Book of Abstracts

PHOTONICA 2019

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

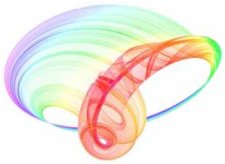
Book of abstracts

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

ABSTRACTS OF TUTORIAL, KEYNOTE, INVITED LECTURES, PROGRESS REPORTS AND CONTRIBUTED PAPERS

of

The Seventh International School and Conference on Photonics
PHOTONICA2019, 26 August – 30 August 2019, Belgrade, Serbia

and
Machine Learning with Photonics Symposium

and
ESUO Regional Workshop

Editors
Milica Matijević, Marko Krstić and Petra Beličev

Technical Assistance
Danka Stojanović and Goran Gligorić

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Institute of Nuclear Sciences Vinča

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Other institutions that helped the organization of this event are: Institute of Physics Belgrade, University of Belgrade (www.ipb.ac.rs), School 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). Joint event "Machine learning with Photonics Symposium" has been co-organized with programme partners H2020-RISE-CARDIALLY, H2020 – MULTIPLY and H2020-EID-FONTE.

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REFERENCES
[1] http://www.nktphotonics.com

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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

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9. Laser - material interaction

10. Optical metamaterials and plasmonics

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12. Other topics in photonics

ESUO Regional Workshop
Invited Lectures

CALIPSOplus – a gateway for research at light sources

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The Trans-national Access programme of the project CALIPSOplus (Convenient Access to Light Sources Open to Innovation, Science and to the World) provides supported access of European researchers to European and Middle Eastern light sources [1]. This project is funded by the European Commission within the EU Framework Programme for Research and Innovation H2020.

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. Cerals 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 he 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

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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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PHOTONICA 2019

7TH INTERNATIONAL SCHOOL AND CONFERENCE ON PHOTONICS, 26th - 30th August 2019, Belgrade, Serbia

Topics: Quantum optics and ultracold systems, Nonlinear Optics, Optical materials, Biophotonics, Devices and components, Optical communications, Laser spectroscopy and metrology, Ultrafast optical phenomena, Laser-material interaction, Optical metamaterials and plasmonics, Machine learning in photonics (for the first time at PHOTONICA)

Joint events:

- Machine Learning with Photonics Symposium (co-organized with Prof. Darko Zibar)
- The European synchrotron and FEL user organization (ESUO) Regional Workshop
- COST action CA16221 ATOM-QT

Tutorial speakers:

Christian Eggeling, UK
Gerd Leuchs, DE
Stefano Girogini, IT
Yeshaiahu Fainman, US

Keynote speakers:

Karl Unterrainer, AT
Nikos Pleros, GR
Sergej Flach, KR
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Thierry Verbiest, BE
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Invited speakers:

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ESUO Regional Workshop

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ESUO
EUROPEAN SYNCHROTRON AND FEL USER ORGANISATION

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ESUO - SERBIA
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

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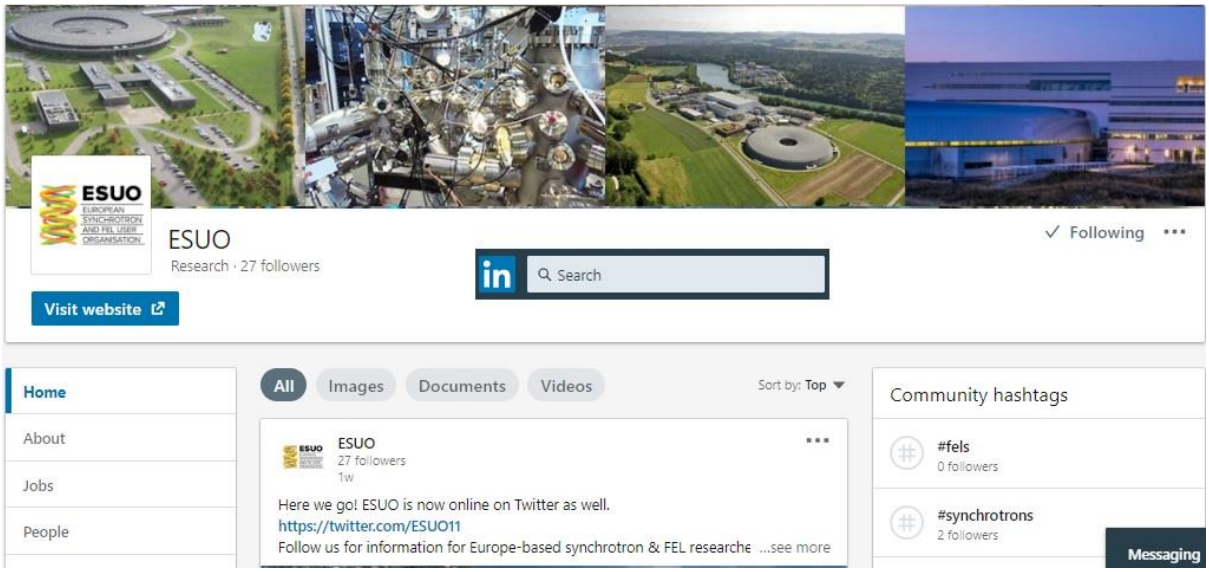
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