

PROCEEDINGS OF SPIE

Quantum Technologies 2024

Florent Baboux
Virginia D'Auria
Tom Bienaimé
Editors

8–10 April 2024
Strasbourg, France

Sponsored by
SPIE

Cooperating Organisations
Photonics 21 (Germany)
EOS—European Optical Society

Published by
SPIE

Volume 12993

Proceedings of SPIE 0277-786X, V. 12993

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

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 Technologies 2024*, edited by Florent Baboux, Virginia D'Auria, Tom Bienaimé, Proc. of SPIE 12993, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510673045

ISBN: 9781510673052 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2024 Society of Photo-Optical Instrumentation Engineers (SPIE).

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 fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center 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.

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: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE 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

vii *Conference Committee*

SESSION 1 **NOVEL PLATFORMS I**

12993 02 **Cold Rydberg atom excitation mediated via an optical nanofiber (Invited Paper)** [12993-1]

SESSION 2 **QUANTUM SENSING AND METROLOGY**

12993 03 **Nonclassicality and wave-particle duality in quantum interferometer** [12993-5]

SESSION 3 **INTEGRATED DEVICES**

12993 04 **Development of superconducting single-photon detectors based on NbTiN and graphene (Invited Paper)** [12993-8]

12993 05 **Towards on-chip demonstration of a high-dimensional quantum random number generator (Best Student Paper Award)** [12993-9]

SESSION 4 **QUANTUM COMMUNICATION**

12993 06 **Enhancing free space DI QKD via employing NPA hierarchy method (Invited Paper)** [12993-12]

12993 07 **Experimental simulation of an underwater QKD system in a real scenario** [12993-13]

SESSION 5 **NOVEL PLATFORMS II**

12993 08 **Structural dependence of antibunching and fluorescence lifetime** [12993-17]

SESSION 6 **QUANTUM IMAGING**

12993 09 **Optimisation of simple quantum illumination** [12993-20]

12993 0A **Application of polarization-entangled photon pairs for studying the density of microorganisms**
[12993-22]

SESSION 7 QUANTUM INFORMATION AND SENSING

12993 0B **Reconfigurable quantum-optical circuits in a complex medium** [12993-26]

SESSION 8 SINGLE-PHOTON EMITTERS

12993 0C **Promising single-photon emitter in the blue-green spectral range with an epitaxial CdSe/ZnSe nanowire quantum dot** [12993-27]

12993 0D **Near-ideal room-temperature single photon emitters coupled with photonic integrated circuits**
[12993-28]

POSTER SESSION

12993 0E **Current challenges of QML: a study on celestial object classification using real IBM quantum computers** [12993-31]

12993 0F **Discrete phase CV-QKD over a hybrid free space - fiber channel with K-means clustering**
[12993-34]

12993 0G **Theoretical investigation of fluorescent defects in hexagonal boron nitride and their applications in quantum technologies** [12993-36]

12993 0H **Optimization of AlGaAs-based Bragg-reflection waveguides for entangled photon sources**
[12993-40]

12993 0I **Polarization entangled photon-pair source in a dual displacement interferometric configuration**
[12993-41]

12993 0J **Precision minimally-destructive detection of ultra-cold atomic ensembles** [12993-47]

12993 0K **Quantum PIC simulation tool for linear optical quantum computing gates** [12993-50]

12993 0L **A novel decoy state BB84 QKD transmission scheme using optical-switch-based polarization multiplexing** [12993-51]

12993 0M **Nonclassicality of output fields from seeded nondegenerate optical parametric oscillator**
[12993-54]

12993 0N **Light shift mitigation for the 5S-5D two-photon transition in rubidium** [12993-55]

12993 0O **QTris: a quantum game** [12993-58]

- 12993 0P **Quantum diamond microscope with circularly polarized microwave excitation for wide-field vector magnetometry** [12993-59]
- 12993 0Q **Towards on-chip magnetometry for SiC power electronics using Si vacancies in 4H-SiC** [12993-60]