

FUNDAMENTALS  
and APPLICATIONS

LIGHT  
MATTER  
INTERACTIONS *for*

*biophysics  
quantum and  
nonlinear optics  
biomedicine  
optical  
communications  
sensors and  
devices*



*Kopaonik, Serbia*  
10-14/MARCH/2024

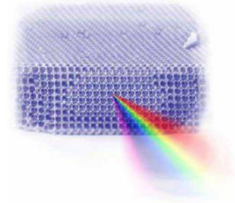


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University of Belgrade  
Institute of Physics Belgrade  
Kopaonik, March 10-14, 2024



Book of Abstracts  
**17<sup>th</sup> Photonics Workshop**  
(Conference)



# **17<sup>th</sup> Photonics Workshop (2024)**

## **Book of abstracts**

Kopaonik, Serbia, March 10-14, 2024

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## Conference program

### Sunday, March 10<sup>th</sup>

**Chairman: Zoran Grujić**

16.00 – 16.30	<b>Registration &amp; opening</b>
16.30 - 17.00	<b>Stanko Tomić</b> <i>Quantum Dots: Nanotechnology in Quantum Colours</i>
17.00 - 17.20	<b>Pedja Mihailović</b> <i>Directions in all-optical computing with an emphasis on the Fabry Perot laser-lock-in approach</i>
17.20 – 17.40	<b>Bratislav Marinković</b> <i>Magical krypton atom: From definition of meter to ultrafast processes</i>
17.40 – 18.00	<b>Vladimir Djokovic</b> <i>Fabrication of efficient NIR light-driven micromotors using particles with Janus morphology</i>
18.00 – 18.15	<b>Jelena Mitric</b> <i>Phonon Investigations in Cd<sub>1-x</sub>FexTe<sub>1-y</sub>Se<sub>y</sub> Single Crystals</i>
18.15 – 18.30	<b>Filip Krajinić</b> <i>Optical system for magnetic field spatial distribution measurement using digital holography</i>
18.30 – 18.45	<b>Miljana Piljević</b> <i>Selective in vitro labeling of cancer cells using NaGd<sub>0.8</sub>Yb<sub>0.17</sub>Er<sub>0.03</sub>F<sub>4</sub> nanoparticles</i>

### Monday, March 11<sup>th</sup>

**Chairman: Goran Mashanovich**

16.00 - 16.30	<b>Refreshment &amp; workshop photo</b>
16.30 - 17.00	<b>Vladan Vuletic</b> <i>Time-Reversal-Based Quantum Metrology beyond the Standard Quantum Limit</i>
17.00 - 17.20	<b>Wenlan Chen</b> <i>Observation of universal dissipative dynamics in strongly correlated quantum gas</i>
17.20 – 17.40	<b>Alessia Burchianti</b> <i>Quantum phenomena and novel matter phases in ultracold atomic mixtures</i>
17.40 – 18.00	<b>Stanko Nikolić</b> <i>Biomedical Applications of two-Foci Cross-Correlation technique in Massively Parallel Fluorescence Correlation Spectroscopy</i>
18.00 – 18.15	<b>Jovana Petrović</b> <i>Role of optics in multiparameter monitoring of cardiovascular function</i>
18.15 – 18.30	<b>Gabriel Cáceres-Aravena</b> <i>Topological Properties of Photonic Systems with Interorbital Interactions</i>

**Chairman: Branislav Jelenkovic**

20.00 - 20.10	<b>Branislav Jelenkovic</b> <i>BioQantSense project overview</i>
20.10 - 20.30	<b>Caterina Dallari</b> <i>Evaluating abnormal levels of intracellular cholesterol through Raman and Surface-enhanced Raman spectroscopy</i>
20.30 - 20.50	<b>Markus Gräfe</b> <i>Nonlinear interferometers for quantum imaging with undetected light</i>
20.50 - 21.10	<b>Frank Setzpfandt</b> <i>Entanglement generation at the nanoscale</i>
21.10 – 21.30	<b>Sara Nocentini</b> <i>The hidden value of responsive materials</i>
21.30 – 21.50	<b>Dejan Pantelic</b> <i>Classical microscope interference-objectives for quantum holography</i>
21.50 – 22.10	<b>Josué Ricardo León Torres</b> <i>Mid-Infrared Quantum Scanning Microscopy with Visible Light</i>

**Tuesday, March 12<sup>th</sup>****Chairman: Ivana Drvenica**

16.00 - 16.30	<b>Refreshment</b>
16.30 - 17.00	<b>Srdjan Antic</b> <i>Photonics Toolkit for Studying Alzheimer's Disease</i>
17.00 - 17.20	<b>Pavle Andjus</b> <i>Subcellular and ultrastructural changes in astrocytes induced by ALS IgG</i>
17.20 – 17.35	<b>Ana Jakovljević</b> <i>The role of tenascin-C in the structural plasticity of perineuronal nets and synaptic expression in the murine hippocampus</i>
17.35 – 17.50	<b>Biljana Ristić</b> <i>Hemocompatibility evaluation of N-doped carbon quantum dots</i>
17.50 – 18.10	<b>Vladimir Srdić</b> <i>Light-induced magnetization reversal in heterostructured oxide thin films</i>
18.10 – 18.30	<b>Lijian Zhang</b> <i>Quantum-limited localization and resolution of optical sources</i>

**Chairman: Bratislav Marinković**

20.00 - 20.30	<b>Goran Mashanovich</b> <i>Photonics pathways in higher education</i>
20.30 - 20.50	<b>Sanja Djurdjić Mijin</b> <i>Cost-Efficient Method for Deterministic Creation of Single Photon Emitters in GaSe</i>
20.50 - 21.10	<b>Milica Ćurčić</b> <i>Vibrational properties of the mechanochemically synthesized Cu<sub>2</sub>SnS<sub>3</sub></i>

21.10 – 21.25	<b>Mirjana Stojanović</b> <i>Demultiplexers based on waveguide arrays</i>
21.25 – 21.40	<b>Duška Popović</b> <i>A dressed states analysis of Autler-Townes patterns in the PES at resonant two-photon ionization of hydrogen by short laser pulses</i>
21.40 – 21.55	<b>Dragana Jordanov</b> <i>Electronic Properties of Predicted Y2O2S using Theoretical Calculations</i>
21.55 – 22.10	<b>Edi Bon</b> <i>The Enigma of Changing Look Active Galactic Nuclei</i>

### Wednesday, March 13<sup>th</sup>

**Chairman: Jovana Petrović**

16.00 - 16.30	<b>Refreshment</b>
16.30 - 17.00	<b>Vlatko Vedral</b> <i>Observing ghost entanglement beyond scattering amplitudes in quantum electrodynamics</i>
17.00 - 17.20	<b>Miroslav Dramićanin</b> <i>Mn<sup>5+</sup>: a source of near-infrared photons for LEDs, optical temperature sensors and bioimaging</i>
17.20 – 17.35	<b>Vesna Đorđević</b> <i>Microwave-Assisted Solvothermal method for synthesis of CsY<sub>2</sub>F<sub>7</sub> and RbY<sub>2</sub>F<sub>7</sub> nanophosphors</i>
17.35 – 17.55	<b>Suzana Petrović</b> <i>Laser surface patterning of Ti/Zr thin films for biomedical application</i>
17.55 – 18.15	<b>Dusan Božanić</b> <i>Photoelectron circular dichroism in isolated hybrid nanosystems</i>
18.15 – 18.30	<b>Radovan Dojčilović</b> <i>Probing cell-nanomaterial interaction with bioimaging of cancer liver cells</i>



**Chairman: Pedja Mihailović**

20.00 - 20.20	<b>Robert Loew</b> <i>Precision cw-spectroscopy of Rydberg states of nitric-oxide molecules</i>
20.20 - 20.40	<b>Theo Scholtes</b> <i>Recent developments in optical magnetometry</i>
20.40 - 20.55	<b>Zoran Grujić</b> <i>On prospects of the free alignment precession based optically pumped magnetometer</i>
20.55 - 21.10	<b>Tim Kügler</b> <i>Structured indium tin oxide heating layers on microfabricated alkali vapor cells for optical magnetometry</i>
21.10 – 21.25	<b>Marija Ćurčić</b> <i>Experimental and theoretical study of the dynamic phase projection error of Mx magnetometer – Progress report</i>

21.25 – 21.40	<b>Miloš Subotić</b> <i>Lock-in Frequency Estimation Algorithm for Optically Pumped Magnetometer</i>
21.40 – 21.55	<b>Milovan Stoiljković</b> <i>Hydrogen Balmer-<math>\alpha</math> isotope analysis in aqueous aerosol using LIBS</i>
21.55 – 22.10	<b>Nikola Vuković</b> <i>Optical and transport properties of THz quantum cascade heterostructures</i>

**Thursday, March 14<sup>th</sup>****Chairman: Ljupčo Hadžievski**

16.00 - 16.30	<b>Refreshment</b>
16.30 - 17.00	<b>Caslav Brukner</b> <i>Quantum causal structures: from fundamentals to applications</i>
17.00 - 17.15	<b>Milica Vinić</b> <i>Diagnostics of laser-induced plasma from a thin oil film</i>
17.15 – 17.30	<b>Danijela Danilović</b> <i>Ag-Bi-I rudořffite nanoparticles as a new material for photovoltaics</i>
17.30 – 17.45	<b>Đorđe Trpkov</b> <i>Non-covalent interactions of nitrogen-doped carbon quantum dots and aromatic amino acids, an experimental and DFT study</i>
17.45 – 18.00	<b>Dragana Tošić</b> <i>Optical Properties of Natural Anthocyanin Dyes Encapsulated in Biopolymers</i>
18.00 – 18.15	<b>Danka Stojanović</b> <i>Atmospheric aerosols monitoring by scanning mobility and optical particle sizers in an urban area</i>
18.15 – 18.35	<b>Robert Loew</b> <i>Johannes Kepler, more than an astronomer</i>

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## Magical krypton atom: From definition of meter to ultrafast processes

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**Abstract.** From 1960 to 1983 the transition  $2p_{10} \leftarrow 5d_5$  (in Paschen notation) of krypton-86 was used to define meter by using 1,650,763.73 its wavelengths in vacuum. It is a reddish-orange light of relatively low intensity. The first Nat. Bureau of Standards' spectrum of Kr from year 1929 specified the wavelength for this transition to be 6056.11 Å [1]. That would give, as presently defined speed of light, the length of 0.999803 m. At that time another transition was set for a close look-up to substitute the cadmium 6438.4696 Å line as a primary standard of wave length, i.e., Kr  $1s_3 \leftarrow 3p_{10}$  line at 5649.56 Å. The partial energy level diagram with Paschen's notation for each manifold could be find e.g. in [2]. Unfortunately, that definition cannot be realized to better than about 4 parts in  $10^9$  [3]. In *j-l* coupling and today's NIST database notation [4] this is the transition with the wavelength of 6056.12628 Å in air and it is attributed to the transition from the  $4s^2 4p^5 ({}^2P_{3/2}) 6d^2 [1/2]^o J=1$  (11.35014101 eV) to the  $4s^2 4p^5 ({}^2P_{3/2}) 5p^2 [1/2]^o J=1$  (11.30345525 eV) state. The basic reference for these NIST states and transition comes from [5]. This wavelength calculated in vacuum by formula  $\lambda_{\text{air}} = \lambda_{\text{vac}}/n$ , where *n* is the index of refraction of air as derived from the five-parameter formula [6], is 6057.80298 Å, giving the deviation of  $1.44 \times 10^{-7}$  m.

Atomic number of krypton is 36 and its ground electron configuration is  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$ . Its inner shell excitation spectrum is rather complex [7]. Auger electrons coming from filling  $L_2$  and  $L_3$  subshells of Kr span the energy range from 1250 eV to 1550 eV [7], while the binding energy of the 1s orbital is of the order of 14.3 keV. Ejected electron spectra in the lower energy region have been studied in [8] where the  $M_{4,5}$ -NN Auger and  $M_{2,3}$ - $M_{4,5}$ N Coster-Kronig spectra induced by electron impact are shown. The large widths of the  $3p_{1/2}$  and  $3p_{3/2}$  (1.80 eV and 1.48 eV, respectively) and the natural width of the 3d shell of  $(88 \pm 4)$  meV indicate fast relaxation processes even in this part of the spectrum. Time-and-energy-resolved measurement of Auger cascades following Kr 3d excitation by attosecond pulses [9] revealed that the electrons with a kinetic energy around 25 eV (assigned as  $M_{4,5}N_1N_1$   ${}^1S_0$  normal Auger lines) have a component corresponding to the second-step Auger decay of the ion after resonant Auger transition  $3d^{-1}np \rightarrow 4s^2 4p^3 4dnp \rightarrow 4s^2 4p^4$  with a lifetime of  $26 \pm 4$  fs. The calculated lifetime of super-Coster-Kronig transitions is small, of the order of 0.1 fs. A fast transition means a broad line (about 6–7 eV), so, these weak and broad lines can hardly be discerned in the experiment and contribute to the background [9].

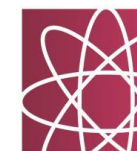
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17<sup>th</sup> Photonics Workshop 2024  
Kopaonik, 10.03.2024



Laboratory for Atomic  
Collision Processes

# Magical krypton atom: From definition of meter to ultrafast processes

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*Laboratory for Atomic Collision Processes*



# Outline

- Krypton atom

*Valence shell electrons of Kr*

- Kr line  $2p_{10} \leftarrow 5d_5$  and definition of the unit of length
- Belgrade measurements yrs:1988; 2004, 2005: Excitation and Elastic cross-sections

*Inner-shell excitation of Kr*

- Role of Kr in 2023 Nobel prize
- Belgrade measurements yrs:2021-2024 : Kr ejected electron spectra

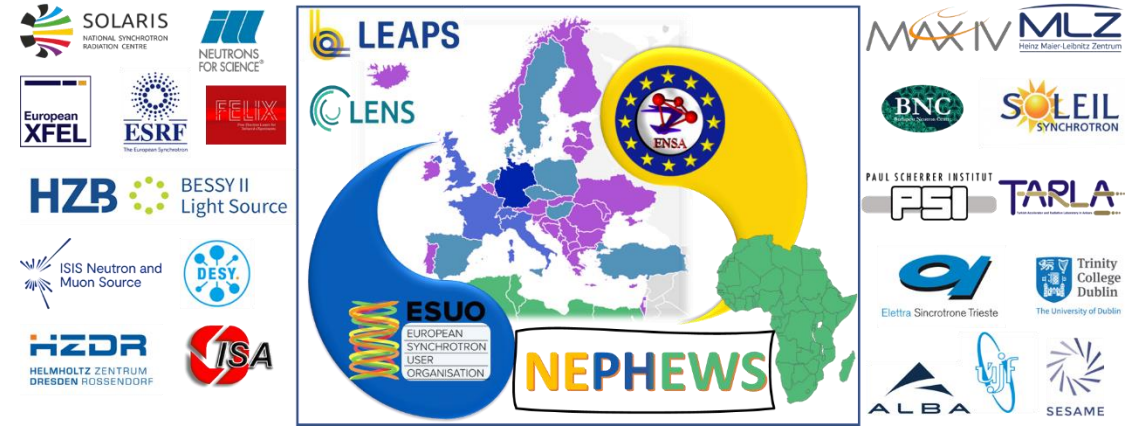
Conclusions and Acknowledgements



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

- Horizon Europe curiosity-driven trans-national access funding:
- NEPHEWS (Neutrons and Photons Elevating Worldwide Science)
- Eol – 8 countries out of 12 – Dr. Dušan Božanić & B.P. Marinković

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