIE

Volume 9894

Proceedings of SPIE 0277-786X, V. 9894

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

Nonlinear Optics and its Applications IV, edited by Benjamin J. Eggleton, Neil G. R. Broderick,
Alexander L. Gaeta, Proceedings of SPIE Vol. 9894, 989401 · © 2016 SPIE
CCC code: 0277-786X/16/\$18 · doi: 10.1117/12.2244121

Proc. of SPIE Vol. 9894 989401-1

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 *Nonlinear Optics and its Applications IV*, edited by Benjamin J. Eggleton, Neil G. R. Broderick, Alexander L. Gaeta, Proceedings of SPIE Vol. 9894 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)
ISBN: 9781510601390

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 © 2016, 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/16/\$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 six-digit CID article numbering system structured as follows:

- 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.

Contents

vii *Authors*
ix *Conference Committee*

SESSION 1 OPTICAL FREQUENCY COMBS

- 9894 03 **Characterizing the dynamics of cavity solitons and frequency combs in the Lugiato-Lefever equation** [9894-2]
9894 04 **Nonlinear inverse engineering for broadband light generation** [9894-3]

SESSION 2 NONLINEAR INSTABILITIES IN OPTICAL SYSTEMS

- 9894 06 **Suppression of modulation instability in pump modulated flat-mirror VECSELS** [9894-5]
9894 07 **Bistability of optical patterns in convective regime** [9894-6]

SESSION 3 NONLINEAR OPTICS IN CAVITIES

- 9894 0A **Dissipative parametric modulation instability and pattern formation in nonlinear optical systems** [9894-9]
9894 0C **Optical bistability in a silicon nitride waveguide grating** [9894-11]

SESSION 4 OPTICAL COMMUNICATIONS

- 9894 0G **Improved optical performance monitoring technique based on nonlinear optics for high-speed WDM Nyquist systems** [9894-16]

SESSION 5 SPATIAL EFFECTS AND NOVEL MEDIA

- 9894 0L **Airy-induced dynamics in nonlinear media** [9894-21]
9894 0M **Beam self-action in planar chalcogenide waveguides** [9894-22]
9894 0N **All-optical gates based on photonic crystal resonators (Invited Paper)** [9894-23]
9894 0O **Three-dimensional dynamic photonic crystal creation by four laser beams interference in colloidal quantum dots** [9894-24]

SESSION 6 SILICON PHOTONICS

9894 OR **Birefringent-multicrystal, single-pass, continuous-wave second-harmonic-generation in deep-ultraviolet** [9894-27]

SESSION 7 QUANTUM NONLINEAR OPTICS

9894 OV **QPMoptics: a novel tool to simulate and optimise photon pair creation** [9894-31]

9894 OW **One and two-photon quantum interference in a Mach-Zehnder interferometer (Best Student Paper)** [9894-32]

9894 OY **Accurate relative-phase and time-delay maps all over the emission cone of hyperentangled photon source** [9894-34]

POSTER SESSION

9894 10 **Creation of advanced optical limiters based on J-type phthalocyanine dimers and their conjugates with single-walled carbon nanotubes** [9894-36]

9894 11 **Optical fiber amplifier with spectral compression elements for high-power laser pulse generation** [9894-37]

9894 12 **Explicit solution of FWM problem under the interaction of co-propagating laser beams in medium with cubic nonlinear response** [9894-38]

9894 13 **Localization of laser pulse and slow light propagation in 2D nonlinear photonic crystal** [9894-39]

9894 14 **Modeling and design of infrared and ultraviolet integrated diamond ring Raman lasers** [9894-40]

9894 15 **First orientation-patterned GaSb ridge waveguides fabrication and preliminary characterization for frequency conversion in the mid-infrared** [9894-41]

9894 16 **Comparison of all optical forwarding packet architectures** [9894-42]

9894 17 **All optical contention detection and resolution for asynchronous variable length optical packets switching** [9894-43]

9894 18 **Aperiodic grating design methods employed for idler-efficiency enhanced beam generation in orientation-patterned GaAs** [9894-44]

9894 19 **Self-phase modulation on a graphene used waveguide** [9894-45]

9894 1A **Wavelength- and polarization-dependent nonlinear optical properties of plasmonic nanoprism arrays** [9894-46]

- 9894 1C **Supercontinuum generation in polarization maintaining photonic crystal fiber by using various harmonics of sub-nanosecond Q-switched laser** [9894-49]
- 9894 1D **Non-linear excitation of atoms by ultrashort electromagnetic pulses** [9894-50]
- 9894 1E **Dielectric response of pure and doped-GaSe crystals studied by an indigenously developed broadband THz-TDS system** [9894-51]
- 9894 1G **Measurement of the third order non-linearity of gold-graphene hybrid nanocomposite for near-infrared wavelengths** [9894-54]
- 9894 1H **Index modulation of transient grating in nonlinear medium** [9894-55]
- 9894 1I **Four-wave mixing UV generation in optical microfibers** [9894-56]
- 9894 1J **Experimental observation of surface acoustic wave Brillouin scattering in a small-core photonic crystal fiber** [9894-57]
- 9894 1K **Direct current modulation of a photomixing signal** [9894-58]
- 9894 1L **Constructing eigenmode excitation spectrum in synthetic photonic lattices using optical heterodyning** [9894-59]
- 9894 1M **Temporal and spectral compression of pulses in fibers with a running refractive index wave** [9894-61]
- 9894 1P **Parallel processing using an optical delay-based reservoir computer** [9894-64]
- 9894 1Q **The influence of phenomenological relaxation and finite temperature on the third order nonlinearity of graphene** [9894-65]
- 9894 1T **Impedance spectroscopy for measuring low optical absorption coefficients of nonlinear optical crystals** [9894-68]
- 9894 1U **Changing of optical absorption and scattering coefficients in nonlinear-optical crystal lithium triborate before and after interaction with UV-radiation** [9894-69]
- 9894 1V **Effective chiral behavior on self-assembled tilted gold nanowires metasurface by means of linear and nonlinear optical techniques** [9894-70]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four 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.

Abdul Khudus, Muhammad I. M., 1I
Ahmed, W. W., 06
Astapenko, Valery A., 1D
Badr, Yehia A., 0Y
Baudet, Emeline, 0M
Bej, Subhajit, 0C
Belardini, A., 1V
Beugnot, Jean-Charles, 1J
Bhaktha, S. N. B., 1E
Bhattacharya, S., 1E
Boidin, Rémi, 0M
Borghi, M., 0W
Botey, M., 06
Brambilla, Gilberto, 1I
Castelló-Lurbe, David, 04
Centini, M., 1V
Cerutti, L., 15
Cesca, Tiziana, 1A
Chauvet, Mathieu, 0M
Cheng, J. L., 1Q
Chon, James W. M., 1G
Churkin, D. V., 0A, 1L
Combríé, Sylvain, 0N
Constantin, Florin L., 1K
Corbari, Costantino, 1I
Das, Amit C., 1E
Datta, P. K., 1E
De Lucia, Francesco, 1I
De Rossi, Alfredo, 0N
Demkin, Artem S., 1U
Devi, Kavita, 0R
Dinleyici, Mehmet Salih, 1H
Dneprovskii, V. S., 0O
Ebrahim-Zadeh, M., 0R
El-Azab, Jala, 0Y
Ezhova, K. V., 0O
Farhat, Amel, 16, 17
Farhat, Rim, 16, 17
Fazio, E., 1V
Feigel, Benjamin, 14
Figen, Ziya Gürkan, 18
Fontana, G., 0W
Fotiadi, Andrei A., 11, 1M
García Ramírez, Emma V., 1A
García, M., 15
Gelens, L., 03
Gemo, Emanuele, 1A
Gérard, B., 15
Gerasimenko, Alexander Yu., 10
Gómez Cervantes, Juan M., 1A
Gomila, D., 03
Grisard, A., 15
Grudtsyn, Yakov V., 12
Guesmi, Latifa, 0G
Haus, Joseph W., 1V
Hegazy, Salem F., 0Y
Hentschel, Michael, 0V
Herrero, R., 06
Hooper, D., 1V
Horak, Peter, 1I
Hübel, Hannes, 0V
Jarutis, Vygandas, 1C
Jewariya, M., 1E
Kalinic, Boris, 1A
Karakilinc, Ozgur Onder, 1H
Konyashkin, Aleksey V., 1T
Korobko, Dmitry A., 1I
Kuchik, Igor E., 12
Kudlinski, Alexandre, 1J
Kumar, S., 06
Kuriakose, Tintu, 0M
Lapin, V. A., 1M
Laude, Vincent, 1J
Laudenbach, Fabian, 0V
Laukkanen, Janne, 0C
Leahu, G., 1V
Lee, Timothy, 1I
Li Voti, R., 1V
Lim, Byungkwon, 1G
Lim, Guh-Hwan, 1G
Lim, Hwee San, 19
Mancinelli, M., 0W
Mandal, K. C., 1E
Mantsevich, V. N., 0O
Marsal, Nicolas, 07, 0L
Mat Jafri, Mohd. Zubir, 19
Mattei, Giovanni, 1A
Menif, Mourad, 0G, 16, 17
Michieli, Niccolò, 1A
Mikheev, Leonid D., 12
Mirisola, E., 07
Moille, Grégory, 0N
Mondal, S., 1E
Nazabal, Virginie, 0M
Němec, Petr, 0M
Nguimdo, Romain Modeste, 1P
Nikifin, Dmitry G., 1U
Obayya, Salah S. A., 0Y

Okhotnikov, Oleg G., 11
 Ozaki, T., 1E
 Parra-Rivas, P., 03
 Parsa, S., 0R
 Patriarche, G., 15
 Pavesi, L., 0W
 Perego, A. M., 0A
 Phan Huy, Kien, 1J
 Pigarev, Aleksey V., 1T
 Polokhin, Alexander A., 10
 Poppe, Andreas, 0V
 Price, H. M., 0W
 Radziunas, M., 06
 Rangel Rojo, Raul, 1A
 Renversez, Gilles, 0M
 Reyes Esqueda, Jorge A., 1A
 Roux, S., 15
 Ryabushkin, Oleg A., 1T, 1U
 Sakhno, Sergey V., 1D
 Sánchez Esquivel, Hectór, 1A
 Sarangan, Andrew, 1V
 Savelyev, Mikhail S., 10
 Sazio, Pier, 1I
 Sciamanna, Marc, 07, 0L
 Sementsov, D. I., 1M
 Sibilia, C., 1V
 Silvestre, Enrique, 04
 Sipe, J. E., 1Q
 Sirutkaitis, Valdas, 1C
 Smirnov, A. M., 0O
 Staliunas, K., 06, 0A
 Sukhorukov, A. A., 1L
 Svirko, Yuri P., 0C
 Syed, Salmaan R., 1G
 Sylvestre, Thibaut, 1J
 Tajaldini, Mehdi, 19
 Tan, Kok Chooi, 19
 Tarasov, N., 0A
 Tchahame, Joël Cabrel, 1J
 Tervo, Jani, 0C
 Thienpont, Hugo, 14
 Tikan, A. M., 1L
 Tikhonov, I. V., 0O
 Tolbin, Alexander Yu., 10
 Tournié, E., 15
 Trenti, A., 0W
 Trofimov, Vyacheslav A., 12, 13
 Trykin, Evgeny M., 13
 Turitsyn, S. K., 0A
 Turunen, Jari, 0C
 Valev, V. K., 1V
 Van der Sande, Guy, 1P
 Vatnik, I. D., 1L
 Vengelis, Julius, 1C
 Vermeulen, Nathalie, 14, 1Q
 Verschaffelt, Guy, 1P
 Weicker, L., 07
 Wiersma, Noémi, 0L
 Wolfersberger, Delphine, 07, 0L

Zolotovskii, Igor O., 11, 1M

Conference Committee

Symposium Chairs

Francis Berghmans, Vrije Universiteit Brussel (Belgium)
Jürgen Popp, Institut für Photonische Technologien e.V.
(Germany)

Symposium Co-Chairs

Ronan Burgess, European Commission Photonics Unit (Belgium)
Peter Hartmann, SCHOTT, AG (Germany)

Honorary Symposium Chair

Hugo Thienpont, Vrije Universiteit Brussel (Belgium)

Conference Chairs

Benjamin J. Eggleton, The University of Sydney (Australia)
Neil G. R. Broderick, The University of Auckland (New Zealand)
Alexander L. Gaeta, Cornell University (United States)

Conference Programme Committee

Fabio Biancalana, Heriot-Watt University (United Kingdom)
Alex S. Clark, Imperial College London (United Kingdom)
Stephane Coen, The University of Auckland (New Zealand)
Arnaud Couairon, Ecole Polytechnique (France)
Richard M. De La Rue, University of Malaya (Malaysia) and University
of Glasgow (United Kingdom)
Christophe Dorrer, University of Rochester (United States)
Majid Ebrahim-Zadeh, ICFO - Institut de Ciències Fotòniques (Spain)
Mark Foster, Johns Hopkins University (United States)
Goëry Genty, Tampere University of Technology (Finland)
Peter Horak, University of Southampton (United Kingdom)
Colin J. McKinstrie, Alcatel-Lucent Bell Laboratories (United States)
Christelle Monat, Ecole Centrale de Lyon (France)
Dragomir N. Neshev, The Australian National University (Australia)

Session Chairs

Optical Frequency Combs
Benjamin J. Eggleton, The University of Sydney (Australia)

Nonlinear Instabilities in Optical Systems

Neil G. R. Broderick, The University of Auckland (New Zealand)

Nonlinear Optics in Cavities

Benjamin J. Eggleton, The University of Sydney (Australia)

Optical Communications

Pascal Del'Haye, National Physical Laboratory (United States)

Joint Session with Conference 9893: Mode-locked Fibre Lasers

Jacob I. Mackenzie, University of Southampton (United Kingdom)

Spatial Effects and Novel Media

Kathy Lüdge, Technische Universität Berlin (Germany)

Silicon Photonics

Leif K. Oxenløwe, Technical Universitet of Denmark (Denmark)

Quantum Nonlinear Optics

Bart Kuyken, University Gent (Belgium)