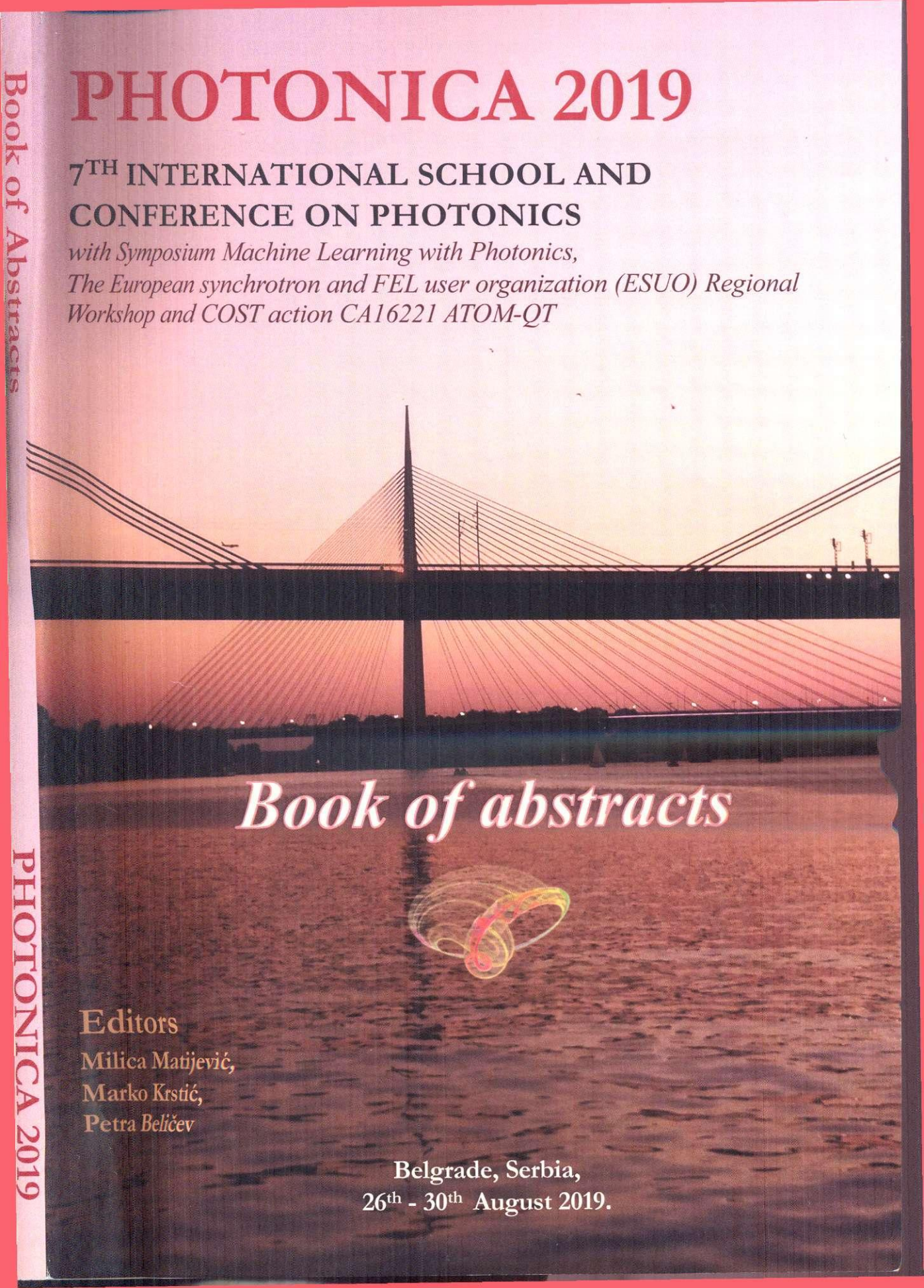


PHOTONICA 2019

7TH INTERNATIONAL SCHOOL AND CONFERENCE ON PHOTONICS

*with Symposium Machine Learning with Photonics,
The European synchrotron and FEL user organization (ESUO) Regional
Workshop and COST action CA16221 ATOM-QT*



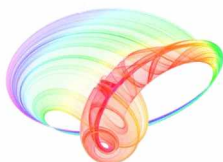
Book of abstracts

Editors

Milica Matijević,
Marko Krstić,
Petra Beličev

Belgrade, Serbia,
26th - 30th August 2019.

Book of abstracts



PHOTONICA2019

**The Seventh International School and Conference on
Photonics, 26 August – 30 August 2019, Belgrade, Serbia**

**& Machine Learning with Photonics Symposium
(ML-Photonica 2019)**



& ESUO Regional Workshop



& COST action CA16221



Editors: Milica Matijević, Marko Krstić and Petra Beličev

Belgrade, 2019

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PROGRESS REPORTS AND CONTRIBUTED PAPERS

of

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PHOTONICA2019, 26 August – 30 August 2019, Belgrade, Serbia

and

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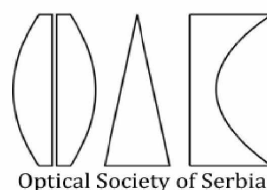
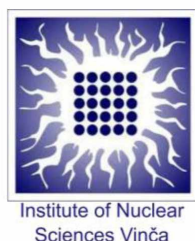
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NKT PHOTONICS

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Conference Topics

1. Quantum optics and ultracold systems
2. Nonlinear optics
3. Optical materials
4. Biophotonics
5. Devices and components
6. Optical communications
7. Laser spectroscopy and metrology
8. Ultrafast optical phenomena
9. Laser-material interaction
10. Optical metamaterials and plasmonics
11. Machine learning in photonics
12. Other topics in photonics

Dear Colleagues, friends of photonics,

We are honored by your participation at our PHOTONICA2019 and your contribution to the tradition of this event. It is our pleasure to host you in Belgrade and in Serbia. Welcome to the world of photonics.

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 the most recent results in many topics covered by the regular talks. In other words, tutorial and keynote speakers will give lectures specifically designed for students and young scientists starting in this field. Apart from the oral presentations, PHOTONICA hosts vibrant poster sessions. A significant number of best posters will be selected and the authors will have opportunity to present their work through short oral presentations – contributed talks.

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. In order to boost transfer of light technologies from academia to industry, mixing it with a useful knowledge from IT sector, for the first time we organize a satellite event - „Machine learning with Photonics“, which will be realized in the form of a special symposium. The field of machine learning potentially brings a new set of powerful tools to optical communications and photonics. The symposium will comprise several topics related to the applications of machine-learning techniques to the physical and networking layers, as well as to non-telecom applications such as biomedical matter and basic concepts of machine learning principles. We expect that these attractive talks will entice young researchers and engineers from the IT sector and target bigger companies to direct their business plans towards innovations in photonics. Additionally, PHOTONICA2019 will include ESUO Regional workshop and COST action “Quantum Technologies with Ultra-Cold Atoms - AtomQT” with the main objective to promote knowledge in various disciplines of photonics.

In addition, the representatives of the companies related to photonics will have significant role at the event by presenting the new trends in research and development sector. Following the official program, the participants will also have plenty of opportunities to mix and network outside of the lecture theatre with planned free time and social events.

This book contains 181 abstracts of all presentations at the VII International School and Conference on Photonics, PHOTONICA2019. Authors from all around the world will present their work at this event. PHOTONICA2019 will host four tutorial and six keynote lectures to the benefit of students and early stage researches. The most recent results in various research fields of photonics will be presented through eighteen invited lectures and twelve progress reports of early stage researchers. Within the three poster sessions and a number of contributed talks, authors will present 100 poster presentations on their new results in a cozy atmosphere of the building of Serbian Academy of Science and Arts.

Belgrade, July 2019
Editors

Table of Content

Tutorial Lectures

T.1 Molecular membrane organization - a super-resolution fluorescence microscopy study	2
<i>C. Eggeling</i>	
T.2 Controlled directional scattering in nano-optics	3
<i>G. Leuchs, S. Nechayev, P. Banzer</i>	
T.3 Quantum Monte-Carlo methods applied to ultracold gases	4
<i>S. Giorgini</i>	
T.4 Nanophotonics Integration Technology and Applications: Si-Photonics and Nanoscale Light Emitters.....	5
<i>Y. Fainman</i>	

Keynote lectures

K.1 High performance THz Quantum Cascade Lasers	7
<i>M. Kainz, S. Schoenhuber, C. Dertl, M.A. Andrews, G. Strasser, J. Darmo, K. Unterrainer</i>	
K.2 Optics in Computing for "More than Moore" performance and "Beyond von Neumann" architectures.....	8
<i>N. Pleros</i>	
K.3 The Wonderful World of Flat Bands	9
<i>S. Flach</i>	
K.4 Numerical optimization of resonant nanophotonic devices	10
<i>F. Binkowski, P.-I. Schneider, M. Hammerschmidt, L. Zschiedrich, S. Burger</i>	
K.5 Nonlinear optical scattering as a tool to study symmetry and dynamical processes	11
<i>T. Verbiest</i>	
K.6 Fluorescence Correlation Spectroscopy as a tool in Developmental Biology.....	12
<i>T. Wohland, S. Veerapathiran, C. Teh, X. Wen Ng, V. Korzh</i>	

Invited Lectures

I.1 Measuring electronic properties of free-standing nanocrystals for solar cell absorbers	14
<i>A. R. Milosavljević, D. K. Božanić, D. Danilović, P. Sapkota, N. Vukmirović, S. Sadhu, R. Dojčilo, W. Huang³, J. Božek, C. Nicolas, L. Nahon, S. Ptasinska</i>	
I.2 SERS spectroscopy: concepts, new materials and application	15
<i>A. Panarin</i>	
I.3 Microwave photonics as a solution for the convergence of radio and optical fiber networks on the physical layer	16
<i>B. Batagelj</i>	
I.4 Linear and Nonlinear circular dichroism in metal-dielectric nanostructures	17
<i>E. Petronijević, A. Belardini, G. Leahu, R. Li Voti, M. Centini, C. Sibilia</i>	
I.5 Laser cooling of atoms using a frequency comb	18
<i>D. Aumiler, N. Šantić, D. Buhin, D. Kovačić, I. Krešić, T. Ban</i>	
I.6 Direct recording of signal integration at individual synapses on dendritic spines: a voltage imaging study.....	19
<i>D. Zecevic</i>	
I.7 0D/1D/2D/3D III-V materials grown by MBE for Optoelectronics	20
<i>J. Song</i>	
I.8 Laser-induced periodic surface structures: from nanoscaled light localization to applications	21
<i>J. Bonse, C. Florian, J. Krüger</i>	
I.9 X-ray induced synthesis of novel optical materials at extreme conditions.....	22
<i>M. Pravica, M. D. Rabasovic, A. J. Krmpot, M. Nikolic, E. Evlyukhin, B. Harris, P. Cifligu</i>	
I.10 Two-photon in-vivo microscopy of capillary blood flow in the kidney	23
<i>S. Frische</i>	
I.11 Ultrafast non-linear optical and electronic dynamics in transition metals: superplasmonic states and hot electrons for advanced applications.....	24
<i>S. Kudryashov, A. Samokhvalov, P. Danilov, N. Smirnov, S. Shehgyina, N. Bushev, A. Ivanova, A. Rudenko, S. Bezhanov, S. Uryupin, V. Veiko, B. Gakovic, D. Milovanovic, A. Ionin</i>	
I.12 Discrete Flat Band Photonics	25
<i>R. A. Vicencio</i>	
I.13 Multi-spatial mode quantum optics: fundamentals and applications	26
<i>V. Boyer, P. G. Petrov, E. Fradgley, J. Rayne, C. Gill</i>	
I.14 Energy losses and transition radiation produced by the interaction of fast charged particles with two-dimensional materials.....	27
<i>Z. L. Miskovic</i>	
I.15 Constant-Intensity Waves in Non-Hermitian Media.....	28
<i>K. G. Makris</i>	

I.16 Mirrorless lasing for remote magnetometry	29
<i>A. Wickenbrock, F. Pedreros Bustos, A. M. Akulshin, D. Budker</i>	
I.17 Superradiant THz Radiation: Sources and Applications	30
<i>M. Gensch</i>	
I.18 Mid-infrared silicon photonics for sensing and communications.....	31
<i>M. Nedeljkovic, W. Cao, A. Osman, Z. Qu, J. Soler Penadés, Y. Qi, D. J. Rowe, Y. Wu, C. G. Littlejohns, D. J. Thomson, G. Z. Mashanovich</i>	

Progress Reports

P.1 Dynamic Stark shift and multiphoton ionization of sodium by femtosecond laser pulses	33
<i>A. Bunjac, D. B. Popović, N. S. Simonović</i>	
P.2 Semiconductor optical amplifiers: modeling and analysis for optical access networks.....	34
<i>A. R. Totović, J. V. Crnjanski, M. M. Krstić, D. M. Gvozdić</i>	
P.3 Circular dichroism in twisted resonator based chiral metamaterial.....	35
<i>D. B. Stojanović</i>	
P.4 Optical properties and visible-light photocatalytic response of TiO ₂ thin films deposited by PVD methods	36
<i>D. Pjević</i>	
P.5 Propagation of single and multi-photon states in integrated laser-written waveguide networks	37
<i>D. Guzman-Silva</i>	
P.6 Investigations of the application of inorganic substrates based on TiO ₂ nanocrystals for the detection and quantification of small molecules with SALDI TOF mass spectrometry.....	38
<i>I. Popović</i>	
P.7 Development of photo-sensitive nanocomposite system for controlled metallo-drug delivery in skin cancer therapy	39
<i>M. Nešić, M. Stepić, L. Korićanac, M. Radoičić, Z. Šaponjić, I. Popović, M. Petković</i>	
P.8 Lattice dynamics of iron-based superconductors and related compounds.....	40
<i>M. Opacic, N. Lazarevic, D. Tanaskovic, C. Petrovic, Z.V.Popovic</i>	
P.9 Development and comparison of the techniques for solving the inverse problem in photoacoustics	41
<i>M. Nesic, M. Popovic, K. Djordjevic, V. Miletic, M. Jordovic-Pavlovic, D. Markushev, S. Galovic</i>	
P.10 Exploring possibilities of regular self-pulsing in monolithic and external cavity mid-IR QCLs	42
<i>N. Vukovic, J. Radovanovic, V. Milanovic, D. Boiko</i>	

P.11 Bioimaging of liver cancer cells incubated with partially reduced graphene oxide	43
<i>R. Dojčilović, J. Pajović, D. K. Božanić, N. Jović Orsini, S. Kaščakova, M. Refregiers, V. Djoković</i>	
P.12 Mechanisms and time scales of free-charge generation in organic photovoltaics: hot and fast or cold and slow.....	44
<i>V. Janković, N. Vukmirović</i>	

ML-Photonica2019 - Invited Lectures

ML.1 Greedy Boolean learning in large photonic neural networks	46
<i>D. Brunner</i>	
ML.2 Nonparametric Bayesian methods for networks.....	47
<i>L. Kocarev</i>	
ML.3 Machine learning for photonics	48
<i>D. Saad</i>	
ML.4 Matrix versus Machine Learning for transmitting images through multimode fibers	49
<i>C. Moser</i>	
ML.5 Fast Compressive Raman Bio-imaging.....	50
<i>H. B. de Aguiar</i>	
ML.6 Defibrillation outcome prediction as a potential guide to resuscitation.....	51
<i>M. D. Ivanovic, M. Ring, J. Hannink, F. Baronio, Lj. Hadziewicz, B. Eskofier</i>	
ML.7 Machine learning in photonic communication systems	52
<i>D. Zibar</i>	
ML.8 Pre- and post-transmission digital signal processing using neural networks applied to fiber-optic communication systems relying on power modulation and power detection: Advantages and drawbacks	53
<i>M. Chagnon</i>	
ML.9 Optimization and configuration of Programmable Photonics ICs.....	54
<i>D. Pérez López</i>	
ML.10 Imaging with Scattered Light.....	55
<i>O. Katz</i>	
ML.11 Ising Machines and Random Optical Networks by Tumor Spheroides	56
<i>C. Conti</i>	
ML.12 Using machine learning to ‘predict’ extreme events in fiber-optics instabilities from single-shot spectral measurements	57
<i>G. Genty</i>	
ML.13 Mode-locked Fiber Laser Controlled by Machine Learning Algorithms	58
<i>A. Kokhanovskiy</i>	

ML.14 Greedy Boolean Learning in Photonic Recurrent Neural Networks	59
<i>X. Porte Parera</i>	
ML.15 Roadmap from Academia to IT industry	60
<i>I.Ilić</i>	

ESUO Regional Workshop Invited Lectures

ERW.1 CALIPSOplus – a gateway for research at light sources	62
<i>A. Anselmo, A. Vollmer, B. Seidlhofer, B. Schramm, M. Grobosch, M. Helm</i>	
ERW.2 VUV Angle-resolved Photoelectron Spectroscopy on Isolated Hybrid Nanostructures	63
<i>D.K. Božanić, G. Garcia Macias, L. Nabon, R. Dojčlović, J. Pajović, V. Djoković</i>	
ERW.3 Synchrotron SAXS/WAXS on colloidal nanocrystals and supercrystals	64
<i>R.T. Lechner</i>	
ERW.4 Photoionization spectroscopy and dynamics studies at the Gasphase Beamline @ Elettra	65
<i>R. Richter</i>	
ERW.5 Applications of synchrotron based spectroscopic techniques in biology	66
<i>K. Vogel-Mikuš, I. Arčon</i>	
ERW.6 The activities of the European Synchrotron and FEL User Organisation for even brighter European Photon Science.....	67
<i>U. Pietsch, C. Blasetti, A. S. Freire Anselmo, M. Grobosch, M. Helm, B. Schramm, A. Vollmer</i>	
ERW.7 Application of GISAXS in analysis of nanostructured materials	68
<i>M. Mičetić, K. Salamon, L. Basioli, M. Tkalčević, I. Mekterović, S. Bernstorff</i>	

1. Quantum optics and ultracold systems

QO.1 Generation of Multimode Squeezing in a Coupled Waveguide Array.....	70
<i>S. Rojas, E. Barriga, C. Muñoz, P. Solano, C. Hermann-Avigliano</i>	
QO.2 Searching for quantum scars in constrained bosonic models	71
<i>A. Hudomal, I. Vasić, N. Regnault, Z. Papić</i>	
QO.3 Degenerate Fermi gases of polar molecules with tilted dipoles.....	72
<i>V. Veljić, A. Pelster, A. Balaž</i>	
QO.4 Probing fractional Hall states in driven optical lattices	73
<i>I. Vasić, A. Hudomal, N. Regnault</i>	
QO.5 Exploring the Fermi-Hubbard model with a quantum gas microscope	74
<i>P. Bojović, J. Vijayan, P. Sompet, G. Salomon, J. Koepsell, S. Hirth, I. Bloch, C. Gross</i>	

QO.6 Transient properties of electromagnetically induced transparency in spherical quantum dot with hydrogen impurity	75
<i>Lj. Stevanović, J. Zimmermann, N. Filipović, V. Pavlović</i>	
QO.7 Pulse propagation through rectangular quantum dots under conditions of electromagnetically induced transparency	76
<i>V. Pavlović, Ž. Lazjić, Lj. Stevanović, N. Filipović</i>	
QO.8 Ground state and collective modes of dipolar BECs	77
<i>D. Vudragović, V. Veljić, I. Vasić, A. Balaž</i>	
QO.9 Field-Induced Narrowing and Broadening of a Magnetic Resonance in a Bichromatic Microwave Field	78
<i>W. Gawlik, M. Mrózek, A. M. Wojciechowski, A. G. Buznykin, E. Yu. Perlin</i>	

2. Nonlinear optics

NO.1 Comparison of mid-infrared nonlinear crystals efficiency	80
<i>A. A. Ionin, I. O. Kinyaevskiy, A. M. Sagitova</i>	
NO.2 Waveguiding in Mathieu photonic lattices	81
<i>J. M. Vasiljević, A. Zannotti, D. V. Timotijević, C. Denz, D. M. Jović Savić</i>	
NO.3 Strain of MoS ₂ mapped with second harmonic generation microscopy	82
<i>M. Spasenović, A. J. Krmpot, M. D. Rabasović, N. Vujičić, V. Jadriško, D. Čapeta, M. Kralj</i>	
NO.4 CO laser sum frequencies spectrum tuning by ZnGeP ₂ crystal temperature tuning.....	83
<i>A. A. Ionin, I. O. Kinyaevskiy, Yu. M. Klimachev, A. Yu. Kozlov, A. M. Sagitova, Yu. M. Andreev</i>	
NO.5 An analysis for fiber optical parametric amplifier in presence of attenuation and random dispersion fluctuations	84
<i>M. S. Kovacevic, K. K. Y. Wong, A. Djordjević</i>	
NO.6 Amplitude squeezing by four wave mixing in hot potassium vapor	85
<i>M. M. Ćurčić, B. M. Jelenković</i>	
NO.7 Evolution of laser pulse propagation in Four Wave Mixing atomic medium.....	86
<i>D. Arsenović, Ž. Nikitović, B. Zlatković, I. Radojičić, M. Ćurčić, A. J. Krmpot, B. Jelenković</i>	
NO.8 Double-periodic solutions and Talbot carpets of extended nonlinear Schrödinger equations	87
<i>S. N. Nikolić, O. A. Ashour, N. B. Aleksić, Y. Zhang, M. B. Belić, S. A. Chin</i>	
NO.9 Numerical study of the supercontinuum generation in the telecommunications windows in photonic crystal fiber	88
<i>M. Veljković, A. Mancić, D. Milović, A. Maluckov</i>	

NO.10 Localized modes in two-dimensional “plus” lattice	89
<i>M. Stojanović Krasić, M. G. Stojanović, A. Maluckov, M. Stepić</i>	
NO.11 Spontaneous isotropy breaking for vortices in nonlinear left-handed metamaterials	90
<i>T. Kukolj, M. Cubrovic</i>	
NO.12 Designer kit for an affordable and compact 0.1 – 1 TW laser.....	91
<i>A. M. Rodin, P. Mackoni</i>	
NO.13 Light propagation along helical waveguides: Variational approach	92
<i>A. I. Strinic, N. B. Aleksic, M. R. Belić, M. S. Petrovic</i>	
NO.14 Localized modes in two-dimensional octagonal-diamond lattices.....	93
<i>M. G. Stojanović, M. Stojanović Krasić, M. Johansson, I. A. Salinas, R. A. Vicencio, M. Stepić</i>	
NO.15 Necklace beams in media with cubic-quintic nonlinearity	94
<i>A. I. Strinic, N. B. Aleksic, M. M. Petroski, M. S. Petrovic</i>	
NO.16 Solitary and traveling wave solutions for the Davey-Stewartson equation using the Jacobi elliptic function expansion method	95
<i>N. Z. Petrović</i>	
NO.17 Self-organization of soliton-tweezers in suspensions of nanocomposites and graphens..	96
<i>M. Lekić, I. Milosević, S. Rokotoarimalala, V. Skarka</i>	
NO.18 Cubic Quintic Ginzburg Landau Equation as a Model for Resonant Interaction of EM Field with Nonlinear Media	97
<i>B. N. Aleksic, L. A. Uvarova, M. R. Belic, N. B. Aleksic</i>	
NO.19 An estimation of far field intensity distribution for photonic crystal fibers based on empirical relations.....	98
<i>Lj. Kuzmanovic, M. M. Milosevic, M. S. Kovacevic, A. Djordjevich</i>	

3. Optical materials

OM.1 Effects of temperature on luminescent properties of CaGdAlO ₄ :Er,Yb nanophosphor...	99
<i>D. Sevic, M. S. Rabasovic, J. Krizan, S. Savic-Sevic, M. D. Rabasovic, B. P. Marinkovic, M. G. Nikolic</i>	
OM.2 Confinement Effects on Absorption of Molecular Crystalline Nanofilms.....	100
<i>A. J. Šetrajčić–Tomić, N. R. Vojnović, I. J. Šetrajčić, S. M. Vučenočić, D. I. Ilić, M. Vojnović, S. K. Jačimovski, J. P. Šetrajčić</i>	
OM.3 Chemical doping of Langmuir-Blodgett assembled few-layer graphene films with Au and Li salts aimed for optoelectronic applications	101
<i>I. R. Milošević, B. Vasić, A. Matković, J. Vujin, S. Aškerabić, C. Teichert, R. Gajić</i>	
OM.4 Mechanochemical Preparation and Application of Graphene Oxide for obtaining 3D Graphene-based Hydrogel/Aerogel.....	102
<i>M. Kralj, I. Sović, I. Halasz</i>	

OM.5 Sol-gel tantalum pentoxide thin films with tunable refractive index for optical sensing applications	103
<i>R. Georgiev, B. Georgieva, K. Lazarova, M. Vasileva, T. Babeva</i>	
OM.6 Macroporous silicon photonic crystals for gas sensing purposes	104
<i>D. Cardador, D. Segura, A. Rodríguez</i>	
OM.7 Optical and Structural Investigation of Cr ₂ O ₃ Thin Films: the Effect of Thickness on Their Applicability in Differential Photodetectors	105
<i>M. Gilić, J. Mitrić, S. Petrović, D. Perusko, J. Ćirković, L. Reissig, N. Romčević</i>	
OM.8 Optical and mechanical properties and electron-phonon interaction in graphene doped with metal atoms.....	106
<i>A. Šolajić, J. Pešić, R. Gajić</i>	
OM.9 The influence of nanosheet size on formation of graphene films by Langmuir-Blodgett deposition from the liquid phase	107
<i>S. Andrić, T. Tomašević-Ilić, D. Vasiljević-Radović, M. Spasenović</i>	
OM.10 Structural properties of Eu ³⁺ doped YVO ₄ : Far – infrared spectroscopy.....	108
<i>J. Mitrić, N. Paunović, J. Ćirković, M. Gilić, M. Romčević, N. Romčević</i>	
OM.11 Tunable quantum phase transitions in asymmetric HgTe/Cd _x Hg _{1-x} Te double quantum wells	109
<i>D. B. Topalović, V. V. Arsoski, M. Ž. Tadić, F. M. Peeters</i>	
OM.12 “Point-by-point” inversion vs. parametrized fitting of ultrathin film’s dielectric function measured by rotating polarizer ellipsometry	110
<i>M. M. Jakovljević, S. Aškrabić, M. Artemyev, A. V. Prudnikau, A. V. Antanovich, G. Isić, B. Vasić, U. Ralević, Z. Dohčević-Mitrović, R. Gajić</i>	
OM.13 Influence of In ⁺ ions implantation in GaAs and Si on their optical characteristics	111
<i>O. Stepanović, M. Popović, M. Novaković, M. Nenadović, J. Potočnik, Z. Rakočević</i>	
OM.14 Wavelength Converter Materials for Photovoltaics Containing Rare-Earth Ions	112
<i>M. Sendova-Vassileva</i>	
OM.15 Negative thermal expansion of pullulan multilayers	113
<i>S. Savić-Sević, D. Pantelić, B. Muric, D. Vasiljević, B. Kolaric, B. Jelenković</i>	
OM.16 Large-scale deposition of self-assembled thin films from liquid phase exfoliated h-BN	114
<i>T. Tomašević-Ilić, Đ. Jovanović, R. Panajotović, R. Gajić, M. Spasenović</i>	
OM.17 Atomic layer deposited Al-doped ZnO for flexible optoelectronics	115
<i>D. Z. Dimitrov, V. Marinova, S. H. Wang, B. Blagoev, S. H. Lin, J. Y. Juang</i>	
OM.18 Analytical model of amplification in strained Ge	116
<i>E. E. Orlova, R. W. Kelsall</i>	

OM.19 Intersubband transitions in spherical quantum dot-quantum well nanoparticles	117
<i>R. Kostić, D. Stojanović</i>	

4. Biophotonics

B.1 Diatom frustules: A biomaterial with promising photonic properties	118
<i>M. Ghobara, R. Gordon, L. Reissig</i>	
B.2 Wearable laser Doppler flowmetry implementation for the analysis of microcirculation disorders	119
<i>E. Zharkikh, Yu. Loktionova, I. Kozlov, E. Zherebtsov, A. Zherebtsova, A. Dunaev, V. Sidorov, S. Sokolovski, E. Rafailov</i>	
B.3 The use of microbial rhodopsin proteins in differential photodetection	120
<i>C. Po-Chuan, M. Kurihara, T. Lindner, K. Buchanan, S. Dalgleish, Y. Sudo, L. Reissig</i>	
B.4 Optical fiber grating sensors for the measurement of superficial temporal artery pulsations	121
<i>J. Krsic, M. Miletic, V. Atanasoski, Lj. Hadzjevski, M. Ivanovic</i>	
B.5 One-step fabrication large area of microlens arrays	122
<i>B. Muric, D. Pantelic, D. Vasiljevic, B. Jelenkovic</i>	
B.6 Nonlinear microscopy and time resolved fluorescence spectroscopy of <i>Chelidonium majus</i> L.	123
<i>M. S. Rabasović, D. Sevic, B. P. Marinkovic, A. J. Krmpot, M. D. Rabasovic</i>	
B.7 Multi-spectral Unmixing using Principal Component Analysis (PCA) for an Accurate Fluorescence Detection in Fluorescence Endoscopy	124
<i>J. Kim, M. Lee, S. Lee, K. Jhang</i>	
B.8 Revealing the optical response of <i>Stegastes apicalis</i> fin parts using fluorescence spectroscopy	125
<i>M.D. Radmilovic, M.S.Rabasovic, D.Sevic, D.Pantelic, B.Kolaric, S.R. Mouchet, P.Vukusic</i>	
B.9 Ultrastructural investigation of perineuronal nets in tenascin-C deficient mice by super-resolution microscopy	126
<i>A. Jakovljević, M. Efenberkova, M. Tucić, V. Stamenković, P. R. Andjus</i>	
B.10 Measuring temperature changes of butterfly's wing through deformation: a holographic approach	127
<i>M. Simovic-Pavlovic, D. Grujic, P. Atanasijevic, D. Vasiljevic, B. Kolaric, D. Pantelic</i>	
B.11 Laser-generated nanoparticle-coated microrelief against the formation of bacterial biofilms	128
<i>I. N. Saraeva, E. R. Tolordava, A. A. Nastulyavichus, A. K. Ivanova, S.I. Kudryashov, A.A. Rudenko, D.A. Zayarny, A.A. Ionin, Yu. M. Romanova</i>	
B.12 Cellular noise of butterfly wing scales as a potential true random number generator	129
<i>M. Radmilovic, D.Pantelic, V.Lazovic, B. Kolaric</i>	

B.13 <i>In vivo</i> Third Harmonic Generation Imaging of <i>Phycomyces blakesleeana</i>	130
<i>T. Pajić, K. Stevanović, N. Todorović, A. Krmpot, M. Rabasović, B. Jelenković, M. Živić</i>	
B.14 Long-period grating sensors for the measurement of apexcardiogram.....	131
<i>M. Miletić, J. Krsić, V. Atanasoski, M. Ivanović, B. Bojović</i>	
B.15 Effects of cerium-dioxide nanoparticles in cervical cancer cells studied by Raman spectroscopy.....	132
<i>M. Miletić, S. Aškerabić, I. Schie, J. Rüger, L. Korićanac, A. S. Mondol, B. Vasić, Z. Dohčević-Mitrović</i>	
B.16 Femtosecond laser for dentinal hard tissue ablation	133
<i>T. Lainović, A. J. Krmpot, M. D. Rabasović, D. Pavlović, E. Novta, L. Blažić, D. Pantelić</i>	
B.17 Antibacterial coatings based on polymer-metal nanoparticles	134
<i>N. A. Smirnov, S. I. Kudryashov, A. A. Nastulyavichus, A. A. Rudenko, A. A. Ionin</i>	
B.18 Laser irradiated thioridazine: application in fighting multiple drug resistance acquired by bacteria	135
<i>T. Tožar, M. Boni, A.M. Udrea, A. Staicu, M. L. Pascu</i>	

5. Devices and components

DC.1 Multiple parameter fiber-integrated sensors based on diced Fabry-Perot micro-resonators	136
<i>S. Suntsov, C. E. Rüter, I. Pflažgraf, D. Kip</i>	
DC.2 Quasinormal modes of finite linear arrays of spherical silicon nanoparticles.....	137
<i>B. Radjenović, M. Radmilović Radjenović</i>	
DC.3 Differential Photodetectors: From Photonic Devices to their Use as an Analytical Platform	138
<i>L. Reissig</i>	
DC.4 From single-pixel to multi-pixel differential photodetectors.....	139
<i>A. Singh, S. Dalgleish, L. Reissig</i>	
DC.5 Method to realize a non-reciprocal wave retarder.....	140
<i>M. Al-Mahmoud, V. Coda, E. Dimova, A. Rangelov, G. Montemezzani</i>	
DC.6 Broadband polarization beam splitting based on three coupled anisotropic waveguides..	141
<i>R. Alrifai, V. Coda, A. A. Rangelov, G. Montemezzani</i>	
DC.7 High-beam quality sealed-off laser systems oscillating in middle infrared spectral range on strontium atomic transitions for application in material science and medicine	142
<i>I. Kostadinov, K. Temelkov</i>	

DC.8 Two different types of S-Shaped J-V characteristics in organic solar cells	143
<i>A. Khalf</i>	
DC.9 All niobia Bragg stacks for optical sensing of vapors	144
<i>R. Georgiev, B. Georgieva, T. Babeva</i>	
DC.10 Organic solar cell physics analyzed by Shockley diode equation	145
<i>M. Stanojević, J. Gojanović, P. Matavulj, S. Živanović</i>	
DC.11 Graphene-based liquid crystal display devices.....	146
<i>V. Marinova, S. Petrov, D. Dimitrov, S. Huei Lin</i>	
DC.12 Application of a simple low cost colorimetric probe for ground water quality analysis and evaluation.....	147
<i>B. Batinić, J. Bajic, B. Obrowski, N. Lakovic, J. Radic, M. Brkic, V. Rajs</i>	
DC.13 Colorimetric fiber-optic sensor based on reflectance spectrum estimation for determining color of printed samples.....	148
<i>B. Batinić, J. Bajić, N. Laković, N. Kulundžić, A. Jožua, M. Vasiljević Toskić</i>	
DC.14 Surface treatments of metal surfaces by new generation of high intensity laser sources .	149
<i>P. Hauschmütz, R. Jagdheesh, S. Zulić, J. Kaufman, J. Brajer, D. Rostohar, T. Mocek</i>	
DC.15 Broadband Multimode Emission of Quantum Cascade Lasers in Strong Magnetic Fields	150
<i>A. Gajić, J. Radovanović, N. Vuković, V. Milanović, D. L. Boiko</i>	
DC.16 Ultrafast optical devices functioned by <i>in situ</i> synthesized nonlinear graphene.....	151
<i>Yong-Won Song</i>	

6. Optical communications

OC.1 Test-Bed with EDFA Bi-Directional Amplifier for transmission of an ultra-stable coherent optical frequency.....	152
<i>S. Bhonmick, J. Vojtech, R. Velc</i>	
OC.2 Analysis of the linewidth enhancement factor impact on the spectral and noise characteristics of the gain switched laser optical frequency combs.....	153
<i>M. Ž. Banović, M. M. Krstić, J. V. Crnjanski, D. M. Gvozdić</i>	
OC.3 Large-Signal Modulation of an RSOA Enhanced by Inductive Peaking.....	154
<i>J. P. Babić, A. R. Totović, J. V. Crnjanski, M. M. Krstić, D. M. Gvozdić</i>	

7. Laser spectroscopy and metrology

LS.1 Negative-Mode LDI-MS of corrosion products on the surface of Ag-Cu-X (X- Zn, Pd, In) alloys	155
<i>B. Vurdelja</i>	

8. Ultrafast optical phenomena

- UO.1** Ultrafast High-Field THz beamline at X-ray FEL 156
R. Pan, E. Zapolnova, T. Golz, M. Rabasovic, A. Krmpot, J. Petrovic, M. Gensch, N. Stojanovic

9. Laser - material interaction

- LM.1** Laser micromachining of sub-micron hole patterns and gratings for X-ray interferometry imaging 157
R. Carreto, B. Lüscher, R. Holtz, B. Resan
- LM.2** Femtosecond laser surface engineering of biopolymer ceramic scaffolds coated with ZnO by low temperature ALD method 158
A. Daskalova, I. Bliznakova, L. Angelova, B. Blagoev, H. Deglercq, A. Trifonov, I. Buchvarov
- LM.3** Nanopatterning of silicon surfaces by ultrashort laser pulses 159
A. A. Nastulyavichus, S. I. Kudryashov, I. N. Saraeva, A. A. Rudenko, A. A. Ionin, D. A. Kirilenko, A. L. Shakhmin, E. R. Tolordava
- LM.4** Inducing LIPSS on multilayer thin metal films by femtosecond laser beam of different orientations 160
A. G. Kovačević, S. M. Petrović, B. Salatić, M. Lekić, B. Vasić, R. Gajić, D. Pantelić, B. M. Jelenković
- LM.5** Laser ablated ZnO and hybrid ZnO-Au nanoparticles 161
A. K. Ivanova, S. I. Kudryashov, I. N. Saraeva, A. A. Ionin
- LM.6** The use of nanoparticles to improve the analytical capabilities of LIBS for solution sample analysis 162
V. Kiris, A. Nevar, N. Tarasenko, N. Tarasenko, M. Kuzmanović, J. Petrović, M. Momčilović, J. Savović
- LM.7** Titanium target irradiation by picosecond laser in air and water – surface morphology and synthesis of nanoparticles 163
M. Trtica, J. Stašić, D. Batani, R. Benocci, V. Narayanan, J. Ciganović

10. Optical metamaterials and plasmonics

- OMP.1** Low-cost plasmonic arrays of elliptic nanoholes 164
N. Zaric, E. Petronijević, A. Belardini, T. Cesca, G. Mattei, C. Sibilia
- OMP.2** Liquid crystal based tunable metasurfaces for beam steering at terahertz frequencies .. 165
B. Vasić, G. Isi, R. Gajić, R. Beccherelli, D. C. Zografopoulos
- OMP.3** MXene-based ultrathin metamaterial for enhanced wideband optical absorption 166
Z. Jakšić, M. Obradov, D. Tanasković, O. Jakšić, D. Vasiljević Radović

OMP.4 Broadband enhancement of light harvesting and photocatalytic devices	167
<i>K. Cvetanović Zobenica, M. Rašljić, M. Obradov, I. Mladenović, Z. Jakšić</i>	
OMP.5 Detection of Glucose by Chitosan Coated Nanogold array on Optical Sensor Platform	168
<i>B. Balkan, C. Canbek Özdiğ, M. Gulsoy</i>	
OMP.6 Thin layers of phase change materials for optical control of metamaterials in the infrared	169
<i>E. Petronijević, C. Sibilia</i>	
OMP.7 Surface plasmon polariton launching by light scattering on grooves in metal films.....	170
<i>U. Ralević, G. Isić, M. Falkner, R. Gajić</i>	
OMP.8 Multiple Defect Modes in One-Dimensional Quasiperiodic Photonic Crystal.....	171
<i>S. E. Svyakhovskiy, P. S. Pankin, A. M. Vyunishev, I. V. Timofeev, S. Ya. Vetrov</i>	
OMP.9 Confinement of light through realistic 3D cavity superlattices	172
<i>M. Kozon, S. A. Hack, J. J. W. van der Vegt, A. Lagendijk, W. L. Vos</i>	
OMP.10 Plasmonic defect states in metallodielectric superlattices.....	173
<i>G. Isić, S. Vuković, Z. Jakšić, M. Belić</i>	
OMP.11 Refractive index change due to bianalyte adsorption in plasmonic sensors	174
<i>I. Jokić, O. Jakšić, M. Frantlović, Z. Jakšić, K. Radulović</i>	

11. Machine learning in photonics

MLP.1 Deep learning based classification of high intensity light patterns in photorefractive crystals	175
<i>A. Mančić, M. Ivanović, C. Hermann-Avigliano, I. J. Hadžievski, A. Maluckov</i>	
MLP.2 Automated design and global optimization of projection lenses for lithography based on global search algorithms	176
<i>N. Zorić, I. Smirnova, A. Kuleshova</i>	
MLP.3 Computationally intelligent characterization of a photoacoustic detector	177
<i>M. I. Jordović-Pavlović, A. D. Kupusinac, K. Lj. Djordjević, S. P. Galović, D. D. Markushev, M. V. Nešić, M. N. Popović</i>	
MLP.4 Machine Learning in Ca signaling via fluorescence probes for diagnostics of Neuroinflammatory Diseases	178
<i>A. Korenić, D. Bijelić, B. Ersen Kerman, A. Çapar</i>	

12. Other topics in photonics

- OP.1** Generation of zeroth- and first-order long range nondiffracting Gauss-Bessel beams by annihilating multiple-charged optical vortices 179
L. Stoyanov, M. Zhekova, A. Stefanov, I. Stefanov, G. G. Paulus, A. Dreischuh
- OP.2** The apokamp discharge – transient luminous event in physical laboratory 180
V. Kozhevnikov, A. Kozhev, A. Kokovin, A. Sitnikov, E. Sosnin, V. Panarin, V. Skakun, V. Tarasenko
- OP.3** Anisotropic nanostructures for broadband achromatic polarization-insensitive meta-lenses 181
Z. Bharghani, W.T. Chen, A. Y. Zhu, J. Sisler, F. Capasso
- OP.4** Effect of nitrogen presence during the deposition on structural and optical properties of Ge quantum dot lattices in alumina matrix 182
M. Tkalcčević, L. Basioli, K. Salamon, I. Šarić, J. S. Parramon, I. Bogdanović Radović, S. Bernstorff, M. Ivanda, M. Bubaš, Z. Fogarassy, K. Balázs, M. Petravić, M. Mičetić
- OP.5** Inner-shell spectroscopy of titanium (IV) iso-propoxide 183
S. D. Tošić, M. Radibratović, J. Chiarinelli, M. Milčić, P. Bolognesi, L. Avaldi, R. Richter, M. Coreno, B. P. Marinković
- OP.6** Understanding trends in lithium binding at two-dimensional materials 184
S. Stavrić, Z. S. Popović, Ž. Šljivančanin
- OP.7** Luminescent PMMA films and SiO₂ nanoparticles functionalized with Ln³⁺ complexes for highly sensitive ratiometric optical temperature sensors in the physiological range 185
D. Mara, A. M. Kaczmarek, F. Artizgu, K. Van Hecke, R. Van Deun
- OP.8** Inverted field interferometer for measuring the topological charge of optical vortices 186
N. Dimitrov, M. Zhekova, G.G. Paulus, A. Dreischuh
- OP.9** Ideal Efficiency of Resonant Cavity Perovskite Solar Cells 187
Z. Djurić, I. Jokić
- OP.10** Ultrafast Dynamics of Quantum Cascade Laser: Modelling and Optical Properties 188
A. Demić, Z. Ikonić, R. W. Kelsall, D. Indjin
- OP.11** Electron quantum transport in InGaAs/GaAsSb double barrier resonant tunneling structures 189
M. Indjin, J. Griffiths

**ESUO Regional Workshop
Invited Lectures**

CALIPSOplus – a gateway for research at light sources

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CALIPSOplus dedicates particular attention to leveraging scientific excellence across the EU and to widening the use of light sources throughout the region. A Twinning programme has been set up aiming at establishing and further developing new scientific communities, particularly from countries without own light source [2]. In the Twinning programme, potential users are partnered with host groups that share their know-how and expertise in applying the available experimental techniques to common research areas. Scientists new to research with synchrotron-based techniques have the opportunity to participate in a fully-financed hands-on introduction to the facilities.

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VUV Angle-resolved Photoelectron Spectroscopy on Isolated Hybrid Nanostructures

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Aerosol photoemission spectroscopy became an important method for studying electronic structure of submicrometer particles without the influence of substrate [1]. It comprises irradiation of the focused particle beam by either vacuum-ultraviolet (VUV) or soft x-ray radiation under high vacuum conditions and subsequent detection and discrimination of the photoelectrons according to their kinetic energies and momenta [2-4]. As intermediates between atoms or molecules and macroscopic matter, nanometer-sized objects exhibit specific electronic and transport properties that strongly depend on their size, morphology and surface chemistry. Modification of nanoparticle surfaces by conjugation with molecules presents a convenient method of altering a wide range of physicochemical characteristics of the nanomaterials, which does not require development of new synthetic procedures. Furthermore, by a proper choice of molecules used in surface modification, additional properties of the hybrid nanostructures can be achieved, which could not be found in the starting materials. In this lecture, we will present the selected results of our investigations on hybrid nanostructures comprised of noble metal and metal oxide nanomaterials functionalized by biologically relevant molecules. Particular attention will be given to the vacuum-ultraviolet angle-resolved photoelectron spectroscopy (VUV ARPES) studies on isolated functionalized nanosystems performed at the DESIRS beamline. The emergence of the photoelectron circular dichroism in hybrid nanoparticles will be briefly discussed.

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Synchrotron SAXS/WAXS on colloidal nanocrystals and supercrystals

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Colloidal nanocrystals (NCs) offer the opportunity for realising novel materials with tailored functionalities. By chemical synthesis, a large variety of semiconducting and metallic NCs can be realized [1] that can be used as efficient light emitters [1, 2] or in novel batteries designs [3].

Especially an inner core/shell structure of the semiconducting NCs leads to a significantly increased photoluminescence output. Here, not only the chemical and the crystalline core/shell profile, but also the NCs' shape determines their optical performance. This relation between structure and functionality we have revealed by combining different scattering techniques at several synchrotron sources with local sensitive microscopy techniques [2, 4].

The NC's shape can also significantly influence the super-crystal structure of colloidal supercrystals [1], where NCs act as building blocks to form 3D nanocrystal solids with designed properties. We have probed recently such a self-assembly with in-situ synchrotron SAXS using nearly monodisperse Bi NCs [5]. By combining synchrotron experiments with simulations, we are able to link the supercrystal structure via the NC-shape to the atomic Bi crystal structure.

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Photoionization spectroscopy and dynamics studies at the Gasphase Beamline @ Elettra

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The high photon intensity and resolution available at third generation synchrotron undulator beamlines is revealing fine details in the soft x-ray spectra of free species in the gas phase - particularly of small molecules. In addition, experimental developments - in particular those of coincidence techniques - permit insight in the important dissociation processes. The high sensitivity allows the extension of the range of targets – including atoms, molecules, radicals, vapors and clusters. Coincidence techniques give access not only to cations and electrons, but also to metastable, neutral and negative ion fragments.

The possibilities offered by different types of experiments will be discussed using results from recent studies. The examples include

- State-selected dissociative ionization of small organic and biologically important molecules in the valence and inner shell region [1, 2]. The results, together with calculations, can be used to disentangle the differences in fragmentation of similar molecules exposed to VUV radiation. In the core region correlations between the core-excited site and the preferential cleavage of specific bonds can be studied.
- Production of negative ions following core ionization of water and small organic molecules [3, 4]. Negative- and (multiple) positive-ion coincidence spectroscopy can be a sensitive probe of weak features in the decay and fragmentation channels of small molecules.
- Detection of neutral dissociation products - fluorescence and metastable states [5, 6] yields detailed information near inner shell ionization thresholds.

Further insights into the dynamics can be obtained from time-resolved experiments. In the range of ionizing radiation processes the application of synchrotron-laser experiments is a natural extension of the laboratory multi-color studies. Preliminary results of an ongoing study of the dissociation dynamics of the gas-phase dye molecules by time-resolved photoelectron spectroscopy will also be presented.

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Applications of synchrotron based spectroscopic techniques in biology

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Development of synchrotron radiation-based spectroscopy and microscopy techniques has opened new possibilities to study the structure and biochemical composition of organs, tissues, cells and biomolecules, which is critical for both basic and applied research [1].

In this talk X-ray absorption spectroscopy and micro-X-ray fluorescence microscopy, using synchrotron radiation at different European synchrotron radiation facilities [2], will be presented as tools to reveal the mechanisms of metal uptake, accumulation and metabolism in food-chains to better understand metal toxicity and tolerance mechanisms, for the purpose of risk assessment and restoration of heavy metal polluted sites.

In addition, food quality and safety present an important aspect, connected to mineral malnutrition on one site and metal pollution on the other. Cereals as major staple food accumulate only low amounts of essential trace elements like Fe and Zn, while on the other hand they can contain elevated amounts of hazardous Cd. Designing high mineral nutrient and low hazardous element crops present a challenge for modern plant breeders. Synchrotron-based techniques can assist in revealing element accumulation and speciation patterns and help breeders to choose suitable crop genotypes.

The support by The European Synchrotron and FEL user organisation (ESUO) [3] and the project CALIPSOplus under Grant Agreement 730872 from the EU Framework Programme for Research and Innovation HORIZON 2020 for the XAS experiments, and the access to synchrotron radiation facilities of Elettra, PETRA III, ESRF, Alba and Soleil is acknowledged.

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- [3] The European Synchrotron and FEL user organisation (ESUO) home page:
<https://www.wayforlight.eu/en/users/esuo/>

The activities of the European Synchrotron and FEL User Organisation for even brighter European Photon Science

U. Pietsch¹, all other ESUO delegates², C. Blasetti³, A. S. Freire Anselmo⁴, M. Grobosch⁵, M. Helm⁵, B. Schramm⁵, A. Vollmer⁴

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The European Synchrotron and FEL User Organisation (ESUO) represents about 22 000 users of the European synchrotron radiation (SR) and Free-Electron Laser (FEL) facilities, which offer various kinds of experiments ranging from physics over life sciences up to cultural heritage. Established in 2010 [1], ESUO is composed of national delegates from 30 European member states and associated countries and is headed by an executive board of eight members [2].

The missions of ESUO are the following:

- To represent interests and needs of all SR and FEL users working in Europe
- To support facilities in their ambitions to create equal access opportunities for scientists, based solely on scientific merit, and to make this access as simple as possible
- To enable future strategies/funding schemes, to create equal (transnational) access opportunities for European scientists, independently of their financial resources
- To foster contacts with users in Widening and European neighboring countries, sharing knowledge/expertise
- To strengthen cooperation with National User Organisations
- To initiate collaborations / synergies with user organisations of other analytical facilities

In the past few years, ESUO has contributed to networking activities in the framework of successfully completed European FP7 projects such as ELISA (March 2009-August 2011) and CALIPSO (June 2012-May 2015). Today, ESUO continues advocating the interests of the users in the framework of networking activities that are part of the HORIZON 2020 project CALIPSOplus [3] (May 2017-April 2021, Grant Agreement No 730872). In this context, ESUO is involved in activities aiming at fostering the use of large-scale facilities by scientists from Eastern Europe and the Baltic countries, at promoting gender balance in the user community, and at facilitating the interaction between less experienced and established users. Amongst others, these activities will be presented in the proposed contribution. With the aim to contribute to shaping future research at European synchrotron and FEL user facilities, ESUO is cooperating with the League of European Accelerator-based Photon Sources (LEAPS) initiative [4].

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Application of GISAXS in analysis of nanostructured materials

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We demonstrate the application of GISAXS technique in investigation of three-dimensional lattices of nanostructures [1, 2]. The successful analysis of three-dimensionally ordered nanostructures demands application of suitable model for description of the nanostructure ordering. In opposite case, it is possible to get good agreement between the experimental and the simulated data, but the parameters obtained by fitting may be completely incorrect. In the lecture we examine systems having different types of nanostructure ordering, and we show how the choice of the correct model for the description of ordering influences the analysis results. We compare several theoretical models and show how to use GISAXS in investigation of self-assembled arrays of nanoparticles and also in arrays of nanostructures obtained by ion-beam treatment of thin films or surfaces. All theoretical models are supported by the experimental data, and the possibilities and limitations of GISAXS in determination of material structure are discussed. The free web-platform for analysis of GISAXS data *GisaxStudio* will be presented [3].

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1. International School and Conference on Photonic (7; 2019; Beograd)

2. Machine Learning with Photonics Symposium (2019; Beograd)

3. ESUO Regional Workshop (2019; Beograd)

4. COST action CA16221 (2019; Beograd)

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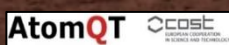
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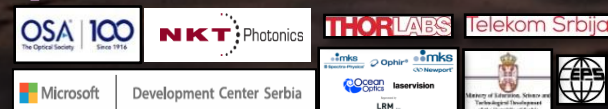
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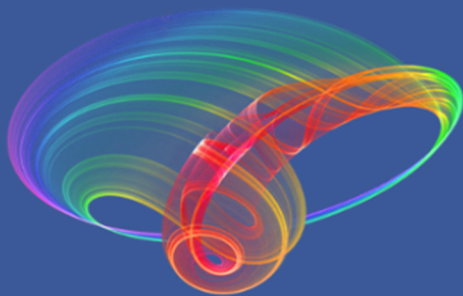
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ESUO

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THE EUROPEAN SYNCHROTRON AND FEL USER ORGANISATION

Timetable ESUO Regional Workshop

Satellite to Photonica 2019 Conference

Website: <http://uranus.ipb.ac.rs/~esuo-serbia/>

Wednesday 28th August 2019

Venue : Serbian Academy of Sciences and Arts (SASA), Belgrade
Knez Mihailova 35



Serbian Academy of
Sciences and Arts

08:30 - 8:40 Opening address: ESUO Chair and Local organizer

08:40 - 09:20 Prof. Ullrich Pietsch, University of Siegen, *"ESUO: European landscape of synchrotron radiation and Mission of ESUO"*

09:20 - 09:50 Katarina Vogel Mikuš, Slovenia, *"Applications of synchrotron based spectroscopic techniques in biology"*

09:50 - 10:20 Dušan Božanić, Serbia, *"VUV angle-resolved photoelectron spectroscopy on isolated hybrid nanostructures"*

10:20 - 10:40 Coffee break

10:40 - 11:10 Bratislav Marinković, Serbia, *"Core Shell Investigation and Radiation Damage Mechanisms of Nitroimidazole Compounds studies at the Gasphase Beamline @ Elettra"*

11:10 - 11:40 Maja Mičetić, Croatia, *"Application of GISAXS in analysis of nanostructured materials"*

11:40 - 12:10 Rainer Lechner Austria, *"Synchrotron SAXS/WAXS on Colloidal Nanocrystals and Supercrystals"*

12:10 - 12:40 Ana Sofia Freire Anselmo, HZB, Germany, *"CALIPSOplus - a gateway for research at light sources"*

12:40 End of the session of ESUO Regional Meeting as a satellite to Photonica 2019

Open session of the ESUO Regional Workshop

Wednesday 28th August 2019

Venue : Faculty of Physics, University of Belgrade
Studentski trg 12-16, Amphitheatre No. 661, III floor.



14:00-14:15 Dr. Bratislav Marinković: *"ESUO-Serbia organization and research perspectives"*

14:15-14:45 Prof. Ullrich Pietsch: *"European landscape of synchrotron radiation and Mission of ESUO"*

14:45-15:15 Dr. Ana Sofia Anselmo: *"Opportunities for financing offered by CALIPSOplus program"*

15:15-16:00 Q&A, Discussions and Conclusions

16:00 End of the ESUO Regional Workshop

