

PROCEEDINGS OF SPIE

Quantum Optics and Photon Counting 2019

**Ivan Prochazka
Roman Sobolewski
Ralph B. James
Peter Domokos
Adam Gali**
Editors

**1–3 April 2019
Prague, Czech Republic**

Sponsored by
SPIE

Cooperating Organisations
ELI Beamlines (Czech Republic)
Laserlab Europe
European Optical Society
HiLASE (Czech Republic)

Published by
SPIE

Volume 11027

Proceedings of SPIE 0277-786X, V. 11027

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

Quantum Optics and Photon Counting 2019, edited by Ivan Prochazka, Roman Sobolewski,
Ralph B. James, Peter Domokos, Adam Gali, Proc. of SPIE Vol. 11027, 1102701
© 2019 SPIE · CCC code: 0277-786X/19/\$18 · doi: 10.1117/12.2535605

Proc. of SPIE Vol. 11027 1102701-1

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 SPIDigitalLibrary.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 *Quantum Optics and Photon Counting 2019*, edited by Ivan Prochazka, Roman Sobolewski, Ralph B. James, Peter Domokos, Adam Galí, Proceedings of SPIE Vol. 11027 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

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

ISBN: 9781510627208
ISBN: 9781510627215 (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 © 2019, 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/19/\$18.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.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 first 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>
ix	<i>Introduction</i>

SESSION 1 QUANTUM STATES AND PHOTON COUNTING I

11027 04	Timing properties of superconducting nanowire single-photon detectors (Invited Paper) [11027-2]
----------	---

SESSION 2 QUANTUM STATES AND PHOTON COUNTING II

11027 07	Towards absolute all optical satellite range finding by photon counting (Invited Paper) [11027-6]
11027 08	Lunar laser ranging utilizing a highly efficient solid-state detector in the near-IR [11027-7]
11027 09	Photon counting detector package optimized for space debris optical tracking [11027-8]
11027 0B	Sub-nanosecond gating of InGaAs/InP SPAD (Invited Paper) [11027-10]

SESSION 3 QUANTUM STATES AND PHOTON COUNTING III

11027 0D	Multiuser optical information authentication using photon counting in spiral phase transform domain [11027-13]
11027 0F	Distance accuracy evaluation of airborne ghost image via sparsity constraints LiDAR system [11027-15]

SESSION 4 QUANTUM STATES AND PHOTON COUNTING IV

11027 0H	Efficient entanglement generation in exciton-polaritons using quantum control [11027-12]
----------	---

POSTER SESSION

- 11027 0K **A high-performance thermoelectric single-photon detector for telecom wavelengths**
[11027-21]
- 11027 0L **Radiation hardness of semiconductor single photon detection structure** [11027-22]
- 11027 0O **Quantum control of entanglement in coupled spins using shortcuts to adiabaticity and optimal control** [11027-25]

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.

Bimbova, Roberta, 09
Blazej, Josef, 09, 0L
Buttafava, Mauro, 0B
Chen, Jiuying, 0F
Cheng, Yuhao, 04
Chi, Xiaoming, 04
Eckl, Johann J., 08
Gu, Chao, 04
Hu, Jian, 0F
Hu, Nan, 04
Hu, Xiaolong, 04
Iliopoulos, Nikos, 0O
Karanikolas, Vasilos, 0O
Kodet, Jan, 07, 09
Kumar, Ravi, 0D
Kuzanyan, Armen S., 0K
Kuzanyan, Astghik A., 0K
Lan, Xiaojian, 04
Li, Chuanrong, 0F
Liu, Haiyi, 04
Meng, Yun, 04
Nikoghosyan, Vahan R., 0K
Paspalakis, Emmanuel, 0H, 0O
Pisa, Vladislav, 0L
Prochazka, Ivan, 09
Quan, Chenggen, 0D
Renna, Marco, 0B
Sanzaro, Mirko, 0B
Schreiber, Karl Ulrich, 07, 08
Schüler, Torben, 08
Sopko, Bruno, 0L
Sopko, Vit, 0L
Stefanatos, Dionisis, 0H, 0O
Tang, Lingli, 0F
Teng, Geer, 0F
Tosi, Alberto, 0B
Wu, Hao, 04
Wu, Haohao, 0F
Xu, Liang, 04
Zhang, Dandan, 0F
Zhang, Huijing, 0F
Zhou, Mei, 0F
Zichi, Julien, 04
Zou, Kai, 04
Zwiller, Val, 04

Conference Committee

Symposium Chairs

Bedřich Rus, ELI Beamlines (Czech Republic)
Saša Bajt, Deutsches Elektronen-Synchrotron (Germany)
Mike Dunne, SLAC National Accelerator Laboratory (United States)
Chris B. Edwards, STFC Rutherford Appleton Laboratory
(United Kingdom)
Ivo Rendina, Istituto per la Microelettronica e Microsistemi, CNR (Italy)

Honorary Symposium Chair

Erich Spitz, French Academy of Sciences, National Academy of
Technologies (France), Advisor to Thales (France)

Conference Chairs

Ivan Prochazka, Czech Technical University in Prague
(Czech Republic)
Roman Sobolewski, University of Rochester (United States)
Ralph B. James, Savannah River National Laboratory (United States)
Peter Domokos, Wigner Research Centre for Physics, Institute for Solid
State Physics and Optics (Hungary)
Adam Gali, Wigner Research Centre for Physics, Institute for Solid
State Physics and Optics (Hungary)

Conference Programme Committee

Josef Blazej, Czech Technical University in Prague (Czech Republic)
Ulrich Schreiber, Technische Universität München (Germany)
Valery Zwiller, KTH Royal Institute of Technology (Sweden)

Session Chairs

- 1 Quantum States and Photon Counting I
Roman Sobolewski, University of Rochester (United States)
- 2 Quantum States and Photon Counting II
Ulrich Schreiber, Technische Universität München (Germany)
- 3 Quantum States and Photon Counting III
Ivan Prochazka, Czech Technical University in Prague
(Czech Republic)

- 4 Quantum States and Photon Counting IV
Josef Blazej, Czech Technical University in Prague (Czech Republic)

Introduction

This book contains the Proceedings of the SPIE conference on Quantum Optics and Photon Counting. The conference was held on 1–3 April in Prague, Czech Republic as part of the SPIE Optics + Optoelectronics 2019. The meeting was organized into five technical sessions on quantum states and photon counting. Oral talks were given on 1–2 April 2019, and a poster session was provided on 3 April.

The purpose of the conference was to provide a forum for scientists and engineers from the single-photon detector development and user communities to present and evaluate the most recent results on quantum optics and photon-counting detectors and discuss a variety of detection and imaging applications. A total of 21 presentations, including 1 plenary talk (of the 5 symposium-wide plenary talks) and 5 posters, were provided at the conference. This book provides detailed documentation describing a portion of the presentations. The editors hope that it will serve as an important record of the meeting, provide an update on the status of photon-counting detectors and applications, and serve as a useful resource for those working in the field.

The Conference Chairs would like to thank the Session Chairs and members of the Conference Program Committee, who offered their time to enlist the involvement of researchers working in the field.

Ivan Prochazka
Roman Sobolewski
Ralph B. James
Peter Domokos
Adam Gali

