PHOTONICA2015

V International School and Conference on Photonics
& COST actions: MP1204 and BM1205
& the Second international workshop "Control of light and matter waves propagation and localization in photonic lattices“
www.vin.bg.ac.rs/photonica 2015

Book of Abstracts

Editors
Suzana Petrović, Goran Gligorić and Milutin Stepić

Belgrade, 2015.

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24 August – 28 August 2015

Belgrade, Serbia

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Suzana Petrović, Goran Gligorić and Milutin Stepić

Vinča Institute of Nuclear Sciences, Belgrade, Serbia

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ABSTRACTS OF TUTORIAL, KEYNOTE AND INVITED LECTURES AND CONTRIBUTED PAPERS

of

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Technical assistance
Petra Beličev, Marijana Petković

Publisher
Vinča Institute of Nuclear Sciences
Mike Petrovića Alasa 12-14, P.O. Box 522
11001 Belgrade, Serbia

Printed by
Serbian Academy of Sciences and Arts

Number of copies
300

ISBN 978-86-7306-131-3

The PHOTONICA2015 (The Fifth International School and Conference on Photonics) is organized by the Vinča Institute of Nuclear Sciences, University of Belgrade (www.vinca.rs), the Serbian Academy of Sciences and Arts, the Optical Society of Serbia and Aston University, Birmingham, UK. Co-organizers of this meeting are: the Institute of Physics Belgrade, University of Belgrade (www.phy.bg.ac.rs), Faculty of Electrical Engineering, University of Belgrade (www.etf.bg.ac.rs), Institute of Chemistry, Technology and Metallurgy, University of Belgrade (www.ihtm.bg.ac.rs), Faculty of Technical Sciences, University of Novi Sad (www.ftn.uns.ac.rs), Faculty of physics, University of Belgrade (www.ff.bg.ac.rs), and Faculty of biology, University of Belgrade (www.bio.bg.ac.rs), under auspices and with support of the Ministry of Education, Science and Technological Development, Serbia.

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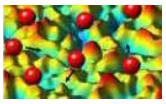
Conference Topics

1. Quantum optics
2. Nonlinear optics
3. Ultrafast phenomena
4. Laser spectroscopy
5. Devices and components
6. Biophotonics
7. Optical communications
8. Sensing: plasmonics, fiber optics and interferometers
9. Holography and adaptive optics
10. Optical materials

BMBS COST Action BM1205
European Network for Skin Cancer Detection using Laser Imaging
(24-28 August)

MPNS COST Action MP1204
TERA-MIR Radiation: Materials, Generation, Detection and Applications
(24-28 August)



WORKSHOP
Control of light and matter waves propagation and localization in photonic lattices
(28-29 August)

The **International School and Conference on Photonics- PHOTONICA**, is a biennial event held in Belgrade since 2007. The first meeting in the series was called ISCOM (International School and Conference on Optics and Optical Materials), but it was later renamed to Photonica to reflect more clearly the aims of the event as a forum for education of young scientists, exchanging new knowledge and ideas, and fostering collaboration between scientists working within emerging areas of photonic science and technology.

A particular educational feature of the program is to enable students and young researchers to benefit from the event, by providing introductory lectures preceding most recent results in many topics covered by the regular talks. In other words, apart from the regular lectures, the plenary speakers will also give tutorial lectures specifically designed for students and scientists starting in this field.

The Conference consists of oral presentations and vibrant poster sessions. The wish of the organizers is to provide a platform for discussing new developments and concepts within various disciplines of photonics, by bringing together researchers from academia, government and industrial laboratories for scientific interaction, the showcasing of new results in the relevant fields and debate on future trends. This year our conference will contribute celebration of the International Year of Light as a global initiative which will highlight to the citizens of the world the importance of light and optical technologies. This PHOTONICA 2015 will include two COST Action meetings and one workshop with the main objective to promote knowledge in various disciplines of photonics. In additional to the lectures and seminars, a Round Table "Scientific publishing: Editors et altera" will be organized where the editors will present editorial and publishing policies of their journals and share their experiences. Following the official program, the participants will also have plenty of opportunity to mix and network outside of the lecture theatre with planned free time and social events.

This book contains 219 abstracts of all presentations at the **5th International School and Conference on Photonics, PHOTONICA2015**. Authors from 50 countries from all continents will present their work at the conference. There will be six tutorial and seven keynote lectures to the benefits of students and young researches. Twenty four invited lectures, five progress reports of young Serbian researchers and thirty one contributed talks will present most recent results in their research fields. Within the two poster sessions, students and young researches will present 146 poster presentations on their new results in a cozy atmosphere of the Serbian academy of science and arts.

Belgrade, July 2015
Editors

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Devices and components

Optical communication

Modeling and applications of Quantum Cascade in external magnetic field

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The rapidly emerging field of nano-optoelectronics is based on the understanding and control of intersubband transitions in nano-dimensional systems. One of the most striking outcomes of intersubband transitions engineering is the quantum cascade laser (QCL) – an efficient and reliable unipolar semiconductor laser source [1], with the possibility to operate from the mid-infrared (MIR) to the THz range of frequencies. These powerful devices are particularly appreciated for such wide scope of operating wavelengths which can be achieved by using the same heterostructure combination, but changing the design of the active region, i.e. 'tailoring' the layers' widths and composition. This renders QCLs suitable for numerous applications, including free-space communications, medical diagnostics and in particular, chemical sensing and monitoring [2].

In the MIR part of the spectrum, QCLs are of great interest for gas sensing and monitoring. We explore the possibilities of using advanced tools for global optimization, namely the genetic algorithm, to obtain structural parameters of gain-maximized QCL emitting at specified wavelengths, suitable for detection of pollutant gasses, such as SO_2, HNO_3, CH_4 and NH_3, in the ambient air. Then we introduce a strong external magnetic field perpendicular to the epitaxial layers, to fine tune the laser output properties [2]. This magnetic field alters the electron energy spectrum by splitting the continuous energy subbands into discrete Landau levels whose arrangement influences the magnitude of the optical gain. In addition, strong effects of band nonparabolicity result in subtle changes in the lasing wavelength at magnetic fields which maximize the gain, thus allowing us to explore the prospects of multi-wavelength emission of the given structure.

THz frequencies belong to the quite under-utilized part of the electromagnetic spectrum, despite their significant application potential. This is mostly due to the lack of coherent solid-state THz sources. The so called „THz gap" falls between two frequency ranges that have been well developed, the microwave and millimeter-wave frequency range. THz QCLs are great candidates to fill in this gap [3]. We have analyzed two structures lasing in this region (both of them reported in the literature, but not studied under the influence of an external magnetic field), the three- and four-well (per period) based structures that operate at 3.9THz and 1.9THz, respectively, implemented in $GaAs/Al_{0.15}Ga_{0.85}As$. Numerical results are presented for magnetic field values from 1.5 T up to 20 T, while the band nonparabolicity is carefully accounted for.

Because of their high output gain, QCLs are suitable to be used as active media in metamaterial unit cells, thus enabling evasion of metallic inclusions present in conventional metamaterials [4]. We analyze a quantum cascade structure lasing at 4.6THz, placed under the influence of a strong magnetic field. We first solve the full

system of rate equations for all the relevant Landau levels, and obtain the necessary information about the carrier distribution among the levels, after which we are able to evaluate the permittivity component along the growth direction of the structure, as well as the range of frequencies at which the structure exhibits negative refraction for a predefined total electron sheet density.

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Dissipation through localised loss in lattice bosonic systems

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In the recent years, controlled dissipation has proven to be a useful tool for probing of a quantum system in the ultracold setup [1]. We consider dynamics of lattice bosons induced by a dissipative local defect [2]. We address superfluid and supersolid phases that are ground states of an extended Bose-Hubbard Hamiltonian. To this end, we solve the master equation using the Gutzwiller approximation and find that in the usual homogeneous superfluid phase repulsive interactions lead to enhanced dissipation process. On the other hand, our mean-field approach indicates that the effective loss rates are significantly suppressed deep in the supersolid phase where repulsive nearest neighbour interactions play a dominant role. Our numerical results are explained by an analytical insight and in particular, in the limit of strong dissipation we recover the quantum Zeno effect.

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