Book of Abstracts

MEDOPTICS 2025

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4th International Conference on Medical Optics (MEDOPTICS)

Oludeniz, Turkey

October 21-27, 2025

Invited Speakers

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Yury I. Gurfinkel	Lomonosov Moscow State University, Russia
Joel E. Michalek	Long School of Medicine, USA
Daniel Razansky	ETH Zürich, Switzerland
Salah Oudjertli	University Habilitation, Algeria
Shigao Huang	University of Macau, China
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Nicola Daldosso	University of Verona, Italy
Kostadinka Bizheva	University of Waterloo, Canada
Christos Boutopoulos	University of Montreal, Canada
Kenn Freedman	Texas Tech University Health Science Center, USA
Ang-yang Yu	Independent Researcher & Consultant, China
Mohamed Akbi	Ecole Normale Supérieure Abderrahmane Taleb de Laghouat Algeria
Pavel Subochev	IAP RAS, Russian Federation
Mohd Ab Rahman	Universiti Kebangsaan Malaysia, Malaysia
Plamena Angelova Stroh	UCL Queen Square Institute of Neurology, UK
Alexey V. Feofanov	Lomonosov Moscow State University, Russian Federation
Kirill V. Larin (Plenary Speaker)	University of Houston, USA
Meltem İzzetoğlu	Villanova University, USA

Rozalina Zakaria	Universiti Malaya, Malaysia
Shakeel Khan	Aligarh Muslim University, India
Igor Ponomarev	P.N. Lebedev Physics Institute, Russian Federation
Abdalem Rasheed	University of Mosul, Iraq
Yoshiyuki Uruma	National Institute of Technology (KOSEN), Japan
Nadezhda Kudryasheva	Institute of Biophysics SB RAS, Russian Federation
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Martin Bernier	COPL, Laval University, Canada
Alexey A. Tsyganenko	St. Petersburg State University, Russia
Grigory Gelikonov	BioMedTech LLC, Russian Federation
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PLENARY SPEAKER

Id-616

Optical Neuromonitoring for the Study of Cognitive Aging and Age-related Diseases

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Abstract. There is a growing interest in the deployment of optical technologies for the field of cognitive activity and brain health assessment since they allow use in real-time and under real-world settings. Understanding the inner workings and functional make-up of the human mind and monitoring and prediction of an individual's current and future neurophysiological state by properly adapting these optics-based neuroimaging methodologies in conjunction with other brain and body sensing modalities in recent powerful machine learning paradigms, can guide clinicians, scientist and researchers in improving the diagnosis, treatment and prevention of cognitive disorders and decline. As such, functional near-infrared spectroscopy (fNIRS) is an emerging optical neuroimaging technology that holds untapped potential for clinical use and research applications that require fast, reliable and ecologically valid brain imaging method adaptable to more complex and dynamic environments. The technology uses near-infrared (NIR) light to assess changes in blood oxygenation and volume in the cerebral cortex and allows the design of safe, portable, wearable, noninvasive, and affordable neuromonitoring systems with rapid application time, superior immunity to movement noise, compatibility for multimodal use with other brain and body sensing modalities, and near-zero run time cost. This talk will introduce the principles underlying fNIRS technology, sensor/device development and evolution, its data analytics using novel signal processing algorithms and machine learning methods, and various multi-modal and multi-domain applications including in the field studies and clinical evaluations. Special focus will be given to functional neuromonitoring applications on cognitive aging under various age-related diseases such as mild cognitive impairments, multiple-sclerosis, Parkinsonian syndromes, and others versus healthy controls. In these select studies, cognitive activity differences as measured by fNIRS during single and dual task walking and driving in addition to various attention, working memory, and executive function tests in older adults with and without age-related diseases in comparison to younger adult populations will be summarized.

Keywords: Optical Brain Imaging; Functional Near Infrared Spectroscopy; Cognitive Activity Monitoring; Aging and Age-Related Diseases; Walking, Driving; Attention; Working Memory; Executive Function.

References:

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PLENARY SPEAKER

Id-629

Recent Advances in Optical Coherence Elastography

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Abstract. The development of novel methods and techniques for structural and functional imaging, monitoring, and quantifying various biological processes in tissues and small organs has garnered tremendous interest, given the diverse applications of Biomedical Optics. In this talk, I will provide an overview of several research projects in my lab on the development and applications of Optical Coherence Elastography and Brillouin Spectroscopy techniques for non-invasive biomechanical analysis of various tissues and cells, with a primary focus on Ophthalmological and Developmental Biology applications.

Keywords: Biomechanics; Optical Coherence Elastography; Brillouin Spectroscopy

INVITED SPEAKER

Id-622

Application of Luminous Bacteria in Nanobiotechnology and Biomedicine: Monitoring of Biological Activity and Biosynthesis of Nanoparticles

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Abstract. We developed the application of luminous marine bacteria in two directions: monitoring the biological activity of nanoobjects and biosynthesis of nanoparticles (NPs). First direction allows application of the *Photobacterium phosphoreum* bacteria as a classic toxicity bioassay due to the simplicity and high speed of analysis. Main physiological parameter of this bacteria-based bioassay is bioluminescence intensity. The luminous bioassay was adapted to monitor bioeffects of NPs – toxic and anti (pro)oxidant properties, radioprotective activity. The NPs with different core structure and surface modification have been studied: (1) fullerenols with different frame sizes, the number of oxygen substituents, and involvement of endohedral or exohedral metals, (2) iron oxide NPs with different surface modifiers, (3) three-component nanocomposites including metal-organic frameworks, iron oxide and modifiers (ascorbic acid or humic substances). The content of reactive oxygen species (ROS) was assessed using the chemiluminescent luminol method. The specific effects of NPs were explained by changes in enzyme activity, hydrophobic interactions involving cell membranes, electron affinity, and ROS imbalance. The NPs mentioned (1-3) are perspective for balancing radical processes in organisms, cancer therapy, and as contrast MRI agents. The second area of research is related to the biosynthesis of elementary selenium NPs: electron microscopy detected NPs in bacteria exposed to Na_2SeO_3. The energy dispersion spectrum revealed a high content of selenium in these NPs. The maxima of the NPs' distribution were found in the range of 45-55 nm. The property of bacteria is important for biotechnological and medical applications, including pharmacology, production of food additives and products enriched with selenium.

Keywords: Luminous Marine Bacteria; Bioluminescence; Nanoparticles; Biological Activity; Reactive Oxygen Species.

Acknowledgment: This research was funded by the Russian Science Foundation № 24-24-20001, https://rscf.ru/project/24-24-20001/ and Krasnoyarsk Regional Fund of Science. Enzyme purification was supported by the State Assignment of the Ministry of Science and Higher Education of the Russian Federation, project FWES-2024-0018.

INVITED SPEAKER

Id-625

Mid-Infrared Fiber Lasers for Medical Applications

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Abstract. Mid-infrared (mid-IR) fiber lasers, especially those emitting near 3 µm, have potential to become powerful tools in a diverse range of medical applications due to their unique interaction with biological tissues [1,2]. The strong absorption of laser beam around 3 µm by water (Fig. 1), the primary constituent of the human body, facilitates precise bio-processing with minimal collateral thermal damage and coagulation zones. This characteristic enables precise tissue ablation, therefore reducing the risk of thermal damage to adjacent areas. While alternative laser technologies, such as CO_2 and Er:YAG lasers, have been utilized for medical applications, fiber lasers offer a more compelling combination of attributes, including high beam quality, efficiency, compactness and stability, which are highly advantageous in clinical settings [3]. In addition, their capability to generate short pulses enables cold tissue vaporization process, which facilitates damage-free procedures in medicine. This feature allows mid-infrared fiber lasers to be utilized for a broad spectrum of medical procedures, ranging from hard tissue applications like bone and dental processing to soft tissue surgeries such as skin and corneal procedures, with a high degree of precision and control.

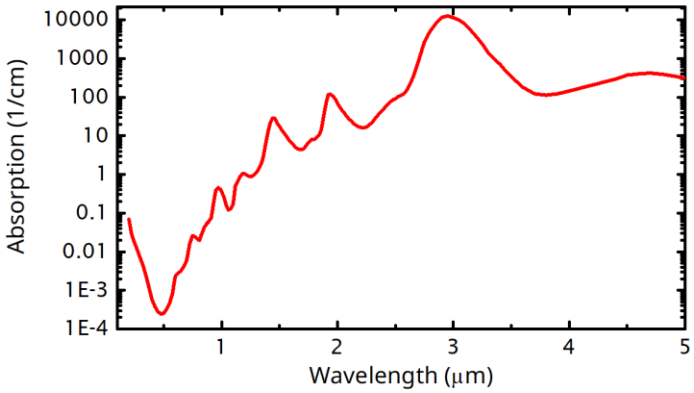

Fig. 1: Absorption spectrum of liquid water

In recent years, mid-infrared fiber lasers have demonstrated considerable progress in terms of output power, pulse energy and stability, driven by component advancements and increasing demand across numerous fields, with medicine being a crucial area of application. This presentation will outline recent advancements in mid-infrared fiber lasers, focusing on their power scalability, component development and potential for providing solutions in medical applications.

Keywords: Mid-Infrared Fiber Lasers; Medical Lasers; Medical Applications; Zblan Fiber; Fluoride Fiber Lasers.

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POSTER PRESENTATION

Id-632

Enzymes Mitigate the Changes in Ros Levels Induced by Modified Silica-Magnetite Nanocomposites

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Abstract. Nanoparticles and nanocomposites based on magnetite (Fe_3O_4) are promising platforms for biomedical applications due to their biocompatibility, magnetic properties, and tunable mesoporous structure. A key therapeutic potential lies in their ability to induce ferroptosis, an iron-dependent cell death pathway driven by lipid peroxidation. By delivering a high iron load into tumor cells, these composites can catalyze pervasive lipid ROS production, with passing traditional cancer resistance mechanisms. This study investigates the reactive oxygen species (ROS) generation and biological activity of novel silica-magnetite nanocomposites, TA-AA-Fe_3O_4 and TA-HA-Fe_3O_4, where TA is a silicon dioxide copolymer, AA is ascorbic acid, and HA is humic acids. TA, AA and HA are surface modifiers of Fe_3O_4, they are crucial for preventing nanoparticle aggregation and directly influencing Fenton reaction-driven ROS generation. To address the challenge of contradictory data (resulting from complex biological systems) in nanotoxicology, we employed a standardized bioluminescent enzymatic assay (bacterial luciferase/oxidoreductase) as a simple, rapid biosensor under controlled conditions. We compared ROS activity in both non-biological (enzyme-free aqueous solutions) and biological (enzymatic system) environments, with and without model oxidative stress induced by 1,4-benzoquinone. Our findings reveal a significant disparity: while the nanocomposites exhibited substantial ROS fluctuations and synergistic generation in non-biological media, the enzymatic system exerted a pronounced neutralizing effect, suppressing ROS levels without affecting bioluminescence. This difference between the higher reactivity in simple aqueous solutions and the neutral effect in the enzymatic system highlights the critical role of biological matrixes. The results indicate that enzymatic environments can mitigate the radical processes initiated by iron-based nanomaterials. This is crucial for predicting their biological activity and potential for applications like ferroptosis-based tumor therapy.

Keywords: Iron-Based Nanocomposites; Reactive Oxygen Species; Bioluminescence; Chemiluminescence; Cancer Therapy.

Acknowledgment: This research was funded by the Russian Science Foundation № 25-25-20098, https://rscf.ru/project/25-25-20098/ and Krasnoyarsk Regional Fund of Science.

POSTER PRESENTATION

Id-778

Using Scanning Electron Microscopy in Exploring the Morphology of *Antrocephalus Hypsopygiae* (Hymenoptera: Chalcidoidea: Chalcididae)

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Abstract. *Antrocephalus hypsopygiae* Masi, 1928 (Hymenoptera: Chalcidoidea: Chalcididae) has the only one certainly primary known host, the moth *Hypsopygia costalis* (Fabricius, 1775) (Lepidoptera: Pyralidae) (The Gold Triangle, The Clover Hay Moth, The Clover Hayworm). It was also associated with *Chilo suppressalis* (Walker, 1863) (Lepidoptera: Crambidae) and with *Naranga aenescens* Moore, 1881 (Lepidoptera: Noctuidae). The caterpillars of *H. costalis* feed on dry vegetable matter, been found in haystacks and thatching. It's a serious pest to clover hay and to stored grains, dried fruits and seeds, even crackers and dry pet food. The caterpillars create webbing that can spoil and clump the stored products, making them unsuitable for consumption, leading to economic losses. *A. hypsopygiae*, by parasitizing the pupae of *H. costalis*, can be a useful species in the natural biological control of this pest. Current geographical distribution of *A. hypsopygiae* include Morocco, Spain, France, Croatia, Cyprus, Russia, Kazakhstan, Turkmenistan, Iran, Iraq. Recently we found it in Romania, and we see exemplars from Greece. We see also pictures with exemplars from Bulgaria and Hungary on internet platforms like iNaturalist and some Facebook groups. With the help of the Scanning Electron Microscopy (SEM) we investigate the micromorphology of *Antrocephalus hypsopygiae*, including the morphology of the head, mouthparts, antenna, mesosoma, metasoma, legs, wings, ovipositor, genital armature, ovarian eggs. Using a stereomicroscope, we examinate the external morphology of the ovarian eggs and with a DSLR camera we present macro photographs with living specimens of *A. hypsopygiae*. SEM proved to be very useful in the study of the micro sculptures of the surface of the body and in investigating the types of the sensilla present on the body. *Antrocephalus* Kirby, 1883 (Chalcididae: Haltichellinae) genus, with more than one hundred thirty species, majority of them in the tropical and subtropical regions, it's quite difficult taxonomically. Using the SEM technique, we can see some hidden and cryptic characters, difficult or impossible to see using the classic light microscopy, this helping in characterize and identify these microhymenoptera species.

Keywords: Antrocephalus Hypsopygiae; Chalcididae; Scanning Electron Microscopy; Morphology.

All Submissions & Topics

Optical Coherence Tomography	Id- 629 - Recent Advances in Optical Coherence Elastography
Lasers for medical applications	Id- 625 - Mid-İnfrared Fiber Lasers for Medical Applications
Photobiology	Id- 632 - Enzymes Mitigate the Changes in Ros Levels Induced By Modified Silica-Magnetite Nanocomposites
Optical Biomedical Diagnostics	Id- 622 - Application Of Luminous Bacteria in Nanobiotechnology And Biomedicine: Monitoring of Biological Activity and Biosynthesis of Nanoparticles
Near-Infrared Spectroscopy in Multimodal Brain Research	Id- 616 - Optical Neuromonitoring for The Study of Cognitive Aging and Age-Related Diseases