Opening and welcome remarks
G.S. Sokolovskii; Ioffe Institute, Russia

MoPL-01 11:15-12:00
Ultrafast magnetism - terra incognita beyond the classical approximations (Plenary)
A. Kimel; Radboud University, The Netherlands
While magnetism is essentially the strongest quantum mechanical phenomenon, modern description of magnetization dynamics and magnetization reversal relies on thermodynamics and the corresponding approximations. I will show that ultrashort (sub-100 ps) stimuli push magnetic media into a strongly non-equilibrium state, where the conventional description of magnetic phenomena in terms of equilibrium thermodynamics fail and the experimentally observed ultrafast magnetization dynamics and reversal challenge the current theories. For instance, while the conventionally accepted Curie-Neumann’s principle states that “the symmetries of the causes are to be found in the effects”, in ultrafast magnetism the principle fails and magnetization dynamics becomes counter-intuitive. We will demonstrate that ultrafast (sub-100 ps) heating with the help of ultrashort laser pulses causes magnetization reversal without any magnetic fields, laser-induced spin dynamics is strongly non-linear, where new channels of spin-lattice interaction open-up and the principle of superposition fails i.e. 1+1>2.

MoPL-02 12:00-12:45
Light as a factor in controlling plant growth and development (Plenary)
Yu.N. Kulchin; Institute of Automation and Control Processes FEB RAS, Russia
For optimal growth and development, plants need to perceive and process information from both their biotic and abiotic environments. A particularly important environmental signal is light, to which plants react differently. Since plants are photosynthetic and immobile, they must show a special sensitivity and reaction in response to the illumination quality and dynamics. The diverse reaction of plants to light requires a complex determination of its intensity, polarization, duration and spectral composition of illumination. The purpose of this report is to present the results of studies of the influence of these various factors on the process of plant development.

MoPI-03 12:45-13:30
Semiconductor colloidal quantum dots: benefits and challenges for optoelectronic applications (Plenary)
A.V. Rodina; Ioffe Institute, Russia
A brief review on the colloidal quantum dots (semiconductor nanocrystals) discovery, research directions and applications will be presented. Benefits and challenges of colloidal nanocrystals for optoelectronic applications will be discussed. The modeling results of nanocrystal surface effect on the electronic structure and radiative recombination efficiency will be presented. The work was supported by the RFS grant No. 23-12-00300.
Recent progress in fiber lasers at NTO IRE-Polus and their novel applications *(Invited paper)*

N.N. Evtikhiev; NTO IRE-Polus, Russia

We present a review of the recent progress in development and novel applications of fiber lasers developed at NTO IRE-Polus.

TuR02-02 09:30-10:00

High efficiency active air cooled 12kw fiber laser system *(Invited paper)*

Dakang Meng, Song Yang, Xianming Zhang, Jinhui Liu, Jianwu Ding; GW Laser Technology, China

Here we present an innovative Active Air Cooled 12kw fiber laser system with the build-in closed-loop-controlled waterless cooling system, not only improve the component and the overall laser reliability but also improve the overall system electric-optical efficiency by as much as 30%.

TuR02-03 10:00-10:15

1030 nm amplified spontaneous emission suppression in Yb-doped fiber amplifier operating near 976 nm

S.S. Aleshkina¹, D.A. Davydov¹, V.V. Velmiskin¹, M.V. Yashkov², A.A. Umnikov², S.V. Alyshev¹, L.D. Ishkakova¹, M.M. Bubnov², D.S. Lipatov², M.E. Likhachev¹;

¹Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center; ²Branch of Institute of Radio Engineering and Electronics RAS; ³Moscow Institute of Physics and Technology (National Research University); ⁴"NTO IRE-Polus", Russia

We report on a novel Yb-doped fiber design aimed at improving the lasing near 976 nm by spectral filtering of the amplified spontaneous emission near 1030 nm. A very sharp short-pass filter, allowing fine adjustment of the stop-band position by bending the fibres, was implemented by incorporating suitably selected high index absorbing rods into the silica cladding.

TuR02-05 10:45-11:00

Temperature dependence of the pump radiation transfer efficiency in side-pumped optical fibers

R. Shaidullin¹, V. Dolgov², I. Kuranov³, N. Kovalenko¹, O. Ryabushkin¹; ¹Fryazino Branch of Institute of Radio Engineering and Electronics RAS, Moscow Institute of Physics and Technology (National Research University); ²"NTO IRE-Polus", Russia

A method for measuring temperature dependence of optical radiation transfer coefficients between two waveguides in the distributed side-coupled cladding-pumped fiber has been developed. Proposed technique significantly increases the speed and accuracy of measurements. Obtained results allow to find the optimal polymer composition for fiber coating in high-power fiber lasers.

- Coffee Break -

Efficient gas lasers pumped by diffuse discharges initiated by runaway electrons *(Invited paper)*

A.N. Panchenko, V.F. Tarasenko; Institute of High Current Electronics SB RAS, Russia

New method for pumping gas lasers based on diffuse discharges initiated by runaway electrons in gaps with an inhomogeneous electric field was proposed and realized. Efficient lasing in spectral ranges from IR to VUV was obtained. Ultimate efficiency of nitrogen, HF(DF) and VUV F2 lasers had been achieved. New operation modes of VUV H2 laser on Lyman band were obtained.

TuR02-07 11:30-12:00

Broadband hybrid laser systems based on mid-IR multiline gas lasers and nonlinear crystals *(Review)* *(Invited paper)*


Frequency conversion of CO and CO2 lasers emission in nonlinear crystals resulted in significant expansion of their output spectral range up to ~2 – 20 μm and the increase of the number of spectral lines generated by these hybrid systems.

TuR02-08 12:00-12:30

Planar IR lasers with RF and microwave pumping *(Invited paper)*

A.P. Mineev, S.M. Nefedov, P.A. Gonchorov; Prokhorov General Physics Institute RAS, Russia

The output power and spectral characteristics of radiation were studied during RF or MW gas-discharge excitation of planar IR-lasers depending on the group delay dispersion of the resonator and the modulation depth of the saturable absorber. It is concluded that pulse generation depends on the dynamics of the modulation depth changes of the saturable absorber during multiple passes of the pulse through the laser resonator.

TuR02-09 12:30-13:00
TuR02-10
13:00-13:15
Yellow neon laser pumped by a pulsed inductive longitudinal discharge
A.M. Razhev1, D.S. Churkin1,2, R.A. Tkachenko1,2, 1Institute of Laser Physics SB RAS; 2Novosibirsk State University, Russia
The experimental results show the energy, temporal and spatial lasing characteristics of Penning neon laser (λ = 585.3 nm) pumped by a pulsed inductive longitudinal discharge are presented. The maximum lasing energy of about 0.14 mJ was achieved. The average generation duration was 200 ns (FWHM) which corresponds to pulse power of 700 W.

TuR02-11
13:15-13:30
Resonance-enhanced multiphoton ionization of molecular oxygen at the 222 nm KrCl laser wavelength
E.V. Ionushkaite, A.V. Shutov, Lebedev Physical Institute, Russia
We study the photo-ionization mechanism of molecular oxygen at the rare wavelength of 222 nm using a KrCl laser. It was found that the ionization mechanism is (2+1) REMPI process. Value of the (2+1) REMPI cross section was calculated.

TuR02-12
15:00-15:30
Semiconductor lasers: technological aspects of their production and applications (Invited paper)
G.T. Mikaelyan, LLC «Lassard», Russia
A review of the current state of the art of semiconductor diode laser production technology and the level of achieved parameters is presented. We also consider the achieved level in the field of light-emitting diodes and lasers based on indirect bandgap semiconductors with strained layers that are promising for applications in high-speed information systems.

TuR02-13
15:30-16:00
High power solid state lasers with non-stationary gain media (Invited paper)
N.G. Zakharov, V.I. Lazarenko, E.S. Safronov, E.V. Saltikov, I.I. Karpov, M.V. Volkov, G.M. Mishchenko, RFNC-VNIIEF, Russia
In this paper we present the results of numerical and experimental research pertaining to high power solid state lasers with various non-stationary-gain media as Yb:YAG and Cr:ZnSe. Dependencies of output laser power and beam quality on pump power and gain medium velocity are given. Efficiencies of air-cooled and water-cooled heat sinks are discussed.

TuR02-14
16:00-16:15
New scheme of Faraday isolator with dV/dT distortions compensation
I.L. Snetkov, FRC A.V. Gaponov-Grekhov Institute of Applied Physics RAS; Lobachevsky State University of Nizhny Novgorod, Russia
A new scheme of a Faraday isolator with compensation of the contributions to thermally induced depolarization from the temperature dependence of the Verdet constant was proposed. The efficiency of using the proposed scheme and comparison with known schemes is analyzed analytically and numerically at two cases: a cryogenic isolator and an isolator on crystalline material cut in a critical orientation.

TuR02-15
16:15-16:30
Thermally induced distortions of radiation in multipass Faraday isolators
A.V. Starobor, O.V. Palashov, Federal Research Center A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia
We investigated thermally induced depolarization in multi-pass Faraday isolators schemes, that are inevitable for low Verdet constant media. It is shown theoretically and experimentally that it is possible to increase isolation ratio 1.6 times by choosing the optimal distance between beams in “linear” arrangement and there is no optimum for the arrangement of beams along a circle.
Adaptive optical image correction system for the Large Solar Vacuum Telescope (Invited paper)
A.G. Borzilov, P.A. Konyaev, V.P. Lukin; V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia
The report presents an analysis of the results of processing experimental data obtained during the expedition of the LCAO IOA SB RAS in August 2023 at the LSVT of the Baikal Astrophysical Observatory of the Institute of Solar-Terrestrial Physics SB RAS.

TuR04-02 09:30-10:00

Axially symmetric Hermite-Gaussian beams for the space-earth quantum cryptography channel (Invited paper)
D.D. Reshetnikov, A.L. Sokolov, V.Yu. Venediktov, V.M. Petrov; 1 Faculty of Physics, St. Petersburg State University, 2 ISC “Research-and-production corporation ‘Precision system and Instruments’” (RPC PSI), Russia
The work provides a description of Hermite – Gaussian beams with an axially symmetric polarization structure, suitable for quantum space communication and cryptography systems. The possible creation and detection of such beams within the framework of a communication and cryptographic polarization protocols using the devices with a radial polarizer is discussed.

TuR04-03 10:00-10:15

Imaging of a natural star under the angle of the anisoplanatism effect
V.A. Bogachev, A.V. Nemtseva, F.A. Starikov; 1 Lomonosov Moscow State Univ., 2 Sarov Physics and Technology Institute of the National Research Nuclear University MEPhI, Russia
The results of numerical simulation of light propagation from a natural star through the turbulent atmosphere to the ground-based telescope and obtaining star image using adaptive optical system are presented taking into account the effect of angular anisoplanatism.

TuR04-06 11:30-12:00

Problems of using laser guide stars (Invited paper)
L.A. Bolbasova, V.P. Lukin; V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia
The problems of using sodium laser guide star (LGS) in adaptive optics (AO) system of ground-based telescopes are considered. The research was carried out with the financial support of the Russian Science Foundation project No.22-22-00289.

TuR04-07 12:00-12:30

Generation of high-power terahertz vortex Bessel beams by diffractive optical elements at the NovoFEL and their application in plasmonics (Invited paper)
N.D. Osintseva, Yu.Yu. Choporova, V.V. Gerasimov, V.S. Pavelev; O.E. Kameshkov, V.D. Kukotenko, M.S. Komlenok, B.A. Knyazev; Budker Institute of Nuclear Physics SB RAS, 2 Novosibirsk State University, Russia; 3 Samara National Research University, Russia; 4 The Australian National University, Research School of Physics, Australia; 5 Prokhorov General Physics Institute RAS, Russia
The report is dedicated to the study and application of terahertz vortex Bessel beams formed by diffractive optical elements at the Novosibirsk Free Electron Laser. Generation of vortex surface plasmon polaritons for prospective multiplex wire communication lines was demonstrated.

TuR04-08 12:30-13:00

Hybridly polarized optical vortices (Invited paper)
S.S. Stafeev, V.V. Kotlyar; 1 Faculty of Interdisciplinary Studies, National University of Defense Technology, China
In this work numerically using Richards-Wolf equation and experimentally using spatial light modulator we have investigated optical vortices with hybrid polarization. The polarization of these beams combines azimuthal polarization and circular polarization.

TuR04-09 13:00-13:30

Integrated vortex emitter design for mode signal multiplexing (Invited paper)
R.V. Kuts, L.I. Bakirova, V.S. Lyubopytov; Ufa University of Science and Technology, Russia
The work describes an optical vortex emitter based on an integrated ring resonator, which also multiplexes vortices in one optical beam. An algorithm for numerical calculation of the structure dimensions is proposed. It is shown that simultaneous emission of two pairs of conjugate vortices at the same wavelength is possible with the designed structure.

Location: Pudovkin 1+2 Room; Date: Tuesday, July 02, 2024

- Lunch Break -
Microring optimization for the tunable vortex beam emitter
L.I. Bakirova, G.S. Voronkov, V.S. Lyubopytov, V.Kh. Bagmanov; Ufa University of Science and Technology, Russia
We present a novel method for optimizing a micro-ring resonator (MRR) for emitting vortex beams with orbital angular momentum of a variable order. The MRR consists of a ring waveguide with periodic holes, side-coupled to a bus waveguide.
TuR04-11
15:15-15:30

Modeling the propagation of Laguerre-Gaussian beams through a turbulent medium
D.D. Reshchinikov, T.K. Korol, E.V. Malyutina, V.M. Petrov; Faculty of Physics, St. Petersburg State University, Russia
In this work, the influence of atmospheric turbulence on Laguerre-Gaussian modes of various orders is investigated using phase masks for a spatial light modulator. The possibility of using optical vortices for atmospheric communication channels and cryptographic channels under an optimal set of modes for this are discussed.
TuR04-12
15:30-15:45

New aberration modes for the improvement of laser beam focusing in case of Kolmogorov phase distortion statistics
D.A. Yagnyatinskiy; LUCH JSC, Russia
For the laser beam focusing in case of Kolmogorov phase distortion statistics new "Karhunen-Loève-Lukosz" aberration modes with a property of minimizing the residual geometrical root-mean squared focal spot radius are proposed. Calculations indicate that sequential correction of these modes up to 7th order inclusive gives the improvement of focusing parameters in comparison with other known aberration modes.
TuR04-13
15:45-16:00

Mode decomposition algorithm for enhancing the phase measurement accuracy
D.S. Kharenko1,2, M.D. Gervaziev1,2, A.A. Revyakin1,2, K.V. Serebrennikov1, F. Mangini3, M. Ferraro3, S. Wabnitz3, S.A. Babin3; Institute of Automation and Electrometry SB RAS, Russia; 1Department of Physics, Novosibirsk State University, Russia; 2DIET, Sapienza University of Rome, Italy; 3Department of Physics, University of Calabria, Italy
Holographic mode decomposition methods are extremely fruitful in revealing the physical mechanism of nonlinear effects, but also suffer from unresolved issues. In this work we improve the measurement accuracy of the relative modal phases, by adjusting the modal intensities.
TuR04-14
16:00-16:15

Mode decomposition for enhancing the phase measurement accuracy
D.S. Kharenko1,2, M.D. Gervaziev1,2, A.A. Revyakin1,2, K.V. Serebrennikov1, F. Mangini3, M. Ferraro3, S. Wabnitz3, S.A. Babin3; Institute of Automation and Electrometry SB RAS, Russia; 1Department of Physics, Novosibirsk State University, Russia; 2DIET, Sapienza University of Rome, Italy; 3Department of Physics, University of Calabria, Italy
Holographic mode decomposition methods are extremely fruitful in revealing the physical mechanism of nonlinear effects, but also suffer from unresolved issues. In this work we improve the measurement accuracy of the relative modal phases, by adjusting the modal intensities.
TuR04-15
16:15-16:30

Fiber acousto-optic vortex-involved interaction: photon-phonon spin and orbital momentum transfer and transformation
D. Vikulin, B. Sokolenko, N. Shostka, C. Alexeyev, M. Yavorsky; Vernadsky Crimean Federal University, Russia
The novel processes of spin and orbital angular momentum transfer and conversion during an interaction between topologically charged vortex photons and vortex phonons in a waveguiding medium are described.
TuR04-16
16:30-16:45

Numerical simulation of coherent summation of laser beams in the presence of non-idealities in the dipole focusing system
D.N. Bulanov, A.V. Korzhimanov, E.A. Khazanov, A.A. Shaikin; Inst. of Applied Physics RAS, Russia
A programming library was developed, using Stratton-Chu diffraction integrals for calculating reflected fields. Focusing schemes with tunable number of beams and mirrors placement were studied, considering the influence of phase distortion and aberrations. The intensity above 3×10^25 W/cm2 was found theoretically attainable in a system of 12 beams of 50 PW each with about 90% of that value realistically achievable.
TuR04-17
16:45-17:00

Contrrollable formation of giant nonlinearities in integrated optical travelling wave modulators
V.S. Gerasimenko1,2, N.D. Gerasimenko2, V.M. Petrov1,2; Research and Educational Center for Photonics and Optoinformatics, ITMO University, 1Quanetelecom, 2Dept. of General Physics, St. Petersburg State University, Russia
Optical frequency combs formed by phase modulator can be used in many physical applications. In this paper we experimentally demonstrate, that simple scheme containing a phase modulator and an optical fiber back-coupling loop can be used to increase the optical frequency comb spectral width several times.
TuR04-20 18:00-18:15
Development and research of an angular metasurface scale and a new method for measuring the rotation angle
E.A. Eremova1, I.R. Krylov1, I.V. Prokhrova1, E.V. Shalymov1, V.I. Shoey2, V.Yu. Venediktov3, A.A. Zhinchik1; 1ITMO University; 2St. Petersburg State University; 3St. Petersburg Electrotechnical University “LETI”, Russia
A new optical method for measuring the rotation angle is considered, based on the sensitivity of the resonant response of a metasurface to its orientation. The scale prototype was made of tantalum oxide on a quartz glass substrate. The prototype spectrum and the dependence of the optical response on the rotation angle are consistent with the simulation results.

TuR04-21 18:15-18:30
High-speed electro-optic beam deflector based on lithium niobate waveguide with snake-shaped electrode
Hongdiao Cheng1, Yongchun Zhong2, Zhe Chen1; 1 Department of Optoelectronic Engineering, Jinan University; 2 Key Laboratory of Optoelectronic Information and Sensing Technologies of Guangdong Higher Education Institutes, Jinan University; 3JiHu Laboratory, Foshan, Guangdong, China
A push-pull electro-optic beam deflector based on a lithium niobate waveguide with a snake-shaped electrode is demonstrated. When applying a electric voltage on the snake-shaped electrode, this design will create a push-pull effect on the optical field and greatly improving the deflection efficiency.
Relativistic self-trapping of power laser pulse and accompanying radiation-nuclear phenomena (Invited paper)
V.Yu. Bychenkov; Lebedev Physical Institute RAS; Dukhov Research Institute of Automatics (VNIIA), Russia
We describe the self-trapping regime of super-intense laser pulse propagation in a near-critical density plasma that is favorable for generation of multi-nC high energy electron bunch. The latter is of strong demand for numerous applications. The properties of the generated electrons and their different radiation-nuclear applications will be discussed.

High-brilliance synchrotron radiation in relativistic self-trapping regime
O.E. Vais1,2, M.G. Lobok1,2, V.Yu. Bychenkov1,2; VNIIA; LPI, Russia
Synchrotron radiation source based on the laser-plasma acceleration of electrons in the relativistic self-trapping regime of the laser pulse propagation has a small size, short duration and low divergence that provides a high brightness. We discuss angular-spectral characteristics of this secondary radiation, which can be generated using the high-power laser facilities that already exist or are under construction in Russia.

Bremssstrahlung gamma-ray source for prompt gamma-ray activation analysis based on the regime of relativistic self-trapping of light
M.G. Lobok1,2; V.Yu. Bychenkov1,2; VNIIA; LPI, Russia
A numerical GEANT4 experiment on gamma-activation of thin plates made of natural gold and depleted uranium was carried out as a first-principles experiment. A comparison between bunch of monoenergetic collimated electrons with energy 15 MeV and a PIC (VSIM) simulated one from relativistic self-trapping electron source, which interacted with a bremsstrahlung converter preceding gamma-activation and nuclear-spectra analysis, was performed.

Laser initiated strong THz pulses (Invited paper)
A.V. Brantov1,2, M.G. Lobok1,2, A.S. Kuratov1,2; Lebedev Physical Institute RAS, Dukhov Research Institute of Automatics (VNIIA), Russia
The report presents the theory and modeling of the generation of powerful terahertz pulses as a result of the transition radiation of the most energetic electrons heated by a laser pulse. The influence of various effects on the shape of the half-cycle generated pulse is discussed. An increase in the efficiency of terahertz radiation using low-density targets has been demonstrated.

Electron acceleration and THz emission during laser-cluster interaction
N.A. Kuzechkin1, A.A. Angeluts1, A.V. Balakin1, P.M. Solyanykin1, A.P. Shkurinov1; National Research Centre «Kurchatov Institute»; Department of Physics, Lomonosov Moscow State University, Russia
We have studied the processes of electron acceleration and THz emission, undergoing simultaneously during laser excitation of the gas-cluster jet. The properties of the electron beam and THz radiation power were measured under various conditions of the cluster excitation and parameters of the laser radiation.

Efficient generation of low-frequency radiation at back-reflection of intense laser pulses from near-critical-density targets
A.V. Kozhimianov; Gaponov-Grekhov Institute of Applied Physics RAS, Lobachevsky University of Nizhny Novgorod, Russia
It is shown that when intense laser pulses are reflected from a near-critical density plasma, the Doppler shift leads to generation of intense radiation in both the high-frequency (ultraviolet and x-ray) and low-frequency (mid-infrared) ranges. The efficiency of energy conversion into the wavelength range above 3 μm can reach several percent, which allows to obtain relativistically intense mid-infrared pulses.

- Lunch Break -

Study of electron acceleration dynamics by modifying a gas target with a shock wave
I.N. Tsymbalov1,2, D.A. Gorlova2, K.A. Ivanov1, A.B. Savel’ev1; Institute for Nuclear Research RAS, Russia
We present a method for studying the dynamics of electron acceleration based on interrupting the acceleration process by the shock wave front created by an additional nanosecond laser pulse. Experimentally obtained electron spectra at various stages of acceleration are provided, as well as confirming results from PIC modeling.
X-ray yield enhancement from microplasma produced by tandem high-frequency fiber lasers

A.A. Garmatina¹, E.I. Mareev¹, N.V. Minin¹, N.M. Asharchuk¹, T.A. Semenov¹, V.V. Rovenko¹, Y.S. Krivonosov¹, I.G. Dyachkova¹, A.V. Buzmakov¹, D.A. Zolotov¹, V.M. Gordienko²,³, V.E. Asadchikov¹; ¹Kurchatov Complex Crystallography and Photonics, NRC “Kurchatov Institute”, ²Faculty of Physics, Moscow State University, Russia

We created a laser-plasma X-ray source based on the femtosecond fiber laser with high yield ~2x10⁹ phot/s/2π (3-12 keV), and with a source size diameter of approximately 10 microns. The X-ray yield and the source size were optimized by using artificial intelligence, the He flow and nanosecond pre-pulse.

- Coffee Break -
TuR06-07 17:30-18:00

Super-resolution of microsphere-assisted imaging (Invited paper)
A.V. Maslov1, A.A. Erykalin1, V.N. Astratov2; 1 Department of Radiophysics, University of Nizhny Novgorod, Russia; 2 Department of Physics and Optical Science, University of North Carolina at Charlotte, USA

In the last decade, imaging through contact microspheres stimulated active interest due to the ability to produce images of objects with spatial feature scales smaller than the Abbe limit. Yet, there is no convincing explanation of this effect. Here we propose a theoretical model which reproduces the super-resolved images and identifies the mechanisms of their formation.

TuR06-08 18:00-18:15

Measuring anatomy of vascular structures: workflow for analysis of 3D optoacoustic angiographic data
A.Yu. Korobov1; Z.V. Besedovskaya1, E.A. Petrova1, A.A. Kurnikov1, A.M. Glyavina1, I.N. Druzhkova1, M.A. Sirotkina1, S.V. Nemirova1, A.G. Orlova1, D.A. Gorin1, D. Razansky1, P.V. Subochev1; 1 Ultrasonic and Opto-Acoustic Diagnostics Laboratory, Institute of Applied Physics RAS, IAP RAS, 2 CNBR, Skolkovo Institute of Science and Technology, Skoltech, 3 Privolzhsky Research Medical University, Russia; 4 Laboratory of the Main Geomagnetic Field and Petro magnetism, Institute of Physics of the Earth RAS, 5 Institute of Applied Physics RAS, Russia

Vascular system visualization has become a pressing subject. A game-changing method is optoacoustics, a non-invasive hybrid technique. After the angiographic image is obtained there are enhancement and reconstruction methods to make the data suitable for quantifications. We present a visually-accessible workflow for quantification 3D angiographic images using the Thermo Fisher Scientific Amira / Avizo 3D Visualization & Analysis Software.

TuR06-09 18:15-18:30

6-wavelength VIS - SWIR laser with acousto-optic attenuation
M.O. Shari kova1, A.S. Machikhin1, A.I. Lyashenko1; STC UI RAS, Russia

We propose a technique for simultaneous selection and attenuation of up to eight spectral components through smooth tuning the frequencies and amplitudes of acoustic waves in acousto-optic crystal equipped with two piezoelectric transducers.

TuR06-11 18:45-19:00

Multilayer interference metamaterials for advancing THz-TDS technique
N.A. Nikolaev1, A.A. Rybak1, S.A. Kuznetsov1,2; 1 Institute of Automation and Electrometry SB RAS, Novosibirsk State University, 2 Design and Technology Institute of Applied Microelectronics, Rzhanov Institute of Semiconductor Physics SB RAS, Russia

Here we present the design of high-performance, THz filters. The filters help us to implement antialias filtering and subsampling (undersampling) methods in the terahertz time-domain spectroscopy (THz-TDS) technique. It is shown that the proposed approaches can significantly reduce the data acquisition time of the spectrometer, which in turn can speed up terahertz vision systems built on the basis of THz-TDS.

TuR06-12 19:00-19:15

Predicting vascular states: ML modeling of optoacoustic imaging data for detection changes in the vasculature
Z.V. Besedovskaya1, A.Yu. Korobov1, M.M. Trofimov1, D.A. Ushakov1, A. Kurnikov1, A. Glyavina1, V.V. Klinshov1, S.V. Nemirova1, A.G. Orlova1, P.V. Subochev1; 1 CNBR, Skolkovo Institute of Science and Technology, Skoltech, 2 Ultrasonic and Opto-Acoustic Diagnostics Laboratory, Institute of Applied Physics RAS, RAS, Russia

Optoacoustic is a powerful technique for studying health and disease models and is used in preclinical research. We implemented ML algorithms for vascular states prediction using the preprocessed images datasets. It allows us to divide multiple features reflecting the vascular network complexity and define different conditions. This algorithm can be suitable for clinical applications like the vascular pathologies diagnostics.
TuR08-03 18:15-18:30

Target design for high-pressure temperature matter using inelastic x-ray scattering at the HED Instrument at the European XFEL
D. Bespalov1,2, K. Appel1, E. Brambrink1, D. Kraus1, R. Redmer2, U. Zastrau1,1 High-Energy Density Science, European XFEL; 2Institut für Physik, Universität Rostock, Germany
This work presents an optimized target design for high-resolution inelastic x-ray scattering at the HED instrument, European XFEL. Utilizing hydrodynamics simulations and preliminary tests, the laser-irradiated aluminum target exhibits enhanced capabilities for studying WDM under extreme conditions.

TuR08-04 18:30-18:45

Side-band modes in open optical resonators of pulse-periodic free electron lasers
V.V. Kubariev, Budker Institute of Nuclear Physics; Voevodsky Institute of Chemical Kinetics and Combustion, Russia
Using the examples of terahertz and far-infrared Novosibirsk free electron lasers, a new cavity type of side-band modes that arise for certain periodic cavity geometries when the pump and cavity axes do not coincide is described.

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

TuR08-01 09:00-09:30

Machine learning control of complex nonlinear dynamics in fibre lasers (Invited paper)
S. Boscolo1, J. Peng1, X. Wu2, Y. Zhang3, C. Finot3, H. Zeng3, 1Aston Institute of Photonic Technologies, Aston University, United Kingdom; 2State Key Laboratory of Precision Spectroscopy, East China Normal University, China; 3Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-Universite’ de Bourgogne, France
We review our recent work on the use of genetic algorithms to assist in the control and study of non-stationary nonlinear wave dynamics in ultrafast fibre lasers. These include repetitive patterns, such as breathing solitons and breather molecular complexes, and non-repetitive rare events.

TuR08-02 09:30-10:00

Beam self-cleaning and wave thermalization in multimode fibers (Invited paper)
F. Mangini1, M. Ferraro1, W.A. Gemenchii, M.D. Gervaziev2, D.S. Kharenko3,4, D.S. Kharenko3,4, A.P. Mineev2, I.A. Bufetov1, 1Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia; 2Prokhorov General Physics Institute RAS, Russia; 3Joint-Stock Company ‘The Engineering Centre of Fiber Optics’, Russia
Spatial beam self-cleaning in multimode optical fibers may be described as a result of wave thermalization. Our mode decomposition experiments confirm the validity of this approach, but also point to open questions.

TuR08-03 10:00-10:15

Integrated microresonator as a nonlinear reflecting mirror in fiber laser cavity for optical frequency comb generation
A.A. Mirkchyan1, Z. Ali1, M.S. Mischovesky1, N. Dmitriev1, A. Nasibulin2, I. Bilenko2, Yu.G. Gladush2, 1Skolkovo Institute of Science and Technology, 2Russian Quantum Center, Russia
We introduce integrated microring cavity within the fiber laser resonator as both a source for cavity solitons and a nonlinear reflecting mirror. We showcase a self-starting and robust soliton frequency comb generation with a spectral width surpassing 400 nm, far exceeding the erbium amplification window.

TuR08-04 10:15-10:30

Dynamics of long period pulsations when intra-cavity loss changes
A.V. Sudin1, S.N. Ushakov2,3, I.A. Volkov1, K.N. Nishchev1, M.Y. Vlasov1,2, 1National Research Mordovia State Univ.; 2Prokhorov General Physics Inst. RAS; 3Joint-Stock Company ‘The Engineering Centre of Fiber Optics’, Russia
We report on the dynamics of laser generation during the transition from quasi-stable mode-locking to mode-locking accompanied by long period pulsations. In this case, the optical spectrum in the long period pulsation regime is accompanied by emission in three spectral regions with maximum at three wavelengths: 1562, 1598 and 1623 nm.

TuR08-05 10:30-10:45

He-He gas-discharge fiber laser
D.G. Komissarov1, A.V. Gladyshev1, S.M. Nefedov1, A.F. Kosolapov1, V.V. Vel'minskii1, A.P. Mineev1, I.A. Bufetov1, 1Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center; 2Prokhorov General Physics Institute RAS, Russia
Operation of a 2.03-μm He-He gas-discharge fiber laser based on a hollow-core fiber and pumped by a microwave radiation at 2.45 GHz is investigated. Optimal gas-mixture composition and pressure are identified. Opportunities for further development of gas-discharge fiber lasers are discussed.

TuR08-06 10:45-11:00

Stochastic narrowband generation in a random fiber Raman laser
O.A. Gorbunov1, I.D. Vatnik1, S.V. Smirnov1, D.V. Cherkin1, Novosibirsk State University, Russia
Just above the generation threshold the spectrum of a random fiber laser consists of ultra-narrow localized modes, which evolve for time intervals of about 1 ms and decompose afterwards. We characterize its main features: lifetimes and power of these modes, their temporal and statistical properties and articulate the mechanism of modes’ decay as a nonlinear wave mixing process.

- Coffee Break -
Nonlinear optical properties of distilled water in visible-mid-IR range  

P.A. Danilov¹, I.D. Matayev¹,², D.A. Pomazkin¹, P.Ya. Ilushin¹,², S.I. Kudryashov¹; ¹Lebedev Physical Institute; ²Bauman Moscow State Technical University; ³Lomonosov Moscow State University, Russia

In this work, experimental studies of the important characteristics of plasma channels generated by fs-laser pulses with wavelengths of 0.36-1.7 μm in distilled water have been completed. We confirmed the quadratic dependence of the critical self-focusing power on the fs-pulse wavelength and determined the nonlinear refractive index of water in the visible-mid-IR range.

Optoacoustic effects on laser breakdown in a liquid  

A.V. Bulanov; V.I. Il’ichev Pacific Oceanological Institute FEB RAS, Russia

The work is devoted to the study of acoustic effects accompanying an optical breakdown in a liquid generated by focused laser radiation during interaction with the liquid surface. It is proposed to use an optical-accoustic method associated with the use of laser radiation that causes optical breakdown - optical cavitation, accompanied by a strong sound generation effect.

SRS of 60-ps laser pulses in water: optical breakdown at unexpectedly low pulse energy with droplet ejection  

S.M. Pershin¹; V.A. Orlovich¹, A.I. Vodchits¹, I.A. Khodasevich², M.Ya. Grishin¹; ¹Prokhorov General Physics Institute RAS, Russia; ²B.I. Stepanov Institute of Physics NASB, Belarus

New nonlinear phenomenon has been observed: stimulated Raman scattering (SRS) of laser (532 nm, 60 ps) induced a breakdown close to the surface by pump pulse energy 20-fold lower than focusing into bulk water. Reversed single-multi-beams filamentation of SRS stokes beam was observed when the focal plane shifting from the water surface to the depth.

Stimulated Raman scattering of 240 fs laser pulses in PMMA  

S.M. Pershin¹; M.Ya. Grishin¹, M.V. Panarina¹, A.A. Ushakov¹, I.A. Khodasevich²; ¹Prokhorov General Physics Institute RAS, Russia; ²B.I. Stepanov Institute of Physics NASB, Belarus

Experiments on stimulated Raman scattering (SRS) in polymethylmethacrylate excited by 240 fs laser pulses (515 nm, ≤11 μJ/pulse) have been carried out. We have discovered a linear growth of the SRS threshold as the focal plane was moved into the sample volume. The physical mechanism of such SRS threshold dependence is discussed.

The influence of ultrasonic waves on the efficiency of stimulated Raman scattering in liquids  

N.V. Tcherniega, M.A. Shevchenko, A.N. Maresev, A. Matrokhin, S.F. Umanskaya, V. Voronova; Lebedev Physical Inst. RAS, Russia

The work shows that the presence of ultrasonic waves in a liquid media leads to a significant (more than an order of magnitude) increase in the conversion efficiency of stimulated Raman scattering under picosecond laser pumping. The effect is possibly associated with the formation of feedback mechanisms in the media.

Emission induced by an energy transfer from electronic excitations in SiO₂ to N₂ molecules  

N.V. Pestovskii, S.Yu. Savinov; Lebedev Physical Institute RAS, Russia

For the first time, an emission induced by an energy transfer from electronic excitations in SiO₂ to N₂ molecules surrounding SiO₂ samples is observed. Electronic excitations were created in SiO₂ by the two-photon absorption of laser radiation at 205 nm and by the bombardment with a high-current electron beam. A scheme of energy transfer at the SiO₂ surface is suggested.

Shaping energy landscape of organic polariton condensates in double dye cavities  

A.D. Putintsev¹, K.E. McGhee ², D.A. Sannikov¹, A.V. Zasedatelev¹, J.D. Topfer¹, T. Jessewitsch¹, U. Scherf¹, D.G. Lidzey², P.G. Lagoudakis¹; ¹Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, Russia; ²Centre for Quantum Engineering and Computation, School of Physics and Astronomy, University of Sheffield, UK

We render a new approach to tune the energy landscape of room temperature polariton condensates by controlling the population of excited molecules in an extra uncoupled layer of organic BN-PFO molecules introduced on top of a strongly coupled BODIPY-Br layer and exploit concomitant effect of excited state absorption to demonstrate control over localized polariton dissipation.

Machine learning-based distortion compensation algorithms for telecommunication systems (Invited paper)  

A Redyuk; Novosibirsk State University, Russia

High baud rate optical communication systems serve as the primary method for transmitting vast amounts of data across distances spanning from hundreds of meters to thousands of kilometers. Machine learning methods, widely applied in various fields in recent years, offer promising solutions to emerging challenges, such as compensating for nonlinear signal distortions and more.

- Lunch Break -
Spectral filtering of non-classical light (Invited paper)
V.Yu. Shishkov, Moscow Institute of Physics and Technology, Russia

The investigation of non-classical light is a pivotal point in physics, showing the quantum nature of photons and promising extreme advantages for particular tasks. The implementations of non-classical light to real-world technologies are often associated with integral photonics and require the resonant interfaces that couple the light source and the rest of the photonic scheme. These interfaces always act as effective spectral filters, suppressing some frequencies. Generally, the spectral filters change both the spectrum of the non-classical light and its statistics. The alteration of the light statistics under spectral filters is a fundamental problem that defines the range of applications of non-classical light sources. In this talk, I will showcase the influence of the spectral filters on the statistics of light for some particular problems, including an incoherently pumped two-level system, Mollow triplet, and Raman scattering light. I will also discuss the theoretical methods used to investigate the statistics of the spectrally filtered light.

Statistical properties of light produced by spontaneous Raman scattering
I.V. Panyukov, V.Yu. Shishkov, E.S. Andrianov; Dukhov Research Institute of Electronics and Applied Electromagnetics, Russia

In natural systems of nonclassical light is produced by spontaneous Raman scattering on an ensemble of molecules. We consider cross-correlations between Stokes and anti-Stokes signals produced by spontaneous Raman scattering. We show that cross-correlations remain nonclassical even when the flow of uncorrelated photons exceeds the flow of correlated photons in the scattered Raman light by an order of magnitude.

Multiphoton processes from single-photon emitters (Invited paper)
E. Zubizarreta Casalengua, Technical University of Munich, Germany

We have shown that in resonance fluorescence, beyond the one-photon physics, a new multiphoton world is lying underneath that includes squeezing and other interesting quantum phenomena. As an insightful example, we studied the cross-correlations between the side peaks of detuned resonance fluorescence and showed that two photons, one from each band, are emitted in a cascade.

Photon-number encoding for quantum optical applications (Invited paper)
C.A. Solanas, Univ. Autonoma de Madrid, Spain

The talk will discuss how to generate superposition and entanglement encoded in the photon number basis schemes, harnessing the resonant driving of quantum dots. These generated quantum states of light could offer advantageous solutions in quantum communication protocols.

Effective programming of a photonic processor with complex interferometric structure
I.V. Kondratyev, K.N. Urusova, A.S. Argenchev, S.S. Kuzmin, N.N. Skryabin, I.V. Dyakonov, S.S. Straupe, S.P. Kulik; Quantum Technology Centre, Lomonosov Moscow State University; Russian Quantum Center; Laboratory of quantum engineering of light, South Ural State University, Russia

We have programmed a 4×4 reconfigurable photonic processor, consisting of two 4×4 directional-couplers cascaded with three phaseshifters. We measured 100 unitaries on chip and compared them with predictions from the processors’ model – the average fidelity is 98.5%. We have also demonstrated optical port-to-port switching in a broadband wavelength region from 915 to 975 nm without direct optimization on chip.

Dissipative phase transition in quadratically driven Kerr oscillator
V.Yu. Mylnikov, S.O. Potashin, M.S. Ukhityary, C.A. Downing, G.S. Sokolovski; Ioffe Institute, Russia; Department of Physics and Astronomy, University of Exeter, UK; Research Center for Quantum Physics, National Research and Innovation Agency (BRIN), Indonesia

The nonequilibrium dissipative phase transition of the Kerr oscillator with two-photon drive and dissipation is studied. We investigate properties of the steady state and critical slowing down near the phase transition point.
Quantum ghost polarimetry with correlated photons
E.F. Bityaev, D.M. Agapov, D.N. Frolosetv, A.S. Chirkin; Faculty of Physics, Moscow State University, Russia

In this work, a theory of quantum ghost polarimetry in the post-selection regime is proposed. Two-dimensional ghost images of polarized objects using correlated photons were experimentally obtained.

R11: LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION AND GLOBAL NAVIGATION

TuR11-01 15:00-15:30
Coherent laser systems for remote atmosphere sensing (Invited paper)
A.S. Boreysho1,2, M.A. Konyaev1,2; ISTU «VOENMEH» named after D.F. Ustinov; 1 Laser Systems Ltd., Russia

The paper studies the current trends in development of coherent laser remote sensing systems as well as analysis of the technical requirements for laser components.

TuR11-02 15:30-16:00
Lasers for satellite and lunar ranging (Invited paper)
A.F. Kornev; «Lasers & Optical Systems» Co. Ltd., Russia

A review of lasers for satellite and lunar ranging is made. The requirements for such lasers and the basic principles of their design are discussed. The lasers we have developed are described, in particular the Nd:YAG 3 J, 330 Hz, 7 ns laser for location of various space objects, including space debris, and 250 mJ picosecond laser for lunar ranging.

TuR11-03 16:00-16:15
Picosecond Nd:YAG laser for SLR in outdoor conditions
A.F. Kornev1, V.V. Koval2, Yu.V. Katsev3, V.D. Nenadovich2, A.L. Sokolov1; «Lasers & Optical Systems» Co. Ltd., Russia

The design features of a high-frequency laser transmitter for SLR stations operating in a wide temperature range (from -50°C to +55°C) are reported. The laser generates pulses with a duration of 35 ps at a wavelength of 532 nm with a pulse energy of more than 2.5 mJ and a pulse repetition rate of at least 500 Hz.

TuR11-04 16:15-16:30
Confirmation of the characteristics of the GLONASS system by means of query and non-query measurements of new generation SLR stations
V.V. Pasynkov1, V.F. Braginets2, A.V. Chaporgin3; 1 JSC “RPC “PSI”; 2 Branch of JSC “RPC “PSI”, 3 Institute of Navigation, Russia

The methods of confirming the characteristics of the GLONASS system by means of query and non-query measurements by quantum optical systems of a new generation as a necessary condition for the successful functioning of the GLONASS system are considered.

TuR11-05 16:30-16:45
Design and systems characteristics for free-space laser communication terminals
K.V. Alybin, D.A. Boyaroy, V.N. Grigoriev, I.V. Kuzmin, S.V. Petushkov, D.A. Saffeev, V.V. Murashkin, R.K. Lozov; JSC RPC “PSI”, Moscow, Russia

The design of a low-orbit on-board terminal for high-speed space laser communication has been examined, and its systems characteristics have been presented.

TuR11-06 16:45-17:00
14.7 Gbit/s visible light laser communication over 100 m free-space transmission utilizing Huffman coding based probabilistic shaping
Yuning Zhou, Zengyi Xu, Zhilan Lu, Junwen Zhang, Chao Shen, Jianyang Shi, Zhiwei Li, Nan Chi; Key Laboratory for Information Science of Electromagnetic Waves (MOE), Department of Communication Science and Engineering, Fudan University, China

We demonstrate 14.7 Gb/s free-space visible light laser communication over 100 m using probabilistic constellation shaping with GaN blue laser diode. The resulting data rate is the highest reported in 100 m free-space single-carried VLC system.

TuR11-07 17:30-17:45
Free-space laser communication terminals
D.A. Boyaroy1,2, V.N. Grigoriev1, I.V. Kuzmin1, S.V. Petushkov1, V.V. Murashkin1, S.V. Polkanov1, R.K. Lozov1; 1 SC Scientific and Production Corporation Precision Instrument Engineering Systems; 2 National Research University “Moscow Power Engineering Institute”, Russia

A low-orbit laser communication terminal designed to transmit data both to a similar low-orbit correspondent terminal and to a ground station is considered.

TuR11-08 17:45-18:00
Experimental research of an on-board laser micro accelerometer for the space gravitational gradiometer’s nanosatellite
F.V. Fateev, S.S. Donchenko, R.A. Dvlatov; FSUE Scientific Research Institute for Physical-Engineering and Radiotechnical Metrology (VNIIFTRI), Russia

The paper considers the possibility of constructing an accelerometer for a space gravity gradiometer based on an optical interferometer instead of a capacitive measuring system. The layout of the accelerometer sensing element and a bench for measuring its sensitivity are described.
TuR11-09 18:00-18:15
Features of the diffraction pattern formation of the laser radiation, reflected from the CCRs in automatic system for docking the space transport vehicle and orbital station
The optical cube reflectors (CRs) of the automatic docking systems of the space transport vehicles (STV) and orbital stations (OSs) are observed. The influence of CRs edges chamfers and offset of three dihedral angles of the CRs on the energy distribution of the radiation reflected from the CRs for different distances between the STV and the OSs has been determined.

TuR11-10 18:15-18:30
Laser ranging based on two-photon absorption excited by the optical comb of a fiber femtosecond laser
W. Xia, P. Chen, H. Hao, D. Guo, M. Wang; School of Computer and Electronic Information/School of Artificial Intelligence, Nanjing Normal University, China
This paper proposes a laser ranging technique based on the autocorrelation method of two-photon absorption. Theoretical analysis shows that the optical autocorrelation method based on two-photon absorption can be used for absolute distance measurement. In the laser ranging system, the real-time absolute distance measurement is achieved by locking the position of the peak point of the two-photon absorption autocorrelation signal.

TuR11-11 18:30-18:45
The protocol of quantum key distribution on beams with space structured polarization
D.D. Reshetnikov¹, A.L. Sokolov², E.A. Vashukevich¹, V.M. Petrov², T.Yu. Golubeva¹; ¹St. Petersbourg State University, ²National Research University Moscow Power Engineering Institute, Russia
The work proposes a protocol for quantum key distribution using Laguerre-Gaussian beams with space structured polarization invariant to rotation of the radial coordinate in a plane normal to the beam propagation axis.

TuR11-12 18:45-19:00
Object detection by a microjoule-pulse LiDAR through a 18-m water layer: docking & navigation
S.M. Pershin¹, M.Ya. Grishin¹, V.A. Zavozin¹, P.A. Titovets², M.O. Fedysk²; ¹Prokhorov General Physics Institute RAS, ²Moscow Technical University of Communications and Informatics, Russia
The LiDAR backscattering signal (3 ns, 532 nm, 2 μJ) was recorded for the first time through 18 m of water and 7 m of air. Reflectors placed on the target surface are found to multiply the backscattering signal. Underwater maneuvering of unmanned robots, docking and navigation in flooded areas using a LiDAR with eye-safe radiation level is discussed.
Simulation of the evolution of an electron bunch in a vacuum laser photodiode

I.V. Danilova, P.V. Tomashchevich, S.A. Smirnov, A.P. Brovyko; ‘NTC “SYNEZ”, AO NIIEFA, Department of Micro- and Nanoelectronics, ETU “LETI”, Russia

The main aim of this study is the development of a simulation model for determining electron bunch properties after acceleration in the vacuum laser photodiode. As a result, the model, considering the impact of the roughness of the photocathode surface and the electron temperature on the thermal emittance, was developed. In addition, the optimal design of the photocathode was determined.

Magnetic control of whispering-gallery modes in high-Q magneto-optical crystalline microresonator

K.N. Min’kov, D.D. Ruzhitskaya, P.O. Kapralov, O.V. Borovkova; Russian Quantum Center, Skolkovo; Faculty of Physics, Lomonosov Moscow State University, Russia

Optical whispering gallery mode detuning by means of the applied external magnetic field in high-Q microresonator made of magneto-optical garnet is demonstrated. The loaded quality factor of the magneto-optical microresonator is 1.45 10^5 at 1550 nm wavelength and free spectral range of 75.7 GHz.

Random lasing in suspension of ZnO nanoparticles during a phase transition

S.F. Umanskaya, M.A. Shevchenko, N.V. Tcherniega, A.N. Maresev, A. Matrokhin, V. Voronova; Lebedev Physical Inst. RAS, Russia

This work shows that during the transition from the liquid to the solid phase of an aqueous suspension of ZnO nanoparticles, the concentration of particles on the ice surface increases (i.e., the scattering mean free path of particles on the ice surface increases), which leads to a decrease in the random lasing signal when maintaining absorption at a low level was investigated.

Optomechanics of nanoparticles in the hybrid anapole state

S.R. Rozental', N.S. Babich', D.A. Kislov', Center for Photonics and 2D Materials, ITMO University, Russia

S.B. Bodrov, N.A. Abramovsky, M.V. Platonova, M.I. Bakunov; ITMO University, Russia

The report analyzes the optomechanical interaction of a Gaussian beam and a cylindrical silicon nanoparticle in the hybrid anapole state. It was shown that in the anapole state the pressure force is reduced up to 30 times compared to the non-anapole state. Furthermore, the anapole particle has an additional equilibrium position when it is perpendicular to the beam.

Efficient Cherenkov-type optical-to-terahertz conversion in a prism-coupled LiTaO3 crystal

S.B. Bodrov, N.A. Abramovsky, M.V. Platonova, A.N. Stepanov, M.I. Bakunov; ITMO University, Russia

We report experimental results on generating terahertz Cherenkov radiation in a 1-mm thick LiTaO3 slab glued to a Si prism and pumped by a femtosecond Ti:sapphire laser with a tens of microjoules pulse energy. The optical-to-terahertz conversion efficiency ~0.15%, a focused terahertz field strength of 70 kV/cm, and the spectral bandwidth up to 4.5 THz are demonstrated.
Vortex-generating light-induced phase converter in azobenzene polymer
I.A. Budagovsky1, M.P. Smayev1, A.S. Zolot’ko1, A.Yu. Bobrovsky1; 1Lebedev Physical Inst. RAS, ‘Lomonosov Moscow State Univ., Russia
The formation of the modified area, which acts as phase converter for vortex generation, in the amorphous thin layer of the azo-containing polymer under the action of structured light beam is considered. The beam with radial polarization induces the axially-symmetric optical axis distribution which convert the probe Gaussian beam into optical vortex with the topological charge 2.

Tunable broadband polariton lasing from perovskite nano crystals at room temperature
M.D. Kolker1, D.A. Samnikov1, A.D. Putintsev1, T. Cookson1, A.P. Pushkarev2, P.G. Lagoudakis3; 1Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, ITMO University, Russia
We investigate the potential of perovskite nanocrystals to serve as a platform for tunable and broadband exciton-polariton lasing at room temperature. A novel DBR-PVS/krystal-Air-DBR system with a locally variable mode volume allows to attain a 20-nm-range spectral tuning of the lasing mode, promising a way for an automatized mechanical adjustment of emission properties in all-optical polariton logic.

A comparison of the sensitivity of two temperature sensing devices, designed in fiber optics
G.E. Sandoval-Romero1, F. Velazquez-Carreon1,2, A. Perez-Alonzo1,2, E.E. Garcia-Unzueta1; 1Instituto de Ciencias Aplicadas y Tecnología, Universidad Nacional Autónoma de México; 2Programa de Maestría y Doctorado en Ingeniería, Universidad Nacional Autónoma de México, Mexico
In this work the practical comparison of the sensitivity to temperature changes of a sensor fabricated in fiber Bragg grating (FBG) immersed in a cross-sectional area of 45 mm2 polydimethylsiloxane (PDMS) which is 2 times larger than when the FBG is in conventional form is performed.

Plasma characterization in liquid jets through third harmonic reflection
S. Hilal, M.V. Melnik, A.O. Ismagilov, A.N. Tsypkin; ITMO University, Russia
This study estimates plasma properties in water, isopropyl, and ethanol liquid jets using the double pump technique and time-resolved experiments on third harmonic (TH) reflection dynamics. Isopropyl demonstrates the highest plasma frequency, followed by ethanol, and water exhibits the lowest. Findings are validated through a theoretical model based on Keldysh theory.

Modification of amorphous Ge2Sb2Te5 film by XZ femtosecond laser scanning
M.P. Smayev1, I.A. Budagovsky1, D.O. Kuzovkov1,2, P.I. Lazarenko1; 1Lebedev Physical Institute RAS, ‘National Research Univ. of Electronic Technology; 2SPC Lasers and Equipment TM, Russia
The modification of an amorphous Ge2Sb2Te5 film under femtosecond pulses at two-coordinate scanning was studied. During the modification of the obliquely oriented sample with respect to the beam axis, the parameters of the acting radiation changed, providing a change in regimes of modification: formation of amorphous-crystalline periodic structures, crystallization of the irradiated area, appearance of pre-ablative structures, and ablation.

Cherenkov self-synchronized ultrashort Raman solitons on the whispering gallery modes of silica microspheres
E. Anashkina1,2, A.Y. Yulin1, A. Osipov2, A.V. Gaponov-Grekhov Inst. of Applied Physics RAS, ‘Lobachevsky State Univ., ITMO Univ., Russia
We demonstrate a new regime of generation of the ultra-short optical pulses on the whispering gallery modes of the spherical silica micro-resonators. This regime appears when the pump frequency is close to the Cherenkov resonance position of the generated Raman soliton. Demonstrated regime is promising for the generation of broadband robust frequency combs on the chip-scale micro-resonators.

The trajectory of the propagation of oblique rays in optical fibers with a stepped profile of the reflective index
D.V. Ryakhovskii, A.A. Makovetskii, S.M. Popov, A.A. Zamyatin; Kotelinkov Institute of Radio Engineering and Electronics RAS, Russia
The latest results on calculation of trajectory of propagation of oblique rays in optical fibers. First algorithm is based on reducing sequential calculation of the coordinates of the ray reflection points in vector form. The second algorithm is reduced to an independent calculation of the transverse coordinates of the reflection points. The formula was obtained for the calculation.

Highly transient Raman conversion in SrMoO4 under ultrafast double-pulse pumping
Yu.A. Kochukov1,2, D.P. Tershchenko1, S.N. Smetanin1,2, A.G. Papashvili1, K.A. Gubina2, V.V. Bulgakova1, A.A. Ushakov1, V.E. Shukshin1, E.E. Dunaeva1, L.S. Voronina1, L.I. Ileva2; 1Prokhorov General Physics Institute RAS, 2National University of Science and Technology MISIS, Russia
Highly transient stimulated Raman scattering in a SrMoO4 crystal on both stretching (888 cm−1) and bending (327 cm−1) Raman modes under ultrafast double-pulse pumping by orthogonally polarized pump pulses at 1030 nm with a controllable chirp and a different delay between them was investigated.

Metal capillaries: new prospects for application in Raman spectroscopy
V.V. Vitkin1, A.P. Kouzov2, E.E. Popov1, N.N. Filipov1, I.K. Chubchenko1; 1ITMO University, 2Perm State University, Russia
The use of thin metal capillaries can significantly enhance the Raman signals due to the increase of the photon-molecule interaction volume and thus qualitatively improves the capabilities of Raman spectroscopy. Furthermore, studying Raman scattering in metallic capillaries can open the way to detect three-wave mixing in isotropic media and to develop new approaches to molecular chirality.

Periodically poled waveguides in lithium niobate
A.R. Akhmatkhanov1, E.S. Savelyev1, A.V. Sosunov2, A.R. Kornilicyn1; 1Ural Federal University; 2Perm State University, Russia
Lithium niobate crystals with periodical domain structure within a waveguide allow realization of effective confined nonlinear optical interaction. Creation of such structure requires deep knowledge about domain structure kinetics in material and its stability during waveguide creation. We present the study of these phenomena in congruent lithium niobate with waveguides created by soft proton exchange and annealed proton exchange methods.

Hidden photon detection
K.S. Gochelashvili1, V.N. Goryachev1, G.N. Gol’tsman1, V.N. Evdokimov1, S.V. Erini2, A.V. Semenov1, V.A. Sysoyatin2; 1Prokhorov General Physics Institute RAS, 2NRC ‘Kurchatov institute’ - IHEP, Moscow Pedagogical State University, Russia
The report discusses a proposal to search for hidden photons (dark matter candidate) using an experimental setup “ERA” installation. The source of the creation of hidden photons is a powerful source of laser radiation. The search for hidden photons is the first option of the research program in the experiment to test the predictions of the Standard Model.
We report on a new «random» fiber laser which operates on 1588 nm in the pulse-periodic pump regime. The laser operates in the pulse-periodic pump regime with a repetition rate up to 50 Hz. 

TuR08-p20
15:00-18:30
Continuous signal processing using windowed Nonlinear Fourier Transform
I.S. Chekhovskoy,1,2 E.V. Sedov,1,3 G.A. Patrin1, O.V. Shtyrina1; 1 Novosibirsk State University, 2 Russian Federation Nuclear Center, Sarov, Russia
For the first time we report a new approach to managing the Fresnel zone size in the case of weak spatial modulation, which can be applied to any fiber and bulk optical elements. 

TuR08-p21
15:00-18:30
Researching the features of second harmonic generation in GaP nanowires
A.S. Funtikova1, A.M. Mozharov1,2, V.V. Fedorov1,2, I.S. Mukhin1,2, V.A. Sharov2,3; 1 Peter the Great St. Petersburg Polytechnic University, 2 Alferov University, Russia; 3 Aston Institute of Photonic Technologies, Aston University, UK
The nonlinear of the GaP NWs depending on the orientation of the radiation source in order to achieve optimal direction of the second harmonic. Data were obtained on the relationship between the irradiation wavelength and the geometric parameters of NWs, which can be used to create integrated systems with optical activation.

TuR08-p22
15:00-18:30
Multi-frequency laser spectroscopy of sub-Doppler resonances in miniature vapour cells
I.S. Mesenzova,1 S.M. Ignotovich1, D.V. Brazhnikov1,2, M.N. Skvortsov1, I.S. Mukhin1,2, V.A. Sharov1,3; 1 Peter the Great St. Petersburg Polytechnic University, 2 Allero夫 University, Russia; 3 Ioffe Institute, Russia
We present a new way to handle signal processing in fiber-optic networks. It combines chromatic dispersion compensation (CDC) with sliding window techniques to make processing signals more precise and effective. The Nonlinear Fourier Transform (NFT) is a key tool used here to manage chromatic dispersion and the Kerr effect, which are crucial for transmitting signals over long distances.

TuR08-p23
15:00-18:30
Erbium laser for extended telecom range
S.M. Popov1, A.A. Rybalovskii1, D.V. Ryakhykovskii1, Yu.K. Chamorovskii1, D.S. Lipatov1, D.Kotelnikov Institute of Radio Engineering and Electronics, 2 Prokhorov General Physics Institute, Russia
We report on a new «random» fiber laser which operates on 1588 nm (long-wavelength telecom range (1570 nm or «L-band») in the continuous-wave mode with a slope efficiency of 16% under pumping at a wavelength of 975 nm. The laser's cavity is FBG-array which formed by UV-inscription in the photosensitive erbium doped optical fiber (OF) during the OF’s drawing process.

TuR08-p24
15:00-18:30
Interference effects of coherent population trapping resonances detected by the Ramsey method in gas cells with alkali atoms and a buffer gas
G.V. Voloshin, A.N. Litvinov, K.A. Baranets, A.S. Kuraptsve; Peter the Great St. Petersburg Polytechnic University, Russia
In this work, a semiclassical theory of pulsed excitation of coherent population trapping resonances is constructed, taking into account the magnetic structure of the levels of excited atoms. As a result, the possibility of interference of different pulsed excitation channels is shown, observed as a nonmonotonic dependence of the resonance amplitude on the magnetic field and ellipticity of laser radiation.
TuR08-p31  15:00-18:30

Terahertz radiation from array of double-walled carbon nanotubes with surface plasma polaritons excited by optical pulses

S.A. Afanas’ev1, A.S. Kadochkin1,2, S.G. Moiseev1,2, D.G. Sannikov1,2, Il’yanovsk State University; 1Scientific Manufacturing Complex Technological Centre; 2Kotel’nikov Institute of Radio Engineering and Electronics RAS, Russia

The concept of terahertz generator based on an array of double-walled carbon nanotubes is proposed. Two external laser beams perform the initial excitation of plasmon modes. Amplification of exited slow surface plasma polaritons is provided by a drift current in the nanotubes. The high-frequency current enable the emission of THz radiation into the far field, owing to an antenna effect.

TuR08-p32  15:00-18:30

Novel principle of the optical damage detection in nonlinear-optical crystals with RF oscillator

K.V. Zotov1, N.V. Tereshchenko1, A.Yu. Ostapiv1, G.Yu. Ivanov1, O.A. Ryabushkin1; 1Moscow Institute of Physics and Technology (National Research University); 2Kotel’nikov FIRE RAS, Russia

We introduce a novel principle of the laser-induced damage detection in nonlinear-optical crystals with radiofrequency oscillator. The method is based on the real-time measurements of the absorption coefficient using a Pierce oscillator. The proposed method was used to determine the laser-induced damage threshold (LIDT) of a lithium niobate crystal. The LIDT value was 500 mJ/cm2, accounting for the self-focusing.

TuR08-p34  15:00-18:30

A source of ultracold 87Rb atoms for an atomic interferometer-gravimeter

A.E. Bonett1, A.N. Gorsharho2, D.N. Kapusta1, O.N. Prudnikov1, A.V. Taichenachev2, S.N. Bagayev2, Institute of Laser Physics SB RAS, 1Novosibirsk State University; 2Novosibirsk State Technical University, Russia

In this work, we created a source of ultracold atoms for a quantum interferometer-gravimeter. A cloud of 107–108 atoms with the temperature of around 6 μK was obtained. An effective selection of rubidium atoms in the nonmagnetic substrates was carried out.

TuR08-p35  15:00-18:30

Two-photon absorption in Na2Mo2O7 crystal excited by picosecond pulses at 523 nm

D.S. Chunaev1, S.B. Kravtsov1, V.E. Shukshin1, V.D. Grigorieva1, V.N. Shlegel1, P.G. Zverev1, Prokhorov General Physics Inst. RAS, Russia; 2Nikolaev Inst. Inorganic Chemistry SB RAS, Russia

Two-photon absorption in Na2Mo2O7 anisotropic crystal was studied when excited by laser pulses with duration of 25 ps and wavelength of 523 nm. The measured two-photon absorption coefficient varied from 6.7 to 0.13 cm/GW depending on the orientation of the crystal.

TuR08-p36  15:00-18:30

Evaluation of nonlinear optical response of Cu and Ni clasmell bis-phthalocyanines using a correlation model

M.S. Savel’yeva1, P.N. Vasilevskiy1, A.Yu. Tolbin1, A.Yu. Gerasimenko1, S.V. Selishchev1, MIET, 1IRM, Sechenov University, 1INME RAS, 1IFAW FRC PCP MC RAS, 1IBTI, Sechenov University, Russia

To create limiters of laser radiation, bis-phthalocyanines Cu and Ni of clasmell type were synthesized. To determine nonlinear optical (NLO) parameters from the results of Z-scanning and measurements of optical limiting, the radiation transfer equation for rectangular pulse shape was used, for which an analytical solution was obtained. Cu phthalocyanine was identified as an effective NLO material by correlation model.

TuR08-p37  15:00-18:30

Robust launching of soliton molecules in a hybrid mode-locked Er-doped fiber laser

D.A. Dvoretskyi1, I.O. Orekhov1, S.G. Sazonkin1, U.S. Lazdovskaya1, N.M. Bagomolov1, V.A. Davydov1, V.E. Karaski1, L.K. Denisov1, Bauman Moscow State Technical University, 1IFL V. E. Vereshchagin Institute for High Pressure Physics, Russia

Robust launch of low-noise soliton molecules is obtained in a hybrid mode-locked Er-doped fiber laser based on high-density well-aligned single-walled carbon nanotubes as a saturable absorber.

TuR08-p38  15:00-18:30

Effect of collisions and optical pumping on the shape of magnetic resonance

K.A. Baranets’, A.N. Ulitinov; Peter the Great St. Petersburg Polytechnic University, Russia

In this work we investigate the form of magnetic resonance in gas cells with alkali metal atoms and buffer gas depending on the parameters of the laser pumping. The influence of collision effects such as quenching and breaking the hyperfine interaction on optical pumping and the shape of magnetic resonance is studied. These studies have application in optical magnetometers.

TuR08-p39  15:00-18:30

Two-stage deep laser cooling of Yb -171 ion in a radio frequency trap without using a magnetic field

D.S. Krysko1, O.N. Prudnikov1, A.V. Taichenachev1, V.I. Yudin1, S.V. Chepurov1, S.N. Bagayev1, Institute of Laser Physics SB RAS; 2Novosibirsk State University; 3Novosibirsk Technical University, Russia

We propose a new scheme of two-stage deep laser cooling of 171Yb+ in a radiofrequency trap without use of magnetic field. The proposed scheme is of interest for the progress in optical frequency standards and quantum computing where the precise control of magnetic field is required.

TuR08-p40  15:00-18:30

Laser induced damage threshold of ZnGeP2 and generation of IR radiation when exposed to pulsed laser radiation with a wavelength of ~2.1 μm

N.N. Yudin, A.I. Gribenkov, V.V. Dyomin, M.M. Zinkev, S.N. Podzvalov, V.S. Kuznetsov, E.S. Shlyunov, A.B. Lyoren, A.Yu. Kalin, H. Saiti, A.Sh. Gabdulkhakhanov, National Research Tomsk State University, Russia

This work summarizes the mechanisms of the laser-induced damage (LID) of high-purity ZGP crys-tals under periodically pulsed nanosecond irradiation by a Ho3+:YAG laser at 2.1 μm.

TuR08-p41  15:00-18:30

Stimulated Raman scattering in sodium dimolybdate crystal

D.S. Chunaev1, S.B. Kravtsov1, V.E. Shukshin1, V.D. Grigorieva1, V.N. Shlegel1, P.G. Zverev1, Prokhorov General Physics Inst. RAS, Nikolaev Inst. of Inorganic Chemistry SB RAS, Russia

Stimulated Raman scattering was obtained in anisotropic Na2Mo2O7 crystal with frequency shift of 937 cm~1 when excited by picosecond pulses at wavelength of 1047 nm. Raman gain coefficient was measured depending on the orientation of the crystal.

TuR08-p42  15:00-18:30

PCM for driving active THz modulators: frequency and polarization sensitivity

M.R. Komnikova1,2, A.K. Tret’yakov1, A.R. Shevchenko1, A.M. Mumlyakov1, M.I. Krasil’nikov1, Yu.V. Kistenev1, A.P. Shkurinov1,2, 1Faculty of Physics, Lomonosov Moscow State University; 2Institute of Nanotechnology of Microelectronics RAS, Russia

Optical properties of phase-change materials (PCM) GeTe and GeTe2 were studied. Active planar metamaterials based on PCM with ultrafast switching of THz field characteristics were developed. A new technique for obtaining the complex refractive index of metamaterials was proposed and experimentally confirmed. Optical activity and circular dichroism in the interaction of THz field with active metamaterials were investigated.

TuR08-p43  15:00-18:30

Influence of cascaded processes on frequency doubling process

V.A. Trofimov1, D.M. Khartonov2, M.V. Fedotov2, 1South China University of Technology, Guangzhou, China; 2Lomonosov Moscow State University, Russia

We show that weak third harmonic generation causes cascaded processes that may influence frequency doubling processes both in negative and positive ways. Two cases of serious influence of weak third harmonic generation on second harmonic intensity evolution are discussed.
TuR08-p44 15:00-18:30

Transition oscillations in the dynamics of molecules with a large Raman scattering cross section
E.A. Tershchenskova, V.N. Tchermieva, A.N. Maresov, A. Matrokhin, V. Voronova; Russia
The nonstationary dynamics of a quantum dot with a strong coupling of vibrational and electronic degrees of freedom is considered. It is shown that in the dynamics of the quantum dot dipole moment collapses and revivals are observed and appear in the emission spectrum as splitting of the spectral line near the exciton transition frequency.

TuR08-p45 15:00-18:30

LIBS efficiency increase via plasmonic nanoparticles in the study of synthetic opal matrices
S.F. Umanskiaya, M.A. Shevchenko, N.V. Tchermieva, A.N. Maresov, A. Matrokhin, V. Voronova; Russia
A method of depositing plasmonic particles on synthetic opal matrices was used for increasing the efficiency of laser-induced breakdown spectroscopy. It was shown that the maximum amplification corresponds to a plasmon resonance localized between silver particles. The optimal conditions for increasing the signal intensity were experimentally determined, and numerical modeling was carried out, consistent with the obtained data.

TuR08-p46 15:00-18:30

The nonlinear optical properties of the water clusters with oxygen molecule
V.A. Orlovich, I.A. Khodasevich, S.M. Pershin, G.A. Pitsevich; "B.I. Stepanov Institute of Physics NASB, Belarus; "Prokhorov General Physics Institute RAS, Russia; "Department of Physical Optics and Applied Informatics, Belarusian State University, Belarus
Amazing growing the elements of polarizability tensor and the first hyperpolarizability tensor of the water clusters after oxygen molecule capture was predicted by ab initio quantum – chemical calculations. This phenomenon may be the reason of the new spectral component near 3000 cm−1 appearance on the water-air interface found by picosecond stimulated Raman scattering at 532 nm excitation.

TuR08-p47 15:00-18:30

Laser cooling and trapping of 87Rb atoms in pure-optical two-frequency light trap
R.Ya. Ilenkov, O.N. Prudnikov, A.V. Taichenachev, V.I. Yudin; "Institute of Laser Physics SB RAS, Novosibirsk State University, Russia
The laser cooling and trapping of 87Rb atoms in pure-optical two-frequency trap is studied in details. The atoms can be simultaneously cooled and trapped by bichromatic laser field that opens up possibility to realize principally new type of pure optical trap.

TuR08-p48 15:00-18:30

Mechanism of Rabi-excitation of discrete modes outside the spectral line of a superradiant laser
E.R. Kocharovskaya, V.I. Kocharovsky; "Nonlinear Dynamics and Optics Division, Institute of Applied Physics RAS; "Plasma Physics and High-Power Electronics Division, Institute of Applied Physics RAS, Russia
In a low-Q combined cavity, there is superradiant lasing of a strongly-symmetric powerful polariton mode accompanied by excitation of several symmetric weak polariton or electromagnetic modes. The former is resonant to the laser spectral line, and the lasers are outside it. Such a lasing takes place due to a self-consistent asymmetric grating of population inversion that provides undamped Rabi oscillations.

TuR08-p49 15:00-18:30

Study of nonlinear refractive index of barium chlorochenogenides
E.V. Enishin, N.Yu. Kostyukova, A.A. Boyko, G.S. Shevrydyaeva, D.V. Badikov; Russia
For the first time, the nonlinear optical characteristics of BaGa2Se7, BaGa2GeSe6, and Ba2Ga2GeSe6 crystals were measured at 1.053 μm in nanosecond regime. Two-photon absorption in tested plates was observed only in BaGa2GeSe6 crystal. The obtained values of nonlinear refraction fit well with the theoretical dispersion function.
**TU85 DAY**

**TU85-R04-P55**
Photodynamic processes in prospective downconversion luminophores NaLa(MoO$_4$)$_3$:Yb
A.S. Nicarnutdinov,$^1$ A.V. Astrakhamtseva,$^2$ K.S. Tsai,$^3$ S.V. Kuznetsov,$^2$ K.A. Subbotin,$^2$
Kazan (Volga Region) Federal University,$^1$ Prokhorov General Physics Institute RAS, Russia
Luminescence characteristics of prospective downconversion material NaLa(MoO$_4$)$_3$:Yb were investigated by means of selective laser spectroscopy. The luminescence quantum yield for Yb$^3+$ ions was measured as 123%. Photodynamic processes and energy transfer mechanisms responsible for efficient energy transfer are discussed.

**TU85-R04-P56**
Ultrashort pulse laser based Raman DTS for mid-range FUT high spatial resolution measurements
A.G. Chernutsy,$^1$ T.V. Gritsenko,$^2$ A.A. Zhimov,$^3$ I.O. Orekhov,$^4$ S.G. Sazonkin,$^1$ R. Khan,$^5$
D.A. Dvoretsky,$^6$ A.B. Perv, Bauman Moscow State Technical University, Russia
We report on a study of distributed fiber-optic temperature sensor based on Raman scattering, in which an ultrashort-pulse laser fiber is used. Together with the short pulse duration and pulse repetition rate decimation scheme using an acousto-optical modulator, we were able to achieve experimentally 0.3 m spatial resolution over more than 8 km long fiber-under-test.

**TU85-R04-P57**
Optimization of degenerate four-wave mixing threshold parameters in dual-pumped microresonator
N.S. Tatarinova,$^1$ A.V. Masalov,$^2$ A.E. Shlikov,$^3$ I.A. Bilenko,$^4$ V.E. Lobanov,$^2$
D.A. Chemoshentsev,$^5$ Russian Quantum Center, $^1$Moscow Inst. of Physics and Technology, $^2$Lebedev Physical Institute RAS, $^3$Faculty of Physics, Lomonosov Moscow State Univ., $^4$Skolkovo Inst. of Science and Technology, Russia
The numerical and analytical analyses were conducted to determine the optimal parameters of a bichromatically pumped microring resonator system, focusing on the generation process of squeezed light states.

**TU85-R04-P58**
Photoluminescent microbit inscription inside dielectric crystals by ultrashort laser pulses for archival applications
S. Kudryashov,$^1$ P. Danilov,$^2$ N. Smirov,$^3$ E. Kuzmin,$^4$ A. Rupasov,$^5$ G. Krasin,$^6$ M. Kovalev,$^7$
A. Gorevoy,$^8$ Lebedev Physical Institute RAS, Russia
Inscription of embedded photoluminescent microbits, as carriers of archival memory, inside bulk natural diamond, LiF and CaF$_2$ crystals was performed in sub-filamentation regime by 525 nm, 0.2 ps laser pulses focused by 0.65 NA microscope objective as a function of pulse energy, exposure, and inter-layer separation. This research was funded by the Russian Science Foundation (project no. 21-79-30063).

**TU85-R04-P59**
Measurement of dispersion characteristics and quality factors of optical microresonators
D.V. Morozov,$^1$ A.K. Vorobyev,$^2$ N.Yu. Dmitriev,$^1$ D.A. Chemoshentsev,$^2$
I.A. Bilenko$^{1,3}$, Russian Quantum Center, $^1$Moscow Institute of Physics and Technology, $^2$Prokhorov General Physics Institute RAS, Russia.
We perform an experimental measurement of dispersion characteristics and quality factors of optical integrated silicon nitride ring microresonators with different geometries. Our study reveals that a microresonator dispersion characteristics may be predefined at fabrication stage by geometry optimization.

**TU85-R04-P60**
Surface plasmon polariton pulses generation via nonlinear effects in graphene double-layer structure
S.G. Mozisev$^1$, D.A. Korobko$^2$, Ilyanovsk State University, $^1$Kotelnikov Institute of Radio Engineering and Electronics RAS, Russia
The parameters of a thin film structure with graphene sheets (two graphene sheets spatially separated by a dielectric layer) are defined, which ensure the transformation of the initially continuous mid-infrared surface plasmon polariton wave into a train of short pulses due to the modulation instability effect.

**TU85-R04-P61**
Suspension freezing as a novel approach for increasing the efficiency of the laser-induced breakdown spectroscopy method in the study of nano and submicron particles
M.A. Shevchenko, S.F. Umanskaya, N.V. Treniengua, A.N. Mareev, A. Matrokhin, V. Vordonova, Lebedev Physical Institute RAS, Russia
The work demonstrates a novel method for increasing Laser-induced breakdown spectroscopy signal intensity when analyzing the elemental composition of nano and submicron particles contained in a suspension. The method is based on the displacement of particles by a solidification front during the process of directed freezing of a liquid.

**TU85-R04-P62**
Parallel beam pumped picosecond Raman laser on water with a preamplifier
S.M. Pershin, M.Ya. Grishin, P.A. Chizhov, V.N. Lednev, A.A. Ushakov, Prokhorov General Physics Institute RAS, Russia
Stimulated Raman scattering (SRS) in water was achieved when excited by a picosecond pulsed Nd:YLF laser (527 nm) parallel beam. A set of sample cuvettes of different lengths was used. The SRS was achieved when the pump optical path in water reached a certain value. Such experimental setup can be considered as a SRS laser with a parallel-beam-pumped preamplifier.

**TU85-R04-P63**
Time-dependent polarization measurements of ultrashort pulses at 1.9 µm based on GRENOLtule
D.T. Batov$^1$, V.S. Voropaev$^2$, R. Jafari$^3$, A. Akturk$^4$, R. Trebino$^5$, V.A. Lazarev$^6$, M.K. Tarabrin$^7$, Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical University, Moscow, Russia; $^5$Swamp Optics LLC, Atlanta, USA; $^7$School of Physics, Georgia Institute of Technology, Atlanta, USA.
Time-dependent polarization measurements of ultrashort pulses at 1.9 µm from a tulum-doped fiber laser system tuned with polarization controllers are demonstrated using the GRENOLlule device and the TURTLE method.

**TU85-R04-P64**
Second harmonic generation with joint scalar and vector phase matching in biaxial crystal LBO
S. Grechin,$^1$ E. Shashkov,$^2$ I. Epatski,$^2$ A. Sadowskiy,$^1$ Prokhorov General Physics Institute RAS, $^1$NTO IRE-Polus, Russia
The results of experimental investigations of SHG with two laser crossed beams in biaxial crystal LBO are presented. It is shown for the first time that in biaxial crystals at different wavelengths there are directions in which joint scalar and vector phase matching takes place.

**TU85-R04-P65**
Spectral and energy characteristics of picosecond SRS in heavy water
The forward and backward stimulated Raman scattering in heavy water was studied when excited by picosecond pulses (60 ps) at the 532 nm. The forward experimental investigations of SHG with two laser crossed beams in biaxial crystal LBO are presented. It is shown for the first time that in biaxial crystals at different wavelengths there are directions in which joint scalar and vector phase matching takes place.

**TU85-R04-P66**
New method for finding the temporal soliton at three waves interaction
V.A. Trofimov$^1$, D.M. Kharitonov$^2$, M.V. Fedotov$^1$, ‘South China University of Technology, Guangzhou, China; ‘Lomonosov Moscow State University, Russia
New approach of obtaining the temporal soliton or soliton-like temporal structure at three waves interaction is proposed and demonstrated. It consists of two parts. In the first one, we construct the unchanged solution in long pulse duration approximation. In the second one, the condition of this solution stability to second order dispersion influence is derived.
TuR08-p67

Laser written multi-track waveguides
S.A. Zhuravitskii1, N.N. Skryabin1, I.V. Dyakonov1, A.A. Kalinkin1, S.S. Straupe1, S.P. Kulk1; 1Quant. Tech. Cent., Lomonosov Moscow State University, 2Russian Quantum Center, Russia

In our work, we investigated the influence of writing parameters on the waveguide characteristics in a regime of homogenous refractive index modification. The possibility of increasing the refractive index contrast by writing partially overlapping or non-overlapping tracks was studied.

TuR08-p68

Picosecond SRS in water excited by Bessel beams
V.A. Orlovich1, S.M. Pershin1, A.I. Vodchits1, I.A. Khodasevich1, M.Ya. Grishin1; 1B.I. Stepanov Institute of Physics NASB, Belarus; 2Prokhorov General Physics Institute RAS, Russia

The process of stimulated Raman scattering (SRS) in water induced by Bessel beam of the picosecond pulses (60 ps) at the 532 nm was studied. Generation of two Stokes and two anti-Stokes SRS components was obtained. A substantial narrowing of the first Stokes component’s OH band to 75 and 65 cm⁻¹ in backward and forward SRS was observed.

TuR08-p69

Temperature noncritical frequency conversion in ZnGeP2 crystal
S. Grechin1, I. Murav’ev2; 1Prokhorov General Physics Institute RAS; 2Bauman MSTU, Russia

The results of function possibilities for all possible frequency conversion processes in ZnGeP2 crystal are presented. At the first time was defined the possibility of temperature noncritical mode for different frequency conversion processes.

TuR08-p70

Delay measurement in fiber optic devices using a tunable delay line
O.V. Kolmogorov, S.S. Donchenko, D.V. Prokhorov, B.R. Alekperova; FSUE “VNIIFTRI”, Russia

The diagram and principle of operation of an installation for measuring signal propagation delays in fiber-optic devices, built on the basis of a reference tunable optical delay line, are presented. The results of estimating the uncertainty of measurements performed using the installation are presented.

TuR08-p71

Transmission bistability of high-intensity THz radiation propagation in a nonlinear LiNbO3 Fabry-Perot interferometer
A.O. Nabilkova1, E.N. Oparin1, M.V. Melnik1, A.P. Fokin3, A.S. Sedov3, A.N. Tsypkin1, S.A. Kozlov2; 1Laboratory of Quantum Processes and Measurements, ITMO University; 2Laboratory of Femtosecond Optics and Femtotechnologies, ITMO University; 3Institute of Applied Physics RAS, Russia

This study examines the bistability characteristics of a “mirrorless” Fabry-Perot interferometer by combination of analytical modeling and experimental investigation. The research reveals that the use of a nonlinear LiNbO3 crystal as the medium leads to noticeable optical hysteresis under input intensities of up to 3.5x10⁹ W/cm² at a frequency of 0.23 THz.

TuR08-p72

Glass modification by backside irradiation using nano-second laser pulses
H. Saleh, Y.A. Konin, A.A. Petrov; Institute of Laser Technologies, ITMO University, Russia

The fiber fuse effect was successfully initiated in various bulk glass materials using backside irradiation with a nanosecond pulsed laser, employing different metallic foils as absorbers. The study reveals unique resultant structures within the glass, which vary depending on the initiation conditions and laser parameters used.
WeR01-01  09:00-09:30  Near and mid infrared channeled waveguide lasers in rare-earth ion-doped fluoride crystals (Invited paper)
A. Sennaroglu*, Y. Morova*, B. Ayev†, M. Tonelli*, B. Morova*, H. Jahangir†, I. Baylam†, A.D. Lieto†, G. Citriniti*, E. Damiano†, Laser Research Laboratory, Departments of Physics and Electrical- Electronics Engineering, Koç University, Turkey; †Koç University Surface Science and Technology Center (KUYTAM), Turkey; *MEGAMATERIALS s.r.l and Dipartimento di Fisica dell’Università di Pisa, Italy; †Department of Physics, Koç University, Turkey
Femtosecond laser written waveguide lasers operating in the near and mid infrared region at 1318 nm and 2700-2800 nm were investigated by using Nd3+ :BaY2F8 and Er3+:YLF4 crystals.
WeR01-02  09:30-09:45  Self-sweeping fiber laser for application in BOTDA system
N.R. Poddubrovskii, I.A. Lobach, S.I. Kablukov; Institute of Automation and Electrometry SB RAS, Russia
We present here an Er-doped self-sweeping fiber laser developed for Brillouin optical time domain analysis systems. The laser has passive wave-length sweeping in range of 2 GHz with tuning step of 6.25 MHz. The laser based distributed sensing system with spatial resolution, sensing line length and sensitivity of 5 m, 25 km and 2 MHz, respectively, is experimentally demonstrated.
WeR01-03  09:45-10:00  Ultra-long fiber laser with split pulse shaping for secure key generation and distribution
B.N. Nyushkov*, I.I. Korel*, S.V. Smirnov; Novosibirsk State Technical University, Russia; *Novosibirsk State University, Russia
We report an ultra-long pulsed Erbium fiber laser in which pulse-shaping is split between two communicating parties. They contribute random binary values to the secure key generation and distribution by making independent choices of their states in the split pulse shaping. The key exchange is secured whenever different choices lead to the same pulse duration, thereby confusing an eavesdropper.
WeR01-04  10:00-10:15  Hard excitation mode in optomechanical systems
A.A. Zyablovsky*, E.S. Andrianov*; Dukhov Research Institute of Automation and Electrometry (VNIIA)*; Institute Theoretical and Applied Electrodynamics RAS, Russia
We predict the existence of a hard excitation mode in an optomechanical system of two optical modes interacting with each other via a phonon mode. We demonstrate that the hard excitation mode arises due to an additional phase condition for nonzero solutions. We propose a concept of highly sensitive sensor based on the optomechanical system operating in the hard excitation mode.

WeR01-05  10:15-10:30  Coherent combination of 4 laser channels amplified in a single Yb:YAG crystal
I. Kuznetsov*, S.A. Chizhov†, O.V. Palashov*, P.A. Smolin*, I.I. Karpov*; *Nonlinear Dynamics and Optics Department, A.V. Gaponov-Grekhov Institute of Applied Physics RAS; †Volga State University of Water Transport, Russia
The scheme for amplification of 4 beams in a single-rod Yb:YAG amplifier and their coherent combining using a tiled aperture scheme is proposed and demonstrated experimentally. Gain coefficient of 10 in each channel with >60% power in the central interference maximum, and phase stabilization with <3% standard deviation were successfully achieved. This approach will allow scaling average and peak power.
WeR01-06  10:30-10:45  Optimization of single-frequency continuous wave self-sweeping fiber laser based on separated gain and absorption dynamic gratings
E.K. Kashirina, I.A. Lobach, S.I. Kablukov; Institute of Automation and Electrometry SB RAS, Russia
We report on optimization of a single-frequency self-sweeping fiber laser with continuous-wave (CW) intensity dynamics operating near telecommunication L-band wavelength of 1607 nm with sweeping range of 2.45 nm. The laser output power was increased to 4 mW and frequency step was reduced to 10.3 MHz. The developed single-frequency self-sweeping fiber source can be use for optical frequency domain reflectometry.
WeR01-07  10:45-11:00  Russian development and production of lasers: hybrid, solid-state and fiber laser systems
D.V. Sachenko; JSC "NordLase", Russia
NordLaser LLC is a leading company in the field of laser systems development, manufacturing, and service provision. This presentation highlights the competencies of the company, focusing on its expertise in developing, producing, and servicing lasers and laser technology.

- Coffee Break -

WeR01-08  11:30-12:00  Development of ultrafast lasers for high-repetition-rate VUV source generation (Invited paper)
Zhigang Zhao; Shandong University, China
Abstract is not available.
WeR01-09  12:00-12:15  Raman dissipative soliton parameters near 1.7 microns depending on external cavity dispersion
V.M. Volosii*, D.S. Kharenko*, N.A. Koliada*; *Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; †Novosibirsk State University, Novosibirsk, Russia
In this paper, we have studied a Raman dissipative solitons oscillator at a wavelength near 1.7 microns with external cavity pumping from an erbium doped mode-locked laser. It was numerically simulated in various configurations to investigate the effects of dispersion management on the pulse characteristics and modes of operation.
WeR01-10     12:15-12:30
PM Tm-doped fiber laser harmonically mode-locked using single-walled carbon nanotubes
V.A. Belova1, E.S. Ilyashkina1, S.I. Migirev1, D.T. Batov1, V.S. Voropayev1, A.A. Mirkchyan1, Yu.G. Gladush1, D.V. Krasnikov1, A.G. Nasibulin1, V.A. Lazarev1, M.K. Tarabrin1, 1Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical University, 1Center for Photonic Science and Engineering, Skolkovo Institute of Science and Technology, Russia
A polarization maintaining thulium-doped fiber laser mode-locked by single-walled carbon nanotubes has been developed. The fundamental pulse repetition frequency of the laser is 84 MHz. Harmonic mode-locking is observed with a maximum pulse repetition frequency of 504 MHz. Following pulse parameters are achieved: pulse duration of 440 fs, center wavelength of 1912 nm, maximum average power of 600 mW.

WeR01-11     12:30-12:45
Cr:Forsterite oscillator synchronously pumped by an ytterbium ultrafast laser
V.M. Aliaboeva1, A.V. Pushkin1, F.V. Potemkin1, Lomonosov Moscow State Univ., Russia
With output radiation of the synchronously pumped Cr:Forsterite laser difference frequency generation at a wavelength near 6 μm at a high repetition rate is realized. The energy and spectral parameters of pulses in various generation regimes are characterized. Such a seeding source is promising for development powerful CPA systems in mid-IR range based on iron doped chalcogenide crystals.

WeR01-12     12:45-13:00
Features of high-order soliton molecule amplification in an Er-doped fiber amplifier
I.O. Orekhov1, A. Ismaeeel1, S.G. Sazonkin1, D.A. Dvoretzkiy1, A.A. Krylov1, L.K. Denisov1, V.E. Karasik1, Bauman Moscow Technical State University, 1Moscow Institute of Physics and Technology, 1Prokhorov General Physics Institute RAS, 1Dianov Fiber Optics Research Center, Russia
We report on the generation high-order soliton molecule and its amplification in single-cascade amplifier based on erbium-doped fiber. The amplification of 15 pulses regime with 432 fs pulses duration and 46 mW average power in 1m long erbium-doped fiber amplifier led to the generation of 20 pulses regime with 449 fs pulses duration and 102 mW average power.

WeR01-13     13:00-13:15
Hybrid amplification of highly-chirped pulses around 1.3 micron in an all-fiber configuration
E.A. Evmenova1, D.S. Kharenko1, A.M. Khega1, K.E. Riumkin1, F.V. Afanasiev1, 1Inst. of Automation and Electrometry SB RAS; 1Novosibirsk State Univ.; 1Prokhorov General Physics Inst. RAS; 1G.G. Devyatikh Inst. of Chemistry of High-Purity Substances RAS, Russia
We report the amplification of highly chirped dissipative solitons around 1.3 μm in an all fiber configuration by two methods: Stimulated Raman Scattering in a standard passive fiber and using active centers in a Bi-doped fiber pumped by CW radiation. The former provides spectrally uniform amplification resulting in good quality of compressed pulse, and the latter provides a 16-fold net gain.

WeR01-14     13:15-13:30
Self-started tunable femtosecond Cr2+:ZnSe laser from 2.15 to 2.4 μm
E.A. Kozlova1, A.A. Mirkchyan1, D.A. Nazarov1, M.K. Tarabrin1, Yu.G. Gladush2, 1Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical University, 1Center for Photonic Science and Engineering, Skolkovo Institute of Science and Technology, Russia
This study presents the development of a tunable femtosecond laser on a Cr2+:ZnSe crystal with a Lyot filter in the mid-infrared region. The system provides continuous wavelength tunability in the range of 2.15-2.4 μm with a maximum spectrum width of 96.5 nm at a wavelength of 2.2 μm.

- Lunch Break -

R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

Location: Stenberg 1 Room, Floor 3; Date: Wednesday, July 03, 2024

WeR03-01     09:00-09:30
A quantum dot laser with a single asymmetric barrier layer: A novel design for high temperature-stability
C. Hammack, L.V. Arsyu1; Virginia Polytechnic Institute and State University, USA
A semiconductor quantum dot laser with a single asymmetric barrier layer is studied. The use of a barrier layer is shown to considerably enhance the laser temperature stability – the characteristic temperature is well above that of the reference quantum dot laser that does not have a barrier layer.

WeR03-02     09:30-09:45
High-power superluminescent diodes based on chirped InGaAs/GaAs quantum well-dots
N.Yu. Gordeev1, A.S. Payusov1, G.O. Kornysyov1, Yu.M. Shernyakov1, A.A. Beckman1, Yu.A. Salii1, S.A. Mintairov1, N.A. Kalyuzhnyy1, M.V. Maximov1, Ioffe Institute, Russia; 2Aferov University, Russia
We have designed and investigated superluminescent diodes with the active regions based on 5 and 7 layers of chirped InGaAs quantum well-dots. The devices have shown spectra as broad as 120 nm and output cw optical power as high as 34 mW.

WeR03-03     09:45-10:00
Experimental reservoir computing based on a laser subject to optoelectronic feedback
G.O. Danilenko, E.A. Viktorov, A.V. Kovalev, ITMO University, Russia
We experimentally study a reservoir computing system based on a DFB laser diode with positive optoelectronic feedback. The system is operated in the vicinity of the Hopf bifurcation with N = 25 nodes, and 40 MHz input symbol rate. We evaluate memory capacity of the system and a chaotic time series prediction error.

WeR03-04     10:00-10:15
Dynamics of lasing switching between the high and excited-state in a quantum-dot microdisk
A.M. Nadtochiy1, A.A. Karaborchev1, N.A. Fominykh1, I.S. Makho1, K.A. Ivanov1, Yu.A. Guseva1, M.M. Kulagina1, S.A. Blokhin1, N.V. Kryuchkovskaya1, A.E. Zhukov1, 1International Laboratory of Quantum Optoelectronics, HSE University, 1Ioffe Institute, Russia
A quantum-dot microdisk was optically pumped by a mixture of continuous-wave excitation and sub-ps pulses of various powers. Depending on the level of the pulsed excitation, the ground-state lasing intensity can be either enhanced (for weak pulses) or fully quenched (for strong pulses). In the latter case, the excited-state lasing is ignited for a short time.
Devising the ways to expand throughput of a directly modulated long-wavelength VCSEL
M.E. Belkin 1, K. Voropaev 2, D. Klyushnik 1, M.G. Vasiliev 1, MIREA - Russian Technological University, 2PLC OKB-Planeta, 3Institute of General and Inorganic Chemistry RAS, Russia

The comparison of the two approaches to increasing vertical cavity surface emitting laser throughput, including the standard pulse amplitude modulation and a new technology associated with the use of optical injection locking, which provides a significant expansion of the slave laser’s direct modulation bandwidth, is proposed and validated by the simulation and measurements.

Single-mode MBE-grown 1550 nm wafer-fused VCSELs for high-speed PAM4 data transmission (Invited paper)
S.C. Tian 1, G.A. Sapunov 1, S.A. Blokhin 1, I.N. Kovach 1, L.Ya. Karachinsky 1, L.I. Novikov 1, A.V. Babichev 1, K.O. Voropaev 1, A.Yu. Egorov 1, D. Bimberg 1, 2, 3Bimbberg Chinese-German Center for Green Photonics, CIOMP CAS, Changchun, China; 2Technical University of Berlin, Germany; 3Ioffe Institute, Russia; 4TMU University, Russia

We study high-power, high bit rate, single-mode 1550 nm vertical-cavity surface-emitting lasers fabricated using wafer-fusion. We achieved a 34 Gbps non-return-to-zero data rate by applying 16 mA bias current and 1.4 V modulation voltage. Using 4-Level Pulse Amplitude Modulation we achieved 42 Gbps data rate by applying the same bias current and 1.6 V modulation voltage.

- Coffee Break -

Auger recombination in mid-Infrared lasers based on group IV SiGeSn MQW (Invited paper)

Detailed calculations of Auger recombination in direct-bandgap GeSn QWs show very unusual Auger rate dependence on the emission wavelength length and temperature. Unlike in most III-V materials, the Auger rate decreases with the increase of wavelength or temperature. The obtained results suggest that GeSn materials offer a great potential for optoelectronics and integrated photonics.

Plasmonic photoconductive antennas based on Bi(2-x)SbxSeyTe(3-y) topological insulators
P.M. Kovaleva 1, K.A. Kuznetsov 2, P.I. Kuznetsov 3, D.V. Lavrukhin 4, R.R. Galiev 5, D.S. Ponomarev 6, G.Kh. Kitaeva 7, Lomonosov Moscow State University, 2Kotelnikov IRE RAS, 3Institute of Ultra High Frequency Semiconductor Electronics RAS, 4Prokhorov General Physics Institute RAS, 5Moscow Institute of Physics and Technology, Russia

The study presents the first experimental observation of enhanced THz radiation in plasmonic photoconductive antenna (PCA) based on Bi2-xSbxSeyTe(3-y) topological insulator (TI). The optimized plasmonic grating geometry maximizes optical light transmission, stimulating efficient surface plasmon-polariton (SPP) excitations along the TI/grating interface. The plasmonic TI-based PCA showed a ~9-fold enhancement in emitted THz power.

- Lunch Break -

Four-wave mixing in a laser diode gain media due to resonant backreflection from the microresonator
D.M. Sokol 1, 2, N.Yu. Dmitriev 1, D.A. Chernoshentsev 1, 3, A.V. Maslov 1, 4, V.E. Lobanov 1, I.A. Bilken 1, 2, A.E. Shitikov 1, 2, 4, I.I. Novikov 1, 2, 4, A.Yu. Egorov 2, 5, G.S. Sokolovskii 1, 2, 4, M.I. Andreev 3, I.V. Yarotskaya 3, M.A. Ladugin 3, A.A. Marmalyuk 3, L.Ya. Karachinsky 2, 4, S.O. Slipchenko 1, N.A. Pikhtin 1, A.V. Babichev 1, K.O. Voropaev 3, A.Yu. Egorov 4, D. Bimberg 1, 2, 3, Bimberg Chinese-German Center for Green Photonics, CIOMP CAS, Changchun, China; 2Technical University of Berlin, Germany; 3Ioffe Institute, Russia; 4TMU University, Russia

Semiconductor laser diodes integrated with ring microresonators show potential for improving stable laser sources, comb sources, and quantum state generation. The complex dynamics of this system must be considered for diverse applications. When the microresonator’s mode is excited, it imposes its frequency on the laser diode, causing strong nonlinear interactions within the laser gain medium and leading to self-oscillations.

Terahertz high-resolution microscopy based on rutile solid immersion lens
V.A. Zhelnov 1, N.V. Chernomyrdin 1, A.A. Gavdush 1, I.E. Spector 1, V.N. Kurlov 1, M. Skorobogatyi 2, 3, 4, P.M. Kovaleva 1, K.A. Kuznetsov 2, K.I. Zaytsev 1, Prokhorov General Physics Institute RAS, 2Osipyan Institute of Solid State Physics RAS, Russia; 3Department of Engineering Physics Polytechnique Montreal, Quebec, Canada

We use rutile as a material of solid immersion lens and demonstrate that our microscope provide the highest resolution in the range of 0.06-0.11 λ.

- Lunch Break -

THz and Multi THz Lasers Based on Heterostructure with HgCdTe/CdHgTe with Quasirelativistic Dispersion Laws (Invited paper)
S.V. Morozov

We show that in the long-wavelength part of mid-IR HgCdTe/CdHgTe QWs offer the quasi-relativistic carrier dispersion law that suppresses the Auger recombination, enabling stimulated emission (SE) up to 31 μm, and laser generation up to 24 μm in the temperature range from 10 to 80 K.
Use of plasma sources in the epitaxy of III-V compounds (Invited paper)
P. Bulkin; LPICM CNRS Ecole Polytechnique IP Paris, Palaiseau, France

The talk will describe the evolution of plasma sources used for epitaxy, both for MBE and CBE and MOCVD machines and current state of technology. Different types of plasma sources available on the market will be considered. Design criteria, evaluation tests and ways of performance improvements will be discussed.

Wavelength switching in low-dimensional structures at high current densities
A.A. Beckman1,2, O.K. Kornev1, A.S. Payusov1, Yu.M. Shernyakov1, N.Yu. Gordeev1, M.V. Maximov2; Ioffe Institute; ‘Alferov University, Russia

We study lasing switching from ground to excited states transition (two-state lasing) at high injection currents in lasers with active region based on quantum well-dots (QWDS). Pure ground state lasing is maintained in the QWD devices up to higher currents than in QW ones. The use of broad waveguide results in a decrease in the threshold of two-state lasing.

Switching from invisibility to coherent emission by phase-change materials
S. Lepeshov1, A. Vyshnevyy2, A. Krasnok3; ‘Technical University of Denmark (DTU), Denmark; ‘Moscow Institute of Physics and Technology (MIPT), Russia; ‘Florida International University, USA

Detailed balance principle dictates that effective light emitters should also strongly absorb light. On the device level, a good laser is a strong scatterer. Here, we propose the concept of dual-mode laser that features anapole state cloaking in the passive regime and coherent emission when activated. Switching between these regimes is achieved thanks to the phase-change material.

Laser beam steering via optical phased array antenna (Invited paper)
P. Bulkin; LPICM CNRS Ecole Polytechnique IP Paris, Palaiseau, France

This research investigates the method of controlling a laser beam using optical phased arrays (OPA) and possible applications of this technology. The study examines the basic principles of system operation and beam control methods. We identify existing solutions for the implementation of OPA and carry out a constructive analysis.

Lasers with cavities coupled by a Bragg grating (Invited paper)
A.P. Pogoda1, V.M. Petrov2, N.L. Istomin3, A.S. Boreysho1; Ministry of Defense of the Russian Federation, Russia

A comprehensive view of the problem of optical interaction of radiation developing in systems with several cavities is presented. Static and dynamic gratings in the lasers based on narrowband and broadband active media are considered. A number of practically implemented systems are shown and fundamental limitations are indicated.

Nonlinear multiplexing of optical second harmonic in high-dimensional nonlinear photonic crystals (Invited paper)
A.M. Vyushnev1,2, V.G. Arkhipkin1,2; FRC KSK SB RAS, Russia

The results of second harmonic generation (SHG) in one-(1D), two-(2D) and three-dimensional (3D) nonlinear photonic crystals (NPCs) are presented. The theory of second harmonic generation of femtosecond laser pulses in high-dimensional periodic nonlinear photonic crystals is developed. High-dimensional NPCs are shown to be promising for nonlinear multiplexing and discrete angular spectrum formation.
WeR04-26  11:30-12:00
Holographic interferometers for optical digital medical tomography (Invited paper)
V.M. Petrov¹, D.V. Masygin¹, A.A. Sevryugin¹, E.V. Shalymov¹, D.V. Venediktov¹, V.Yu. Venediktov²; ¹Faculty of Physics, St. Petersburg State University, ²Department of Laser Measurement and Navigation Systems, St. Petersburg Electrotechnical University “LETI”, Russia
He reports a recent achievement in holographic interferometry for digital optical tomographs used in biomedical applications. The most common practical techniques are considered: sample rotating, single-shot, phase-shifting, and the technique of adaptive holographic interferometers. Estimates of technical parameters are given and the advantages and disadvantages of various schemes. The basic concepts of coding of the studied objects are given.

WeR04-27  12:00-12:30
Laser propulsion of 2D nanomaterials on flat surfaces (Invited paper)
Ivan M. Kislyakov; Shanghai Inst. of Optics and Fine Mechanics, China
Mechanical manipulation of nanoblocks is becoming an important task in connection with the development of nanotechnology and nanoelectronics. Mechanisms of movement of two-dimensional nanosheets by a femtosecond laser beam over flat surfaces in a dry environment are considered in connection with the latest discoveries in the laser-induced motion of VSe2 and TeSe2 nanosheets firmly attached to a flat sapphire substrate.

WeR04-28  12:30-13:00
Photonics of liquid crystal droplets in isotropic environment (Invited paper)
K.D. Baksanova, P.V. Dolganov; Osipyan Institute of Solid State Physics RAS, Russia
We report investigations of optical properties of liquid crystal droplets embedded in isotropic liquid. Emphasis is made on droplets formed by cholesteric liquid crystals. The dynamic behavior of droplets in the process of their coalescence is studied.

WeR04-29  13:00-13:30
Physico-chemical and nonlinear optical properties of aqueous polymer media containing carbon and inorganic nanoparticles (Invited paper)
A.V. Venediktov¹,², I.M. Kislyakov¹, P.V. Ivanov¹, A.Yu. Vlasov¹; ¹St. Petersburg State University, Russia; ²Shanghai Institute of Optics and Fine Mechanics, CAS, China
We considered aqueous-polymer mixtures containing carbon nanoparticles: liquid matrixes “Polyvinyl alcohol-water-stabilizing surfactant”; system “Pluronic F-127-water” able to form physical hydro-gel; thin films with alternating layers of polyvinyl alcohol and polycarbazole. We present the data on the phase behavior of aqueous-polymer mixtures and those containing a surfactant, and discuss the nonlinear optical properties of the above-mentioned systems.

- Lunch Break -

WeR04-30  15:00-15:30
Recent advances in nonlinear optics and ultrafast dynamics of 2D materials (Invited paper)
Jun Wang; Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Science, China
2D materials significantly enhance nonlinear optical phenomena which makes them in demand for optical switching. Further optimization for needs of optical signal processing and laser beam control is developed in the direction of layer numbers and substrate modifications and defect engineering. Here we review our recent progress in this area, which we believe will be desirable for optoelectronics and photonics.

WeR04-31  15:30-15:45
Reconfigurable optical traps based on acousto-optic spatial filters
K.B. Yushkov¹, D.V. Obydennov¹,², V.Ya. Molchanov¹; ¹Univ. MISIS, ²Lomonosov Moscow State Univ., Russia
We designed and fabricated acousto-optic spatial filters (AOSFs) for applications in laser beam shaping (LBS) and optical trapping. Several advanced LBS modes have been experimentally studied including multifrequency monochromatic beam shaping and polychromatic femtosecond beam shaping. We also demonstrated generation of dark bottle beams with a novel configuration of a phase-controlled AOSF.

WeR04-32  15:45-16:00
Switching platform for writing/erasing laser-induced periodic surface structures (LIPSS) on GST
V.B. Glukhenkaya¹, M.P. Smayev², G.N. Pestov³,², M.A. Saurov¹, P.I. Lazarenko¹; ¹National Research University of Electronic Technology; ²Lebedev Physical Institute RAS; ³Scientific-Manufacturing Complex “Technological Centre”, Russia
A switching platform which provides writing/erasing of extended two-phase periodic laser-induced surface structures on the GST has been developed: writing is carried out by fs laser pulses, and erasing – by electric current ones. The obtained results demonstrated possibility of using a thin-film resistive heater to create elements of non-volatile integrated optical and optoelectronic devices, for example, tunable diffraction gratings.

- Coffee Break -
Stability analysis of platicons in optical microresonators (Invited paper)
V.E. Lobanov, O.V. Borovkova; A.K. Vorobyev; D.A. Chermoshentsev; 1, I.A. Bilenko; Russian Quantum Center, 1Faculty of Physics, Lomonosov Moscow State University, 2Moscow Institute of Physics and Technology
Stability domains of platicons in high-Q Kerr optical microresonators with normal group velocity dispersion are studied numerically for a wide range of pump intensities. The effect of pronounced stability domain fragmentation at high pump amplitudes is observed. The existence of stable drifting platicons at high pump intensities is revealed. The influence of thermal effects on platicon stability is addressed.

Tapered fiber reinforcement for stable coupling with WGM microresonator
K.N. Minikov, D.D. Ruzhitskaya, K.E. Lakhmanskiy, O.V. Borovkova; Russian Quantum Center, Skolkovo; Faculty of Physics, Lomonosov Moscow State University, Russia
A method of the tapered fiber reinforcement for the stable coupling with a whispering gallery mode microresonator is developed. It is revealed that the slight curvature of tapered fiber results in its stronger fixation and prevents the sticking of the fiber and microresonator. An excitation of WGMs by reinforced curved tapered fiber with curvature radius about ~15 mm is demonstrated.

Design of a Micro Ring Resonator as a nonlinear computational unit for neural networks accelerator
E. Protosenko, E. Volkova, A. Shipulin; ScTecTech, Russia
Micro Ring Resonator was considered to be a nonlinear element for a Neural Network accelerator. Its thermal nonlinearity was tested with a neural network model on the MNIST dataset, showing an accuracy rate of 99.17%. The power and time delay of each operation were estimated to be 0.2 mW and 0.3 ms (60 nJ per operation).

External control of “symmetry broken” CW/CCW states in bidirectionally pumped nonlinear microspheres
E.A. Anashkina, A.V. Andrianov; A.V. Gaponov-Grekhov Inst. of Applied Physics RAS, Russia
Kerr microresonators with bidirectional pumping demonstrate complex dynamics including multistability and spontaneous symmetry breaking even for two CW/CCW waves. We found that taking into account a relative phase between CW/CCW pumps provides additional control of CW/CCW states and their “symmetry breaking”. Moreover, in glass microspheres with sufficiently strong Raman nonlinearity, states with broken symmetry of CW/CCW Raman waves are demonstrated.

A review: basic fractional nonlinear-wave models and solitons (Invited paper)
B. A. Malomed; Tel Aviv University, Israel
This is a summary of propagation of waves in fractional media. Parallel to the originally proposed fractional quantum mechanics, Recently, much interest has been drawn by the proposal to emulate fractional diffraction in optical cavities. This possibility suggests to include the nonlinearity of optical media. Many results have been reported for solitons, vortices and other modes supported by optical nonlinearities.
Periodic and quasiperiodic arrays of coupled exciton-polariton condensates (Invited paper)

S.Yu. Alyakin1, H. Sigurdsson2, Y.V. Kartashov3, K.A. Sitnik4, I.S. Grusov4, J.D. Töpfer1, P.G. Lagoudakis1; 1Hyroid Photonics Laboratory, Skolkovo Institute of Science and Technology, Russia; 2Science Institute, University of Iceland, Iceland; 3Institute of Spectroscopy RAS, Russia

We study composite microcavity exciton-polaritons, which can undergo power-driven out-of-equilibrium Bose-Einstein condensation. Optical malleability of the exciton-polariton system makes it appealing for design and study of condensed matter systems. In this work, we realize and discuss periodic lattices and quasiperiodic arrays of exciton-polariton condensates imprinted by all-optical means using spatially shaped non-resonant laser light.

New mode of a steady-state superradiant lasing

V.I. Kocharovsky1, E.R. Kocharovsky2; 1 Plasma Physics and High-Power Electronics Division, Institute of Applied Physics RAS, Russia; 2Nonlinear Dynamics and Optics Division, Institute of Applied Physics RAS, Russia

For a superradiant laser with low-Q slightly asymmetric Fabry-Perot cavity, there is strongly-asymmetric single-mode lasing defined by an inhomogeneous self-consistent half-wavelength population-inversion grating. We find analytically the universal profiles of this grating and the counter-propagating waves which form the grating. We outline the ways of control of the superradiant polariton mode and demonstrate its stability far above the lasing threshold.

PCEVD-fabricated microresonators for nonlinear photonics

N.Yu. Dmitriev1, A.M. Mumlyakov2, M.V. Shibalov2, I.V. Trofimov3, I.A. Filipov3, A.A. Anikanov1, M.A. Tarkhov2, I.A. Silenok1, V.A. Makarov1,2; 1Russian Quantum Center, 2Institute of Nanotechnology of Microelectronics RAS, 3Faculty of Physics, Lomonosov Moscow State University, Russia

We demonstrate characteristics of high-Q ring silicon nitride microresonators fabricated with novel PCEVD process. Proposed process allows to fabricate silicon nitride waveguides with thickness over 1 um. Studied 1µm-thick silicon nitride ring microresonators features anomalous GVD and loaded Q factor over 1 million.
WeR08-35  16:15-16:30
High-Q crystalline germanium microresonators for Mid-IR
T.S. Tebeneva1, A.E. Shitikov1, K.N. Min’kov2, V.E. Lobanov2, I.A. Bilenko1,2; 1Russian
Quantum Center; 2Faculty of Physics, Lomonosov Moscow State University, Russia
We report on the whispering gallery modes microresonators fabrication from crystalline germanium. The resulting Q-factor exceeding 10^7 is the highest ever recorded for Ge microresonators measured at the 2.68 μm pump wavelength. Self-injection locking of a laser diode to germanium microresonator, which is one of the ways to stabilize the laser frequency is achieved.

WeR08-36  16:30-16:45
Laser beam structure influence on optical and structural modification of phase-change materials
M.P. Smayev1, P.A. Smirnov1,2, I.A. Budagovsky1, M.E. Fedyanina2, V.B. Glukhenkaya2, A.V. Romashkin1, P.I. Lazarenko2, S.A. Kozyukhin1; 1Lebedev Physical Institute RAS; 2National Research Univ. of Electronic Technology; 3Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia
We studied a transition of amorphous Ge2Sb2Te5 thin films into the crystalline state under the action of structured cw laser beams. Light beams with an annular intensity profile are significantly more efficient for Ge2Sb2Te5 crystallization compared to the fundamental Hermite-Gaussian HG00 mode due to a more uniform temperature distribution inside the irradiated region.

WeR08-37  16:45-17:15
Kerr squeezed solitons for metrology (Invited paper)
Gerd Leuchs1, Nikolay A. Kalinin2,1, Arseny A. Sorokin3, Thomas Dirmeier1,2, Elena A. Anashkina1,4, Alexey V. Andrianov1, Joel F. Corney4, Luis L. Sánchez-Soto1,2; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; 3Institute of Applied Physics, RAS, Nizhny Novgorod, Russia; 4Advanced School of General and Applied Physics, Lobachesky State University of Nizhny Novgorod, Russia, and Spain
A particularly robust source of squeezed quantum light is provided by the optical Kerr effect in a fibre. Using soliton pulses, the nonlinear interaction is effectively increased. The development of Kerr squeezing towards sensing applications advanced with the demonstration of interferometric phase sensitivity enhancement. N. Kalinin et al., Nanophotonics 12, 2945 (2023). We report on the status of the project.

- Coffee Break -
WeR09-05 11:30-12:00

Ternary N-based nanostructures: growth and properties (Invited paper)
G.E. Cirlin¹, R.R. Reznik¹, ², V.O. Gridchin¹, ², ³; ¹St. Petersburg State University; ²Alferov Institute; ³Institute for Analytical Instrumentation, Russia

It was found that InGaN/Si nanowires (NWs) system is quite delicate and a small change in the growth temperature leads to a significant change in structural properties of nanowires and shifts the photoluminescence emission from blue to red. We will also demonstrate that InGaN NWs form a core/shell structure.

WeR09-06 12:00-12:30

MBE growth and properties of III-V hybrid nanostructures on silicon for quantum applications (Invited paper)
R.R. Reznik¹, K.P. Kotlyar¹,²,³, A.I. Khrebtov¹,²,³, I.V. Ilkiv¹,²,³, V.O. Gridchin¹,²,³; ¹St. Petersburg State University; ²National University of Science and Technology; ³Institute for Analytical Instrumentation, Russia

Different hybrid nanostructures based on III-V compounds were formed using MBE on the silicon surface for the first time. The dependence of the synthesized nanostructures physical properties on growth conditions was studied. Based on experimental data, modeling of the optical properties of the synthesized nanostructures was carried out.

WeR09-07 12:30-13:00

Chiral manganese (II) halides with efficient circularly polarized luminescence (Invited paper)
Jing Li, Qidong Pang; School of Chemistry and Chemical Engineering/State Key Laboratory of Featured Metal Materials and Life-cycle Safety for Composite Structures, Guangxi University, China

Chiral hybrid metal halides hold great potential as the circularly polarized luminescence (CPL) light sources. We have obtained new enantiomeric pairs of one-dimensional hybrid chiral-manganese(II) chloride single crystals, R/S-(3-hydroxy piperidine)MnCl3. The single crystals show red emission with near-unity photoluminescence quantum yield and high CPL activity, which are attributed to the enhanced crystal rigidity resulting from the hydrogen bonding networks.

- Lunch Break -

WeR09-08 13:00-13:30

Synthesis, characterization, and application of cane molasses-derived carbon quantum dots (Invited paper)
Aimiao Qin; Guilin University of Technology, China

Carbon quantum dots (CQDs) possess excellent properties of photoluminescence, low toxicity and good biocompatibility and show great application prospects. In this report, multifunctional fluorescence CQDs were controlled prepared from sugarcane molasses by hydrothermal method, which can be used to construct LED devices, fluorescent sensors and CD sensors for detection of heavy metal ions, antibiotic and fluorescence imaging.

WeR09-09 15:00-15:30

Terahertz surface plasmon refractometry of composite graphene nanolayers (Invited paper)
V.V. Gerasimov¹,², V.D. Kukotenko¹, A.I. Ivanov³, I.V. Antonova³, I.Sh. Khasanov³; ¹Budker Institute of Nuclear Physics SB RAS; ²Novosibirsk State University; ³Institute of Solid State Physics SB RAS; ⁴Scientific and Technological Centre of Unique Instrumentation, Russia

Graphene and composite thin graphene layers are of great interest for integrated plasmonics in the terahertz (THz) frequency range. The results of experimental studies of the optical constants of composite layers of graphene nanoparticles with a thickness of 10 to 1000 nm using the methods of plasmonic interferometry and surface plasmon resonance refractometry will be presented.

WeR09-10 15:30-16:00

Size-dependent lanthanide energy transfer amplifies upconversion luminescence quantum yields (Invited paper)
Guanying Chen; Harbin Institute of Technology, China

We revealed a size-dependent lanthanide energy transfer effect in a conceptual design of hexagonal sodium yttrium fluoride core–shell–shell upconversion nanoparticles, transforming our long-existing conceptual understanding of lanthanide energy transfer (size independence)

WeR09-11 16:00-16:15

Wide bangap nanostructured β-Ga2O3-GaN for UV applications
L.A. Mochalov¹, M.A. Kudryashov², I.O. Prokhorov¹, Yu.P. Kudryashova², S.V. Telegin³, E.U. Rafaello³, A.N. Baramov³, A.V. Knyazev³; ¹Lobachevsky University, Russia; ²Aston University, United Kingdom; ³University of Montpellier, France

Nanostructured β-Ga2O3-GaN films with different GaN phase contents for UV-C photodetectors were prepared by PECVD. Compared to thin continuous films, nanostructures have a higher surface-to-volume ratio, which increases their photosensitivity. The synthesized materials were studied by various analytical methods.

WeR09-12 16:15-16:45

Understanding materials at the atomic scale through ab-initio simulations (Invited paper)
N. Seriani; The Abdus Salam ICTP, Italy

Environmental conditions strongly affect nanostructured materials, their shape and composition, and therefore their functional properties. First-principles simulations based on density functional theory can give insight into these effects. They can contribute to understand phenomena like the shape evolution of nanoparticles, photoabsorption, and more complex chemical and photochemical properties. I will discuss successes, limitations, and perspectives of these techniques.
Ultrafast carrier dynamics of nanomaterials to manipulate light harvesting (Invited paper)

Amitava Patra; School of Materials Sciences, Indian Association for the Cultivation of Science; Institute of Nano Science and Technology, India

Here, we investigate the carrier dynamics, energy transfer, and charge carrier dynamics of 2D nanoplatelets, perovskite nanocrystals, and conjugated polymer nanoparticles.

- Coffee Break -

R10: NONLINEAR QUANTUM PHOTONICS

WeR10-12  15:00-15:30
Fundamental theory of Fano resonance in cavity QED systems (Invited paper)
Makoto Yamaguchi; Tokai Univ., Japan

We show a fundamental theory of Fano resonance in cavity QED systems, based on a Markovian quantum master equation. The Fano formula is, then, generalized over the weak- and strong-coupling regimes with pure dephasing. We also study the emission spectra and find that the interference responsible for the Fano resonance is robust against pure dephasing.

WeR10-13  15:30-15:45
Benchmarking of 8-qudit quantum processor based on optical transition in 171Yb+ ions
I. Zalivako1,2, A. Borisenko1,2, I. Semerikov1,2, A. Korolkov1,2, P. Sidorov1,2, K. Galstyan1,2, N. Semenin1,2, V. Smirnov1,2, M. Aksenov1,2, E. Kiktenko1, A. Fedorov1, K. Khabarova1,2, N. Kolachevsky1,2, 1 Russian Quantum Center; 2 Lebedev Physical Institute RAS, Russia

The results of benchmarking single- and two-qubit operations and realizing basic quantum algorithms, including Bernstein-Vazirani algorithm, Grover search as well as H2 and LiH molecular simulations performed on the 8-qudit ion quantum processor will be presented.

WeR10-14  15:45-16:00
Generation of polarization-entangled photon pairs from a single lithium niobate waveguide with a single poling period
Xinyue Zhang, Wei Fang, Limin Tong; College of Optical Science and Engineering, Zhejiang University, China

We propose the generation of polarization-entangled photon pairs based on two type-0 spontaneous parametric down-conversion processes in a thin-film lithium niobate waveguide. By utilizing the waveguide dispersion, both TE and TM polarized photons can be generated efficiently with a single poling period in the waveguide. Numerical simulations using mode analysis are performed to identify suitable waveguide configurations.

WeR10-15  16:00-16:15
Measurement of covariance of analog detector readings in the field of spontaneous parametric down-conversion
T.I. Novikova1,2, K.A. Kuznetsov1,2, I.V. Korolev1,2, I.V. Pentin1,2, G.Kh. Kitaeva1; 1 Lomonosov Moscow State University, 2 SCONTEL, Russia

An approach is considered that can be applied to calibrate detectors operating in the analog signal recording mode. Statistical distributions of the readings of such detectors are studied taking into account fluctuations in the amplitudes of single-photon detector pulses.

WeR10-16  16:15-16:30
Stimulated emission in a complex background
D.V. Grosman, E.O. Lazarev, G.K. Sizykh, D.V. Karlovets; ITMO University, Russia

In our research we are interested in the processes of an induced photon emission by an atom, with the field that stimulates emission being a localized wave-packet photon. We are interested in determining how the quantum numbers and characteristics of the final two-photon state can be related to those of the initial wave packet reference photon.
An enhanced modeling approach for quantum cascade structures and superlattices

D.A. Barykin1,2, N.A. Kostromin1,2, A.S. Dashkov1,2, L.I. Goray1,2,3,4; Alferov University, Institute for Analytical Instrumentation, University associated with IA EAEU, Russia

This paper discusses the development of a numerical simulation method of quantum cascade structures. The approach uses an enhanced rate equation method with quantum adjustments. The verification results on three structures demonstrated that the enhanced rate equation method provides better accuracy compared to the classical one. The algorithm can be used in the modeling of quantum-cascade structures and superlattices.

Multi-GHz repetition-rate pulse generation by gain instability in a semiconductor-based all-fiber laser

A.V. Ivanenko1, A.E. Bednyakova1, V.Y. Smirnov1, E.V. Nushkov1, N.V. Zemlyakov3; Federal Nuclear Center – All-Russia Research Institute of Technical Physics named after Academician E.I. Zababakhin, Russia

A novel method for generating multi-GHz regular pulse trains in lasers. This method relies on self-sustaining cross-gain modulation achieved by incorporating negative optical feedback into a cavity with a semiconductor optical amplifier. This approach facilitates pulse formation without an active modulation or saturable absorber and enables multi-plexing of the laser system to achieve diverse repetition rates.

Design of multimode optical fibers based on optimization of harmonically-tempered refractive Index profiles

V.M. Gololobov1, E.A. Milkov1, P.S. Anisimov1, V.V. Zemlyakov2; Russian Research Institute, Huawei Technologies Co. Ltd, Russia

We introduce a new design approach for multimode fibers. We demonstrate modified-index multimode fibers with substantially reduced differential mode group delay for fifteen LP modes. Finally, we show the impact of the optimization parameters on the resulting optical fiber profile.

Terahertz emission in a Co/IrMn heterostructure with exchange bias

E.D. Lebedeva1, P.Yu. Avdeev1, A.V. Gorbatova1, I.Yu. Pashenkin1, M.V. Sapoznikov2, A.M. Buryakov1; MIREA - Russian Technological University, Russia

A spintronic emitter, made of layers of ferromagnetic Co and antiferromagnetic IrMn, was studied for exchange bias using THz-TDS method. Laser heating and weak magnetic fields were found to alter exchange bias direction. Mechanism of THz radiation generation in emitter was examined.

Kilowatt-class multi-element first cladding fiber laser

D.V. Kulakov1, A.V. Bochkov1, Yu.V. Ivchenko1; Federal State Unitary Enterprise «Russian Federal Nuclear Center – All-Russia Research Institute of Technical Physics named after Academician E.I. Zababakhin», Russia

The article presents the results on experimental elaboration of a fiber laser technology with multi-element first cladding (MFC) manufactured at RFNC – VNIITF. A mockup of ytterbium single-mode fiber laser of 1000 W maximum output power has been designed and implemented.
Development 515 nm Q-switched thin disk laser
A.B. Kozlov, N.P. Badalyan, E.V. Kuznetsov, M.M. Zemlyanov, A.V. Shvetakov; RDI Polyus, Russia
This paper discusses the results of the development of SHG 515 nm Q-switched thin disk lasers in the Research and Development Institute Polyus of M.F. Stelmakh. The main constructive elements of the thin disk laser, abilities of SHG and the demands to its technical characteristics are considered too.

Spectral, lasing and mechanical strength characteristics of crystals Yb:Li:ZnWO4
K.V. Kuleshov1, K.A. Subbotin1,2, P.A. Loiko1, Yu.I. Zimina1,2, A.I. Titov3, Ya.S. Didenko1,2, D.A. Lis2,2, S.K. Pavlov1,2, P. Camy3, A. Braud3, R.M. Solé4, M. Aguilo4, F. Díaz5, W. Chen6, X. Mateos4, V. Petrov5, G.Z. Elabedine4, P.A. Volkov7; 1 Prokhorov General Physics Institute RAS; 2 Mendeleev University of Chemical Technology of Russia, Russia; 3 Centre de Recherche sur les Ions, les Matériaux et la Photonique, Université de Caen Normandie, France; 4 Instytut Równia i Virgili, Sporganica et Cristallographica de Materials Tarragona, Spain; 5 Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Germany; 6 Fujian Institute of Research on the Structure of Matter CAS, China; 7 IREAS Shared Knowledge Center, Russia
Spectral and mechanical strength properties of Yb3+, Li+:ZnWO4 crystals were investigated, diode-pumped ZnWO4 laser with an output power of 2,41 W was demonstrated.

Influence of Fe2+-co-doping on Cr3+:ZnO crystal properties
M.E. Drochepenko, K.A. Piotrnik, H. Jelinkova, A. Rihak; Prokhorov General Physics Institute RAS, Russia; 2 Czech Technical Institute in Prague, Czech Republic
The influence of Fe2+-co-doping on the room-temperature spectroscopic properties of Cr2+ ions in ZnO:Fe as a solvent and its polarized emission properties in the visible and near-infrared wavelength ranges is studied revealing a multi-site behavior of this promising laser material.

Filters based on tapered optical fibers 1.2 - 1.6 μm
A.V. Shirmankin, V.A. Kamynin, V.B. Tsvetkov; Prokhorov General Physics Institute RAS, Russia
This work presents the development and analysis of tunable spectral filters using tapered fibers. The filter was created by heating and pulling single mode optical fiber to form tapers. The optical signal propagating in the fiber within the 1.2 to 1.6 μm range was filtered by bending the taper.

Growth, spectroscopy and multi-site behavior of monoclinic Eu:MgWO4 crystal
K.A. Subbotin1, A. Baillard2, A.I. Titov1, D.A. Lis1, Yu.I. Zimina1,2, Ya.S. Didenko1,2, G.Z. Elabedine3, R.M. Sole4, M. Aguilo4, F. Diaz5, W. Chen6, X. Mateos4, P.A. Volkov7; 1 Prokhorov General Physics Institute RAS; 2 Mendeleev University of Chemical Technology of Russia, Russia; 3 Centre de Recherche sur les Ions, les Matériaux et la Photonique, Université de Caen Normandie, France; 4 Fujian Institute of Research on the Structure of Matter CAS, China; 7 IREAS Shared Knowledge Center, Russia
Monoclinic Eu3+-doped MgWO4 crystal is grown from the flux using Na2WO4 as a solvent and its polarized emission properties in the visible and near-infrared wavelength ranges are presented, the transmission and photoluminescence spectra of the samples (before and after the application of mirrors) are presented.

Incoherent source of laser radiation
S. Kobtsev; Division of Laser Physics and Innovative Technology, Novosibirsk State University, Russia
A possibility is considered of a pulsed incoherent source of laser radiation on the basis of a mode-locked fibre laser. Incoherent laser radiation may consist of noise-like pulses, chirped pulses or chirped noise-like pulses. Different ways of generation regime implementation with suitable pulses are discussed.

Growth, structure, thermal properties and spectroscopy of Tm4+-doped MgMoO4, laser crystal
A.I. Titov1,2, K.A. Subbotin1,2, Y.S. Didenko1,2, D.A. Lis1,2, Yu.I. Zimina1,2, G.Z. Elabedine3, K. Eremeev3, R.Maria Solé4, M. Aguilo4, P.A. Volkov5, P.A. Popov1, E.V. Chernova4, F. Díaz5, P. Camy3, X. Mateos4; 1 Prokhorov General Physics Institute RAS; 2 Mendeleev University of Chemical Technology of Russia, Russia; 3 Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, France; 4 Nederlandse Organisatie voor Wetenschappelijk Onderzoek, Netherlands; 5 IREAS Shared Knowledge Center, Russia
Tm3+–doped MgMoO4 crystal was grown by the Czochralski method, the actual Tm concentration in the crystal, the tensor of thermal expansion coefficients and thermal conductivity was determined. Spectroscopic studies were shown broad emission band extending beyond 2 μm (the 3F4 → 3H6 transition) and a long 3F4 excited-state lifetime that makes this crystal promising for broadly tunable and mode-locked lasers.
Development of a noncritical Pockels cell on KTP crystal

WeR01-p13

15:00-18:30

Contrast, angular and spectral selectivity of a temperature-noncritical Pockels cell on KTP crystal

S.V. Gagarsky1, S.G. Grechin1, P.Y. Druzhinin2, I.R. Istangulova1, V.A. Rusov3, A.N. Sergeev4

1 ITMO University, 2 Prokhorov General Physics Institute RAS, Russia; 3 NRC "Kurchatov Institute" - IREA Shared Knowledge Center, Russia

The results of experimental investigations of contrast, angular and spectral properties for temperature-noncritical Pockels cell on KTP crystal are presented.

WeR01-p14

15:00-18:30

Increasing the average and peak power of thin slab based laser amplifier


We developed Yb:YAG slab scalable laser amplifier and investigated numerically and experimentally the main problems limiting its average and peak power: overheating, surface breakdown and pump power scaling.

We have shown that using composite gradient doped slab with compensation of beam area compression effect allows to use pump power to 1000W with maximum output energy of 50mJ with a M2<1.5.

WeR01-p15

15:00-18:30

Er/Yb fiber laser with a fundamental ultrashort pulse repetition rate of 484 MHz

A.D. Zverev1, V.A. Kamyin1, B.I. Denker1, S.E. Sverchkov1, V.V. Velesmisk1, Y.G. Gladush1, D.V. Krasikov1, A.G. Nasibulin1, V.B. Tsvetkov1, Prokhorov General Physics Institute RAS, Russia

We present the development of Er/Yb:YAG slab laser with repetition rate 216 MHz.

WeR01-p16

15:00-18:30

Investigation of solid solutions of Eu3+-doped CaNa2Gd12/2B2O5MoO4 (x = 0-1) crystals

Y.S. Didenko1, K.A. Subbotin1, A.I. Titov1, S.K. Pavlov1, V.V. Voronov1, L.D. Iskhakova1, E.V. Chernova1, P.A. Volkov1, K.V. Kuleshova1, Y.I. Zimin2, D.A. Lis2

1 NRC "Kurchatov Institute" - IREA Shared Knowledge Center, Russia

The single crystals of the concentration series of CaMoO4 – Na0.5Gd0.5MoO4 scheelite-like solid solutions was grown and investigated.

According to most of the properties studied, this solid solution shows some deviations from additivity.

WeR01-p17

15:00-18:30

Creation of a luminescent crystal based on silver halides doped with chlorides of rare earth elements

F.M. Kucherenko, A.E. Lvov, A.S. Korsakov, L.V. Zhukova, Ural Federal University, Russia

The work is devoted to the preparation of a luminescent crystalline substance based on AgBr0.8I0.2 : NdCl3 and obtaining its luminescence spectra.

WeR01-p18

15:00-18:30

Pockels cells on RTP crystals for for high-peak and medium power picosecond Nd:YAG laser systems

V.A. Rusov1, V.E. Yakobson1, A.A. Mirzaev2, M.V. Nezheevaysov2, S.B. Eronko1, V.V. Koval1, A.F. Kornev1, V.D. Nenadovich1

1 Vavilov State Optical Institute; 2 "Lasers & Optical Systems" Co. Ltd., 3 OJC «RPC «PSI», Russia

A technology for manufacturing Pockels cells on domestic high-resistance RTP crystals with a contrast of at least 100:1 for Nd:YAG lasers has been developed. The use of manufactured Pockels cells in a picosecond Nd:YAG laser made it possible to obtain the following characteristics: a duration of 35 ps, and a maximum energy of 4.2 mJ.

WeR01-p19

15:00-18:30

Pleochroism of β-BBO crystals grown from NaBaBO3 vanadium, and molybdenum-based melt solutions: visible and infrared spectral range

D.M. Ezhov1, E.A. Simonova1, A.A. Goreyavcheva1, V.A. Svetlichnyi1, E.A. Kolk3 (Tomsk State University, Sobolev Institute of Geology and Mineralogy SB RAS)

We present study on optical properties of β-BBO crystals grown from three distinct melt solutions: Na2O-NaF, NaBaBO3-V2O5, and BaMoO4-BaF2. Polarized VIS and FTIR spectra as well as with Raman scattering spectra were measured.

WeR01-p20

15:00-18:30

Narrow-linewidth widely tunable high-pulse-energy mid-IR ZGP-based parametric source

O. Antipov1, I. Ivanov1, A. Dobrynin1, Yu. Getmanovskiy1, V. Sharkov2

1 Institute of Applied Physics RAS; 2 Nizhny Novgorod State University, Russia

Narrow-linewidth widely tunable mid-IR light source based on an optical parametric oscillator (OPO) and an optical parametric amplifier (OPA) was created for selective excitation of semiconductor THz luminescence and environmental monitoring.

WeR01-p21

15:00-18:30

Effect of liquid medium viscosity on laser cleaning of surface with artificial radioactive contamination

M.D. Cheban1, S.A. Filatova1, K.A. Scherbakov2, D.N. Mamontov1, Prokhorov General Physics Institute RAS, Russia

We present the development and study results of a special cleaning technique for stainless steel surfaces with a coating simulating radioactive contamination.

Laser radiation at a wavelength of ≈1 µm with pulse duration of 8 ns and 270 fs was used to remove the simulated contamination.

WeR01-p22

15:00-18:30

New multipass telescopic scheme design for a multi-element disk laser amplifier

A.I. Gorokhov, E.A. Perevezentsev, I.B. Mukhin; Inst. of Applied Physics RAS, Russia

A new telescopic multipass scheme for a high energy multi-element disk laser amplifier is proposed. The possibility of scaling the system to required number of elements was confirmed with the pilot source. Yb:YAG amplifier with two disc AEs and two 2.5 kW pumps is assembled and ready for testing.

WeR01-p23

15:00-18:30

Growth and polarized spectroscopy of stoichiometric NaEu(WO4)2 laser crystal

K.A. Subbotin1, A. Ballard1, A.I. Titov1, S.K. Pavlov1, E.V. Zharkov1, P.Carney1, F. Mateos1, P. Loiko1, Prokhorov General Physics Institute RAS, Russia

We present study on optical properties of NaEu(WO4)2 laser crystal grown by the Czochralski method and its polarized spectroscopic properties are studied. The stimulated-emission cross-section for the deep-red S00 → 7F4 transition is 2.5×1020 cm2 at ~702 nm for π-polarization.
Narrowband ultrashort pulses generation in different fiber schemes using a highly chirped Bragg grating

Temperature dependence of lasing properties of 8.3(3) at.% Yb:YSAG ceramics

Study of the spectral and kinetic characteristics of the Er3+ ion in BaY2Lu6F24 mixed crystals to assess the possibility of continuous laser oscillation at a wavelength of 2.7 μm

Growth, structure and spectroscopy of Yb3+ -doped MgMoO4 crystal

Spectroscopic properties of different cobalt ions optical centers in calcium orthovanadate crystals

Temperature dependence of spectral and kinetic characteristics of 8.3(3) at.% Yb:YSAG laser ceramics

Gain-switched single-frequency ytterbium fiber laser

Dispersion properties of composite Erbium-Ytterbium doped optical fibers

Gain-switched single-frequency ytterbium fiber laser

Calcium orthovanadate crystals doped with cobalt ions via thermal diffusion and during Czechralski growth process are studied. The spectroscopic properties of M1 and M2 Co2+ optical centers are presented. Nonlinear transmission and efficient absorption cross-sections are measured for Co2+ - M2 centers. A narrow fluorescence line at 1170 nm is attributed to trivalent Co ions.
Numerical study of mid-infrared laser in rare-earth-doped chalcogenide multicore fibers

N.I. Sahnikov, A.V. Andrianov, E.A. Anashkina; A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia

Numerical study of mid-IR fiber lasers based on Tb, Nd, or Pr-doped chalcogenide multicore fibers with 25 single-mode cores arranged in a square grid is presented. It is shown that the 10-W level of output laser power can be achieved for an out-of-phase supermode of chalcogenide rare-earth-doped fiber with pump intensities below the fiber damage threshold.

Phase-sensitive OTDR accuracy improvement using engineered optical fiber with artificial reflectors

D.M. Bengalskii, D.R. Kharasov, E.A. Fomityakow, S.P. Nikitin, O.E. Naniil; V.N. Treshchikov, T8 LLC; V.S. Tsvetkov, Belgorod State University; D.G. Zverev, E.V. Lukinova, V.V. Semashko, Kazan Physical-Technical Institute, FRC Kazan Scientific Center RAS, Russia

We investigate performance of the Phase-sensitive OTDR operated with the fiber with artificial reflectors evenly spaced along the fiber length. Numerical simulations of the qOTDR signal demonstrate significant (by more than 16 dB) reduction of the phase error when a standard fiber is replaced with the engineered fiber. The experimental results confirm the numerical simulations.

Spectroscopy investigation of highly doped LiCaAlF6:Ce2+ crystals

A.A. Shavelev, A.S. Nizamutdinov, A.A. Shakirov, I.D. Sidorov, S.L. Korableva, D.O. Zverev; A.A. Rodionov, E.V. Lukinova, V.V. Semashko, Kazan Federal University; Belgorod State University; Kazan Physical-Technical Institute, FRC Kazan Scientific Center RAS, Russia

Crystals Ce3+:LiCaAlF6, which are characterized by the formation of several types of Ce3+ ion centers, have been studied. We showed that for Ce3+:LiCaF6, with an increase in the concentration of Ce3+ ions in the melt, crystalization occurs in such a way that the concentration of impurity centers of lower symmetry increases to a greater extent than centers of higher symmetry.

Research of the efficiency coupling of fiber laser radiation into a laminar water jet

G.N. Dubrovin, P.E. Samarion, D.V. Myasnikov; NTO «RE-Polus», Russia

This work examines the features of the process of propagation of laser radiation inside a water jet. The influence of beam parameters (Rayleigh length, focus position, number of aperture) on the loss of average power in a water jet is investigated. Different types of pulsed fiber lasers are considered.

Luminescence properties of Er3+:Y2O3 sesquioxide ceramics

V.Yu. Zhumkhyov, V.S. Tsvetkov, A.A. Shvetchenko, E.A. Dobretsova, Yu.N. Pyrkov, D.A. Permin, O.N. Postnikov, V.B. Tsvetkov; General Physics Institute RAS, Institute of Chemistry of High-Purity Substances RAS, Russia

5-15 at.% Er3+:Y2O3 sesquioxide ceramics were fabricated and studied. Transmission spectra of the samples were obtained in a wide spectral range. Ceramics exhibit high transmittance values (up to 80%). Luminescence spectra were obtained at 1.5 and 3 μm, the intensity of the luminescence line at a wavelength of about 1.5 μm increases with decreasing concentration.

Advanced distributed feedback lasers based on composite erbium-ytterbium doped fiber

M.I. Skvortsova, K.V. Proskurina, I.V. Golikov, S.R. Abdullaeva, A.V. Dostovalov, D.S. Lipatov, A.S. Lobanov, A.A. Rybakovsky, S.A. Babin; Institute of Automation and Electrometry SB RAS; G.G. Deyatykh Institute of Chemistry of High-Purity Substances RAS; Prokhorov General Physics Institute RAS, Diason Fiber Optics Research Center, Russia

Composite Er/Yb-doped fiber in combination with point-by-point inscription technology enables formation of distributed-feedback laser with cavity length of 20 mm whose parameters are better than the parameters of erbium-doped fiber DBR-lasers having much longer cavity. The short DBR laser generates single-frequency radiation at 1535 nm with linewidth ~100 Hz and 10 mW output power at 215 mW 980-nm pumping.

Direct observation of stimulated emission of NV centers in synthetic HPHT diamond

V.F. Lebedev, T.S. Misnikova, Ya.A. Ryvkin, D.E. Genin, A.V. Samolov, E.I. Lipatov, V.G. Vincet, I.V. Klepikov, A.V. Kolladin, R.V. Isakov; St. Petersburg State University of Aerospace Instrumentation; Tomsk State University; LLC "VELMAN"; LLC NPK Almaz; LLC "New Diamond Technology", Russia

Direct observation of stimulated emission of NV centres in HPHT-diamonds are presented. The spectra and pulse durations of the SE were simultaneously recorded. It was found that the shapes of the spectra and the intensity of SE depend on the number of emitting centres and the position of the crystal relative to the focus of the pump beam.
Optical centers of Yb\(^{3+}\) ion in YScO\(_3\) crystal fiber
O.K. Alimov, M.E. Doroshenko, E.A. Dobretsov, K.A. Pierpoint, S.Ya. Rusanov, V.V. Kashi, V.B. Tsvetkov; General Physics Institute RAS, Russia
The spectral-kinetic properties of Yb\(^{3+}\) optical centers in YScO\(_3\) crystal fiber were studied using selective laser spectroscopy. Three distinct types of Yb\(^{3+}\) optical centers were identified. Here we discuss nature of Yb\(^{3+}\) optical centers formation.

YAG crystal gradient-doped with Yb\(^{3+}\) ions: growth and properties
V.V. Petrov\(^1\), V.A. Petrov\(^2\), G.V. Kuptsov\(^1\), A.O. Kuptsova\(^1\), V.V. Galutski\(^2\), E.V. Stroganova\(^2\); Institute of Laser Physics SB RAS, Novosibirsk State University, Russia
Yttrium-aluminum garnet crystals with a gradient distribution of Yb\(^{3+}\) ions (Yb:YAG) were grown using the Czochralski method with liquid re-charge. The concentration of Yb\(^{3+}\) ions along the length of the crystal boule varied from 0 to 4 at.%. The subsequent studies showed the existence of a limiting gradient along the length of the crystals connected with formation of the impurities.

Numerical simulation of supercontinuum generation in all-fiber Er-doped master oscillator fiber amplifier
F. Yan\(^1\), A. Ismael\(^1\), I.O. Orehkov\(^1\), S.G. Sazonkin\(^1\), D.A. Dvoretskij\(^1\), A.A. Krylov\(^1\), L.K. Denisov\(^2\), V.E. Karasik\(^1\); Bauman Moscow State Technical University, Moscow Institute of Physics and Technology, Prokhorov General Physics Institute RAS, Moscow. Fibar Optics Research Center, Russia
Numerical study based on nonlinear Schroedinger equation was conducted to optimize the characteristics of all-fiber master oscillator fiber amplifier based on erbium-doped fiber laser. The generation of supercontinuum in high-nonlinearity fiber (HNLF) was achieved. The optimization of HNLF length, and the average power of amplified pulses led to 1155 nm spectral width at -20 dB.

Investigation of the efiect of mirror shape distortions on the optical quality of radiation in unstable resonators
S.Yu. Strakhov, A.V. Savin, N.V. Sotnikova; Baltic State Technical University «Voenmeh», Russia
The paper considers the effect of mirror shape distortions on the optical quality of radiation in unstable resonators. The influence of the level and characteristic type of distortion on the M2 parameter, the Strehl number, and the radiation divergence angle is investigated.

Optical centers of Yb\(^{3+}\) ion in YScO\(_3\) crystal fiber
A.V. Samsonov\(^1\), V.M. Yamshchikov\(^1\), G.N. Kachalin\(^1\), A.A. Tarakanovsky\(^1\), M.D. Naumov\(^1\), RFNC - VNIIEF, Russia
The results of computational and theoretical studies of diode-pumped alkali laser parameters are presented. A mathematical model is constructed, a numerical simulation of the equations of kinetics and laser radiation transfer considering the width of the pumping spectrum is given, and the optimal parameters of the laser installation were obtained, at which the calculated “light-to-light” efficiency is more than 50%.

Manufacturing of optical fibers for the range of 4-27 μm based on silver halide single crystals
A.A. Yuzhakova, A.E. Livov, D.D. Salmagareev, I.V. Yuzhakov, P.V. Pesterova, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia
A technology has been developed for producing step-index fibers based on the AgBr – AgI system single crystals. The fiber cladding is made of 8 mol. % AgI in AgBr, core 12 mol. % AgI in AgBr. The fiber diameter was 1120 μm, core diameter 550 μm. The fiber is suitable for IR lasers and pyrometry.

Theoretical research of a potassium diode-pumped alkali laser
A.V. Samsonov\(^1\), V.M. Yamshchikov\(^1\), G.N. Kachalin\(^1\), A.A. Tarakanovsky\(^1\), D.A. Elikhimov\(^1\); RFNC - VNIIEF, Russia
The results of computational and theoretical studies of diode-pumped alkali laser parameters are presented. A mathematical model is constructed, a numerical simulation of the equations of kinetics and laser radiation transfer considering the width of the pumping spectrum is given, and the optimal parameters of the laser installation were obtained, at which the calculated “light-to-light” efficiency is more than 50%.

Optical compressor as a spatial filter of PW laser beams before nonlinear temporal compression stage
S.Yu. Mironov, A.E. Khazanov; Institute of Applied Physics RAS, Russia
Impact of optical compressor on beam self-filtering before nonlinear pulse compression stage is analyzed numerically.
High power Q-switched and gain-switched fiber lasers
A.E. Alekseev, E.D. Maslova, A.A. Gagarin, S.V. Larin; IPG IRE-Polus, Russia
A compact all-fiber passively Q-switched and gain-switched Ytterbi-um-doped lasers are demonstrated. The basic laser architecture consists of two cavities encloses in fiber Bragg gratings. Several types of pulsed lasers were demonstrated: single-mode, few-mode, multimode with average output powers of 130W, 500W and 1kW. To optimize the laser performance, a special numerical model has been developed.

Obtaining stimulated emission on transitions from vibrationally excited levels of a KrF molecule at the high-power pulse discharge excitation
S.A. Yampolskaya, A.G. Yastremskii, Yu.N. Panchenko, A.V. Puchikin; Inst. of High Current Electronics SB RAS, Russia
The work theoretically and experimentally demonstrates the possibility of expanding the spectral range of tuning stimulated emission at the B–X transition of the KrF molecule due to radiation from upper vibrational levels.

WeR02-p09 10:00-13:30
A graded-index confined bismuth-doped fiber for cladding-pumped, 1550nm band high-power amplifiers
The optical radiation in a gaseous medium upon the irradiation of a cadmium into gas medium under nanosecond electron beam irradiation is studied. A cadmium foil was placed in the irradiation chamber of 5 ns was studied. A cadmium foil with electron beam of energy of 150 keV and a pulse duration of 2.5 kHz has been studied. Laser pulses with an energy of 80–120 mJ with duration of 25–35 nanoseconds were obtained.

WeR02-p10 10:00-13:30
Measurement of optical absorption coefficient of lithium-sodium molybdate crystals
We introduce the measurement results of the optical absorption coefficient of the nonlinear-optical crystal lithium-sodium molybdate LiNa5Mo9O30 (LNM). The absorption coefficient of LNM at 1070 nm wavelength was determined using piezoelectric resonance laser calorimetry.

WeR02-p11 10:00-13:30
Estimation of broadening the spectrum of laser radiation in the development of optical schemes of narrow-band fiber lasers
M.G. Slobozhanina, A.N. Slobozhanin; Federal State Unitary Enterprise «Russian Federal Nuclear Center - Zababakhin All-Russia Research Institute of Technical Physics», Russia
The paper presents a method for analytically assessing the change in the spectral linewidth of laser radiation during its amplification in high-power fiber amplifiers. The verification of the resulting expressions is given.

WeR02-p12 10:00-13:30
Temperature-induced distortions of the stacked-actuator deformable mirrors with various apertures under different cooling regimes
V.V. Toporovsky, P.M. Kuzmitsky, I.V. Galaktionov, A.V. Kudyashov; Sadovsky Institute of Geosphere Dynamics RAS, «Moscow Polytechnic University, Russia
The behavior of the stacked-actuator deformable mirrors under 10kW power was simulated with finite element method. Thermomechanical analysis of the wavefront correctors was performed in three main cases: without thermostatting, cooling through actuators and with applying periphery thermostabilization. The simulation showed that the best cooling is achieved with heat dissipation along the periphery of the mirror substrate.
Gradient method for piezoresonance laser calorimetry

K.V. Zotov, I.V. Tereshchenko, A.Yu. Ostapiv, G.Yu. Ivanov, D.D. Kazarinova, O.A. Ryabushkin; 1 Moscow Institute of Physics and Technology (National Research University), 2 Kotelnikov Institute of Radio Engineering and Electronics RAS, Russia

Gradient method for laser calorimetry was introduced in ISO 11551:1997 standard but was excluded later on because of its errors proneness due to the finite thermal conductivity. We demonstrate that in the case of piezoelectric resonance calorimetry it shows good agreement with the methods included in the actual standard since the temperature is averaged in the method.

Modeling of an optically pumped rare gas laser driven by a nanosecond repetitively pulsed discharge

M.V. Zagidullin, P.A. Mikheev, A.D. Dvornikov, R.A. Kuramshin; 1 Samara Branch of Lebedev Physical Institute, 2 Samara State Kirolev University, Russia

Numerical simulations of an active medium of an optically pumped rare gas laser driven by a nanosecond repetitively pulsed discharge in an Ar-He mixture at an atmospheric pressure, were performed. Calculations were carried out within the framework of a one-dimensional model of the transfer of plasma components and electron energy, with an account for spatially inhomogeneous optical pumping.

Thermal lens measurement in LNM with Gerchberg-Saxton algorithm

A.S. Burkov, N.V. Tereshchenko, N.A. Khollov; 1 Moscow Institute of Physics and Technology, 2 NTO IRE-Polus, Russia

Thermal lensing in LNM crystal was investigated with a technique, based on Gerchberg-Saxton algorithm. Abrerrations of thermal lens, as well as its focal length were measured at 35 W of optical power, depending on the polarization of the incident light, with -0.32 m for one polarization, and more than 10 m thermal lens for the other orthogonal polarization.

Optical fuse as a countermeasure against light injection attacks on quantum key distribution systems

E.V. Borisova, A.A. Ponomonov, B.I. Galagan, V.V. Koltashov, N.R. Arutyunyan, V.V. Makarov; 1 Russian Quantum Center, 2 Prokhorov General Physics Institute RAS, 3 Dianov Fiber Optics Research Center, Russia

In this paper, we propose an original device that can protect quantum key distribution (QKD) systems from the effects of intense laser radiation. Carbon nanomaterials dispersed in a polymer can be used as a fuse for QKD systems.

Simulation of the process of laser radiation on steel

Dias Sultamuly, Iulija S. Ruzankina; St. Petersburg Electrotechnical University "LETI", Russia

Protection of metals from corrosion is currently a relevant task, as corrosion can lead to significant deterioration in the quality and strength of metal structures, which in turn can cause accidents or costly repairs. Experimental studies have shown that the use of laser treatment is a promising method for protecting steel products from corrosion.

Investigation of the formation of green color on carbon steel using laser radiation

Yu.A. Adamenkov, M.A. Gorbunov, V.A. Shaidulina, A.A. Kalacheva, A.V. Juriev, E.V. Kabak; FSUE "RFNC - VNIEF", Russia

We have shown that the application of laser treatment is a promising method for restoring patina on the surface of cultural heritage objects made of iron-containing metals.

Optically pumped Ar-He gas laser

A.A. Kalacheva, Yu.A. Adamenkov, M.A. Gorbunov, E.V. Kabak, V.A. Shaidulina, A.V. Juriev; RFNC-VNIIEF, Russia

We represent the results of experiments on studying an optically pumped Ar-He laser (OPRGL). Measurements of output power of generation with a pulse energy of 3 J were carried out. Calculations were performed within the framework of a one-dimensional model of the transfer of plasma components and electron energy, with account for spatially inhomogeneous optical pumping.
WeRo2-p32 10:00-13:30

Study of migration of elements on the metal surfaces after laser shock peening in water medium
D.A. Bessonov, Yu.V. Chebotarevsky, T.N. Sokolova, E.L. Surmenko, P.N. Ustinov; Saratov State Technical Univ., Russia
The results of the laser shock peening in water medium are presented. The estimation of chemical composition of surface was studied by LIBS-method. The diffusion of paints and migration of elements of the substrate was observed layer-by-layer for aluminum and steel plates.

WeRo2-p33 10:00-13:30

Radiation power distribution over the beam cross section in a nitrogen laser pumped by longitudinal discharge
Z.V. Shvets, B.A. Kozlov; Ryazan State Radio Engineering Univ., Russia
The influence of exciting pulses on the distribution of radiation in beam cross section nitrogen laser has been studied. The determining role in the formation of radiation with minimal power in the “halo” is played pulse repetition frequency and rise time of the voltage pulses.

WeRo5-p01 10:00-13:30

Generation of long-lived strong magnetic fields in laser targets with cylindrical micro-channels
A.A. Andreev,1,2 L.A. Litvinov,1 K.Y. Platoni,1 St. Petersburg State University; 1Peter the Great St. Petersburg Polytechnic University; 2Ioffe Institute, Russia
Superstrong magnetic field generation by a circularly polarized intensive laser pulse in a target consisting of several touching cylindrical nano-channels is considered. The cylindrical shells collapse towards the cylinder axis leads to magnetic field increase and continues for a sub-picosecond time. As a result, a long-lived Giga-Gauss magnetic field is generated in the laser target volume.

WeRo5-p02 10:00-13:30

Plasma-mirror -based laser pulse contrast enhancement system for multiterawatt laser facility
Laser pulse contrast enhancement system (CeS) for a 200 TW femtosecond laser was developed on the base of the double plasma mirror technology. We report optical schemes of the CeS, optical alignment system and results of the first experiments on the interaction of the high-contrast laser pulses with solid targets at intensities up to 1020 W/cm².

WeRo5-p03 10:00-13:30

Research of ultrashort laser processing Si and glass for microelectronics applications
D.M. Kataev,1 N.N. Evthikhiev,2 N.V. Grezhev,1 M.A. Murzakov,1 1LLC “IRE-POLUS” LTD; 2National Research Nuclear University MEPhI, Russia
Research of the laser processing by femtosecond pulses of borosilicate glass and silicon substrate has been carried out. At pulse energies in the range up to 15 μJ, a weld is formed at the interface “glass-silicon substrate”. Experiments were carried out on laser cutting glass to form a base structure. The work of perforating holes in the Si was completed.

WeRo5-p04 10:00-13:30

Research of the interaction ultrashort pulses in the processes of laser welding dissimilar metal and glass joints
M.A. Murzakov,1 N.N. Evthikhiev,2 D.M. Kataev,1 1LLC “IRE-POLUS” LTD; 2National Research Nuclear University MEPhI, Russia
Results of experiments on the formation of metal-glass welded joints under influence of 1-3 ps pulses are presented. When laser radiation interacts with metal and glass, mechanical bond is formed at the interface between dissimilar materials. It is shown that the formation welds occurs at pulse energies of 30 μJ.

WeRo5-p05 10:00-13:30

Experimental observation of Weibel instability in the astrophysical and Fast Ignition relevant plasmas induced by ultrashort 250 TW laser pulse
R.S. Zemskov, S.E. Perevalov, A.V. Kotov, A.A. Murzanev, A.N. Stepanov, A.A. Soloviev, M.V. Starodubtsev, A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia
Weibel instability was observed experimentally in the plasma generated after irradiation a solid target with a 250 TW ultrashort laser pulse at the PEARL petawatt laser facility. A small-scale current-structured Weibel instability has been studied using various optical diagnostics. The influence of laser radiation intensity and an external magnetic field on generation of the Weibel instability has been investigated.

WeRo5-p06 10:00-13:30

Numerical simulation of broadband chirped pulses amplification in Yb3+:KGW using Maxwell-Bloch equations
I.V. Kuzmin, S.Yu. Mironov, E.R. Kocharovskaya; Federal Research Center Institute of Applied Physics RAS, Russia
The features of broadband chirped infrared laser pulses amplification by using a numerical solution of the Maxwell-Bloch equations for a four-level medium are considered in this work.
Theoretical model of the self-trapping of a laser pulse in a relativistic plasma
I.I. Metelski\textsuperscript{1,2}, V.F. Kovalev\textsuperscript{1}, Y.V. Bychenkova\textsuperscript{1,2}; The Federal State Unitary Enterprise Dukhov Automatics Research Institute (VNIIA); Lebedev Physical Institute RAS; Keldysh Institute of Applied Mathematics RAS, Russia
Using a model approach the previously discovered in numerical simulation regime of stable propagation of relativistically intense laser pulses in a plasma over distances much greater than the Rayleigh length was studied. Conditions for matching the laser spot size with the plasma density and laser pulse intensity, which correspond to the self-trapping of radiation for relativistic plasma nonlinearity, are obtained.

Development of multicolor parametric amplifier based on sub-ps ytterbium laser
K.A. Glushkov, I.B. Mukhin, E.A. Perevezentsev; Institute of Applied Physics RAS (IAP RAS), Russia
A universal multicolor converter of sub-ps pulses of ytterbium lasers in a few cycle femtosecond pulses with the ability to adjust the central wavelength in the range from 650 to 2500 nm has been created. The possibility of amplification of these pulses to the mJ energy level by OPCPA and FOPA methods has been studied.

Temporal transformation of noise-like pulse bunches in an Erdoped fiber laser
A.Yu. Fedorenko, A.O. Prudnikov, I.O. Orekhov, D.A. Dvoretskiy, S.G. Sazonkin, LK. Denisov, V.E. Karasik, Bauman Moscow State Technical University, Russia
A fiber laser generating noise-like two-pulse bunches with duration of ~66 fs is presented. The transformation of these pulses into a multi-bound soliton regime with a duration of 142 fs is investigated.

Energy relaxation in a strongly excited electron subsystem of a Nickel film on a substrate
S.A. Romashkevich, S.A. Eladshin, P.A. Tyganyko, S.I. Ashitkov; Joint Institute for High Temperatures RAS, Center for Materials Technologies, Skolkovo Institute of Science and Technology, Russia; Universidad Industrial de Santander, Bucaramanga, Colombia
Non-destructive and non-contact all-optical methods for characterization of thermal and mechanical properties of layered materials with nanoscale spatial and femtosecond/picosecond temporal resolutions are in ever-increasing demand. We report on an experimental study of energy relaxation in a strongly excited electron subsystem of a Nickel film on a substrate upon ultrafast irradiation using time-resolved reflectivity measurements with phase-sensitive signal detection.

Dependence of electron beam characteristics on laser pulse polarization
O.D. Svinidova\textsuperscript{1,3}, M.G. Lobok\textsuperscript{1,3}, V.Yu. Bychenkova\textsuperscript{1,3}, LPIL, VNIIA, PIrogov RNRMU, Russia
In this work we investigated the influence of the laser pulse polarization on an electron beam accelerated in the longitudinal wake field of the laser pulse.

Generation of second and third harmonics of XUV pulse by noble-gas atoms in the presence of intense infrared field
A.A. Romanov\textsuperscript{1,2}, A.A. Sialev\textsuperscript{1,2}, N.V. Vvedenski\textsuperscript{1,2}, M.V. Frolov\textsuperscript{1,2}; Institute of Applied Physics RAS, Nizhny Novgorod State University, Voronezh State University, Russia
The generation of second and third harmonics of XUV pulse by noble-gas atoms in infrared pulse is studied by solving numerically time-dependent Kohn-Sham equations. We show that all electrons in outer shell of atoms contribute significantly to these harmonics. Generation of XUV harmonics can be used to measure nonlinear susceptibilities in XUV range and monitor the phase of XUV pulse.

Spectral “breathing” of extremely compressed mid-infrared wave packet in dispersive medium
A. Dormidonov, E. Zolotnaya; Dukhov Automatics Research Institute, Russia
Features of multioctave frequency broadening of Mid-IR single-cycle light bullet are investigated. The group velocity dispersion moves the generated high frequencies out of the light bullet’s core that limits the short-wavelength cutoff of the supercontinuum. The periodic change of cosine and sine-mode during the propagation of the light bullet leads to the formation of a striped pattern of supercontinuum distribution.

The fs-laser inscription of fiber Bragg gratings based on spatial light modulator
A.V. Dostovalov\textsuperscript{1}, A.Y. Kokhanovskiy\textsuperscript{1}, A. Revjakin\textsuperscript{1}, Z.E. Munkueva\textsuperscript{1,2}, D.S. Kharenko\textsuperscript{1,2}, S.A. Babin\textsuperscript{1,2}; Institute of Automation and Electrometry SB RAS, School of Physics and Engineering, ITMO University, Novosibirsk State University, Russia
We introduce a flexible method utilizing femtosecond laser technology for writing FBGs inside fiber core. Using a spatial light modulator enables precise positioning of the focal point within the core. This method enables to create uniform, phase-shifted, apodized FBGs and allows to change of the grating pitch dimension from a single point to more complex shapes, showcasing 3D structuring.

Magnonic oscillations of cluster laser plasma
A.A. Andreev\textsuperscript{1}, L.A. Litvinov\textsuperscript{1}, K.Yu. Platonov\textsuperscript{1}, St. Petersburg State University, Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia
We explore the generation of super strong magnetic fields in cluster plasmas using circularly polarized, relativistically intense laser pulses. The resulting magnetic fields induce magnetic moments and magnon oscillations within clusters, with a characteristic terahertz frequency. Our focus is on the consequent dynamics and interactions of these magnetic moments, crucial for understanding terahertz radiation generation in cluster plasma environments.

Features of vibrational nonlinear response in THz Kerr effect
M.S. Guselnikov, S.A. Kozlov, ITMO University, Russia
It was recently discovered via Z-scan technique that some media possess giant nonlinear refractive index coefficient n2 in terahertz spectral range. This result was doubted, because n2 measured via terahertz Kerr effect is occurred orders of magnitude smaller. Here we theoretically showed that parameter n2 measured in terahertz Kerr effect is not n2. Our calculations matched with experimental results.

Particle drift, diffusion, and acceleration in quasi-static fields generated by ultrashort relativistically intense laser pulse channeling in near-critical density targets
A.J. Castillo\textsuperscript{1,2}, S.G. Bokharev\textsuperscript{1,2}, Yu.V. Bychenkov\textsuperscript{1,2}; Peoples’ Friendship University of Russia (RUDN University); Lebedev Physics Institute RAS, The Federal State Unitary Enterprise Dukhov Automatics Research (VNIIA), Russia
The dynamics of charged particles in the self-generated quasistatic fields of channels produced by the interaction of an ultrashort relativistically intense laser pulse with near-critical density plasmas has been studied numerically. We identify distinctive mechanisms of drift, diffusion, and acceleration of electrons in quasi-static fields generated in the laser plasma channel produced by ultrashort intense laser pulses.

High-order harmonics generation by solid slabs in two-color infrared and ultraviolet field
A.A. Romanov\textsuperscript{1,2}, A.A. Sialev\textsuperscript{1,2}, N.V. Vvedenski\textsuperscript{1,2}, M.V. Frolov\textsuperscript{1,2}; A.V. Gaponov-Grekhov Institute of Applied Physics, Lobachevsky State University of Nizhny Novgorod, Voronezh State University, Russia
High-order harmonic generation (HHG) by solid slab in infrared (IR) field with the addition of ultraviolet (UV) pulse is studied numerically using developed code. It is shown that dependence of harmonic yield near HHG cutoff on time delay between IR and UV pulses represents interference pattern with oscillation frequency equal to UV-pulse frequency and averaged shape coinciding with UV-pulse envelope.
Interferometric reconstruction of the complex amplitude (IRCA) of femtosecond pulses
A. Mukhamedyanov1, K.A. Akmarov2, K.A. Emelyanov2, S.A. Babaev2, S.P. Nikitin2; 1FEB RAS, 2ITMO University, Russia
A novel femtosecond diagnostic technique based on interferometric reconstruction of the complex amplitude (IRCA) is introduced. It employs single-scan acquisitions of the Michelson interferometer signal along with the fringe-resolved autocorrelation function. Fourier transform spectroscopy is used to evaluate pulse spectrum. The pulse E-field is calculated based on acquired ACF and spectrum. Such approach simplifies hardware, reduces mechanical dimensions and costs.

Shape and temperature fiber sensors based on fs-laser written reflectors in 7-core fiber and machine learning
Z.E. Mukhueva1, K.A. Bronnikov1, D. Sakhno1, A.Y. Kokhanovsky2, A.V. Dostovalov1, S.A. Babin1,2; 1Institute of Automation and Electrometry SB RAS, 2Novosibirsk State University, Russia
We present the experimental results on development of 3D shape and temperature fiber sensors based on random and regular reflectors inscribed by femtosecond laser radiation in 7-core fiber. In the first case the 3D shape measurements accuracy of ~5% was achieved, whereas in the second case temperature sensor utilizing a machine learning algorithm for a spectral analysis was demonstrated.

Femtosecond laser pulse for γ-rays scintillators response investigation
V.A. Simonova, A.D. Savvin, V.P. Mitrokhin, E.D. Zaloznya, A.E. Dormidonov; Dukhov Automatics Research Institute (VNIIA), Russia
The determination of the characteristics of high-speed plastic scintillators without exposure to pulsed γ-rays has been demonstrated. The obtained data are shown to correspond with measurements carried out when exposed to a source of picosecond γ-rays, which confirms the possibility of using a femtosecond laser setup as a safe tool for studying the parameters of scintillation converters of γ-rays.

Features of isotropic dielectric media vibrational nonlinear response in THz Kerr effect
M.S. Gusechkov, S.A. Kozlov; ITMO University, Russia
It was recently discovered via Z-scan technique that some media possess giant nonlinear refractive index coefficient n2 in terahertz spectral range. This result was doubted, because n2 measured via terahertz Kerr effect is occurred orders of magnitude smaller. Here we theoretically showed that parameter measured in terahertz Kerr effect is not n2. Our calculations matched well with experimental results.

Characterization of solid hydrogen isotopes layer parameters in cryogenic target for inertial confinement fusion
E.Yu. Zarubina, M.A. Rogozhina, I.A. Chugurov; The Russian Federal Nuclear Center—All-Russian Scientific Research Institute of Experimental Physics (RFNC-VNIIEF), Russia
The program system for indirect-drive cryogenic target was developed which makes it possible to measure liquid fuel when filling the shell during the performance of the experiment on developing the technology for target creation, to perform the characterization of the solid cryogenic layer parameters, to evaluate characterization results robustness.

Measuring the parameters of relativistic electron beams accelerated from thin solid targets by femtosecond laser pulses of 100 TW power
A series of experiments on the generation of relativistic electrons beams from thin solid targets was carried out using a femtosecond high-intensity laser system. Spectra, angular distributions and total charges of the relativistic electron bunches accelerated in the laser field and transmitted to the back side of the target were characterized.
**Simulation of super-Gaussian laser beam propagation over 1 km turbulent atmospheric path with account for pre-generated Kolmogorov phase screens**

I. Galaktionov, P. Kuzmitsky, V. Toporovsky, A. Kudryashov, Sadosky Institute of Geosphere Dynamics RAS, Russia

The turbulence simulator software that generates the sequence of phase screens with Kolmogorov spectra is developed and tested. The numerical experiment of laser beam propagation over the 1 km atmospheric path is performed and results are investigated.

**Increasing the sensitivity of spark discharge diagnostics during the transition to the long-wave region**

K.T. Smaznova, E.V. Parkevich; Lebedev Physical Institute RAS, Russia

It was shown that in the laser sensing method, the resolution of the spark channel structure increases during the transition from 532 nm to 1064 nm, which makes it possible to obtain quantitative data on the plasma parameters of a single microchannel.

**PECVD synthesis of the CdTe thin films for tandem solar cells application**

L.A. Mochalov1, M.A. Kudryashov1, M.A. Vshivtsev1, Yu.P. Kudryashova1, S.S. Serafomova1, I.I. Terukov1, Lobachevsky University, Russia

The problem of identifying the dynamics of emissions of methane-containing gases is considered. The problem of constructing adequate mathematical models intended for intelligent automated forecasting of emissions of the gas under study has been determined and solved. Methane emission models, algorithmic and software for modeling gas clouds and studying them have been developed.

**Optical solver for diffraction imaging of plasma microstructures in the field of a coherent laser radiation**

E.V. Parkevich, A.I. Khriyanova, T.F. Khriyanyov, D.V. Tolbukhin, K.V. Shpakov, Lebedev Physical Institute RAS, Russia

We demonstrate an optical solver designed for the in-depth imaging analysis of plasma microstructures with the possibility to reconstruct their optical properties by using the results of laser interferometry and shadowgraphy. The solver is based on modeling direct and inverse diffraction problems in various approximations, processing laser interferograms and shadowgrams taking into account the response function of a lens system.

**Visible light communication system based on RGBW LEDs**

D.S. Shlyayev, K.R. Razhzhiva, A.A. Kundius, I.S. Polukhin, E.S. Kolodesnyi, ITMO University, Russia

RGBW Li-Fi communication system with data transfer rate up to 42 Mbit/s was designed.
A.S. Dudin 1,2, D.R. Kharasov 1, E.A. Fomiryakov 1, D.M. Bengalski 1, O.E. Nani 1,2, S.P. Nikitin 1, V.N. Treschikov 1; 1 TB Sensor LLC, 2 Lomonosov Moscow State University, Russia

In this Letter, we report a high-sensitive single-ended distributed acoustic sensor based on a phase-sensitive OTDR with the 130 km operating distance along standard single mode telecom fiber. This sensing range is achieved by incorporating a single erbium-doped fiber segment and remotely pumping it using same sensing fiber at a distance of 98 km from the near end.

WeR06-p15
10:00-13:30
Correction for non-leveling ground-based Doppler wind lidar
Zhang Caishi 1,2, Sheng Yicheng 1, Cao Dingxiang 1, Zhao Deping 1, Chen Zhe 1; 1 Department of Optoelectronic Engineering, Jinan University; 2 Zhuhai Emgo-Tech Co. Ltd.; Jihua Laboratory, Foshan, Guangdong, China

Wind resource assessment is a crucial stage in wind energy development. Doppler wind lidar is an effective tool for accurately measuring the wind field under different circumstances. We have proposed a method to calibrate the pointing orientation of laser beams with a compass and then retrieve the wind profiler even with no leveling to Lidar.

R10: NONLINEAR QUANTUM PHOTONICS - POSTERS

WeR06-p14
10:00-13:30
130-km-sensing-range single-ended high-sensitive distributed acoustic sensor based on phase-sensitive OTDR assisted by remote optically pumped amplifier
A.S. Dudin 1,2, D.R. Kharasov 1, E.A. Fomiryakov 1, D.M. Bengalski 1, O.E. Nani 1,2, S.P. Nikitin 1, V.N. Treschikov 1; 1 TB Sensor LLC, 2 Lomonosov Moscow State University, Russia

WeR06-p16
10:00-13:30
Zernike-based hill-climbing algorithm for super-Gaussian and doughnut-like laser beam shaping by means of a phase-only spatial light modulator
I. Galaktionov, A. Nikitin, J. Sheldakova, V. Toporovsky, A. Kudryashov; Sadovsky Institute of Geosphere Dynamics RAS, Russia

Adaptive optical system with phase-only special light modulator and intensity analyzer for laser beam shaping was assembled. The newly developed Zernike-based hill-climbing algorithm for creating the super-Gaussian and doughnut-like intensity distributions was developed. It was shown that about 60% and 75% of the initial beam energy was concentrated in the focal spot for the doughnut-like and flat-top intensity distributions, correspondingly.

WeR10-p01
15:00-18:30
Crystal growth and optical properties of TbM3 (BO) (M = Al, Ga) crystals
A.E. Kokh 1, A.V. Jamous 1, M.I. Rakhmanova 1, K.A. Kokh 1, A.B. Kuznetsov 1, Sobolev Institute of Geology and Mineralogy SB RAS; 2 Tomsk State University; 3 Sobolev Institute of Inorganic Chemistry SB RAS, Russia

TbGa3(BO3)4 and TbAl3(BO3)4 crystals were grown using the flux method. The produced compounds crystallize in the R32 space group. A strong green emission of the luminescence is primarily dominated by the 5D4 to 7F5 transition in Tb3+. According to the data obtained, the SHG efficiency is higher for the TbGa3(BO3)4 compound due to its higher molar mass.

WeR10-p02
15:00-18:30
Resonant scattering under two-photon excitation in a GaN crystal
L.E. Semenova 1, Y.Y. Maslova 1, M.A. Semenov 1, Prokhorov General Physics Institute RAS, 2 Lebedev Physical Institute RAS, Russia

The resonant hyper-Raman scattering process in a wurtzite GaN crystal was theoretically studied, taking into account the possible dipole transitions to the deeper valence band.

WeR10-p03
15:00-18:30
Increasing BOTDA precision using correlation image processing methods
Yu.A. Konstantinov, F.L. Barkov, A.I. Krivosheev; Perm Federal Research Center UB RAS, Russia

WeR10-p04
15:00-18:30
H 3 diamond color centers for quantum magnetometry
E.I. Lipatov 1,2, O.I. Lyga 1, V.V. Chashchin 1, M.A. Shulepov 1, V.G. Vins 1, A.P. Yelisseyev 1, Tomsk State University, Institute of High-Current Electronics SB RAS, VELMAN LLC, Sobolev Institute of Geology and Mineralogy SB RAS, Russia

The sensitivity of diamond H3 color centers to magnetic field has been demonstrated for the first time. Diamond H3 color centers represent the neutral charge state of N-V-N centers with two donor electrons localized in the vacancy. This suggests the spin splitting of electronic states. Probably, H3 centers may be preferable to NV centers for quantum sensors and computing.

WeR10-p05
15:00-18:30
Achieving subwavelength cavity using an amplifying medium
I.V. Doronin 1,2, I.O. Lyga 1, V.V. Chashchin 1, M.A. Shulepov 1, V.G. Vins 1, A.P. Yelisseyev 1, Tomsk State University, Institute of High-Current Electronics SB RAS, Russia

We show that resonance condition can be achieved for an active dielectric layer of subwavelength size placed in free space. This effect occurs due to the fact that light, when reflected from the amplifying medium-vacuum interface, acquires a negative phase shift that compensates positive propagation phase shift. We show that at large gain rate lasing begins in the proposed subwavelength.

WeR10-p06
15:00-18:30
Center-of-mass tomography for multimode photon states
I.V. Dudinets 1,2, V.I. Man’ko 1,3, Lebedev Physical Institute RAS, Russia

I.I. Lipatov 1,2, O.I. Lyga 1, V.V. Chashchin 1, M.A. Shulepov 1, V.G. Vins 1, A.P. Yelisseyev 1, Tomsk State University, Institute of High-Current Electronics SB RAS, VELMAN LLC, Sobolev Institute of Geology and Mineralogy SB RAS, Russia

There exists tomographic probability representations of quantum mechanics. In these representations the states of quantum systems are described by probability distributions. In our work we study the center-of-mass tomography of multimode electromagnetic field states. We present the concept of entangled probability distribution of random variables. Examples of entangled probability distribution are considered.
High effective LiB, Q, laser
N.G. Zacharov1; A.S. Safronov1; A.V. Savkin1; V.I. Lazarenko1; E.V. Saltikov1; I.I. Karpov1; A.A. Lobanova1, A.A. Danilova1; 1 Russian Federal Nuclear Center; 2 Sarov branch of the Lomonosov Moscow State University, Russia

In this contribution, we investigate second harmonic generation in poly-crystalline LiNbO3 with optical pump. The transition to a resonator design with a moving active medium allowed us to reduce the influence of thermal effects on the characteristics of the output radiation.

Modification of the JINR laser driver to generate relativistic electron beams with orbital angular momentum status report
A.S. Dyatlov; ITMO University, Russia

I report the status of work to modify a powerful laser driver that is planned to be used within the project on development of a source of relativistic electrons with angular momentum.

Optical system for gravimeter based on cold atoms
G.V. Ospenko1, M.S. Aleykniy2; FSUE "VNIITFRI", Russia

The results of the atomic gravimeters optical system development are presented. Frequency and power stabilities of the main parts of the optical system responsible for atom preparation and interrogation are studied. The preliminary results of cold atomic ensemble preparation are given.

Two-temperature distribution in task of laser cooling in fields with a polarisation gradient of atoms
A.A. Kirpichnikova1, R.Va. Il'enkov1, O.N. Prudnikov1; Institute of Laser Physics SB RAS, Russia

We suggested a two-temperature model of velocity distribution for laser cooling of neutral atoms with not small enough recoil parameter. Analysis of temperatures of "cold" and "hot" fractions and their proportions showed better description of ensemble energy. It is of significant importance for solving the problem of achieving deeper laser cooling and analysis of cooled atomic clouds.

Research on EIT in ground state of NV centers in diamond in transverse magnetic field
S.M. Drofa1,2; S.V. Bolshevedovskii1,2; V.V. Goshenko1,2; E Primak1,2; P. Vilyuzhanina1,2; A.N. Smolyarinov1,2; V.N. Sorokin1,2; A.V. Akimov1,2; Lebedev Physical Institute; 2Spinor Technologies; 3Moscow Institute of Physics and Technology; 4Russian Quantum Center; 5National Research Nuclear University MEPhI, Russia

NV-centers are a good platform for quantum sensing. Quantum sensing requires nuclear spin polarization while general methods require high current and therefore can’t be implemented on chip. One of the alternative methods utilizes weak electron-to-nuclear spin transition in transverse magnetic field, which became the topic of this work.

Thermo-optical effects impact on a compact high-Q Fabry-Perot cavity characteristics
K.Yu. Khabarova1,2; D.S. Kryuchkov1,2; N.O. Zhadnov1,2; K.S. Kudelaryov1,2; G.A. Vishnyakova1,2; N.N. Kolachevsky1,2; Russian Quantum Center; Lebedev Physical Institute RAS; 2Moscow Institute of Physics and Technology, Russia

Heating of mirrors by intracavity laser radiation can lead to a change in the optical length of the cavity due to thermal deformation, thermo-optical effect and light pressure. Thermal deformation leads to a hysteretic appearance of the cavity transmission line when scanning the radiation frequency in different directions and to a displacement of cavity zero expansion point and eigen modes.

Coexistence of discrete-variable phase-time coding QKD with intense classical signals over 60 km
A.V. Borisova1, A.N. Klimov2, I.V. Gritsenko1; 1JSC InfoTeCS; 2Quantum Technology Centre, Lomonosov Moscow State University, Russia

This report presents the results of an experimental study of the performance of the QKD system in coexistence with strong C-band signals in a single fiber. The possibility of QKD over a distance up to 60 km with a total power of classical channels up to 20 mW has been demonstrated.

Implementation of reinforcement learning algorithms for fiber mode-locked lasers
A. Kokhanovskiy1,2; K. Serebrennikov1; E. Kuprikov1; School of Physics and Engineering, ITMO University; Institute of Automation and Electrometry SB RAS, 2Department of Physics, Novosibirsk State University, Russia

We demonstrate the application of various types of reinforcement learning algorithms for the following tasks: self-starting, stability under temperature fluctuations, and optimization of the pulsed regimes of fiber mode-locked lasers. The feasibility of implementing reinforcement algorithms for such a multi-stable system as fiber-locked lasers is demonstrated. Major drawbacks of the reinforcement learning algorithms are discussed.

Raman scattering for gas detection
A.V. Sleeva1, A.V. Baryshev; Federal State Unitary Enterprise Dukhov Automatics Research Institute (VNIIA), Russia

Raman spectroscopy allows the detection of gas molecules, including diatomic molecules such as O2, N2 and H2. In a developed system, concentrations of gases in a mixture are determined by the intensity of the Raman spectra peaks. For H2, N2, O2 and CO2, the demonstrated detection limit was tens of ppm with 60 s exposure time.
FROG technique for the entangled soliton pulses identification
Yu.A. Masharina1, L.A. Melnikov1, A.A. Sysolyatin1, I.V. Zhukhtova1, A.D. Zverev2, A.I. Konukhov1,3; 1Yuri Gagarin State Technical University; 2Prokhorov General Physics Institute RAS; 3National Research Nuclear University MEPhI, Russia
We propose to use the source of entangled optical pulse with large photon number, which can be produced via fission of the two-soliton breather in the optical fiber with periodically varying along the fiber dispersion for quantum communications and quantum sensing. For the detection of the scattered field we propose to use the frequency resolved gating technique.

WeR10-p20  15:00-18:30
On investigation dispersive readout technique for NV -center in diamond
E.A. Prinak1,2, M. Kozodeev1, S.V. Bolshevorskii1, V.V. Soshenko1, I.S. Cojocaru1, P.G. Vilyuzhina1,2, S. M. Drofa1, A. Chernyavskiy1,2, V.N. Sorokin1, A.N. Smolyaninov1, A.V. Akimov1,2; 1Moscow Institute of Physics and Technology (National Research University); 2Russian Quantum Center; 3National Research Nuclear University MEPhI; 4Lebedev Physical Institute RAS; 5LLC Sensor Spin Technologies, Russia
Dispersive readout technique proposes a strong coupling of a high quality resonator with a quantum system in order to enhance readout fidelity. In this work we investigate the implementation of the dispersive readout to nitrogen vacancy centers in diamond in order to increase precision and diminish noise of the measurements in quantum sensors.

WeR10-p21  15:00-18:30
Second-harmonic generation in LiNa5Mo9O30 crystalline sample
D.A. Denisov1, D.Yu. Demushkin1, I.V. Grishchenko1, N.A. Khokhlov1, E.S. Barkanova1, A.P. Sadowskij1, A.V. Konyashkin2, A.A. Sysolyatin1; 1Moscow Institute of Physics and Technology (National Research University); 2Russian Quantum Center; 3National Research Nuclear University MEPhI; 4Lebedev Physical Institute RAS; 5LLC Sensor Spin Technologies, Russia
Second-harmonic generation (SHG) of 1030 nm wavelength was performed in lithium-sodium molybdate crystalline sample. The dependences of both SHG power and conversion efficiency on pump power were measured.

WeR10-p22  15:00-18:30
Correlation-based technique for the BFS extraction
F.L. Barkov1, A.I. Krivosheev1, Yu.A. Konstantinov1; Perm Federal Research Center UB RAS, Russia
The paper presents a method for extracting the Brillouin frequency shift from spectra obtained by Brillouin sensors. At low signal-to-noise ratios, the method, and especially its combination with Lorentz curve fitting, outperform existing approaches in accuracy.

WeR10-p23  15:00-18:30
Efficiency assessment for quantum repeater scheme based on multimode optical Schrödinger cat states
R. Goncharov1,2, A. D. Kislev1, V. Egorov1,2; 1Quantum Information Laboratory, ITMO University, Saint Petersburg, Russia; 2Leading Research Center "National Center for Quantum Internet", ITMO University, Saint Petersburg, Russia; 3SMBT-Quantatelecom LLC, Saint Petersburg, Russia; 4Laboratory of Quantum Processes and Measurements, ITMO University, Saint Petersburg, Russia
We study the quantum repeater architecture based on multimode optical cat states proposed in our recent paper (Phys. Rev. Appl. 20, 044030 (2023)). It is shown that, for the scheme that employs the doubling strategy, approximate estimates of the mean waiting time are close to exact values. Our protocol is found to outperform the one using photon pair sources.

WeR10-p24  15:00-18:30
Protection method against bright light attacks based on fiber fuse effect
K.E. Bugai1, I.S. Sushchev1, D.S. Bulavkin1, R. Yu. Lokhmatorov1, D.A. Dvoretsky1,2; 1Bauman Moscow State Technical University, Russia; 2Bauman Moscow State Technical University, Russia
We present a protection method operating on the fiber fuse effect, which restricts the light of eavesdropping devices. Successful proof-of-principle testing was demonstrated, with the method applicable to other components of the power-limiting quantum key distribution system.
WeR10-p30 15:00-18:30
Quantum correlation in twin pulses generated by soliton fission
A.A. Sysolatina, I.A. Melnikova, Ju.G. Konyukhova, A.I. Konyukhov; Saratov State Technical University; Institute of Physics, Saratov State University; Prokhorov General Physics Institute RAS, Russia
We study the quantum fluctuations of a pulse pair parameters created by second-order soliton fission in a dispersion oscillating fiber. The correlation function and squeezing ratio depend on the modulation period and modulation phase of the fiber dispersion. The squeezing ratio depends on the pulse propagation distance and can be enhanced using optimized dispersion parameters.

WeR10-p31 15:00-18:30
Relaxation processes in optical systems with ultra-strong coupling regime
T.T. Sergeyev, A.A. Zhabovskyi; Dukhov Research Inst. of Automatics (VNIIA); Moscow Inst. of Physics and Technology; Inst. for Theoretical and Applied Electromagnetics, Russia
Ultra-strong coupling regime occurs in systems where the coupling strength is above the eigenfrequency of the system. We present an analytical model for calculating relaxation rates in systems with ultra-strong coupling regime. The results show that increasing of coupling strength leads to significant decreasing of relaxation rates. It can be used to suppress losses in optical systems with strong coupling.

WeR10-p32 15:00-18:30
Study of light diffraction on chirped two-layer inhomogeneous holographic diffraction structures PPM-LC
D.S. Rastegin, V.O Dolgirev, S.N. Shanarogovitch; Tomsk State University of Control Systems and Radioelectronics, Russia
In this paper, as a result of numerical modeling, an increase in the width of the selective response of a diffraacted beam is shown by changing the period of recorded chirped double-layer holographic diffraction structures formed in a photopolymer material with nematic liquid crystals.

WeR10-p33 15:00-18:30
Dark-state resonances in elliptically polarized field for alkali vapors in a buffer-gas cell
We investigate dark-state resonances for alkali-metal atoms in a cell with buffer gases excited by frequency modulated elliptically polarized laser field. It is shown that all the resonance parameters depend on the ellipticity and that for some parameters this dependence is crucial for designing high-performance chip-scale atomic clocks.

R11: LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION AND GLOBAL NAVIGATION - POSTERS

Location: Nikolsky + Levinson Foyer, Floor 2; Date: Wednesday, July 03, 2024

WeR11-p01 10:00-13:30
Propagation of homogenized THz millimeter range beams in multi-layered media
G.S. Rogozhnikov, V.V. Kostromykhina; I.N. Nikolaeva, A.G. Efremov; FSUE “Russian Federal Nuclear Center - VNIEF”, Sarov Branch of Lomonosov Moscow State University, Russia
Several problems concerning free space communication in anhydrous media by means of THz waves of millimeter range have been reviewed. Solutions for beam homogenizing and beam spatial quality preservation have been proposed.

WeR11-p02 10:00-13:30
Four-frequency Zeeman laser gyroscopes with a symmetrical cavity, a system for separating rotation signals from orthogonal polarizations and a perimeter control system
The work presents four-frequency Zeeman laser gyroscopes with a cavity in the form of an isohedral and regular tetrahedrons. Optical or mathematical and extremal methods were used to separate the beat signals of counter-propagating waves of orthogonal polarization. Perimeter control system uses the signal of co-directional waves’ beats. A significant suppression of the external magnetic fields influence was shown.
Investigating the feasibility of attacks on the local oscillator in continuous-variables quantum key distribution systems
P.A. Morozova, M.E. Gelert, B.A. Nasedkin; ITMO University, Russia
The study explores the susceptibility of the balanced detector quantum key distribution systems arising from the constraints in electronic components. It empirically establishes the correlation between average intensity values and applied radiation power, while pinpointing the saturation threshold and signal noise levels. The results contribute to recognizing potential blinding attacks and offer insights into defense strategies.

Physical factors causing zero drift and noise in a solid-state laser gyroscope based on YAG:Cr4+ at mode locking
Yu.Yu. Broslavets, A.A. Fomichev, E.A. Polukeev, V.G. Semenov, D.S. Redichkina, A.R. Pokrovskaya; Moscow Institute of Physics and Technology (National Research University), Russia
The work presents the results of creating a solid-state YAG:Cr4+ laser gyroscope working in mode locking. Perimeter control system uses an absorbing cell with acetylene. An electro-optical modulator is used to create a frequency dither; it creates a phase shift at the moment the pulse passes. The main factors influencing the gyroscope zero drift and noise are determined.
Mid IR fiber lasers based on rare earth ions doped chalcogenide glasses (Invited paper)

V.V. Koltashev, V.G. Plotnichenko, B.I. Denker, B.I. Galagan, S.E. Sverchkov, M.V. Sukhanov, A.P. Velmuzhov, M.P. Frolov, Prokhorov General Physics Institute RAS, Russian Academy of Sciences, Russia

We demonstrate chalcogenide fiber lasers emitting at 4.6-5.4 μm. The fibers had 0.20 μm selenide core with of Tb3+ or Ce3+ doping and undoped 0.24-0.25 μm sulfide cladding. The 200 and 7 mW output power with 8 and 17% slope efficiency was obtained for Tb3+ - and Ce3+ -doped fibers respectively.

Neodymium glass laser emitting at ~6 μm.

B.I. Denker, M.P. Frolov, B.I. Galagan, V.V. Koltashev, Yu.V. Korostelin, V.G. Plotnichenko, M.V. Sukhanov, S.E. Sverchkov, A.P. Velmuzhov, Prokhorov General Physics Institute RAS, Russian Academy of Sciences, Russia

This investigation describes the energy transfer in Tb3+, Nd3+ co-doped selenide glass pumped by 2.93 μm Er:YAG laser. At liquid nitrogen temperature it leads to efficient population of 4F11/2 → 4F9/2 level. Stimulated emission corresponding to a novel laser transition 4P1/2 → 4I11/2 was demonstrated. 16 mJ output and spectral tuning from 5.56 to 6.01 μm were obtained.

Thermal lensing and laser-induced damage in special pure chalcogenide glasses under CW and pulsed mid-IR irradiations


In this report, the thermo-optical lensing and laser-induced damage were studied in some ternary and quaternary glasses based on sulfides and selenides of Ge, As, Sb, Ga and In, including doped with Tb3+ and Pr3+ ions. The thermal Z-scan technique with the quasi-CW Tm3+ :ZnWO4 laser crystal Tm3+, Li+ :ZnWO4 single-crystal was grown by the Czochralski (Cz) method. Dispersions and temperature coefficients of the refractive indices (RI), as well as the mechanical strength characteristics of the crystal were measured. Spectroscopic studies of the crystal were carried out. The first laser operation above 2 μm at this crystal was obtained.

Study of a new 2 μm laser crystal Tm3+ :ZnWO4


We present the approaches for improving the properties of mid-IR ultrafast lasers based on mid-IR doped chalcogenide crystals, including energy scaling due to multipass chirped pulse amplification in Fe:ZnSe, spectral synthesis in combination of Fe:ZnSe and Fe:CdSe gain media, as well as spectral broadening in chalcogenide fibers and studying of nonlinear properties of carbon nanotubes.

Nanosecond tunable from 2 to 3 μm Cr:ZnSe solid-state laser

D.A. Nazarov, E.A. Kozlova, M.K. Tarabrin, Bauman Moscow State Technical University, Russia

We developed a tunable in spectral range from 2 to 3 μm pulsed solid state laser based on the Cr:ZnSe crystal with 2.15 mJ maximum output energy at 2.35 μm, 7 ns pulse length and 100 Hz repetition rate. This laser could be used in theranostic system which combines a laser therapy and optoacoustic diagnostic.

- Coffee Break -
**ThR01-22**  11:30-11:45

**Nd:YAG laser terminal level relaxation time direct evaluation and its considering at picosecond pulse amplification**  
V.B. Morozov, A.N. Olenin, D.V. Yakovlev; Physics Faculty of M.V.Lomonosov Moscow State University, Russia  
Direct measurements of the terminal level relaxation time of Nd:YAG laser transition with 1064 nm wavelength were fulfilled based on the gain recovery diagnostics after picosecond saturating pulse passage. The relaxation time is estimated as ~70 ps. The result is important in view of developing effective longitudinally diode-pumped picosecond amplifiers operating under saturation conditions.

**ThR01-23**  11:45-12:00

**Athermal design of Yb:YAG thick disk active element**  
M.R. Volkov1, G.A. Kurnikov1, I.I. Kuznetsov1, I.B. Mukhin1; 1Institute of Applied Physics RAS, 2National Research Lobachevsky State University, Russia  
A specially-shaped heat conducting plate provides efficient heat removal from the disk active element only in its pumped region. Thus, the radial heat flow is blocked and thermally-induced lensing is reduced. The method was implemented with thick-disk Yb:YAG active element and composite Yb:YAG/sapphire. Zero thermal lens active element was demonstrated in the experiment.

**Towards kilowatt average laser power compression by new type of chirped volume Bragg gratings**  
E.A. Perevezentsev, M.R. Volkov, A.V. Starobor, I.B. Mukhin; Institute of Applied Physics RAS, Russia  
A comprehensive study of the first fs-laser-inscribed fused silica chirped volume Bragg gratings is performed. The perspective of the new approach together with a good agreement between the calculated and measured parameters are demonstrated. According to estimations, gratings of this type can be used at a kilowatt average laser power.

**Laser generation on NV- centers in diamonds: state of things and prospects**  
D.E. Gemin1,2, E.I. Lipatov1, V.G. Vins1, A.D. Savvin1, A.V. Samolov1, P.E. Komarova1, V.F. Lebedev1, T.S. Misnikova1, Ya.A. Rykina2; 1National Research Tomsk State University, 2Institute of High Current Electronics, 3Velman LLC, 4Dukhov Automatics Research Institute (VNIA), 5St. Petersburg State University of Aerospace Instrumentation, Russia  
In 2021 laser generation on NV- centers in diamond was demonstrated for the first time. At the time being the parameters of such-like lasers are the following: pulse energy up to 0.2 mJ, pulse duration about units of ns, also we found some interesting features. Most of them are presented in this work. Such-like lasers is a promising for different applications.
Gas lasers on hollow-core fibers (Invited paper)
A.V. Gladyshev, Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia

The joint method of nitrogen laser pumping by electric longitudinal and inductive discharges has been proposed and experimentally implemented. The generation energy reached 2 mJ at nitrogen pressure of 9…10 Torr. Enhancing pumping by inductive discharge made it possible to significantly increase the operating efficiency of an electric-discharge nitrogen laser, and in addition, improve the quality of the laser beam.

New approach of non-coherent power scaling of fiber sources for material processing
S. Larin, N. Brotyman, I. Obronor, R. Vihrov, Industrial division, IRE-Polus, Russia

A new method of a few fiber laser sources combining is proposed: using a single bulk termination with a multiply fiber inputs. A practical implementation of multi-channel pulsed fiber laser for surface cleaning application was demonstrated.

Design of fiber laser based technological equipment for direct laser deposition
G.A. Turichin, E.V. Zemlyakov, K.D. Babkin; Inst. of Laser Welding Technology, St. Petersburg Marine Technical Univ., Russia

Influence of laser beam parameters on DLD productivity and stability discussed in connection with design of laser focusing head and deposition nozzle shape. The process stability conditions on the base of linear stability analysis have been determined and proved experimentally. Practical realization of DLD technology and implementation of developed principles of equipment design will be presented also.

Woof tweeter adaptive optical system for atmospheric turbulence mitigation
V.V. Toporovsky, I.V. Galaktionov, A.N. Nikitin, A.V. Kudryashov, V.V. Samarkin, A.I. Rukosuev; Sadovsky Institute of Geosphere Dynamics RAS, Russia

A woof tweeter approach is presented for compensation of the atmospheric turbulence negative effects. As a wavefront corrector for mitigation of the low-order aberrations with large amplitude the 23-channel bimorph deformable mirror was used. To compensate for high-order aberrations with small amplitude the stacked-actuator deformable mirror with 55 control elements was exploited.

The method for the investigation of wavefront distortion in laser amplifiers
G.V. Kuptsov1, 2, A.O. Kuptsova1, 2, V.A. Petrov1, 2, V.V. Petrov1, 2; 1 Institute of Laser Physics SB RAS, 2 Novosibirsk State Technical University, Russia

The method of laser scanning is proposed and developed for the investigation of radiation wavefront distortion in active elements of high-power laser amplifiers. Optical path difference profile is calculated from experimental analysis of real-time intermodal dynamics in a Raman fiber laser.

Development of high power front-end laser system for a sub-exawatt XCELS facility (Invited paper)

The detailed design of the frontend system for XCELS laser facility has been proposed and frontend prototype is under development. The testing of the main components of the frontend laser on the PEARL laser demonstrates a significant increase of the pulse-to-pulse stability up to 3% RMS and femtosecond pulse shortening up to 36 fs.

Adaptive optical correction of powerful laser beams (Invited paper)
A. Kudryashov; M.A. Sadovskii Institute of Geosphere Dynamics RAS, Russia

In this paper we present the latest results in investigation of the efficiency of the use of adaptive optics to correct for high-power laser beam radiation. A set of deformable mirrors were applied to obtain the highest peak-power of the laser radiation in the world.
New way to multiplexed excitation of matter (Invited paper)

F.V. Potemkin, Lomonosov Moscow State Univ., Russia

Powerful dual-wavelength all-solid-state femtosecond laser complex based on Cr:Forsterite (1.24 μm) and FeZnSe (4.6 μm) crystals allow to create coherent source with multi-band (from VUV to THz) coverage and access to few-cycle pulses. Highly efficient (from 1% up to 10%) nonlinear conversion of IR pump into spectrally broad waveforms offers opportunities to get insight into matter control by light.

1 MW peak power tapered fiber amplifier of picosecond pulses operated near 1030 nm

E.K. Mikhailov, K.K. Bobkov, A.E. Levchenko, V.V. Velmiskin, D.V. Khudyakov, S.S. Aleshkina, T.S. Zaushitsyna, M.M. Babnov, D.S. Lipatov, M.E. Likachev; Prokhorov General Physics Institute RAS, Moscow, Russia

The experimental results of conditions study for formation of a highly directional supercontinuum in the visible region, which occurs during aberration focusing of radiation pulse with a wavelength of 940 nm and a duration of 70 fs are presented.

Electron acceleration and secondary processes with TW femtosecond laser pulses (Invited paper)

A. Savel’ev; Lomonosov Moscow State University, Russia

We present results of computational and experimental studies of several schemes for accelerating electrons with a femtosecond laser pulse with a peak power of 1-2 TW, the possibility of scaling the developed approaches to high peak powers (up to PW), and use of these beams for generating secondary radiation in a wide electromagnetic field ranging from terahertz to gamma.

Two-dimensional pattern of terahertz emission from single-color femtosecond filament (Invited paper)

L. Selezniev, G. Rizaev, M. Levis, D. Mokrousova, O. Pushkarev, D. Shipilo, N. Panov, I. Nikolaeva, O. Kosareva, A. Ionin; Lebedev Physical Institute RAS, Russia

Two-dimensional pattern of terahertz emission from a single-color filament plasma under different experimental conditions were measured. Hollow cone patterns observed at low (0.1-0.3 THz) terahertz frequencies. Non-axisymmetric pattern tightly bound to laser polarization observed at 1 THz.

Generation of highly directional white light in airborne laser plasma (Invited paper)

V.F. Losev; High Current Electronics Institute SB RAS, Russia

The numerical model of the laser amplification process based on the non-linear Schrödinger equation for systems with simultaneously high peak power and pulse repetition rate has been developed. A model describes the interaction of the amplified radiation and the active element in the linear regime and taper configuration, which maximized the threshold of these nonlinear effects and achieved 1 MW peak power directly at the output of the fiber.

Difference frequencies generation into the mid-IR range (5.5-9.5 μm) using femtosecond Ti:sapphire laser and a nonlinear AgGaS2 crystal

I.O. Kinyaevskiy, A.V. Koribut, Ya.V. Grudtsyn, M.V. Ionin; Lebedev Physical Institute RAS, Russia

We experimentally demonstrate laser system generating 100-fs mid-IR pulses tunable within of 5.5-9.5 μm wavelength range. This system is based on difference frequency generation of femtosecond Ti:sapphire laser pulses in a nonlinear AgGaS2 crystal.

Two-dimensional pattern of terahertz emission from single-color femtosecond filament (Invited paper)

L. Selezniev, G. Rizaev, M. Levis, D. Mokrousova, O. Pushkarev, D. Shipilo, N. Panov, I. Nikolaeva, O. Kosareva, A. Ionin; Lebedev Physical Institute RAS, Russia

Two-dimensional pattern of terahertz emission from a single-color filament plasma under different experimental conditions were measured. Hollow cone patterns observed at low (0.1-0.3 THz) terahertz frequencies. Non-axisymmetric pattern tightly bound to laser polarization observed at 1 THz.
Recent progress in research on few-cycle and unipolar electromagnetic pulses (Invited paper)
N.N. Rosanov1, M.V. Arkhipov1, R.M. Arkhipov2, A.V. Pakhomov3; 1Ioffe Institute; 2Phys. Dept., St. Petersburg State Univ., Russia

We review the recent progress in the theory and experiments on extremely short, few- and half-cycle electromagnetic pulses, including the study of their generation and registration, their features, and their impact on micro-objects and media.

ThR05-20 09:30-09:45
Spatio-temporal properties of an atomic medium interaction with vortex vector fields of femtosecond duration
A.V. Andreev, O.A. Shoutova; Lomonosov Moscow State University, Russia

The problem of atomic media interaction with vortex laser fields is studied within the frame of nonperturbative approach and vector focusing description. The response (from 3rd to 17th harmonics) intensity and polarization, depending on the distance between the generation plane and the detector, in the plane perpendicular to the optical axis and in the sagittal plane, was explored.

ThR05-21 09:45-10:15
Generation of CEP stable GigaWatt sub-cycle pulses and its application for spectroscopy of ultrafast electron dynamics in semiconductor (Invited paper)
A.B. Fedotov1,2, I.V. Savitsky1, A.A. Voronin1,2, E.A. Stepanov1,2, A.A. Lanin1,2; 1Lomonosov Moscow State University, Russia; 2Russian Quantum Center, Skolkovo, Russia

The influence of the carrier-envelope phase (CEP) on the supercontinuum spectrum and the characteristics of extremely short pulses formed as a result of nonlinear optical conversion of pump pulses in an argon-filled hollow anti-resonant waveguide have been demonstrated.

ThR05-22 10:15-10:30
Optimization of noncollinear schemes of coherent beam combining
V.I. Turov1, S.N. Bagaev1, S.A. Frolov1, A.V. Kirpichnikov1, S.V. Avtueva1, V.V. Petrov1; 1Laboratory of Physics of Ultrashort Pulse Lasers, Institute of Laser Physics SB RAS, Russia

We present the results of theoretical and experimental studies on the optimization of coherent combining schemes for high-power pulses in noncollinear geometries, detailed analysis of the requirements on the parameters of the combined pulses to achieve high efficiency of coherent combining.

ThR05-23 10:30-10:45
Coherent beam combining set-up prototype for XCELS project
K.F. Burdonov1, A.A. Soloviev1, I.B. Mukhin1, A.E. Pestov1, A.A. Shaykin1, M.V. Starodubtsev1, E.A. Khazanov1; 1Institute of Applied Physics RAS, 2Institute for Physics of Microstructures, Russia

The XCELS project aims to create an optical field of unprecedentedly high intensity at the focal spot using twelve coherently combined femtosecond optical pulses in the approximation of a dipole geometry. We present a prototype experimental setup for combining multiple non-amplified femtosecond laser beams.

ThR05-24 10:45-11:00
Spectral, spatial and temporal characteristics study of laser plasma radiation of sulfur and tungsten targets in the X-ray spectral range
A.T. Sahakyan, V.N. Puzyreva, A.A. Kologrivov, D.M. Bezverkhnyaya, T.T. Kondratenko, A.N. Starodub; Lebedev Physical Institute RAS, Russia

The results of studies of the interaction of nanosecond Nd:glass laser radiation with pure solid Al, Cu, S, Ta and W targets are presented. The emission spectra of the plasma demonstrated the presence of intense radiation in the bands of water and carbon windows for targets made of sulfur or tantalum.

- Coffee Break -
Enhancement of nuclear reaction yield in nano-structure targets irradiated by circular polarized, ultrashort and intense laser pulses

A.A. Andreev1,2, K.Yu. Platonov3, L.A. Litvinov1, S.V. Stolyarev1, I. Vladimirov3, D.A. Gogolev3, A.P. Podgornik1, 2.
S.M. Dubrovskikh, A.S. Pilipenko, A.S. Kustov, E.A. Shibakov, A.V. Potapov; Russian Federal Nuclear Center - Zababakhin All-Russian Research Institute of Technical Physics, Russia

We consider generation of large magnetic fields based on electron inertia in structure targets irradiated by circularly polarized intense ultrashort laser pulses. The optimal (for multi GGs fields) laser and target parameters were found by using the analytical model and 3D PIC simulations. It is shown that such fields slow down the structure expansion, which can be used in nuclear physics.

Simulation of laser initiated generation of DD neutrons and synchrotron X-rays from microdroplet plasma

S.G. Bochkarev1, D.A. Gogolev, O.E. Vais1,2, M.G. Lobok1,2, A.V. Brantov1,2, V.Yu. Bychenkov1,2, I.M. Mordvintsev1,2, K.A. Ivanov1,2, T.A. Semenov1, S.A. Shulypov1, A.V. Lazarev1,2, A.A. Rupasov1,2, A.A. Kologrivov1,2, E.A. Bolkhovitinov1,2, A.I. Zhaivnya1,2, I.N. Tsymbalov1,2, R.V. Volkov1, V.M. Gordinenko1, A.B. Savel'ev1,2, R.Yu. Volkov, V.M. Gordinenko1,2, A.B. Savel’ev1,2, V.Yu. Bychenkov1,2, I.M. Mordvintsev1,2, K.A. Ivanov1,2, T.A. Semenov1, S.A. Shulypov1, A.V. Lazarev1,2, A.A. Rupasov1,2, A.A. Kologrivov1,2, E.A. Bolkhovitinov1,2, A.I. Zhaivnya1,2, I.N. Tsymbalov1,2, R.V. Volkov1, V.M. Gordinenko1, A.B. Savel’ev1,2, V.Yu. Bychenkov1,2, I.M. Mordvintsev1,2, K.A. Ivanov1,2, T.A. Semenov1, S.A. Shulypov1, A.V. Lazarev1,2, A.A. Rupasov1,2, A.A. Kologrivov1,2, E.A. Bolkhovitinov1,2, A.I. Zhaivnya1,2, I.N. Tsymbalov1,2, R.V. Volkov1, V.M. Gordinenko1, A.B. Savel’ev1,2

Location: Richter Room, Floor 3; Date: Thursday, July 04, 2024

R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 6

Enhanced filament-induced nonlinear fluorescence of dyed water aerosol by means of a spatially-localized turbulent screen


We show that a spatially localized layer of turbulent air (turbulent screen) created artificially at the beginning of a long-range optical propagation path can lead to HPL larger-scale filamentation and multiple increase of high-intensity regions in the beam profile, which contributes to an increase in the efficiency of nonlinear fluorescence of dyed water aerosol.

Experimental study of ultrafast laser-induced phenomena in gold

S.A. Romashkevich, S.I. Ashitkov; Joint Institute for High Temperatures RAS, Russia

Intense ultrashort laser pulses can drive the electrons and the lattice in a high-intensity regions in the beam profile, which contributes to an increase in the efficiency of nonlinear fluorescence of dyed water aerosol.

Femtosecond laser-induced periodic surface structures formation on optical fibers

K. Brioniček1, K. Glašekl1, V. Tenentiev1, V. Simonov1, S. Mikerin1, S. Babin1, A. Kuchnižakl1, A. Dostovalovl1, Institute of Automation and Control Processes FEB RAS, 1Pacific Quantum Center, Far Eastern Federal University, Russia

Here we study TLIPSS formation on the curved samples such as a side surface of optical fibers with deposited Ti thin film. Different morphologies depending on the polarization direction of the laser radiation were revealed. TLIPSS formation on fiber tip (normal and angle cleaved) and their perspective applications will be also presented.
**ThR08-38**

**Influence of fluid microstructure on dynamics of laser-induced post-effects**

N.M. Asharchuk, E.I. Mareev, Kurchatov Complex Crystallography and Photonics, NRK «Kurchatov Institute», Russia

The study investigates the dynamics of ultra-short laser pulse interactions with water and supercritical carbon dioxide. Following the laser impact, shock waves and a cavitation bubble are generated. Unlike the cavitation process in water, the cavitation bubble does not collapse in supercritical carbon dioxide; instead clusters ranging in size from 1 to 200 microns are formed.

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**Coffee Break**

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**ThR08-39**

**Dispersion of effective nonlinearity for frequency conversion in biaxial crystals**

E. Shevekina, S.G. Grechin; NTO IRE-Polyus, Prokhorov General Physics Institute RAS, Russia

The results of dispersion estimation for effective nonlinearity in biaxial crystals for different point groups are presented. Phenomenon of nonlinearity dispersion is caused by pronounced changing of the angle to the optical axis of the crystal, which is typical for many recently synthesized media.

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**ThR08-40**

**Gigawatt few-cycle mid-IR pulses generated from advanced non-oxide nonlinear crystals**

A.G. Sakharova, A.E. Shitikov, N.Y. Dmitriev, D.A. Chermoshentsev, I.A. Bilenko; Russian Quantum Center, Moscow Institute of Physics and Technology, Lomonosov Moscow State University, Russia

Advanced nonlinear materials — LGS, HGS and BGGS — were studied for parametric down conversion of Cr:Forsterite laser pulses into 1.5 – 8 μm spectral region. Conversion efficiency as high as 18% resulting in 0.4 – 2.4-gigawatt pulses with a duration of a few-cycles make the developed micromasers a key enabling tool for driving nonlinear optical phenomena.

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**ThR08-41**

**Dual-pumped integrated microring degenerate optical parametric oscillator**

A.V. Vorobyev, N.A. Kapridova, T.R. Yunusov, A.E. Shitikov, D.A. Chermoshentsev, I.A. Bilenko; Russian Quantum Center, Moscow Institute of Physics and Technology, Moscow State University, Russia

We study the nonlinear degenerate four-wave mixing in high-Q integrated silicon nitride ring microresonator dual-pumped by continuous wave lasers. We optimize a microresonator geometry as well as dual-pump powers and frequency detunings. Highly efficient degenerate optical parametric oscillator is demonstrated experimentally.

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**ThR08-42**

**Stable photonic microwave generator based on two semiconductor laser diodes locked to high-Q microring resonator**

A.G. Sakharova, A.E. Shitikov, N.Y. Dmitriev, D.A. Chermoshentsev, I.A. Bilenko; Russian Quantum Center, Moscow Institute of Physics and Technology, Lomonosov Moscow State University, Russia

We present a scalable and stable microwave source based on two distributed feedback semiconductor laser diodes locked to silicon nitride integrated microresonator with free-spectral range of 15 GHz. It is shown that self-injection locking effects provides efficient stabilization and linewidth suppression of the generated signal.

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**ThR08-43**

**Domain switching by NIR femtosecond laser irradiation in the bulk of MgO doped lithium niobate and lithium tantalate crystals**

B.I. Lisijkh, M.S. Kosobokov, V. Shur; Ural Federal Univ., Russia

In this work we have studied the formation of the periodical domain structures in MgO doped lithium niobate and lithium tantalate crystals under near infrared femtosecond laser irradiation. The domain formation was done using various energies, pulse numbers and scanning velocities. The effective second harmonic generation has been demonstrated in crystals with periodical domain structure created in the bulk.

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**ThR08-44**

**SOA-based reservoir computing**

A. Bednyakova, E. Manuylovich, D.A. Ivoilov, I.S. Terekhov, S.K. Turitsyn; Nizhny Novgorod State University, Russia

We present a novel reservoir computing approach in which single nonlinear device — semiconductor optical amplifier, replaces the entire nonlinear reservoir to perform computations, without the conventional use of a delay loop. To study the performance of the proposed scheme, we use it for the benchmark prediction task of learning the Mackey-Glass chaotic attractor.

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**Coffee Break**

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**ThR08-38**

**Periodically poled ferroelectric crystals, thin films and waveguides for light frequency conversion (Invited paper)**

A.R. Akhmatkhanoj, M.A. Chuvakov, A.A. Esmi, A.A. Boyko, B.I. Lisijkh, M.S. Kosobokov, V.S. Shur; Ural Federal Univ., Russia, Novosibirsk State Univ., Russia

The stable regular domain structures were created in lithium niobate crystals and thin films with period less than 150 nm. The fan-out domain structures made it possible to obtain extremely wide wave tuning. The creation of regular domain structures and periodically poled waveguides in the crystal bulk under the focused irradiation of near infrared femtosecond laser second laser has been demonstrated.

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**ThR08-39**

**Permutation of effective nonlinearity for frequency conversion in biaxial crystals**

E. Shevelkina, S.G. Grechin; NTO IRE-Polyus, Prokhorov General Physics Institute RAS, Russia

The results of dispersion estimation for effective nonlinearity in biaxial crystals for different point groups are presented. Phenomenon of nonlinearity dispersion is caused by pronounced changing of the angle to the optical axis of the crystal, which is typical for many recently synthesized media.

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**ThR08-40**

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A.V. Vorobyev, N.A. Kapridova, T.R. Yunusov, A.E. Shitikov, D.A. Chermoshentsev, I.A. Bilenko; Russian Quantum Center, Moscow Institute of Physics and Technology, Moscow State University, Russia

We study the nonlinear degenerate four-wave mixing in high-Q integrated silicon nitride ring microresonator dual-pumped by continuous wave lasers. We optimize a microresonator geometry as well as dual-pump powers and frequency detunings. Highly efficient degenerate optical parametric oscillator is demonstrated experimentally.

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A. Bednyakova, E. Manuylovich, D.A. Ivoilov, I.S. Terekhov, S.K. Turitsyn; Nizhny Novgorod State University, Russia

We present a novel reservoir computing approach in which single nonlinear device — semiconductor optical amplifier, replaces the entire nonlinear reservoir to perform computations, without the conventional use of a delay loop. To study the performance of the proposed scheme, we use it for the benchmark prediction task of learning the Mackey-Glass chaotic attractor.
Preprint number: 1

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**THURSDAY**

**TECHNICAL SESSION**

**July 4**

Location: Stenberg 2 Room, Floor 3; Date: Thursday, July 04, 2024

**R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 7**

**ThR08-45**

11:30-12:00

Interference of radiation at fundamental and tripled frequencies with superbroadening of the few-cycle pulse spectrum in nonlinear media *(Invited paper)*

S.A. Kozlov, I.R. Artsir, M.V. Melnik, A.N. Tsyppkin; ITMO University, Russia

In media with cubic nonlinearity, broadening of the optical pulses' spectrum is observed due to their phase modulation and generation of radiation at triple frequencies. The report discusses the theory of these phenomena and presents the results of their experimental observations in the terahertz spectral range.

**ThR08-46**

12:00-12:30

Nonlinear higher-order topological states and higher-order topological solitons *(Invited paper)*

Yiqi Zhang¹, Yanoslav V. Kartashov², Xian Jiaotong University, China; ²Institute of Spectroscopy, Russia

We show our achievements on the nonlinear manipulation about 0D topological states. Such power thresholdless nonlinear 0D topological states bifurcate from their linear counterparts. Since these nonlinear topological states are localized bound states of the system, they represent higher-order topological solitons with the localization effectively affected by the beam power.

**ThR08-47**

12:30-13:00

Light bullets in higher-order photonic topological insulators *(Invited paper)*

S.X. Ivanov¹, Ya.V. Kartashov²; ¹University of Valencia, Institute of Materials Science (ICMUV), Spain; ²Institute of Spectroscopy, Russia

We consider a new class of stable three-dimensional solitons (light bullets) in higher-order topological insulators based on a two-dimensional Su-Schrieffer-Heeger array of coupled waveguides. These solitons inherit topological protection from their linear corner counterparts and survive in the presence of disorder.

**ThR08-48**

13:00-13:15

Nonlinear propagation of ultrashort pulses in nanophotonic halide perovskite waveguides

A.O. Mikhail¹, N. Glebov¹, M. Masharin¹, A.V. Yulin¹, S.V. Makarov¹, D.N. Krizhanovskii¹, A.K. Samusev¹, V. Kravtsov¹; ¹ITMO University, Russia; ²EPFL, Switzerland; ³The University of Sheffield, United Kingdom; ⁴Technische Universität Dortmund, Germany

Perovskite-based nanophotonic structures are promising systems for studying strong light-matter coupling effects. In this work, we investigate the nonlinear propagation of fs laser pulses in halide perovskite waveguides in the strong exciton-photon coupling regime. Our results demonstrate that self-phase modulation and group velocity dispersion lead to spectral broadening and generation of new frequency components.

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**R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 8**

**ThR08-52**

15:00-15:30

Gratings induced by few-cycle light pulses *(Invited paper)*

R.M. Arkhipov¹,², M.V. Arkhipov¹,², A.V. Pakhomov¹, O.O. Diachkova¹,², N.N. Rosanov¹,²; ¹St. Petersburg State University; ²IIoffe Institute, Russia

This talk revisits our recent results on population density grating formation and control in a resonant medium by extremely short light pulses down to single and subcycle durations.

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**ThR08-53**

15:30-16:00

Topology of light polarization-ellipse strips in near-field and nonlinear optics *(Invited paper)*

K.S. Grigoriev¹, N.Yu. Kuznetsov, V.A. Makarov; Faculty of Physics, Lomonosov Moscow State University, Russia

Axes of polarization ellipses in non-paraxial monochromatic light are known to form non-trivial twisted strips when being traced along closed contours. We gathered statistics of such strips in a a set of linear and nonlinear optical problems and derived analytical formulas for twisting coefficient of the strips, which explained the observed data.

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**- Lunch Break -**
Spectral, spatial and energy stabilization of filament supercontinuum Stokes wing by amplitude modulation

D.V. Pushkarev1,2, N.A. Zhidovtsev1, D.S. Uryupina1, E.V. Mitina1, R.V. Volkov1, A.B. Savelev1,2,1 Faculty of Physics, Lomonosov Moscow State University, 2 Lebedev Physical Institute RAS, Russia

Initial beam modulation by a four-hole amplitude mask allows to enhance pulse-to-pulse stability of the red wing of filament-generated supercontinuum. In particular, the stability of such properties as spectral position and width, angular coordinate, energy of the red-shifted hump, corresponding to a light bullet formed in a loosely-focused filament in air, is improved 1.7, 3.4 and 4.5 times, correspondingly.

Formation and dynamic parameters of light-induced microcavities in a resonant medium

O.O. Diachkova1,2, R.M. Arkhipov1,2, M.V. Arkhipov1,2, A.V. Pakhomov1, N.N. Rosanov1,2,1 St. Petersburg State University; 2 Ioffe Institute, Russia

A dynamic “microcavity,” i.e. a burst of population difference, can arise when ultra-short unipolar pulses overlap in a resonant medium. We study the formation and control of such a microcavity using the analytical and numerical solution of the Maxwell-Bloch equations.

Stimulated terahertz emission from molecular crystals (Invited paper)

V.I. Kovalev1, A.S. Sinko2, A.P. Shkurinov2,1 Lebedev Physical Institute RAS, 2 National Research Centre Kurchatov Institute; 3 Department of Physics, Lomonosov Moscow State University, Russia

Stimulated emission is one of the interesting coherent nonlinear optical phenomena. In the terahertz frequency range, stimulated emission has already been observed and is well described theoretically. However, stimulated emission in this frequency range can have the character of laser generation. In crystalline media, correlated phonon states can be observed, which form a two-level system of the laser type.

Terahertz field and carrier dynamics in optically excited layer at the surface of a GaAs crystal

A.L. Novokovskaya, M.I. Bakunov, Lobachevsky University of Nizhny Novgorod, Russia

Results of FDTD modeling of the terahertz field and carrier transient dynamics in an optically excited layer at the surface of a GaAs crystal are presented. The field demonstrates a monotonic or oscillatory decay on a subpicosecond time-scale, depending on the parameters. The results are important for interpreting the experimental results on terahertz-field-induced photoluminescence quenching and optical second harmonic generation. This work was supported by the Ministry of Science and Higher Education of the Russian Federation (FSWR-2020-0035).

Bright EUV source of coherent radiation driven by near- and mid-IR femtosecond laser system for THz-assisted HHG

B.V. Rumiantsev, E.A. Lobushkin, A.V. Pushkin, E.A. Migal, F.V. Potemkin; Faculty of Physics, Lomonosov Moscow State University, Russia

High-order harmonics generation driven by the femtosecond multi-band laser system, based on Cr:Forsterite (1.24 um) and Fe:ZnSe (4.5 um) crystals, has been realized in an argon gas jet. The measured harmonics orders are in the range of 43-71 eV with total generated photon number at the level of 5x10^8 photons, energy of 4.4 nJ and corresponding conversion efficiency of 3x10^-6.

Dispersion of a GUHP crystal’s optical characteristics in the visible, near-infrared, and terahertz spectra

N.A. Nikolaev1, S.A. Bychkova1, S.I. Mikhein1, V.D. Antsygin1, A.S. Sinko2, A.P. Shkurinov2,1 Institute of Automation and Electrometry SB RAS, 2 Ioffe Institute, Russia

In this work, we report experimental measurements of radiation losses in the crystal along with all three components of the refractive index in the visible, near-infrared, and terahertz spectra. The results obtained allow for the calculation with high accuracy of phase matching conditions for nonlinear frequency conversion of different laser sources.

Fiber laser driven terahertz generation in a LiNbO3 layer sandwiched between Si prisms

M.A. Kumikov, A.I. Shugurov, M.I. Bakunov, Univ. of Nizhny Novgorod, Russia

We demonstrate experimentally that a 55 microns thick layer of LiNbO3 clamped between Si prisms works as a converter of femtosecond Er-fiber oscillator pulses to a single terahertz beam. The pulses of 2.15 nJ energy were converted to broadband terahertz radiation with the efficiency of 1.6x10^-4. Using the converter in a THz-TDS setup provided a dynamic range of 55 dB. The work was supported by the Russian Science Foundation (22-19-00371).

Narrow-band lasing in a randomly distributed feedback fiber laser with embedded optical microcavity

D.V. Kudaishkin, I.D. Vatnik; Novosibirsk State University, Russia

In this work, a high-Q microcavity was incorporated as a filter into a random distributed feedback fiber laser. Because of this, it was possible to obtain a lasing line with a spectral width of 0.03 nm only.
**ThR09-15**

**Modeling the interfacial profiles in III-V VLS axial nanowire heterostructures based on group V interchange**

V.G. Dubrovskii; Faculty of Physics, St. Petersburg State University, Russia

Interfacial abruptness in axial heterostructures within III-V nanowires (NWs) grown by the VLS method is affected by the reservoir effect in catalyst droplets. Here, we present a model which provides explicitly the interfacial profiles in double NW heterostructures based on group V interchange of any composition, and fit the data on Au-catalyzed InP/InAs/GaAs/InP, self-catalyzed GaAs0.6P0.4/GaxAsP1-x/GaAs0.6P0.4 and GaP/GaAs-xP1-x/GaP NW heterostructures.

**ThR09-16**

**Tuning the composition of III-V ternary nanomaterials by V/III flux ratio**

E.D. Leschchenko¹, V.G. Dubrovskii¹; Submicron Heterostructures for Microelectronics, Research and Engineering Center RAS, St. Petersburg State University, Russia

We develop a growth model for ternary AsB1-xC nanomaterials and show that the vapor-solid distribution can be tuned from the equilibrium to kinetic shape by decreasing the total (A+B)/C flux ratio. We demonstrate the excellent fits of available data for AlSbAs epilayers, InSbAs, InAsP and GaAsP NWs grown under different total V/III flux ratios in vapor.

**ThR09-17**

**Modeling the crystal phase switching in self-catalyzed GaAs nanowires**

A.A. Koryakin¹, N.V. Guruleva¹; St. Petersburg State University, Russia

A model is proposed to depict the crystal phase switching in the self-catalyzed GaAs nanowires considering different shapes of the nanowire growth facet.

**ThR09-18**

**Semiconductor nanowires for resonant enhancement, light guiding and hybrid sources development**

A.D. Bolslavskov; Moscow Institute of Physics and Technology; Alferov University, Russia

We present nanophotonic hybrid structure based on a monolayer of MoS2 and GaP nanowires (NW) as a novel system to achieve enhancement and directionality of the emission via employment of the NW modes. Furthermore, we investigate the resonant optical action of our GaP NW with a remarkable Q factor exceeding 350.

**ThR09-19**

**Growth and properties of microstructures based on aluminum fluoride**

A.M. Dautov¹, K.P. Kotyar¹, T.H. Berezovskaya¹, A.M. Khaifizova¹, T. Shugabaev², E. Lendyasheva²; Faculty of Physics, St. Petersburg State University; I'Alferov University; St. Petersburg State Electrotechnological University "LETI", Russia

Aluminum fluoride (AlF3) is a promising material for a variety of industrial applications. Due to its electrophysical parameters, it can become a cheap analogue of silicon dioxide. It can be used in microwave waveguides and optical devices in the ultraviolet range. In this paper, we present a study of the synthesis process of morphologies based on AlF3.

**ThR09-20**

**Formation of nanovoids grating in Zr/SiO2/Si at scanning of tightly focused cw laser beam**

D.A. Belousov, I.R. Kuts, V.P. Korolkov; Institute of Automatics and Electronics SB RAS, Russia

The formation of nanovoid grating at thermochemical laser writing on Zr/SiO2/Si multi-layer material has been demonstrated. Unlike other publications, continuous rather than pulsed laser radiation was used in this work. Possible mechanism of the effect is discussed.

**ThR09-21**

**Large-scale chiral nanostructures with tunable optical activity in UV-visible range**

D.R. Dadadzhanov¹,², N.S. Petrov¹, I.A. Gladskikh¹, G. Markovich¹, Raymond and Beverly Sackler Faculty of Exact Sciences, School of Chemistry, Tel Aviv University, Israel, International Research and Education Center for Physics of Nanostructures, ITMO University, Russia

Circular dichroism in silver nanostructures on dielectric substrate was induced by laser irradiation with circular polarization. The morphology changes of silver nanostructures upon various power density have been explored by scanning electron microscopy. The influence of aging of silver nanoparticles on optical activity in UV-Vis spectral range has been revealed and discussed.

**ThR09-22**

**Pb - catalyzed GaAs nanowires grown by molecular beam epitaxy on Si substrate**

I.V. Shrotn¹,², N.V. Sobirev³, I.V. Ilkiv³, I.P. Soshnikov², R.R. Reznik³, G.E. Cirlin¹,²; St. Petersburg State University; Institute for Analytical Instrumentation RAS, Il'iffe Institute; Alferov Institute, Russia

The Pb-assisted MBE growth of GaAs NWs was demonstrated for the first time. Here we discuss the growth of GaAs nanowire with lead catalyst. Lead could easily dissolve As as well as Ga, which allows to switch nanowire growth from Ga-rich to As-rich growth.

- Coffee Break -

**ThR09-23**

**Effect of topology on the optical properties of quantum confined semiconductor nanocrystals (Invited paper)**

A.L. Simões Gamboa¹, E.N. Bodunov¹, A.V. Fedorov¹; ITMO Univ., Russia; ‘Emperor Alexander I St. Petersburg State Transport Univ., Russia

We investigate theoretically the effect of topology on the optical properties of quantum confined semiconductor nanocrystals. In particular, we compare the wavefunctions, energy spectra, and intraband matrix elements of the momentum operator in a semiconductor hollow sphere with those in a spherical quantum dot.

**ThR09-24**

**Nanoprobes for in vivo Imaging (Invited paper)**

Mingyuan Gao; Center for Molecular Imaging and Nuclear Medicine, School of Life Sciences, Soochow University, China

Functional nanoparticles have shown great potentials in medical applications. Over past years, we have been developing versatile functional nanoparticles and nanoparticle-based probes for detecting tiny tumors and lymphatic micrometastasis, evaluating the vulnerability of athero-sclerotic plaques, and visualizing tumor microenvironment abnormal signatures. In this presentation, we will present our recent studies on above subjects.
Molecular detection using plasmonic nanostructures of particular geometry

G.V. Zmaga 1, A.A. Kuzmin 1, Y. Sun 1, Q. Pan 2, M. Su 2, Y. Song 1, D.A. Zuev 1, P.A. Belov 1; 1 ITMO Univ., Russia; 2Key Laboratory of Green Printing, Inst. of Chemistry CAS, China

Surface-enhanced Raman spectroscopy (SERS) is used to detect substances in low concentration. Neglecting the chemical enhancement phenomena, the model of polystyrene structures with silver nanoparticles was used to obtain Raman signals from molecules of rhodamine 6G. In the current work different geometries of these plasmonic structures are investigated and their ability to enhance the electromagnetic field is compared.

Optical nanoheaters with fluorescent thermometers on board

A.V. Povolotskiy 1, D.A. Soldatova 2, A.A. Tyshchenko 1, A.V. Shmakova 1, D.A. Lukyanov 1, A.S. Konev 1; 1 St. Petersburg State University; 2Peter the Great St. Petersburg Polytechnic University, Russia

The results of the synthesis and study of optical nanoheaters based on gold nanoparticles and fluorescent ratiometric thermometers based on porphyrins are presented. Plasmonic nanoparticles are combined with molecular thermometers into hybrid nanostructures, allowing controlled heating. These optical nanomaterials can be used in various fields of science, industry and medicine, in particular, for photothermal therapy.

Optical properties of epitaxial InAs/GaAs quantum dots overgrown under different V/III flux ratios

S.V. Balakirev 1, A.M. Nadtochiy 1, N.V. Kryzhanovskaya 1, D.V. Kirichenko 1, N.E. Chernenko 1, N.A. Shandyba 1, S.D. Komarov 2, A.S. Dragunova 2, A.E. Zhukov 2, M.S. Solodovnik 3; 1Southern Federal University; 2HSE University, Russia

Using photoluminescence and excitation spectroscopy, we study optical properties of InAs/GaAs quantum dots overgrown under different V/III flux ratios. While multiple peaks around 1.37 eV are observed in the photoluminescence spectrum at low V/III ratio, it is red-shifted and becomes smoother with increasing ratios. We explain this behavior in terms of enhanced quantum dot decomposition depending on the V/III ratio.

Quantum dots. Hydrophilization techniques for analytical applications

O.A. Goryacheva, D.V. Tsypka, E.A. Mordovina, T.S. Ponomaryova, D.D. Drozd, A.V. Markin, I.Yu. Goryacheva; Institute of Chemistry, Saratov State University, Russia

Quantum dots are semiconductor crystals with unique optical properties. Analytical applications are made possible due to the stability of the crystal, the ability to vary the fluorescence wavelength, and the capacity for non-radiative energy transfer. They are influenced by the composition, structure and coating of QDs.
I.I. Novikov 1, V.Yu. Panevin 2, N.A. Pikhtin 3, A.Yu. Egorov 1; 1 ITMO University, 2 Peter the M.I. Mitrofanov 3, S.O. Slipchenko 3, A.V. Lyutetskii 3, V.P. Evtikhiev 3, L.Ya. Karachinsky 1, V.S. Kostrov 2; 1 Institute of Electrophysics UB RAS; 2 Ural Federal University named N.V. Chernomyrdin 1; 1 Prokhorov General Physics Institute RAS; 2 Research Institute Great St. Petersburg Polytechnic University, 3 Institute of Human Morphology, Russia

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1. Terahertz subwavelength-resolution polarization-sensitive microscopy based on solid immersion effect

D.R. Il’enchkova1, D.D. Rybnikov1, V.A. Zhelnov1, A.I. Alekseeva1, K.I. Zaytsev1, N.V. Chernomyrdin1; ‘Prokhorov General Physics Institute RAS, ‘Research Institute of Human Morphology, Russia

In our work we demonstrate a reflection-mode polarization-sensitive terahertz (THz) microscope based on solid immersion effect. We apply it to study THz anisotropy of test media with 0.15μ spatial resolution, including freshly excised rat brain, where the most pronounced birefringence is observed in the Corpus callosum. The obtained results show the prospects of applying THz polarization-sensitive microscopy in medical imaging.

ThR03-p01 10:00-13:30

2. Analysis of high-repetition-rate high-power laser pulse generation dynamics using a one-dimensional model of rate equations

A.E. Rizaev, A.A. Podoskin, A.D. Bondarev, Z.N. Sokolova, V.A. Kapitonov, V.N. Malets, S.O. Slipchenko, N.A. Pikhtin; Ioffe Institute, Russia

This study uses a numerical model to analyze the dynamics of high-power semiconductor lasers pumped by a high-frequency pulse sequence. It explores the distribution of photons and gain along the laser cavity and proposes an approach to optimize laser parameters for maximum efficiency and stability. The frequency range of interest from MHz to several GHz.

ThR03-p02 10:00-13:30

3. Active region overheating in quantum cascade lasers

I.I. Vrubel, E.D. Sherotchenko, D.A. Mikhailov, D.V. Chistyakov, V.V. Dudenev, G.S. Sokolovskii; Ioffe Institute, Russia

We study the QCL active region overheating and discuss the effects of nonequilibrium heat dissipation on laser performance. We show that the effective thermal management fundamentally depends on the active region material properties.

ThR03-p03 10:00-13:30

4. Pulsed cathodoluminescence kinetics of Fe:ZnSe ceramic

A.V. Spinin1, A.S. Marakova1, V.I. Solomonov1, A.S. Korsakov2, F.M. Kucherenko2, V.S. Kostrov2; ‘Institute of Electrophysics UB RAS, ‘Ural Federal University named after the First President of Russia B.N. Yeltsin, Russia

Pulsed cathodoluminescence kinetics (PCL) of Fe:ZnSe ceramic samples, which were manufactured at the IEP UB RAS, was studied. The luminescence of divalent iron ions has a wide radiation band in the range of 3.6-4.4 μm at the 5T2 to 5E transition. This material is promising as an active medium for mid-infrared lasers and scintillation sensors.

ThR03-p04 10:00-13:30

5. Highly strained InGaAs/GaAs quantum wells obtained by selective area epitaxy

M.I. Kondratov, V.V. Shamakhov, D.N. Nikolaev, A.E. Grishin, S.O. Slipchenko, N.A. Pikhtin; Ioffe Institute, Russia

Highly strained InGaAs quantum wells obtained by selective area epitaxy in the 100-μm-wide window have been studied. It is demonstrated that the variation in the thickness profile of the GaAs lower waveguide layer, grown by selective area epitaxy, has an impact on the wavelength distribution of the quantum wells across the window width.

ThR03-p05 10:00-13:30

6. Quantum-cascade laser with increased ring radius

E.S. Kolodeznyi1, A.V. Babichev1, N.Yu. Kharin1, A.G. Gladyshev1, G.V. Voynuk1, M.I. Mitrofanov1, S.O. Slipchenko1, A.V. Lyutetski1, V.P. Etvikhe1, L.Ya. Karachinsky1, I.I. Novikov1, V.Yu. Panevin1, N.A. Pikhtin1, A.Yu. Egorov1; ITMO University, ‘Peter the Great’ S. Petersburg Polytechnic University, Ioffe Institute, Russia

The lasing at 7.59 μm wavelength was achieved in quantum-cascade surface emitting lasers with increased radius of ring cavity. The large mode number in single-mode spectrum was caused by over coupling between laser core and second-order Bragg grating.

ThR03-p06 10:00-13:30

7. Dielectric spectroscopy of Ge,Sb,Te and V02 upon temperature-induced phase transitions

A.A. Bogutskii1, A.A. Gavudish1, G.A. Komandin1, D.S. Ponomarenko2, Qiwa Shi1, K.I. Zaytsev1; ‘Prokhorov General Physics Institute RAS, ‘Institute of Ultra-High Frequency Semiconductor Electronics RAS, Russia; ‘College of Materials Science and Engineering, Sichuan University, China

This study exploits the complex dielectric properties of phase change materials across a wide spectral range, with a focus on thermally induced phase transitions in GST and VO2 films. By analyzing the complex dielectric response of various material phases, including hysteresis loops in VO2 films at differing residual pressures, it uncovers important insights for PCM-based devices and technologies.

ThR03-p08 10:00-13:30

8. 1550-nm VCSELs with p-type active layer doping for improved high-speed performance

D.S. Papylev1, S.A. Blokhin1, Y.N. Kovach1, I.G. Gladyshev3, I.I. Novikov1, E.S.Kolodeznyi1, A.V. Babichev1, K.O. Voropaev1, A.Yu. Egorov1, and L.Ya. Karachinsky1; ITMO Univ., Saint Petersburg, Russia; ‘Ioffe Inst., Saint Petersburg, Russia

The effect of p-type barrier layer doping in the active region on the modulation speed of a long-wavelength VCSEL is considered. Doping of barrier active region led to an increase in the maximum modulation bandwidth and a decrease in the maximum optical power of the VCSEL.

ThR03-p09 10:00-13:30

9. Pulsed laser annealing of sulfur hyperdoped silicon prepared by ion implantation

I.M. Podlesnykh1, M.S. Kovalev1, R.I. Batalov1, B.Bauman Moscow State Technical Univ.; ‘Lebedev Physical Inst. RAS, ‘Kazan Physical Technical Inst. RAS, Russia

Silicon’s band gap (1.12 eV) limits its near-infrared photon absorption. Silicon hyperdoping creates energy states within the band gap, enabling near-IR radiation absorption. Ion implantation is an efficient method for hyperdoping, but radiation-induced defects compromise crystallinity. Pulsed laser annealing mitigates induced defects, enhancing material crystallinity. The study investigates the impact of pulsed laser annealing on sulfur hyperdoped silicon properties.

ThR03-p10 10:00-13:30

10. Focused ion beam as a tool for prototyping new designs of semiconductor lasers

M.I. Mitrofanov1, A.A. Beckman1, E.S. Kolodezny1, A.S. Payusov1, G.V. Voynuk1, V.P. Etvikhe1; Ioffe Institute, ‘SHM R&E Center RAS, ITMO University, Russia

We demonstrate the application of direct focused ion beam lithography to realize various designs of optical elements for the modification optical parameters of different types of semiconductor lasers.

ThR03-p11 10:00-13:30

11. Extreme events in dynamics of frequency-swept semiconductor lasers

A. Stroganov, A.V. Kovalev, E.A. Viktorov; ITMO University, Russia

We numerically model a frequency-swept short-cavity semiconductor laser and report the appearance of extreme events in its dynamics. These events, with probability strictly dependent on the sweep rate, appear as a jump from the isola of periodic solutions to the stable region of the bridge periodic solutions and exhibit a high degree of localization.
Optimization of the energy barrier layer position in 1550 nm high-power laser diodes

A.A. Podskodniy, D.A. Veselov, T.A. Bagaev, V.N. Svetogorov, I.V. Yarotskaya, V.V. Zolotarev, V.A. Kruchko, I.V. Shushkanov, M.A. Ladugin, A.A. Marmalyuk, S.O. Slipchenko, N.A. Pikhtin; Ioffe Institute, ‘M.F. Steklov’ Polyaus Research Institute, Russia

The paper discusses the optimization of AlGaNAs energy barrier layers position in AlGaNAs/AlNAs/InP laser heterostructures at 1550 nm. For the heterostructure design with a single barrier in the p-waveguide, an output optical power of 2W/7A was achieved for a 40 μm aperture sample under continuous pumping, which is 1.8 times higher than the result obtained with a barrierless heterostructure.

Generation of random pulsed sequences by switching lateral modes in a quantum-cascade laser


We study generation of random bit sequences (RBS) with quantum-cascade laser (QCL) and quantum-cascade detector. We show that QCL emission intensity randomly varies due to lateral modes competition and can be converted into RBS.

Optimization of QAM signal parameters in fiber-optic lines with semiconductor amplifiers

P.Ya. Ilyushin, D.E. Shipilo, I.A. Nikolaev, N.A. Panov, O.G. Kosareva; Faculty of Physics, Lomonosov Moscow State University, Lebedev Physical Institute, Russia

We analyze the influence of optical coatings on the electro-optical characteristics of quantum cascade lasers. We compare light-current characteristics of quantum cascade lasers. We compare light-current characteristics of quantum cascade lasers.

Linewidth of 1.55 μm-range single-mode MBE-grown wafer-fused VCSELs


The study of the spectral linewidth of the 1.55 μm-range single-mode MBE-grown wafer-fused VCSELs based on InGaAs/InGaAlAs strained quantum wells is presented. The linewidths as small as 18 MHz and linewidth-power properties of 4 MHz-mW revealed for the VCSELs with low photon lifetime. The α-factor was estimated in the range from 2.8 to 5.1, depending on the population inversion factor.

Dispersion and losses of a THz QCL double metal waveguide calculated by the quasianalytical modified Marcatti method

B.A. Zhmud, A.S. Sobolev, R.A. Khabidullin; V.G. Mokerov Inst., of UHF Semiconductors Electronics RAS, MIPT, Russia

The dispersion characteristics for the guided modes in double metal waveguides (DMW) of quantum cascade lasers (QCLs) are studied theoretically and numerically. Analytical model of the QCL waveguide is based on the modified Marcatti method, which is applied to a rectangular waveguide with anisotropic layered dielectric medium and two perfect conductor or Leontovich boundary conditions representing lossy metal films.

Interrogation of FBG using standard telecom DFB diode as a transceiver

V.S. Oshlakov, A.S. Aleink, S.A. Volkovskiy, D.S. Smirnov; ITMO University, Russia

An low-cost fiber Bragg grating sensor interrogation system based on standard Telecom distributed-feedback laser utilized as a transceiver to detect the spectral response from an FBG, is presented in this paper. The proposed method allows to achieve a resolution of 0.01 nm. The results obtained can be used to miniaturize and simplify the optical design of sensor systems using FBGs.

High power photoactivated current switches for generating sub-ns electrical pulses


High power photoactivated current switches for generating sub-ns electrical pulses.

Wafer-fused 1550-nm VCSELs with the active region based on InGaAlAs and InGaAs QWAs

P.E. Kopytov, S.S. Rosch, E.S. Kolodeznyi, J.N. Kovach, K.O. Voropayev, I.I. Novikov, A.A. Blokhin, ITMO University, Russia

1550-nm VCSELs with an active region based on compressive-strained InGaAs/InAlGaAs QWAs and GaAs/AlGaAs DBRs were fabricated using a wafer-fusion technique. A comparison of VCSELs with different active regions is demonstrated.

High-contrast gratings for multispectral laser sources based on III-V/SOI photonic integrated circuits

I.S. Shashkin, N.V. Shuvalova, P.S. Kop’ev, S.O. Slipchenko, N.A. Pikhtin, Ioffe Institute, Russia

High-contrast gratings for multispectral laser sources based on III-V/SOI photonic integrated circuits.
ThR03-p23  10:00-13:30
Study of the capabilities of high-power UV and blue LEDs for pumping coumarin dyes laser
A.V. Aladov1, A.E. Chernyakova1, A.E. Ivanov1, A.L. Zakheim1, 1Submicron Heterostructures for Microelectronics Research and Engineering Center RAS; 2St. Petersburg Electrotechnical University LETI, Russia
High-power AlGaInN LEDs are of interest for pumping of dyes lasers. In this regard, comprehensive studies of the power and spectral characteristics of LEDs in short-pulse modes used to laser pump were carried out. The energy capabilities and spectral properties of LED excitation of coumarin dyes were revealed.

ThR03-p24  10:00-13:30
1550 nm few-mode laser diodes
Yu.K. Kirichenko1(Bobretsova), D.A. Veselov1, A.Yu. Leshko1, A.E. Rizev1, S.O. Slipchenko1, N.A. Pikhitin1, A.A. Marmalyuk1, Yu.L. Ryaboshiant1, M.A. Ladugin1, Iofe Institute, 1Sign Plus Company, Russia
The main characteristics of 1550 nm few-mode laser diodes with aperture width 20 μm were measured. There are two ranges of pump currents in which the characteristics of lasers behave differently: in the first range there is a scatter in the output characteristics of lasers due to few-mode operating mode; in the second range the laser operates predictably and stably.

ThR03-p25  10:00-13:30
Portable optoelectronic vibration sensor based on self-mixing effect in a laser diode
A.V. Rybalovskii, G.O. Damilenko, I.S. Mamaev, A.V. Kovalev, ITMO University, Russia
We introduce a portable optoelectronic vibration sensor utilizing the self-mixing effect for remote vibration measurement. The device uses a laser diode as emitter and detector, providing non-contact detection of vibration parameters (VP) during equipment operation, without damage and without violating safety requirements. It accurately measures VPs from 50 to 4000 Hz with less than 10% error.

ThR03-p26  10:00-13:30
Compact high-power laser pulse sources with nanosecond (ns) and sub-ns durations for time-of-flight LiDAR systems
S.O. Slipchenko1, A.A. Podoskin1, I.V. Shushkanov1, A.E. Rizev1, M.I. Kondratov1, A.E. Grishin1, V.K. Bakhvalov1, Yu.K. Kirichenko1, A.I. Zhelnin1, T.A. Bagave1, M.A. Ladugin1, A.A. Marmalyuk1, N.A. Pikhitin1, Iofe Institute, Stelmarkh Research Institute Poyluy, Russia
The report discusses the main experimental results related to the development of pulse current sources, enabling pulse durations in the ns and sub-ns ranges. A compact stack, comprising a semiconductor laser and current switch, is demonstrated, achieving a peak optical pulse power of 36 W with a pulse duration of 3ns. Approaches for generating high-power sub-ns laser pulses are also studied.

ThR03-p27  10:00-13:30
Vortex Bessel beam generation from conically refracted laser diode radiation
S.H. Abdurrazak1, V.V. Mylinok1, S.N. Losev1, N.G. Deryagin1, V.V. Dulev1, G.S. Sokolovskii1, Iofe Institute, Russia
We demonstrate generation of Bessel beam from conically refracted laser diode radiation. Conical refraction provides annular distribution of the beam at the axicon that is favorable for efficient Bessel beam generation.

ThR03-p28  10:00-13:30
Noise performance of 89X nm single-mode VCSELs
M.A. Bobrov1, S.A. Blokhin1, Ya.N. Kovach1, A.A. Blokhin1, N.A. Maleev1, A.G. Kuzmenkov1, Yu.M. Zadiranov1, M.M. Kulagina1, Yu.A. Guseva1, A.P. Vasiliev1, N.A. Maleev, D.V. Kirichenko, I.I. Vrubel, A.V. Pavlov1, A.S. Konarykhina2, R.G. Polozkov1, V.V. Dudlev1, G.S. Sokolovskii1, Iofe Institute, St. Petersburg Academic University, 1Peter the Great St. Petersburg Polytechnic University, Russia
We study the QCL active region overheating by the analysis of the refractive index-temperature variation. We apply ab-initio methods and interpret the numerical results by the normal dispersion theory. The outcomes of the work create the reliable theoretical basis for the thermal management of QCL devices via the wavelength chirp measurement.

ThR03-p29  10:00-13:30
Microscopic origins of the thermally stimulated wavelength chirp in quantum cascade lasers
E.D. Chernyachenko1, I.I. Vrubel1, A.V. Pavlov1, A.S. Konarykhina2, R.G. Polozkov1, V.V. Dudlev1, G.S. Sokolovskii1, Iofe Institute, St. Petersburg Academic University, 1Peter the Great St. Petersburg Polytechnic University, Russia
We study the QCL active region overheating by the analysis of the refractive index-temperature variation. We apply ab-initio methods and interpret the numerical results by the normal dispersion theory. The outcomes of the work create the reliable theoretical basis for the thermal management of QCL devices via the wavelength chirp measurement.

ThR03-p30  10:00-13:30
Semiconductor lasers in gain-switching mode for high power sub-ns optical pulses
I.V. Shushkanov, A.A. Podoskin, M.G. Zadorozhnaya, A.A. Klimov, L.S. Vavilova, S.O. Slipchenko, N.A. Pikhitin, Iofe Institute, Russia
Broad-area lasers with a 100 μm aperture based on heterostructures with double asymmetry and active regions at wavelengths of 850 nm using bulk 45 nm GaAs and at 970 nm using quantum wells were investigated. Output optical powers in the single first relaxation peak regime from 12 to 22 W were achieved with pulse durations from 100 to 150 ps.

ThR03-p31  10:00-13:30
Annealing temperature effect on the GaAs nanowire growth on the FIB-modified Si substrate
N.A. Shandyba, M.M. Eremenko, D.V. Kirichenko, N.E. Chechenko, S.V. Balakirev, M.S. Solodovnik; Laboratory of Epitaxial Technologies, Institute of Nanotechnologies, Electronics and Equipment Engineering, Southern Federal University, Russia
It is shown that an increase of the annealing temperature from 600 to 750 °C, on the one hand, to an increase of the nanowire density up to ~40 μm at the maximum dose value. On the other hand, this leads to an increase in the proportion of vertically oriented nanowires up to 100%.

ThR03-p32  10:00-13:30
The dynamics of laser generation in single-mode semiconductor (1060 nm) emitters microbar under sub-ns pulse pumping
The operation of single-mode semiconductor (1060 nm) emitters microbar without optical coupling between the stripes was studied. The operation in the regime of a single relaxation optical pulse with a duration of 140 ps and power up to 3 W was demonstrated. The beam diagram of the microbar corresponded to the pattern of a single-mode emitter.

ThR03-p33  10:00-13:30
Hybrid pulsed laser-thyristors output optical power-time characteristics
T.A. Bagave1, N.V. Gulkov1, A.I. Zhelnin1, M.A. Ladugin1, A.A. Marmalyuk1, Yu.V. Kurnyavko1, V.V. Kirichevsky1, A.M. Morozzyuk1, V.P. Konyayev1, V.A. Simakov1, S.O. Slipchenko2, A.A. Podoskin1, N.A. Pikhitin1, Stelmarkh Research Institute Polyus, Iofe Institute, Russia
High-power hybrid semiconductor lasers-thyristors consisting of thyristor crystals soldered with a semiconductor laser with three emitting sections are studied. Experimental dependences of laser-thyristor output optical power on the charging capacity and pulse duration were obtained.

ThR03-p34  10:00-13:30
PbSe thin films for Mid-IR high-sensitive photodetectors
I.A. Mochalov1, M.A. Kudryashov1, I.O. Prokhovor1, E.A. slapovskiy, Y.O. Kudryashov1, S.V. Teglev1, E.I. Rafailov1, A.N. Baranov1, Lobachevsky University, Nizhny Novgorod State Technical University, Russia; 2University, United Kingdom; 3University of Montpellier, France
In order to obtain the highly sensitive lead selenide layers, the novel PECVD approach was developed. The production and sensitization of the resulting films with iodine pentoxide was carried out in one vacuum cycle. The influence of annealing conditions on the surface morphology and photoelectric properties of the final films was studied.
UV emission of ZnO structures with whispering gallery modes synthesized by different methods.

A.P. Tarasov, National Research Centre "Kurchatov Institute", Russia

ZnO laser microstructures with whispering gallery modes synthesized by different methods were studied. The main contribution to room-temperature optical gain was shown to be from scattering processes of electron-hole pairs rather than direct recombination in an inverted electron-hole plasma. It was found that the bandgap energy and the nature of luminescence do not depend significantly on the specific synthesis method.

ThR03-p36
10:00-13:30

Cost-efficient fiber optic distributed acoustic sensor

A.T. Turov1, F.L. Barkov2, C.A. Lopez-Mercado2, D. Claude1, A.A. Fotiadi1,2, M.A. Konovolova1,2, 1Perm Nat. Res. Polytechnic Univ.; 2Perm Fed. Res. Center UB RAS, Russia; 3Scient. Res. and Advanced Studies Center of Ensenada, Mexico; 4Univ. of Mons, Belgium; 5S.P. Kapitsa Res. Inst. of Technology; 6Inoe Institute, Russia

The work presents the two ways of fiber optic distributed acoustic sensor's (DAS) cost and parameters optimization. As a result, the hardware has been simplified, still meeting the requirements of potential customers, and the following signal-to-noise ratio (SNR) decrease has been compensated by about 11 dB.

ThR03-p37
10:00-13:30

In-well pumping of an InGaN/AlGaNp-based semiconductor disk laser

V.I. Kozlovsky, S.M. Zhenisehbykov, Y.K. Skasrysky, M.P. Frolov; Lebedev Physical Inst., Russia

Semiconductor disk laser based on the InGaN/AlGaNp heterostructure, emitting at λ = 645 nm, was studied under in-well pumping by a pulsed ~1μs dye laser. The pulse power of 72 W with slope efficiency of 17% were achieved.

ThR03-p38
10:00-13:30

Analysis of the thermal resistance of high-power semiconductor lasers based on Al-containing and Al-free heterostructures

M.A. Ladugin, N.G. Vultickov, A.A. Marmalyuk, E.V. Kuznetsov; Polyus Research and Development Institute named after M.F. Stellmakh, Russia

This work is devoted to the computational analysis of high-power CW and QCW semiconductor laser sources in the spectral range 810-980 nm based on Al-containing and Al-free heterostructures.

ThR03-p39
10:00-13:30

Subthreshold electroluminescence from long-side-cleaved quantum-cascade laser

N.Yu. Kharih1,2, A.V. Babichev1, E.S. Kolodezny1, A.G. Gladyshev1, S.O. Slipchenko1, A.V. Lyutetskiy1, I.Ya. Karachinsky1, I.I. Novikov1, N.A. Piktint1, G.S. Sokolovskiy1, A.Yu. Egorov1; ITMO University; 2Peter the Great St. Petersburg Polytechnic University; 3Inoe Institute, Russia

The room temperature subthreshold electroluminescence of 8 μm quantum-cascade lasers grown by molecular-beam epitaxy is measured and analyzed.

ThR03-p40
10:00-13:30

Facile aqueous synthesis of ZnCuInS/ZnS-ZnS QDs with enhanced photoluminescence lifetime for selective detection of Cu(II) ions

N. Mgedle1,2, O.S. oluafamn2, 1Department of Chemical Sciences, University of Johannesburg, 2Centre for Nanomaterials Science Research, University of Johannesburg, South Africa

In this work, the aqueous synthesis of ZnCuInS/ZnS-ZnS multi-shel quantum QDs as a nanosensor for the selective detection of Cu2+ ions was reported. The fluorometric study showed that the developed QDs were selective towards Cu2+ ions compared to other metal ions via fluorescence quenching with a limit of detection of 1.4μM, which is below the acceptable limit in drinking water.

ThR03-p41
10:00-13:30

Image transmission with parallel array of artificial spiking neurons based on VCSEL and SPAD

V.N. Chichevsky, M.V. Lakhtimtskiy, S.Ya. Kilin; Institute of Physics NASB, Belarus

We show that optoelectronic stochastic artificial spiking neuron (ASN) based on a vertical-cavity laser and single-photon avalanche diode in combination with a software implemented network of parallel-connected ASNs allows one to transmit images virtually with no distortion.

ThR03-p42
10:00-13:30

3D-photonic crystals for high-power semiconductor lasers with surface-emission output

I.V. Oreshkoa,2, A.E. Kazakova1, V.V. Zolotarev1, I.V. Shushkanov1, S.O. Slipchenko1, N.A. Piktint1, 1Inoe Institute; 2St. Petersburg Electrotechnical University "LETI" Russia

A model of a two-dimensional photonic crystal (PC) for lasers with vertical radiation output is developed. The influence of geometrical parameters of the PC on the characteristics of mode structures is analysed. Calculations show that PCs based on holes in the shape of a rectangular isoceles triangle are the most preferable by their characteristics for creating surface-emitting lasers.

ThR03-p43
10:00-13:30

An OFDR's hardware and software optimization and its performance estimation

M.E. Beloukrov1, D.A. Kambar1,2, Y.A. Konstantinov1, F.L. Barkov2, D. Claude1, S.Yu. Malyshiev1, A.T. Turov1,2; 1Perm Fed. Res. Center of the Ural Branch of the RAS, Russia; 2Perm Nat. Res. Polytechnic Univ., Russia

In this work, we describe an optical frequency domain reflectometer (OFDR) where the gas cell channel and the auxiliary interferometer are combined into one channel. Data from this channel is extracted using empirical mode decomposition and frequency filtering. With this method we identify events on the trace without loss of quality. The proposed solution makes OFDRs cheaper and smaller.

ThR03-p44
10:00-13:30

Quantum-cascade laser emitting at 8 μm: epitaxy-growth and characterization

E.S. Kolodezny1, A.V. Babichev1, A.G. Gladyshev1, D.A. Mikhailov1, V.V. Dudevlev1, S.O. Slipchenko1, A.V. Lyutetskiy1, I.Ya. Karachinsky1, I.I. Novikov1, N.A. Piktint1, G.S. Sokolovskiy1, A.Yu. Egorov1; ITMO University; 2Inoe Institute, Russia

The results on fabrication and optical characteristic of lattice-matched to InP quantum-cascade laser emitting at 8 μm are reported. The high current dynamic range is observed for lasers with four cleaved facets.

ThR03-p45
10:00-13:30

Reflectivity changes in GST225 thin film induced by laser pulses with variable duration

D.A. Guryev1, V.A. Kamynin1, P.I. Lazarenko1, D.Y. Terekhova1, S.A. Kozjukhin1, V.B. Tsvetkov1; 1Prokhorov General Physics Institute RAS, 2National Research University of Electronic Technology, 3Kurnakov Institute of General and Inorganic Chemistry RAS, Russia

Phase transitions of GST225 thin films with a thickness of 150 nm were induced by laser pulses with durations ranging from 20 to 140 ns and energies ranging from 1 to 15 μJ. The transitions lasted from 0.4 to 0.6 μs, and the optical contrast reached up to 90%. The study also demonstrated the possibility of two-level transitions.

ThR03-p46
10:00-13:30

Optical parametric amplification of quantum cascade laser radiation in ZnGeP2 crystal

O.B. Vyskubenko1,2, G.S. Garanin1, G.G. Zakharov1, I.N. Kuzakova1,2, V.A. Dudevlev1, V.V. Dudelev1, I.O. Kosykh1,2; 1Lebedev Physical Inst., Russia; 2Perm Nat. Res. Polytechnic Univ., Russia

We demonstrate optical parametric amplification of a pulsed quantum cascade laser emitting near 4.6 μm in a nonlinear ZnGeP2 crystal. We report amplification of about 30 dB with output radiation peak power of 373 W.
Wavelength dependence of transparency current of InGaAs/ GaAs quantum well-dense active medium

ThR03-p47 10:00-13:30

Investigation of microlasers with broken rotational symmetry of the cavity and InGaAs/GaAs quantum well-dots in active region

E.I. Moiseev 1, K.A. Ivanov 2, I.S. Makhov 1, R.A. Khabibullin 2, R.R. Galiev 1, A.Yu. Pavlov 1, K.N. Tomosh 1, F.I. Zubov 2, A.V. Nahomy 2, M.M. Kulagina 1, N.A. Kalyuzhnii 2, S.A. Mintairov 1, N.V. Kryzhanovskaya 1, A.E. Zhukov 1; 1 HSE University; 2 Institute of Ultra High Frequency Semiconductor Electronics RAS; 3 Alferov University, Russia; 4 Institute of Physics NASB, Belarus; 5 Ioffe Institute, Russia

We investigate microlasers with InGaAs/GaAs quantum well-dots in the active region with broken rotational symmetry of the cavity. For the first time, lasing at elevated temperatures is demonstrated. Deviation of the cavity shape from the circular leads to the directionality of the emission in the lateral direction. The quality factor of structures is estimated to be at least $10^5$.

S.V. Telegin 1, E.U. Rafailov 3, A.N. Baranov 4; 1 Nizhny Novgorod State Technical University; 2 Lobachevsky University, Russia; 3 Aston University, United Kingdom; 4 LLC Kobaklab, Russia

Advanced thin films of gallium selendie

L.A. Machalov 1, M.A. Kudryashov 2, E.A. Slapovskaya 2, Yu.P. Kudryashova 2, S.V. Telegin 1, E.U. Rafailov 3, A.N. Baranov 4; 1 Nizhny Novgorod State Technical University; 2 Lobachevsky University, Russia; 3 Aston University, United Kingdom; 4 LLC Kobaklab, Russia

A new advanced thin film optical nanostructure of gallium selenide was developed. This structure is a solid membrane photonic laser, which is formed due to the formation of the gallium monoselenide.

N.A. Gamov 2; 1 Io ThR03-p50 10:00-13:30

Defects for halide perovskite active media

D.S. Gets, S.A. Cherevkov, L.E. Zelenkov; ITMO University, Russia

Halide perovskites allow easy synthesis of perfect nanocrystals and quantum dots with extremely low defect number. At the same time the use of perovskite nanocrystals and quantum dots as an active media is limited due to strong Auger recombination. The defect engineering in perovskite materials opens the possibility of Auger recombination suppression and observation of amplified spontaneous emission.

M.A. Ladugin 1, A.A. Marmalyuk 1, A.Yu. Andreev 1, I.V. Yarotskaya 1, N.V. Kryzhanovskaya 1, N.A. Kalyuzhnyy 5, N.A. Kalyuzhnyy 2, N.A. Gamov 2, I.S. Makhov 1, R.A. Khabibullin 2, R.R. Galiev 1, A.E. Zhukov 1; 1 HSE University; 2 Institute of Ultra High Frequency Semiconductor Electronics RAS; 3 Alferov University, Russia; 4 Institute of Physics NASB, Belarus; 5 Ioffe Institute, Russia

High power continuous wave laser bars emitting at 770-880nm with 70% wall-plug efficiency based on Al-free heterostructures

M.A. Ladugin 1, A.A. Marmalyuk 1, A.Yu. Andreev 1, I.V. Yarotskaya 1, N.V. Gultikov 1, L.I. Shestak 1, V.A. Panarin 1, Sigm plus Co.; 1 Nizhny Novgorod State Technical University; 2 Lobachevsky University, Russia; 3 Aston University, United Kingdom

The effective design of (In)GaAs/InGaP/GaAs semiconductor heterostructures grown by MOVPE, which allows to fabricate cw laser bars emitting in the 770-880 nm spectral range, was developed. It was demonstrated that reduced threshold current density and increased external differential efficiency could be achieved.

N.A. Gamov 2; 1 Io ThR03-p51 10:00-13:30

Electron beam pumped ultraviolet light source (240 - 267nm) based on GaN/AlN MQW structures with output pulsed power of several tens Watts

V.N. Jmerik 1, D.N. Nechaev 1, V.I. Kazlovsky 1, Y.K. Skasysky 1, M.M. Zverev 1, N.A. Gamov 1; Ioffe Institute, 1 Lebedev Physical Institute RAS, Russia

Using an electrons with energy about 15 keV, electron source based on a ferroelectric cathode and GaN/AlN MQW Structures the following values of power of UV-pulse radiation were obtained: 50W ($\lambda=240$nm, $J=2240$mA), 69W ($\lambda=248$nm, $J=2500$mA), 71W ($\lambda=267$nm, $J=2340$mA).

G.O. Kornyshov 1, A.S. Payusov 1, A.A. Beckman 1, Yu.M. Shernyakov 1, S.A. Mintairov 5, N.V. Kryzhanovskaya 1, A.E. Zhukov 1; 1 HSE University; 2 Institute of Ultra High Frequency Semiconductor Electronics RAS; 3 Alferov University, Russia; 4 Institute of Physics NASB, Belarus; 5 Ioffe Institute, Russia

GaSe films were synthesized by PECVD. The morphology, structural, luminescent and electrophysical properties of the resulting material were studied for its further use in a wide range of optical and optoelectronic applications and in advanced semiconductor devices. Raman spectra prove formation of the gallium monoselenide.

Electrical properties of GaSe films were studied for its further use in a wide range of optical and optoelectronic applications and in advanced semiconductor devices.
New method of controlling the axis of laser radiation in Anderson differential cuvette in mobile refractometer  
D.S. Provodin, M.A. Yakuševa, N.A. Riabogina, A.A. Goldberg, I.D. Kochetkov, V.V. Davydov; Peter the Great St. Petersburg Polytechnic University, Russia  
A design of mobile refractometer with Anderson’s differential cuvette and new methodology for controlling the axis of laser emission has been developed to ensure measurement of the refractive index of liquid medium in the range of 1.230 to 2.830 with an accuracy of 0.0001 for unambiguous express control of its condition. This result was obtained for the first time.

Beam profiles and radiation coherence at the output of solid-state and dye lasers with an intra-cavity immersion diffuser  
O.A. Burdulokova1, A.L. Koromyslov, V.A. Petukhov, Yu.V. Senatsky; ‘Lebedev Physics Inst. RAS’, ‘Sechenov Univ., Russia  
A diffuser of radiation based on a cuvette with an immersion mixture of LiF crystal microparticles and isobutyl alcohol, transparent in the range of 0.4-1.1 μm (similar to a Christiansen filter), is proposed. Low-coherent solid-state and dye lasers using this immersion diffuser in the resonator are presented.

Refractive phase masks for lensless laser beam shaping  
D.A. Radnaturov, A.Yu. Kokhanovskyi, P.V. Kozmina, S.M. Kostbev; ‘Novosibirsk State University; ‘ITMO University, Russia  
This work describes a method of laser beam transformation in lensless optical systems by phase SLM. This method relies on an iterative algorithm of wavefront reconstruction that uses a physical model of back propagation of a conjugated wave front and smooth morphing of the target beam profile. This method allows formation of beams with a smooth phase and intensity profiles.

Application of piezoactuators to provide the required resolution of laser interferometers  
E.A. Lavrov; Russian Research Institute of Physical, Technical and Radiotechnical Measurements (FSUE ‘VNIIFITr’), Russia  
A drive unit for the reflector of the reference arm of a laser interferometer for measuring displacements has been developed. With its help, the displacement of the reference arm mirror is simulated to accumulate measurement results and provide a resolution of less than 1 micron. Experimental results of measurements of a laser interferometer are considered.

Peculiarities of laser beam parameters control during goniometric measurements of biological liquids refractive index  
B.K. Reznikov, G.V. Stepanenkov, V.V. Davydov, N.Yu. Kolybelnikov, D.V. Osejere; ‘Borsh-Chuevich St. Petersburg State University of Telecommunications; ‘Peter the Great St. Petersburg Polytechnical University, Russia  
The necessity of using laser radiation of several wavelengths to control the biological media state by measured values of refractive indices is substantiated. The technique of measuring n at several wavelengths using a goniometer is proposed. The requirements to laser radiation parameters are defined. Results of biological media studies with different proteins, solids, and other compositions are provided.

Using neural networks to reconstruct the wavefront of laser radiation based on the focal distribution of fluence near the waist  
A.V. Kotov, A.A. Soloviev; Federal Research Center Institute of Applied Physics RAS, Russia  
The paper proposes a method for reconstructing the wavefront of laser radiation based on the focal distribution of fluence near the waist. For the wavefront reconstruction task, we propose to use deep convolutional neural networks. The method has shown good efficiency and can significantly speed up and improve the quality of calibration of an adaptive optical system.

Laser switching of VO2 attenuator in pulse-periodic mode  
A.A. Antonov, I.M. Belousova, A.P. Zvialkov, A.S. Narinovich; Vavilov State Optical Inst., Russia  
VO2 attenuator has been developed capable of smoothly adjusting the intensity of laser radiation for ophthalmic and angiography. It has been experimentally established that the switching speed of VO2 due to the semiconductor-metal phase transition and the reverse restoration of the initial state can be carried out in the GHz range repetition rate of the applied ns laser pulses.

Constructing confocal Fabry-Perot cavity to stabilize multiple lasers for 40Ca+ optical qubit  
S. Zarutsky1, A.O. Kadykov, I.A. Akopyan, A. Matveev1, N.V. Morozov, K. Lakhmanskyi1; ‘Russian Quantum Center; ‘Moscow State Univ., Russia  
We present the design and its characterization for the laser stabilization system for ion-based quantum computer. The design is based on the custom-constructed Fabry-Perot cavity locked to the stable Nd:YAG 532 nm laser. The target 866 nm laser used for 40Ca+ cooling is then locked to the stabilized cavity.

Coherent beam combining of a multichannel fiber laser with an automatic alignment system  
N.M. Rakcheev, S.V. Tutyin, V.S. Tsykin, M.I. Konovaltsov; Russian Federal Nuclear Center All-Russian Research Institute of Experimental Physics, Russia  
In this work, the coherent beam combining of a seven-channel fiber laser is demonstrated. Channel phase alignment is achieved using a two-stage stochastic parallel gradient algorithm. The system of automatic channel reduction on one optical axis is demonstrated.

Laser noise reduction with additional filtering resonator  
A.P. Gordeev1,2, Navjeet Kour1,2, I.B. Bobrov1,2, S.S. Straupe1,2, S.P. Kulik1,2; ‘Faculty of Physics, Lomonosov Moscow State University, ‘Quantum Technology Center, Moscow State University, ‘Moscow Institute of Physics and Technology, Russia  
Rydberg states in quantum computer based on neutral atoms are obtained by shining on the array of cold atoms with two lasers. Stability of the driving lasers and noise reduction are required for high fidelity of quantum gates. Theoretical analysis and experimental setup of PDH-locking scheme with additional filtering resonator will be presented.

Estimation of the electro-optical response of lithium niobate modulators from the high-frequency transmission of traveling wave electrodes  
M.V. Parfenov, A.V. Varlamov, A.V. Tronev, P.M. Agruzov, I.V. Ilichev, A.V. Shamrai; Ioffe Institute, Russia  
The technique for estimation of an integrated-optical modulator electro-optical response without optical measurements was developed and tested for a lithium niobate modulator. The electro-optic response prediction was based on experimentally measured propagation characteristics of high-frequency electrodes using numerical simulation of optical waveguides. The presented technique can be used to perform rapid tests on a wafer in production of integrated-optical modulators.

Glasses with I-VII and II-VI semiconductor nanocrystals for nonlinear optical limiting  
A. Babkina, E. Kolobkova, K. Žyryanova, N. Nikonorov; ITMO Univ., Russia  
The spectral properties of inorganic glasses with I-VII and II-VI nanocrystals and quantum dots are investigated. Nanosized copper halide and cadmium chalcogenide crystals stabilized in glass matrix are shown to be a perspective material for nonlinear optical limiting.
**R09: OPTICAL NANO_MATERIALS - POSTERS**

**Location:** Nikolsky + Levinson Foyer, Floor 2; **Date:** Thursday, July 04, 2024

**ThR09-p01**  
Production of hybrid materials in the MF$_2$ (M=Ba, Ca): LiQ system by co-precipitation  
M.Yu. Andreeva, P.V. Strekalov, K.I. Runina, O.B. Petrova; The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, Russia

**ThR09-p02**  
Fast-slow light effects of chirped laser pulses in epsilon-near-zero nanorods based metamaterials  
A.A. Dotsenko, V.B. Novikov, A.P. Leontiev, K.S. Napskii, T.V. Murzina; Lomonosov Moscow State University, Russia

**ThR09-p03**  
Antireflection microstructures on ZnSe fabricated by wet-etching-assisted femtosecond laser ablation  
A.A. Teslenko, T.G. Konstantinova, A.A. Bushunov, A.R. Ibragimov, I.A. Rodionov; Moscow State University, Russia

**ThR09-p04**  
Optical crystals and ceramics based on the AgCl$_{0.28}$Br$_{0.72}$-Tl system as scintillator materials  
P.V. Pestereva, I.V. Yuzhakov, D.D. Salimgareev, A.E. Lvov, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia

**ThR09-p05**  
Photoluminescence enhancement and Förster resonant energy transfer in a nanoporous alumina-silver nanoparticles hybrid structure  
I.Yu. Nikitin, L.N. Borodina, A.V. Boltenko, M.A. Baranov, I.A. Gladskikh, T.A. Vartanyan; International Research and Educational Center for Physics of Nanomaterials, ITMO University, Russia

**ThR09-p06**  
Formation of linear carbon chains in aqueous chloroauric acid (HAuCl) solutions by laser irradiation  
N.N. Rozhkov, V.V. Kononenko, A.V. Osiyov, V.D. Samyshkin, A.S. Abramov, A.O. Kuchen; Karelian Research Centre RAS, Natural Sciences Center of General Physics Institute, Prokhorov General Physics Institute RAS, Department of Physics and Applied Mathematics, Vladimir State University Named after A.N. and NG Stoletovs, Russia

**ThR09-p07**  
Experimental and theoretical study of a flow photoreactor operating in the strong light-matter coupling regime  
E.A. Granizo, I.S. Kriukova, P.S. Samokhvalov, I.R. Nabiye; Laboratory of Nano-Bioengineering, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia; Life Improvement by Future Technologies (LIFT) Center, Skolkovo, Russia; Laboratoire de Recherche en Nanosciences (LRN-4682), Université de Reims Champagne-Ardenne, France

**ThR09-p08**  
Direct aqueous synthesis of Mn-doped ZnInS/ZnS: the effect of the impurity on singlet oxygen generation and photothermal profiling  
R. Maluleke, S.O. Oluwafemi; Department of Chemical Sciences, University of Johannesburg, Centre for Nanomaterials Science Research, University of Johannesburg, South Africa

**ThR09-p09**  
Upconversion responsivity of 4F9/2-4I15/2 transition of erbium in NaYF$_4$ matrix at high power pump  

**ThR09-p10**  
Multiple optical switching of GST thin films for reflective display applications  
V.B. Glukhenkaya, E.P. Kitsyuk, N.M. Tolkach, G.N. Pestov; National Research University of Electronic Technology, Scientific-Manufacturing Complex "Technological Centre", Russia

*Note: The full text of each poster is not provided here.*
Galleries of bound states in the continuum of dielectric objects: ring, splitting, cuboid
N. Solodochenko 1, K. Samusev 2, M. Limonov 1, 2 1 Department of Physics and Engineering, ITMO University; 2 Ioffe Institute, Russia
In our work, most phenomena are described by non-Hermitian physics, which gave us, for example, bound states in continuum (BIC) with a big quality factor. The main result of this work is the discovery of a new effect: cascades of BIC in various dielectric objects, such as a ring, a split ring and a cuboid.
ThR09-p12 15:00-18:30

Study of the effective optical characteristics of metal surfaces using terahertz surface plasmon interferometry
V.S. Vanda 1, V.V. Gerasimov 1, A.K. Nikitin 1 1 Budker Institute of Nuclear Physics SB RAS, 2 Novosibirsk State University; 3 Scientific and Technological Centre of Unique Instrumentation RAS, Russia
The theoretical and experimental studies of the effective optical constants of metal surfaces in the THz frequency range using dynamic plasmon interferometry will be presented. It was shown that the length of propagation of surface plasmon polaritons over conductors, as well as their optical constants, significantly depend on the surface metal roughness.
ThR09-p13 15:00-18:30

Lasing of polymer microspheres doped with AgInS2 quantum dots and plasmonic nanoparticles
E.O. Soloveva 1, K. Kurassova 1, K.V. Bogdanov 1, A.A. Starovoytov 1, N.A. Toropov 1, N.N. Shevchenko 1, T.A. Vartanyan 1, ITMO University, Russia; 2 Univer. of Southampton, United Kingdom; 3 Inst. of Macromolecular Compounds, Russia
Whispering-gallery mode (WGM) microlasers were made of polystyrene microspheres in an aqueous solution of plasmonic nanoparticles and AgInS2 quantum dots. The emission spectra of doped microspheres exhibited narrow peaks corresponding to WGM. The presence of silver and gold nanoparticles reduces the emission intensity and, in the case of gold, simultaneously increases the microlaser quality factor.
ThR09-p14 15:00-18:30

Luminescent hybrid materials in the PbF2-ZnQ2 system synthesized by co-precipitation method
E.V. Myagkova 1, P.V. Strekalov 1, K.I. Runina 1, O.B. Petrova 1, Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, Russia
Powder hybrid materials based on the organic phosphor bis[bis-hydroxyquinoline] zinc (II) and the inorganic matrix of lead fluoride are considered. Hybrid materials were obtained by co-precipitation from aqueous-alcoholic solutions with ammonium fluoride under different conditions - different concentrations of organic and inorganic components, the order of mixing the reagents.
ThR09-p15 15:00-18:30

Coalescence of III-V and III -nitride nanowires
V.G. Dubrovskii 1, Faculty of Physics, St. Petersburg State University, Russia
We study theoretically the nanowire coalescence process and present the structural diagrams separating the domains of partial or full coalescence depending on the presence or absence of a catalyst droplet at the NW tip and the epitaxy technique (either directional MBE method or vapor phase epitaxy).
ThR09-p16 15:00-18:30

Magnetic control of coherent tunneling in hybrid magnetic-dielectric integrated waveguides
O.V. Borokova 1, A.A. Kolosova 1, V.I. Belotelov 1, 2 1 Russian Quantum Center; 2 Lomonosov Moscow State University; 3 Moscow Institute of Physics and Technology, Russia
Magnetic control of the light routing and transfer in the integrated planar waveguide structure that combined both magnetic (iron garnet) and nonmagnetic (quartz) waveguides on the silicon dioxide chip based on the coherent tunneling by adiabatic passage (CTAP) is addressed. The effect is studied for two different directions of the external magnetic field.
ThR09-p17 15:00-18:30

Thermal tunability of optical transmission of Epsilon-Near-Zero metamaterials based on nanorods in liquid crystals
V.B. Novikov 1, A.K. Zagavskii 1, S.V. Lotnikov 1, N.K. Davidenko 1, A.Yu. Bobrovsky 1, K.S. Napoleon 1, T.V. Murzina 1, Lomonosov Moscow State University, Russia
We revealed a salient thermal effect in the transmission of the epsilon-near-zero metamaterial consisting of an array of plasmonic nanorods in a dielectric template. The flavor of the structure is free-standing nanorod segments surrounded by liquid crystals possessing a strong thermal dependence of the permittivity. The observed resonant enhancement of the thermal sensitivity harnesses nonlocal optical response of the structure.
ThR09-p20 15:00-18:30

Study of light-emitting properties in a GaNPAs heterostructure on silicon
L.N. Dvoretskaya 1, A.M. Mozharov 2, A.S. Funktikova 2, V.V. Fedorov 2, 3, I.S. Mukhin 1, 2 1 Alferov University, 2 Peter the Great St. Petersburg Polytechnic University, Russia
The work demonstrates the results of a study on the creation of a matrix structure based on a p-i-n GaP/GaPNA/GaP diode on Si.
2.5 μm photodetectors based on MBE grown InAlAs/InGaAs/InP metamorphic heterostructures
E.I. Vasilkova 1, E.V. Pirogov 1, K.Yu. Shubina 1, O.V. Barantsev 1, K.O. Voropaev 1, A.A. Vasil'ev 2, I.I. Novikov 1, M.S. Sobolev 1, V.A. Gul'yan, I.E. Ageev, D.A. Zuev; ITMO University, Russia
This study demonstrates nanostructures formation using single-shot femtosecond laser exposure on a thin gold film with zero-order vortex beam retarders. The research investigates the influence of the focused laser beam on the produced nanostructures and explores the dependencies of sizes and types on laser fluence. The proposed method simplifies fabrication and allows scaling up the production of arrays of nanostructures.

Optical properties of self assembled aligned single walled carbon nanotubes
A. Ismaeel 1,2, I.O. Orekhov 1, N.R. Arutyunyan 3, S.G. Sazonkin 1, D.A. Dvoretskiy 1, A.A. Bakal, A.M. Abramova; Chemical Institute, Saratov State University, Russia
This article describes a method for creating a metasurface based on titanium dioxide
K.V. Tsiert' 1, M.I. Tenevich 1, V.I. Popkov 1, A.A. Zhilin 4, V.A. Gul'yan, I.E. Ageev, D.A. Zuev; ITMO University, Russia
This work reports on In0.83Ga0.17As/InP pin-photodiodes based on heterostructures with InAlAs metamorphic buffer layers grown by molecular beam epitaxy. The fabricated photodiodes are sensitive to 2.5 μm light source as shown by the current-voltage characteristics. The measured photodiode dark current is ~ 300 nA under 10 mV reverse bias voltage.
ThR09-p34  15:00-18:30

Spectroscopy of thulium ions in novel oxychloride lead-tellurite glasses
D.A. Butenkov1, A.M. Vasilenkova1, K. Veselisky1,2, P. Loiko2, A. Braud2, P. Camy2, O.B. Petrova1; 1Department of Chemistry and Technology of Crystals, Mendeleev University of Chemical Technology, Russia; 2Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, France; 3Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Czech Republic

Thulium-doped oxychloride lead-tellurite glasses were synthesized, and their spectroscopic properties were studied focusing on Tm3+ emissions at 2 - 3 μm. Tm3+ ions exhibit relatively long luminescence lifetimes of the 3H4 and 3F4 states owing to the low-phonon-energy behavior of the glass matrix.

ThR09-p35  15:00-18:30

Optical properties of modulated structures in chiral liquid crystals
P.V. Dolganov1,2, K.D. Baklanova1, V.K. Dolganov1; Osyipan Institute of Solid State Physics RAS, 1National Research University Higher School of Economics, Russia

Chiral liquid crystals form a number of modulated structures with unusual properties. Here we report experimental studies of the two-dimensional structure forming near the cholesteric-isotropic phase transition. Complex optical patterns with strong nontrivial dependence of the images on light polarization were found and investigated in transmission and reflection.

ThR09-p36  15:00-18:30

Multilayer mirrors based on rubidium for soft X-ray range
M.A. Yamschikova1, V.M. Yamschikov1; FSUE "RFNC-VNIIEF", 2Lomonosov Moscow State University, Russia

This work examines multilayer X-ray mirrors of various compositions. Using a genetic algorithm, a search for optimal layer thicknesses is implemented for each mirror while maximizing reflectivity. Record theoretical reflectance limits of 78% at 13.5 nm and 83% at 17.04 nm are reported.

ThR09-p37  15:00-18:30

High-quality ultrathin metal films for plasmonics and optoelectronics
D.I. Yakubovsky1, M.S. Mironov1, D.V. Grudinin1, I.S. Kazantsev1, A.A. Vyshnevyi1, G.A. Ermolaev2, A.V. Arseni1, V.S. Volkov1; Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, Russia; Emerging Technologies Research Center, XPACECO, Dubai Investment Park First, Dubai, United Arab Emirates

We propose a new method of making high-quality ultrathin gold films what optoelectronic properties are comparable to bulk gold. Excellent plasmonic response were confirmed by observing surface plasmon polaritons using scanning near-field optical microscopy and ellipsometry. The results pave the way for the use of ultrathin gold films in flexible and transparent nanophotonics and optoelectronic applications.

ThR09-p38  15:00-18:30

Photocatalytic activity of TiO2/rGO/CdS nanocomposite
T.M. Senikov, N.H. Ibrayev, E.V. Seliverstova; Institute of Molecular Nanophotonics, Buketov Karaganda University, Kazakhstan

The results of a study of the effect of the concentration of CdS nanoparticles in the TiO2/rGO nanocomposite on its photocatalytic activity are presented. The introduction of CdS into TiO2/rGO leads to an increase in its photocatalytic activity due to the expansion of spectral sensitivity in the visible wavelength range and enhanced charge-transfer parameters.

ThR09-p39  15:00-18:30

Optical study of Er3+ and Nd3+ /Yb3+-doped CeO2 and CeF3 nanoparticles
A.K. Ginkel1, R.M. Rakhmatullin2, O.A. Morozov3, S.L. Korabieva1, V.V. Semashko1, M.S. Pavlukhov1; Kazan Federal University, Institute of Physics, 2V. Zavoisky Physical-Technical Institute, FRC Kazan Scientific Center RAS, Russia

Here, the facile dry synthesis of double-phase CeO2/ CeF3 nanoparticles doped with Er3+ or Nd3+/Yb3+ ions. The influence of the two-phase composition of nanoparticles on the luminescent properties of Er3+ and Nd3+/Yb3+ is also considered. The intensity of Er3+ increases by 3.5 times after fluorination. After the formation of two-phase Nd3+/Yb3+ :CeO2/CeF3 samples, emissions of both Nd3+ and Yb3+ are observed.

ThR09-p40  15:00-18:30

Photoluminescence enhancement of nanowires in IR-range induced by surface plasmon
T.M. Shugabev1, V.O. Gridchin1,2, D. Bulkin1, A. Melnichenko3, A.A. Maksimova4, K.P. Kotlyar1,2,3, V.V. Lendyashova1, K.V. Kryzhanovskaya, R.R. Reznik1, G.E. Lin1, S. Petersburg State Univ., 2Allerton Univ., 3Inst. for Analytical Instrumentation RAS, 4LPICM CNRS, Ecole Polytechnique, IP Paris, France; 5HSE Univ., 6St. Petersburg Electrotechnical Univ. "LETI"; 7Ioffe Inst., Russia

Nanowires are promising solids for creating efficient optoelectronic and nanophotonic devices. Here, we study the optical properties of single InP/InAsP/InP nanowire transferred to Ag/SiOx plasmonic substrate. For the first time, photoluminescence enhancement for these nanowires due to exciton-plasmon interaction was demonstrated.

ThR09-p41  15:00-18:30

Photoluminescent aerogels with RGB emission
K.T. Runina1, D.A. Komsev2, I.Ch. Avetissov3, N.V. Menshutina1, A.E. Lebedev1, E.N. Sudova1, T.S. Vlasova1, I.V. Taydakov5; 1The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, 2The Department of Cybernetics of Chemical and Technological Process, D. Mendeleev University of Chemical Technology, 3The Department of Chemical and Pharmaceutical Engineering, D. Mendeleev University of Chemical Technology, 4Laboratory of Photoelectronic Systems, N.D. Zelinsky Institute of Organic Chemistry RAS, 5The Department of Luminescence, Lebedev Physical Institute RAS, Russia

Three new luminescence aerogels based on silica matrix and –diketone complex with Eu(II) and 8-hydroxiquinoline complexes with Al(III) and Ca(II) have been synthesized and investigated. The obtained aerogels had PL maxima in the red, green, and blue regions of the visible range, respectively.

ThR09-p42  15:00-18:30

Vertical subwavelength grating coupler inspired by the moth’s eye metasurface
I. Kazakov, A.V. Shipulin, ScolTech, Russia

We propose a new design principle for vertical grating couplers for integrated photonics. The principle is based on breaking the symmetry of the waveguide stripe using a moth’s eye-inspired metamaterial. Our simulations of the grating coupler on a 220 nm SOI material platform show a coupling efficiency of 28% and unidirectionality of over 31 dB.

ThR09-p43  15:00-18:30

Polarization coupling in a bent optical waveguide based on thin film lithium niobate
D.N. Moskal'ev1,2, E.D. Voblikov1, V.V. Kristop2,3; 1Perm Scientific-Industrial Instrument Making Company; 2Perm State University; 3Perm National Research Polytechnic University, Russia

In the present paper the simulation of modes in waveguides based on thin film lithium niobate was performed. Further, the coupling coefficients depending on the waveguide angle were obtained. The results showed the maximal absolute value of the coupling coefficient was 0.013, which corresponds to direction of the waveguide at an angle of 50°.
Preparation and optical properties of transparent spinel-based glass-ceramics containing Fe(II) ions

O. Dymshits1,2, V. Bukina1, K. Ererre1, K. Trukhanova1, S. Zapolova1, I. Alekseeva2, L. Basyryova1, K. Bogdanov1, A. Volokitina1, M. Tsieter2, P. Loiko1, V. Popkov1, A. Zhirin1; Center of Nanoheterostructure Physics, Ioffe Institute, 1Glass Department, S.I. Vavilov State Optical Institute, Russia, 2Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), Université de Caen Normandie, France, 3Université de Franche-Comté, CNRS, Institut FEMTO-ST, France, 4International Research and Education Center for Physics of Nanostructures, ITMO University, Russia, 5D.V. Efremov Institute of Electrophysical Apparatus, Russia

Transparent glass-ceramics of magnesium, lithium-gallium, lithium, and zinc aluminosilicate systems based on Fe2+-doped nanocrystals with spinel structure are developed by secondary heat-treatments of glasses melted in reducing conditions using TiO2 or a mixture of TiO2 and ZrO2. The glass-ceramics are promising as saturable absorbers for lasers operating at ~2 μm.

ThR09-p45

Plasmon effect on energy transformation of electronic excitation in molecular systems

N.Xh. Ibrayev1, E.V. Selevtsov1, M.G. Kucherenko; 1Buketov Karaganda University, Kazakhstan, 2Orenburg State University, Russia

The influence of plasmon metal nanoparticles on intra- and intermolecular electronic processes in condensed matters has been studied. The transition absorption of plasmon nanoparticles as well as competitive effect of plasmonic enhancement of fluorescence and Förster energy transfer in the “chromophores/plasmon nanoparticles” system, and plasmonic effect on singlet-singlet and triplet-singlet energy transfer in the same donor-acceptor pair was considered.

ThR09-p46

Luminescence temperature sensing based on spectral characteristic of CeF3·TbF3·YF3 nanoparticles

S.I. Kalinichenko, A.S. Nizamutdinov, M.S. Pudovkin; Kazan Federal University, Institute of Physics, Russia

Luminescence intensity ration Ce3+ and Tb3+ peaks was used as a temperature-dependent parameter (303-523K range). The LIR functions decay with the increase of temperature and depends on Tb3+ concentration. We suggest, that this is due to the competition of two processes: multiphonon-nonradiative transition of Tb3+ from SD3 to SD4 and cross-relaxation between Tb3+ ions, which was considered less temperature-dependent.

ThR09-p47

Ultrafine precursor for laser sintering of Er3+/Yb3+ co-doped Bi2O3-Ge2O5 glasses

A.D. Plekovich, A.M. Kutin, E.E. Rostokina, M.E. Kornshina, K.V. Balueva, K.F. Shumovskaya; Devatykh Institute of Chemistry of High Purity Substances RAS, Russia

A method has been developed for producing an amorphous ultrafine precursor with different ratios of Er:YAG and 20Bi2O3-60B2O3-20BaO. The method of selective laser sintering has been used to demonstrate the possibility of forming functional glass ceramics with a crystalline phase represented by yttrium aluminum garnet and yttrium/erbium borate.

ThR09-p48

Thin film GeTe and GeSbTe for photonic applications

A.A. Burtsev, A.V. Kiselev, V.V. Ionin, A.A. Nevzorov, V.A. Mikhailovsky, N.N. Eliseev, A.A. Lotin; NRC «Kurchatov Institute», Russia

Thin film phase-change materials (PCM) such as germanium telluride are commonly utilized in photonic and optoelectronic devices. This study presents a reversible alternation in the optical properties of thin-film samples due to phase transitions under the influence of pulsed laser radiation using the pump-probe scheme.

ThR09-p49

A model of the process of forming the optimal fractional composition of powders during compaction

A.V. Kharkova, K.A. Frolov, D.A. Kochuev, R.V. Chkalov, D.G. Chkalova; Vladimir State University named after A.G. and N.G. Stoletov, Russia

A mathematical model for estimating the optimal fractional composition of the powder for compaction has been developing. The model has been testing on the data of fractional compositions of three mixtures. The layering of the powder mixture is modeling using the finite element method.

ThR09-p50

Photoluminescence enhancement of InGaN core-shell nanowires via wet chemical treatment

V.O. Gridchin1,2, A.S. Kulagina2, T. Shugabev2,3, A.I. Khrebтов2, V.V. Lendyashova1,2, I.S. Makhov1,2, Yu.B. Samsonenko1,2, R.R. Reznik1,2,3, G.E. Cirillo1,4; 1St. Petersburg State University, 2Alferov University, 3Ioffe Institute, Russia

It has been revealed that removing the shell of spontaneously formed InGaN nanowires increases the amplitude and narrows their emission spectrum. It has been established that radiative recombination dominates in the nanowires. And the dependence of the integrated photoluminescence intensity on the pump power for nanowires after etching is super-linear in comparison with the initial ones.

ThR09-p51

Ultrathin GaN epilayer and GaN epilayer epilayers for UV sensing

O.A. Sinitskaya1, K.Yu. Shubina1, A.M. Mizurov1, M.S. Sobolev1, E.V. Nikitin1, 1Nanoelectronics lab., Alferov University, 2Ioffe Institute, Russia

Ultrathin GaN epilayer is grown on Si(111) substrates by plasma assisted molecular beam epitaxy (PA MBE) and investigated. The UV photodetectors based on epilayers obtained are formed and their I-V and transient photoresponse on-off characteristics are studied. It is shown that GaN epilayer with labyrinth-like morphology are prospective for fast-response UV detectors development.

ThR09-p52

Luminescent properties of the Er3+/Yb3+ co-doped Bi2O3-Ge2O5 glasses

K.S. Serkina, I.V. Zhegucheva, K.I. Runina, I.V. Stepanova; Mendeleev Univ. of Chemical Technology, Russia

Erbium and ytterbium co-doped bismuth-germanate glasses were synthesized and their luminescent characteristics have been investigated. It was shown that addition of these rare-earth oxides leads to an expansion of the luminescence spectral range of Bi2O3-Ge2O5 glasses (1100-1650 nm). Luminescence range broadening as well as luminescence enhancing was achieved by excitation energy transfer between Er3+, Yb3+ and bismuth active centers.

ThR09-p53

Femtosecond laser-induced optical anisotropy in thin chalcogenide vitreous semiconductor films

D.V. Shuleiko1, E.V. Kuzmin2, P.P. Pakholchuk1, D.V. Pepelyaev2, T.S. Kunkel1,2, S.V. Zabolotny1, P.K. Kashkarov1; Faculty of Physics, Lomonosov Moscow State University, 1Institute of Advanced Materials and Technologies, National Research University of Electronic Technology, 2Moscow Institute of Physics and Technology, Russia

Femtosecond (515 nm, 300 fs) laser-induced periodic surface structures of various types were formed on As2Se3 vitreous semiconductor film. These structures have subwavelength (160±10 nm) or wavelength (480±10 nm) period and form within the irradiated area independently or simultaneously, as a hierarchical structure. The formed structures demonstrate birefringence with the difference between the refractive indices up to 0.1.
Composite nanostructures for biomedical applications formed by femtosecond laser irradiation

D.T. Murashko1,2, E.Y. Otsupko1, A.Yu. Gerasimenko1,2; National Research Univ. of Electronic Technology; 1M. Sechenov First Moscow State Medical Univ., Russia

Composite nanostructures were fabricated using carbon nanotubes, that were incorporated in bovine serum albumin matrix. Hardness and Young’s modulus of the nanostructures with carbon nanotubes were 0.3 GPa and 5.9 GPa, respectively. The conductivity of the composite nanostructure were 33 μS. The possibility of transferring composite nanostructures to the skin surface has also been verified.

N.A. Gippius2, S.A. Dyakov2; 1Russian Quantum Center, 2Skolkovo Institute of Science and Technology, 3 Moscow Institute of Physics and Technology, 2Center for Phot. Science and Engineering, Skoltech, 3 Prokhorov General Physics Institute RAS, Russia

We predict the occurrence of Dyakonov surface modes in an anisotropic ring-shaped interface resonator. Our results indicate that for larger rings, the resonant conditions for these surface modes can be effectively described using the propagation constant of the Dyakonov surface waveguide mode in a straight interface waveguide. We examine the field structure of these modes.

Structural laser diagnostic for ordered substances, optical materials, and nanosystems

Ya.A. Fafanov, V.V. Manolov; Institute for Analytical Instrumentation RAS, Russia

New prospects for laser polarization-optical diagnostics of structural features and fluctuations of ordered substances and functional materials are considered. Investigations of the polarization responses of optical materials and elements with a high degree of optical and structural homogeneity, magnetically ordered materials, perfect optical crystals, magnetic nanosystems (nanofluids) and other topical objects are described.

Void-free uniform gap filling between thick PECVD silicon nitride waveguides

A.M. Munylakov1, N.Yu. Dmitriev1, M.V. Shibalov1, I.V. Trofimov1, I.A. Filipov1, A.A. Anikanov1, I.A. Bilenko1, M.A. Tarkhov1; 1Institute of Nanotechnology of Microelectronics RAS, 2Russian Quantum Center, 3National Research University "Moscow Power Engineering Institute", Russia

In this research, we present a novel manufacturing technology for silicon nitride photonics, which is designed to address the issue of defects (voids) in areas where waveguides are closely situated.

Annealing of TiN thin films on silicon

N.V. Sibirev1, I.P. Soshnikov1, I.V. Shrom1, I.V. Ilikiv1; "St. Petersburg State University; 1Ioffe Institute; 2IAlR; 3Alferov University, Russia

III - arsenide nanowires are often grown via the vapor-liquid-crystal mechanism with foreign catalyst. Here we discuss the initial stage of nanowire growth with lead catalyst - annealing of thin film. The influence of thin film thickness, temperature, and time of annealing, was discussed.

Study of the oxygen defects influence on optoelectronic properties of single walled carbon nanotubes

M.I. Paukov1, E.O. Chiglintsev1, D.V. Krasnikov1, G.A. Komandir1, A.V. Chernykh1, A.E. Ersksin1, G.E. Tsipalakova1, I.I. Rakov1, M.I. Paukov1, V.V. Starchenko1, A.V. Arsenin1, I.E. Spector1, K.I. Zaytsev1, D.V. Krasnikov1, N.V. Petrov1, A.G. Nasibulin1, V.S. Volkov1, M.G. Burdanova1,2; 1Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, 2Prokhorov General Physics Institute RAS, 3Institute of Solid State Physics RAS, 4Skolkovo Institute of Science and Technology, 5TMU University, Russia

In this research we quantitatively study defect-induced changes of optoelectronic properties of single-walled carbon nanotubes. Based on the measurements, we suggest empirical laws of the parameters depending on the concentration of dopant. These results might be applicable for many potential applications, including sensors.

Pulse mode of optical exciting the MDMO-PPV polymer embedded in a porous silicon microcavity for detecting nitroaromatic compounds

O.K. Malychev, I.L. Martynov, A.A. Chistiyakov; National Research Nuclear University “MEPhI”, Russia

This paper presents the results of a study of the time dependences of the fluorescence amplitude of the MDMO-PPV polymer under different optical excitation modes. Due to its results, conclusions were drawn about the excitation parameters at which a further reduction of the average radiation intensity does not affect noticeably on the stability of the fluorescence of the polymer.

Enhanced chemiluminescence of luminol by silver and gold nanoparticles: investigating the role of particle size, shape, and concentration

A.V. Palekhova, D.V. Kononov, T.A. Vartanyan, D.R. Dadadzhanov; International Research and Education Center for Physics of Nanostructures, ITMO University, Russia

It was found that with the addition of a certain amount of metal nanoparticles, the intensity of luminol chemiluminescence increases, and this effect is observed at different pH levels. In addition, it was shown that the shape of metallic silver and gold nanoparticles in luminol solutions significantly affects the intensity of chemiluminescence.

Enhanced capabilities of generating THz vortices by utilizing advanced spiral zone plates based on carbon nanotubes

A.V. Radionov1, G.M. Kytys2, N.I. Raginov1, A.V. Chernykh1, A.S. Ersksin1, E.G. Tsipalakova1, I.I. Rakov1, M.I. Paukov1, V.V. Starchenko1, A.V. Arsenin1, I.E. Spector1, K.I. Zaytsev1, D.V. Krasnikov1, N.V. Petrov1, A.G. Nasibulin1, V.S. Volkov1, M.G. Burdanova1,2,3; 1Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, 3Prokhorov General Physics Institute RAS, 4Institute of Solid State Physics RAS, 5Skolkovo Institute of Science and Technology, 6ITMO University, Russia

Optical elements based on nanomaterials are increasingly found in the terahertz (THz) research. These materials offer compactness and unique properties such as flexibility and stretchability, which enable precise control of wave beams. In this work, we demonstrate an innovative approach to controlling the THz wavefront using spiral zone plates (SZPs) made of single-walled carbon nanotubes (SWCNTs).

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**ThR09-p65**

Sodium modification effect on the Tm$^{3+}$-doped Bi$_2$O$_3$ - GeO$_2$ glasses NIR luminescence

K.S. Serkina 1, A.V. Korol 1, D.V. Volkova 1, K.I. Runina 1, I.V. Stepanova 1, The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, Russia

Sodium-modified and thulium-doped bismuth-germanate oxide glasses were synthesized and their spectral-luminescent characteristics have been investigated. It was revealed that sodium modification and thulium doping improved the optical quality and luminescent characteristics of Bi2O3-GeO2 glasses.

**ThR09-p66**

Study of Terahertz transmission of metal halide optical materials

D.D. Salimgareev 1, A.E. Lvov 1, A.A. Yuzhakova 1, A.S. Korsakov 1, L.V. Zhukova 1, Uralski Federal University, Russia

A study was carried out of the AgCl0.25Br0.75 → TlCl0.46I0.54 systems optical materials' transmission in the infrared and terahertz regions. The obtained data will make it possible to produce a variety of optical products, including terahertz fiber optics for the creation of new generation equipment.

**ThR09-p67**

Optical free-standing waveguides with broadband prism couplers made by two-photon lithography

I.O. Batuevi 1, A.N. Androssov 1, A.I. Maydikovski 1, D.O. Apostolov 1, T.V. Murzina 1, ‘Lomonosov Moscow State University', ‘HSE University, Russia

We present a free-standing optical waveguide with prism adaptors printed from polymer with two-photon laser lithography method. The diameter of the printed waveguides ranges from 0.5 to 2 micrometers and the length is 20 micrometers. We demonstrate experimentally obtained optical loss values ranging from 50% at wavelength 450 nm to 89% at 1300 nm, which are confirmed by numerical modeling.

**ThR09-p68**

Optical properties of silver halide single crystals and ceramics - promising materials for fiber optics

D.D. Salimgareev 1, A.E. Lvov 1, D.V. Shatunova 1, E.Y. Kabykina 1, P.V. Pestereva 1, L.V. Zhukova 1, Uralski Federal University, Russia

A study of functional properties of single crystals and optical ceramics of the AgCl → AgBr0.710.3 system was carried out. The range of materials spectral transmission, the refractive index dispersion in a wide range of wavelengths, and the refractive index imaginary part have been determined. The results are the basis for modeling and manufacturing infrared fibers.

**ThR09-p69**

Laser formation of photocatalytically active TiO$_2$ coating

E.Y. Ponkratova 1, A.M. Kuzmichev 2, A.I. Khrebtov 2, A.S. Kulagina 1,2, A.I. Khrebtov 2, A.S. Ruban 3, V.V. Danilov 3, 1St. Petersburg State University, 2Alferov University, Russia; 3Institute of Analytical Instrumentation RAS, St. Petersburg, Russia

The laser formation of photocatalytically active TiO$_2$ coating involves the laser fragmentation technique in a colloidal solution. The mechanical stabilization of carbonyl is achieved due to the electron bonding of carbon chains to gold nanoparticles. We demonstrated that high degree of alignment of the gold-terminated carbonyl chains results in strongly anisotropic light absorption.

**ThR09-p70**

Temperature dependences of light emission and energy transfer in heterostructures with CdTe quantum wells of various thicknesses

M. Filosof, A. Serov, V. Agekyan, I. Shtrum, S. Verbin; St. Petersburg State University, Russia

Understanding the mechanisms of excitation transfer is essential for optimizing the heterostructure design. We study CdTe/CdMgTe heterostructure with four quantum wells (QWs) of different thicknesses. Photoluminescence excitation (PLE) spectra reveal the coupling of QWs separated by thick barriers. The PLE spectra testify in favor of a resonant dipole-dipole interaction. The temperature behavior of QW photoluminescence depends on the excitation level.

**ThR09-p71**

Density functional theory study of In wetting layer formation during droplet epitaxy growth of InAs/AlGaAs quantum dots

D.D. Dukhan1, S.V. Balakirev1, M.S. Solodnov1; Southern Federal University, Russia

In this work we study effect where chemically active Al in substrate leads to increase in surface mobility of adatoms. Simulations showed that lack of As during wetting layer formation characteristic for droplet epitaxy growth allows In adatoms to form dimer rows that, as we hypothesize, shift their electron density towards Al weakening bonds of In adatoms with wetting layer.

**ThR09-p72**

Size-dependent properties of InAs quantum dots in Si

I. Ilkiv1,2, V. Lendyashova1, A. Khrebtov1, V. Talalayev1, B. Borodin1,2, G. Czrl1,2, 1St. Petersburg State University, 2Alferov University, Russia

Here we study stable elongated carbon chains synthesized by the laser fragmentation technique in a colloidal solution. The mechanical stabilization of carbonyl is achieved due to the electron bonding of carbon chains to gold nanoparticles. We demonstrated that high degree of alignment of the gold-terminated carbonyl chains results in strongly anisotropic light absorption.

**ThR09-p73**

Lead borogermanate glasses co-doped Sm$^{3+}$/Gd$^{3+}$ luminescent thermometry materials

S.S. Zykova 1, K.S. Serkina 1, K.I. Runina 1, D.B. Petrova 1, K.A. Boldyrev 1; The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology; Laboratory of Fourier-spectroscopy, Institute for Spectroscopy RAS, Russia

The luminescent properties of co-doped Sm$^{3+}$/Gd$^{3+}$ in the B2O3-GeO2-PbO glass system were investigated in the temperature range of 423-673K. Intensity of the Sm$^{3+}$ band in the range of 525-540 nm (4F3/2→6H5/2) increased with increasing temperature. The fluorescence intensity ratio (FIR) changes between the thermosensitive band and the band is attributed to transition $5G_{7/2}$→$6H_{7/2}$ was calculated and demonstrated.

**ThR09-p74**

Lead-borogermanate glasses co-doped Sm$^{3+}$/Gd$^{3+}$ luminescent thermometry materials

S.S. Zykova 1, K.S. Serkina 1, K.I. Runina 1, D.B. Petrova 1, K.A. Boldyrev 1; The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology; Laboratory of Fourier-spectroscopy, Institute for Spectroscopy RAS, Russia

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**ThR09-p75**

Luminescence features of heterostructures passivated by layers of colloidal quantum dots under intense laser excitation

A.S. Kulagina1, I.I. Khrebtov1, A.S. Ruban1, V.V. Danilov1; St. Petersburg State University, 1Alferov University; 2Emperor Alexander I Saint-Petersburg State Transport University, Russia

The photoluminescence of nanostructures as InP/InAsP/InNP nanowires, passivated by layers of colloidal quantum dots at increasing pump power, has been studied. A feature of the system is the existence of several luminescent centers connected through mechanisms of multi-stage non-radiative excitation transfer. It has been shown that the kinetics of decay of excited states depends on the nature of excitation.
ThR09-p76  15:00-18:30  
Numerical calculation of arranged-microvoid volumetric reflective gratings in ZnSe
A.S. Gerasimenko, A.A. Bushunov, M.K. Tarabrin; Bauman Moscow State Technical University, Russia
In this work, we present the method of creating arranged-microvoid volumetric reflective gratings using femtosecond laser writing. These volumetric modifications are prospective to be used instead of reflective coatings in miniaturized lasers. The calculation results revealed the effectiveness of proposed modifications compared to conventional multilayer reflective coatings that are applied directly on the faces of an active medium crystal.

ThR09-p77  15:00-18:30  
Site-controlled Ga(Al)As nanostructures arrays emitting at 740nm
N.E. Chemenko1, I.S. Makhot2, I.A. Melnichenko2, S.V. Balakirev2, D.V. Kirichenko, N.A. Shandyba1, G.S. Amanzholova1, T.N. Khamza2, E.V. Seliverstova1; 1Buketov applications Optoelectronics, National Research University Higher School of Economics, Russia 2Novosibirsk State University, Russia
We presents the results of experimental studies of growth and optical properties of ordered Ga(Al)As nanostructures arrays on GaAs(001) substrates with regular arrays of holes. We have also shown that the emission wavelength (740 nm) of site-controlled Ga(Al)As nanostructures is practically independent of the patterned surface morphology, while the emission intensity is determined by the effective volume of nanostructures.

ThR09-p78  15:00-18:30  
On investigation femtosecond laser writing of defects in hexagonal boron nitride
P.G. Vilyuzhanina1, E.A. Primakov, I.A. Stepanov, V.V. Bashkov, V.N. Shenshenko, N.S. Solodovechenko, K.B. Samusev, M.F. Limonov; 1ITMO University, Russia
Color centers in h-BN have attracted a lot of attention due to their unique properties: optical detected magnetic resonance (ODMR) and singly-photon emission (SPE) at room temperature. In this work, we present the results of our ongoing investigation on h-BN defects, including femtosecond laser writing for defect creation.

ThR09-p79  15:00-18:30  
Optical properties of functionalized carbon dots and its application
N.Xh. Ibrayev1, G.S. Amanzholova1, T.N. Khamza2, E.V. Seliverstova1; 1Buketov applications Optoelectronics, National Research University Higher School of Economics, Russia 2Novosibirsk State University, Russia
The influence of the composition of carbon dots (CDs) on the features of generation and deactivation of their electron-excited states. The influence of Ag nanoparticles (NPs) on absorption and luminescence of CDs films was studied. Synthesized CDs was considered as molecular oxygen activators. The influence of CDs on the photovoltaic properties of solar cells was studied.

ThR09-p80  15:00-18:30  
Study of the evanescent field of terahertz surface plasmon polaritons on metal-dielectric layers
V.D. Kukotenko1, Y.V. Gerasimov2, V.S. Vanda1; 1Budker Institute of Nuclear Physics; 2Novosibirsk State University, Russia
The results of a study of the influence of the technology of deposition of gold films with a dielectric coating of zinc sulfide, as well as the roughness of the substrate on the penetration depth of the field of surface plasmon polaritons, are presented. This was measured using the “shielding” method at the Novosibirsk free electron laser.
8TH INTERNATIONAL A. M. PROKHOLOV
SYMPOSIUM ON BIOPHOTONICS
Opening and welcome remarks
I.A. Shcherbakov; Prokhorov General Physics Institute of RAS, Russia

14:15-14:30
MoSYP-01 14:30-15:15
Advancing 7TM-protein structural studies: from XFELs to light-enabled cell control (Plenary)
V.I. Borshchevskiy; Moscow Institute of Physics and Technology, Russia
The talk will focus on modern methods of studying the structure of 7-alpha-helical transmembrane proteins and their practical applications. The speaker will discuss the use of synchrotrons and XFELs, along with advancements in single-molecule FRET spectroscopy.

15:15-16:00
MoSYP-02
Laser radiation, ultrasound and nanostructured particles work together to realise the theranostic approach (Plenary)
D. Gorin; Skolkovo Institute of Science and Technology, Russia
The application of photonic and acoustic tools can be used for visualization, navigation of multifunctional carriers and remote-controlled release of bioactive substances. These particles will combine the ability to deploy drugs in a controllable manner with physical triggering, multimodal detection, and visualization as well as sensing of important biological markers.

16:00-16:45
MoSYP-03
Multimodal spectro-imaging for human skin carcinoma in vivo optical biopsy (Plenary)
W. Blondel1, V. Kupriyanov1, S. Zaytsev1, G. Khairallah1, C. Perrin-Mozet1, C. Fauvel1, C. Daul1, Y. Kistenev2, M. Amouroux1, 1Université de Lorraine, CNRS, CRAN UMR7039, France; 2Tomsk State University, Russia; 1Metz-Thionville Regional Hospital, Department of plastic, aesthetic and reconstructive surgery, France
Among skin cancers, 90% are non melanoma skin cancers that are Basal Cell (BCC) and Squamous Cell (SCC) carcinoma arising from keratinocytes. They have the highest incidence whatever the anatomical site and a strong impact on the body physical appearance with socially disabling and surgical consequences. In order to address the need for non invasive methods of margin delineation and surgery guiding, optical biopsy tools have been investigated over more than two decades because of their potential to allow real time characterization of skin tissue state and effective differentiation between malignant and non malignant lesions. These tools probe the modifications of the optical properties of the skin tissues related to the pathological evolution of the latter e.g. epidermis hyperplasia, pleomorphism, nucleus to cell ratio, neovascularization, dermis extra-cellular matrix collagen enzymatic degradation, etc.
This presentation will review and discuss the techniques of human skin cancer optical spectroscopy and imaging (Optical Coherence Tomography, Multiphoton Microscopy, Diffuse Reflectance, Autofluorescence, Raman, and Terahertz spectro-imaging) including instrumentation, light-tissue interaction modelling and data processing/analysis challenges for their validation as in vivo diagnosis methods and their use as clinical real time peroperative tool for early stage characterization and surgical margin delineation.
High-power erbium -doped pulsed fiber laser for non-ablative fractional photo-rejuvenation (Invited paper)

M.Yu. Koptev1, A.N. Morozov1, K.V. Shatilova1, S.V. Muravev1, A.E. Zapryalov1, M.E. Likhachev1, A.V. Kim1; 1Institute of Applied Physics RAS; 2Melsytech LLC; 3Fiber Optics Research Center RAS, Russia

A high-power erbium laser system for fractional photorejuvenation was presented. The system generated rectangular pulses with a duration varying from 200 μs to 5 ms and pulse energy up to 130 mJ. The novelty of the system was the use of a powerful seed source in combination with a synchronously pumped amplifier made on a single-mode erbium-doped LMA fiber.

Optical visualizer of the venous wall with a high degree of contrast (Invited paper)

P.A. Ryabochkina, M.V. Gerasimov, A.D. Taratynova, K.V. Prosvirin; National Research Mordovia State University, Russia

A real-time optical visualization system of the venous bed is presented, created using near infrared (NIR) vein finder technology with spectral discrimination of the light flux (visible and infrared), using a combination of video images and their processing algorithms.

Perspectives on a 3050 nm fiber laser mediated ablative fractional laser treatments in dermatology (Invited paper)

V. Arkhipova1, A. Mimov2, V. Smolyannikova3, I. Larionov4, D. Palthankar4, I. Yaroslavsky1, V. Andreeva1, G. Altshuler4; 1IRE Polus, Russia; 2TORI Clinic; 3Sechenov Medical University, Russia; 4IPG Medical, USA

We have evaluated a novel laser emitting at a wavelength of 3050 nm. We conducted toxicity studies of these particles and in-vivo experiments (on mice) were performed. This system has a strong tissue regenerative effect and a great potential for use in dermatology.

Study of the possibility of using dielectric nanoparticles doped with rare earth ions for the treatment of tumors under non-contact exposure to near-IR laser radiation (Invited paper)

S.A. Khrushchalina1, P.A. Ryabochkina1, O.A. Kulikov1, V.I. Shlyapikina1, V.P. Ageev1, N.Yu. Tabachkova2, S.E. Kukarkina1, E.E. Zimin1; 1National Research Ogarev Mordovia State University, Russia; 2National University of Science and Technology “MISIS”, Russia

In this work, we investigated the possibilities of using Yb-containing particles (ZrO2-30 mol.% Yb2O3) when excited by laser radiation with a wavelength of 980 nm for the treatment of subcutaneous tumors. Cytotoxicity studies of these particles and in-vivo experiments on mice were conducted.

Endovenous laser coagulation of large diameter varicose veins (Invited paper)

V.Yu. Bogachev1,2, V.P. Mineev1; 1The First Phlebological Center; 2Pirogov Russian National Research Medical University; 3IRE-Polus Ltd., Russia

The purpose of this report is to justify the selection of the optimal method of endovenous laser coagulation (EVLC) of varicose veins of large (more than 2 cm) diameter.
Laser formation of biointegrated electronic components based on carbon nanotubes and graphene

A.Yu. Gerasimenko1,2, A.V. Kuksin, E.A. Gerasimenko1, A.S. Morozova1, M.S. Saveliev2,2; 1 Institute of Biomedical Systems, National Research University of Electronic Technology, 2 Institute for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical University, Russia

Based on the revealed features of the interaction of laser radiation with carbon nanotubes and graphene, a new approach is proposed for the fabrication of silicon electronic devices and flexible wearable/implantable bioelectronics. Laser radiation stimulates the formation of graphene-nanotube contacts. That led to the development of novel flexible electrically conductive constructs for tissue recovery and electrostimulation of cell growth.

- Lunch Break -

TuSYA-10 13:15-13:30
Laser formation of biointegrated electronic components based on carbon nanotubes and graphene

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TuSYA-11 15:00-15:30
Thulium fiber laser: experimental study on biological tissue (Invited paper)

M.A. Ryabova1,2, M.Y Ulupov3, G.Y. Yukina2, E.G. Sukhorukova2, J.O. Rakhmonov2; 1 Department of Otorhinolaryngology with Clinic of Pavlov First St. Petersburg State Medical University, 2 Research Center of the Laboratory of Pathomorphology of Pavlov First St. Petersburg State Medical University, Russia

One of the important issues, to develop an optimal mode for minimally invasive outpatient turbinoplasty surgery. In this paper, we select the optimal mode at a wavelength of 1.94 μm on calf kidney tissue to achieve maximum coagulation without ablation of the superficial and interstitial layer. The optimal mode of exposure is concluded.

TuSYA-12 15:30-16:00
Surgery guidance with optical spectroscopy: advances in clinical translation (Invited paper)

E.A. Shirshin; Lomonosov Moscow State University, Russia

Optical spectroscopy has been multiply shown to be capable of assisting surgery guidance based on differences in the detected signal from tissue. However, the progress in clinical translation of optical intraoperational diagnostics is not that obvious. In this talk, we will discuss the state-of-art results in optical surgery guidance in urology with a focus on recently developed clinical systems.

TuSYA-13 16:00-16:30
Dual channel video platform for fluorescence diagnostics in augmented reality (Invited paper)

M.V. Loshchenov1, A.M. Udeneev1,2, N.A. Kalyagina1,2; 1 Department of Laser Micro-nano and Biotechnology, National Research Nuclear University MEPhI, 2 Federal State Budgetary «Federal Scientific and Clinical Center for Medical Rehabilitation and Balneology of the Federal Medical and Biological Agency», 3 Prokhorov General Physics Institute RAS, Russia

The topic of the presentation is a wide overview of the diagnostic video system combining excitation white light in the red region of visible spectrum and usual white light to give the physician ability observing the area of interest in full or semi-full colors so the diagnostic data appears right on top of the picture in natural colors.

TuSYA-14 16:30-16:45
Optical methods for new medical application: identification of disorders in blood circulation and structure of urethral tissues (Invited paper)

E.B. Kiseleva1, A.S. Kuyarov1, L.A. Matveev1, V.V. Dudenkova1, V.V. Elagin1, O.S. Streitsova1; 1 Research Institute of Experimental Oncology and Biomedical Technologies, 2 E.V. Shakhov Department of Urology, 3 Nonlinear Geophysical Processes Department, Institute of Applied Physics RAS, Russia

This study presents for the first time the combined use of several optical methods for in vivo examination of women with primary urethral pain syndrome (PUPS). Laser Doppler flowmetry (LDF) and transvaginal Doppler ultrasound (TVDUS) allow identifying disorders of blood circulation. Collagen fibrosis were revealed by cross-polarization optical coherence tomography (CP OCT) and then confirmed by nonlinear confocal microscopy.

TuSYA-15 16:45-17:00
Erbium laser for modification of dentin surface of the tooth

Y.S. Kozlova, S.N. Razumova, A.S. Brago; Russia

Indications for usage of Erbium family lasers in dentistry are increasing. The success of root canal treatment depends on removing bacteria and smear layer for better adhesion of sealer. Usage lasers in endodontical treatment enhancing success for the treatment in long-term follow up.

TuSYA-16 17:00-17:15
Promising approaches to optimize the efficiency of laser hydroacoustic processing of biological tissues

A.V. Belikov1,2, R. Nasser1, S.N. Smirnov1; 1 ITMO University, 2 Pavlov First St. Petersburg State Medical University, Russia

The results of experimental study of the fiber tip end shape influence on the size of the Yb,Er:Glass-laser-induced cavitation bubble and the value of the bubble collapse pressure, as well as theoretical study of the possibility of using 1.45 μm and 1.54 μm laser radiation to pre-heat the liquid before high-intensity laser pulse action, are presented.

- Coffee Break -
TuSYB-01  09:00-09:30
Wide-band diffuse reflectance spectroscopy with a self-calibrating fiber-optic probe (Invited paper)
A wide-band diffuse reflectance spectroscopy system with a fiber-optic contact probe with two source and two detection fibers has been created. Self-calibration approach made it possible to significantly reduce the influence of surface optical inhomogeneities of tissues and fluctuations of transient characteristics of the device on the obtained result, thus providing reliable data on tissue physiological characteristics.

TuSYB-02  09:30-10:00
Tissue exposure to laser pulses delivered by sapphire medical instruments: advantages for laser coagulation and ablation (Invited paper)
I.N. Dolganova¹, P.V. Aleksandrova¹, A.K. Zotov¹, A.A. Platonova¹, K.I. Zaytsev², V.N. Kurlov², D.G. Kochiev³; Osypian Institute of Solid State Physics RAS, Russia
We describe the advantages of sapphire shaped crystals for manufacturing of medical instruments, in particular, capillary needles for interstitial laser therapy. The application of them for tissue coagulation and ablation is discussed. The particular attention is paid to tissue exposure to short laser pulses delivered by these needles.

TuSYB-03  10:00-10:30
Theoretical and experimental study of the effect of laser heating on the optical characteristics of human skin (Invited paper)
A.V. Belikov¹, V.Yu. Chuchin¹, A.A. Mashanskaya¹; ITMO University; Pavlov First St. Petersburg State Medical University; NPP VOLO LLC, Russia
For the first time in an in vivo experiment, the dependence of the reflectance spectrum of human skin when heated by laser radiation was measured. Theoretical interpretation of the experimental results is given, and it is shown that the change in reflectance observed in the experiment may be associated with the conversion of skin blood hemoglobin into methemoglobin.

TuSYB-04  10:30-10:45
Studies of the effects of hydrogen fluoride laser radiation on biological tissues
V.M. Fomin; JSC "NILIEFA", Russia
The effects were studied of HF-laser radiation on the eye cornea of primates, human skin - in vivo and on a human myocardial wall - in vitro. The obtained data the results of our previous works and the results of studies by other authors demonstrate the effectiveness and safety of the use of the HF lasers in surgery.

TuSYB-05  10:45-11:00
Study of the use of laser radiation with a wavelength of 450 nm to remove pigmented skin formations
S.A. Podurar¹, N.E. Gorbatova¹, A.V. Bryantsev¹, G.P. Kuzmin², O.V. Tikhonevich², Yu.L. Kalachev², G.A. Vare³; Research Institute of Emergency Pediatric Surgery and Traumatology, Prokhorov General Physics Institute RAS, Russia
The optimal parameters of laser radiation for the removal and treatment of pigmented skin formations have been determined.

- Coffee Break -

TuSYB-06  11:30-12:00
Determination of the spectral dispersion for the heart muscle - a Kramers-Kronig approach (Invited paper)
Luís M. Oliveira¹,², Maria R. Pinheiro¹, Hélder P. Oliveira¹, Maria I. Carvalho¹, Valery V. Tuchin¹,²; Polytechnic of Porto, School of Engineering, Portugal; Institute for Systems and Computer Engineering, Technology and Science (INESC TEC), Portugal; Porto University, Faculty of Science, Portugal; Porto University, Faculty of Engineering, Portugal; Institute of Physics and Science Medical Center, Saratov State University, Russia; Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University, Russia; A. N. Bach Institute of Biophotonics, KCI "Biotechnology of the Russian Academy of Sciences", Russia
The refractive index of the pigs heart was measured at wavelengths between 255 and 850 nm to calculate the dispersion. The total transmittance and total reflectance spectra of the pig heart were measured between 200 and 1000 nm to calculate the spectral absorption coefficient. Using Kramers-Kronig relations, the dispersion of the heart was matched to experimental refractive index values.

TuSYB-07  12:00-12:30
Optical monitoring of intradermal delivery of drug-loaded vaterite carriers (Invited paper)
Yu.I. Svenskaya, M.S. Saveleva, P.A. Demina, R.A. Verkhovskii, Yu.I. Surkov, R.A. Anisimov, I.A. Serebryakova, V.V. Tuchin, Saratov State University, Russia
Drug administration via skin appendages has gained great scientific interest, especially concerning delivery to specific targeted regions and the reduction of systemic toxicity. We propose a novel particulate system for the delivery of glucocorticoids into hair follicles aiming to treat inflammatory skin diseases. The system has been shown to be biodegradable and provide high intradermal concentration of the delivered drug.
TuSYB-08 12:30-13:00

Surgery guidance in orthopedics and dentistry (Invited paper)

The assessment of knee joint tissue condition during arthroscopy and the measurement of distance to the dental pulp when removing caries-infected dentin using a fiber-optic implementation of the diffuse reflectance spectroscopy method are investigated.

TuSYB-09 13:00-13:15

Study of liver parenchyma in obstructive jaundice using fluorescence and diffuse reflectance spectroscopy methods

We report on the application of fluorescence and diffuse reflectance spectroscopy for in vivo measurements during biliary drainage. The results show high potential in developing new diagnostic and prognostic markers in liver state evaluation.

TuSYB-10 13:15-13:30

Measurement and simulation of mouse head optical properties at optical clearing

Results of ex vivo measurements of NIR laser beams delivery through the mouse head at immersion optical clearing of the scalp are presented. Monte Carlo radiative transfer simulations performed for a four-layer mouse head model well fit experimental distributions.

- Lunch Break -

TuSYB-11 15:00-15:30

Biophotonics in endocrinology: surgery guidance, optical biopsy and point-of-care testing (Invited paper)
E.A. Shirshin, Lomonosov Moscow State University, The National Medical Research Center for Endocrinology, Russia

In this talk applications of biophotonics in endocrinology will be discussed, namely (1) parathyroid detection and viability assessment for surgery guidance, (2) tumor cells identification with spectrally-resolved confocal microscopy and fluorescence saturation microscopy, (3) body composition analysis with NIR spectroscopy.

TuSYB-12 15:30-16:00

Discovery of novel fluorophores in the human organism with quantitative structure-property relationship approach (Invited paper)
B.P. Yakimov, A.A. Rubekina, L.S. Urusova, E.A. Shirshin, Laboratory of Clinical Biophotonics, Sechenov First Moscow State Medical University, Faculty of Physics, Lomonosov Moscow State University, Endocrinology Research Center, Moscow, Russia

This study explores the application of AI-approach to identify new fluorophores in the human organism. Trained on the multiple representations of the chemical structure of molecules, the approach accurately restored optical properties for known fluorophores and identified new sources in the human body using available databases. The predictions of the presented approach were experimentally validated for fluorophores identified in tissues.

TuSYB-13 16:00-16:30

Time-resolved fluorescence spectroscopy in differential diagnosis of liver cancer in vivo (Invited paper)
E.V. Potapova, V.V. Shupletsov, V.V. Dremin, A.V. Mamoshin, A.V. Dunayev

This work reports a machine-learning-based approach to interpret time-resolved fluorescence spectroscopy data acquired during optical biopsy of the liver. The approach allowed to differentiate between liver parenchyma and tumor with sensitivity and specificity above 0.91 and 0.79, respectively, providing differential diagnosis of liver cancer (primary malignant tumor, metastases, or benign) with sensitivity and specificity of at least 0.80 and 0.95.

TuSYB-14 16:30-16:45

Development of dual-mode hyperspectral/fluorescence lifetime imaging system
V.V. Shupletsov, T.A. Goryunov, E.V. Potapova, V.V. Dremin

This paper presents a microscopic diagnostic system that combines hyperspectral and frequency domain fluorescence lifetime imaging to record the content of chromophores and high-speed changes in cell and tissue metabolism. The efficiency of the system was tested on liver tumor slices of a laboratory mouse.

TuSYB-15 16:45-17:00

Optical express biopsy of lymph nodes with time-resolved fluorescence macroimaging
A.M. Mozherov, A.A. Plekhanov, P.A. Kochetkova, V.V. Goryunov, P.A. Dyachenko, S.V. Ul’yanov, B.P. Yakimov, E.A. Shirshin, V.I. Shcheslavskiy, Privolzhsky Research Medical Uiv., Nizhny Novgorod Regional Oncologic Hospital, Lobachevsky State Univ., Lomonosov Moscow State Univ., Russia

We present a simple and fast approach to perform lymph nodes biopsy in a clinical setting using fluorescence time-resolved macroimaging. Histologic analysis is used as the reference standard. We demonstrate that the obtained data allow us to differentiate healthy and metastatic lymph nodes.

- Coffee Break -
TuSYC-01 09:00-09:30
Confined surface-enhanced Raman scattering for bio-objects detection (Invited paper)
A.K. Sarychev1, A.V. Ivanov1, I.V. Bykov1, K.E. Mochalov2, M.S. Shestopalova2,3, V.A. Oleinikov2,3; 1 Institute of Theoretical and Applied Electrodynamics RAS, 3National Research Nuclear University MEPhI, Russia
Analytical theory and experimental results for surface enhanced Raman scattering of molecules confined in a spherical metal resonator is presented. The EM mechanism of the scattering enhancement is investigated. Raman scattering in silver-coated polystyrene spheres, which model bio-objects, is in agreement with our theory.

TuSYC-02 09:30-10:00
Determination of gold concentration in colloids by UV-vis spectroscopy: universality for various nanoparticles and clusters (Invited paper)
N.G. Kheletsov; Institute of Biochemistry and Physiology of Plants and Microorganisms, Saratov Scientific Centre RAS (IBPPM RAS), Saratov State University, Russia
The UV-vis extinction method universality is demonstrated with six experimental and theoretical Au models: nanospheres, nanoparticle clusters, nanorods, 2D nanotriangles and nanoplates, and 3D nanostars. In total, we fabricated 34 samples with different nanoparticle sizes, shapes, morphology, and Au concentrations. From simulated and experimental data we derived a universal relation between gold concentration and extinction \( [\text{Au}_0](\text{mM}) = 0.44 \times [\text{A}(400)] \).

TuSYC-03 10:00-10:15
Laser-induced fabrication of nanostructures to probe biomolecule Raman and fluorescence spectra
X. Zhu, E.I. Ageev, D.A. Zuev; ITMO Univ., Russia
"Hot spots" generated by laser-induced surface nanostructures help to efficiently enhance Raman and fluorescence signals and improve the accuracy and sensitivity of biomolecules in viruses to be detected, in the hand of composition and structure.

TuSYC-04 10:15-10:30
Plasmon-enhanced chemiluminescence of lucigenin due to interaction with colloidal gold nanoparticles
D.V. Kononov, A.V. Palehova, A.V. Kochakov, A.V. Afanasieva, T.A. Vartanyan, D.R. Dadadzhanov; ITMO University, Russia
Chemiluminescence enhancement of lucigenin in the vicinity of colloidal gold nanoparticles was studied. The chemiluminescence intensity was found to increase twice independent of the nanoparticle’s concentration in the range of 10^{-4} to 10^{-8} M.

TuSYC-05 10:30-10:45
Development of biosensors based on surface plasmon resonance imaging technique
I.R. Rodin, I.N. Pavlov; National Research University “MPEI”, Russia
The work is devoted to the development of a biosensor based on the phenomenon of surface plasmon resonance. In the process of the work, multiple measurements were carried out at the SPRI facility. The values sensitivity of the method and resolution limit were found to be comparable to the sensitivity and resolution of the frustrated total internal reflection method.

TuSYC-06 10:45-11:00
Lateral flow assay dynamics monitoring with real-time optical and magnetic registration: rapid and quantitative tumor marker detection
A.M. Skirda1, V.A. Bragina1, S.L. Znoyko1, A.V. Orlov1; 1 Prokhorov General Physics Institute RAS, 2 Moscow Institute of Physics and Technology, Russia
This study presents an innovative biosensor for point-of-care molecular biomarker detection using lateral flow assay dynamics monitoring with real-time optical and magnetic registration. Spectral interferometry analyzes antibody kinetics targeting the tumor marker CYFRA21-1, leading to the development of rapid quantitative lateral flow tests. A novel tool is proposed for controlling label quantities, enhancing the robustness of real-time dynamics-based quantitative systems.

- Coffee Break -

TuSYC-07 11:30-12:00
Targeted PLGA nanoparticles as versatile platform for the delivery of oncotherapeutic compounds (Invited paper)
V.O. Shipunova1, E.N. Komedchikova1, A.V. Pushkarev1, M.A. Yurchenko1, D.A. Maedi1, A.M. Skirda1, M.P. Nikitin2; 1 Moscow Institute of Physics and Technology, 2 Sirius University of Science and Technology, ‘Prokhorov General Physics Institute RAS, Russia
In this study, we present the creation of targeted polymer nanoparticles, targasomes, which are loaded with paclitaxel for imaging and treatment of HER2-positive cancer. These synthesized nanoparticles were employed for targeted delivery to tumors and tumor growth reduction in vivo.

TuSYC-08 12:00-12:30
Genetically engineered nanocapsules with fluorescent and magnetic markers for cell tracking and targeted drug delivery (Invited paper)
A.N. Gabashvili1, D.D. Namestnikova1, L.I. Gubskiy1, S.S. Vodopyanov1, M.V. Efremova1, P.I. Makarevich1, V.A. Sarkisova1, P.I. Nikitin1, ‘Prokhorov General Physics Inst. RAS, 2Department of Neurology, Neurosurgery and Medical Genetics, Russia; 3Department of Microbiology & Immunology, Albert Einstein College of Medicine, New York City; United States; 4Department of Applied Physics and Science Education, Eindhoven Univ. of Technology, Netherlands; Faculty of Medicine, Lomonosov Moscow State Univ.; 5Cell Proliferation Laboratory, Engelhardt Inst. of Molecular Biology RAS, Russia
Currently, various functionalized nanocarrier systems are extensively studied for biomedical diagnostics and targeted drug delivery. Joining the approaches of genetic and chemical engineering novel carriers have been produced based on encapsulins, which are capsid-like protein structures, consisting of a shell and various payload inside. A range of potential applications of encapsulins have been developed.
Glutathione-loaded magnetic nanoparticles as a protective theranostic carrier in oncology
V.V. Barinov1, D.A. Tarasov2, V.S. Fedorov1,2, L.Y. Yakovleva1, N.M. Yudintseva1, D.E. Bobkov2, B.P. Nikolaev1,2, M.A. Shevtsov1,2; 1 Institute of Cytology RAS; 2 Almazov National Medical Research Centre; 3 St. Petersburg State Institute of Technology (Technical University); 4 Department of Inorganic Chemistry and Biophysics, St. Petersburg State University of Veterinary Medicine, Russia

Glutathione-conjugated magnetic nanoparticles were proposed as a protective drug carrier in theranostics. During the course of work, a stable conjugate was synthesized and had its physico-chemical and antioxidant properties investigated.

TuSYC-10 12:45-13:00

Laser synthesis of iron-based nanoparticles in gaseous media and magnetic field by nanosecond pulses
D.A. Kochujev1, A.S. Chernikov1, M.A. Dzus1, U.E. Kuriola1,2, A.A. Voznesenskaya1, A.F. Gal’kin1, D.V. Abramov1, A.V. Kazar1, A.Yu. Gerasimenko1,2, K.S. Khorkov1; 1Vladimir State University, 2National Research University of Electronic Technology MIET, 3IM. Sechenov First Moscow State Medical University, 4Moscow Polytechnic University, Russia

The paper presents the results of the ablative synthesis of iron nanoparticles in an argon medium under the action of nanosecond laser pulses. Nanoparticles were collected and deposited using a magnetic field.

TuSYC-11 13:00-13:15

Imaging photoplethysmography to study blood supply in patients with systemic lupus erythematosus and systemic sclerosis
N.P. Podolyan1, A.V. Belaventseva1, A.V. Sakovskaya1,2, O.V. Mamontov1,2,4, R.V. Romashko1, A.A. Kamsihin1; 1Laboratory-24, Institute of Automation and Control Processes FEB RAS, 2Institute of Therapy and Instrumental Diagnostics, Pacific State Medical University, 3Department of Circulation Physiology, Almazov National Medical Research Centre, 4Pavlov First St. Petersburg State Medical University, Russia

The parameters of facial blood supply were studied in patients with systemic lupus erythematosus and systemic sclerosis using a non-contact imaging photoplethysmography method synchronized with an electrocardiogram. Statistically significant differences in the amplitude and time of arrival of the pulse wave to different areas of the face were revealed in sick patients compared with the control group.

- Lunch Break -
TuSYA-p01  15:00-18:30
IR spectroscopy for hematology
L.V. Plotnikova1, A.D. Garfullin1, A.Y. Kuvshinov1, S.V. Voloshin1, R.V. Butyrev1, A.D. Kartashova1, A.M. Polyanchikov1, St. Petersburg State University, 2 Russian Research Institute of Hematology and Transfusiology, 2 Kirov Military Medical Academy, 2 Mechnikov Northwestern State Medical University, 1 Institute of Cytology TuSYA-p02  15:00-18:30
Fiber pyrometer based on AgCl2.5Br–AgI fiber for measuring temperature in hard-to-reach places
A.E. Lef, A.A. Yuzhakova, D.D. Salimgareev, P.V. Pestereva, A.S. Konsakov, L.V. Zhukova, Ural Federal University, Russia
The work is devoted to the manufacture of a fiber pyrometer based on AgCl2.5Br0.75 – AgI fibers and using it to measure the temperature of objects in the range of 36-50 °C.
TuSYA-p03  15:00-18:30
Studying thermal effects of infrared femtosecond laser pulses applied for laser assisted hatching procedure on mouse embryos
D.S. Sitnikov, M.A. Filatov, M.V. Kubekina, Y.Y. Sileava, 1 JiHT RAS; 2 Center for Precision Genome Editing and Genetic Technologies for Biomedicine, IGB RAS; 3 Core Facility Centre, IGB RAS, Russia
Infrared femtosecond laser pulses are used for microsurgery of zona pel lucida of mouse embryos at late stages of preimplantation development. Safety of the procedure is studied through embryo viability and heat shock proteins (HSP) gene expression assessment methods. Expression levels of the genes encoding HSPs were shown to increase slightly compared to the negative control group.

TuSYB-p01  15:00-18:30
The effect of optical clearing agents on the results obtained with the digital nailfold capillaroscopy
P.A. Moldon, A.E. Lugovtsov, P.B. Ermolinskii, Y.I Gurfinke, A.V. Priezhev; Lomonosov Moscow State University, Russia
In this work the influence of optical clearing agents (OCA) on the blood flow in nailfold capillaries was studied. It was shown that parameters obtained by nailfold capillaroscopy technique depend on OCAs used for visualization of capillaries.
TuSYB-p02  15:00-18:30
Two approaches to estimate the depth of light penetration into biotissues
A.P. Tarasov, D.A. Rogatkin, Moscow Regional Research and Clinical Institute (MONIKI), National Research Centre ‘Kurchatov Institute’, Russia
The work compares two approaches to evaluate the depth, based, respectively, on the exponential decay, and on the estimation of a volume, where 95% of absorbed light is accumulated. It is shown that the approach, which uses the conventional exponential decay, underestimates the penetration depth in more than 2 times.

TuSYB-p03  15:00-18:30
In vivo study of vascularization and oxygenation of tumor xenografts
A combination of OA and DOS methods has been proposed to assess the vascular structure and oxygenation level of renal (SN-12C) and colon (Colo320, HCT116) cancer models. Differences in the structure of the vascular bed are shown; high vascularity was found for Colo320 and SN-12C. Colo320 showed increased hemoglobin and decreased oxygen saturation compared to SN-12C and HCT116.

TuSYB-p04  15:00-18:30
Histophysiological study of the skin after exposure to holmium laser radiation
V.V. Astashev, P.V. Novokreshchenov, M.S. Kopyeva, S.A. Filatov, V.I. Kozlov, V.A. Duvanskiy, Peoples’ Friendship University of Russia, RUDN University, People’s Friendship University of Russia, Russia
A histophysiological investigation of the experimental animals skin was performed on day 3 after exposure to holmium-doped fiber laser continuous-wave radiation at different power intensities. Using histologic and functional research methods, changes characteristic of the exudative stage of aseptic inflammation were revealed, the severity of which depended on the radiation dose.

TuSYB-p05  15:00-18:30
Raman spectroscopy as a tool for helicobacter pylori diagnostics
E.E. Popov, A.V. Polishchuk, A.V. Kovalev, V.V. Vitkin, ITMO University, Russia
Raman spectroscopy was studied as a diagnostic tool for detecting Helicobacter pylori infection. We suggested a new methodology to account for the changes in the spectrum of Raman scattering caused by pressure variations, which enabled us to measure the 13CO2 fraction with a relative error 2.1%. The results showed a positive correlation with a blood test for H. pylori antibodies.

TuSYB-p06  15:00-18:30
IR spectroscopy as a tool for helicobacter pylori diagnostics
E.E. Popov, A.V. Polishchuk, A.V. Kovalev, V.V. Vitkin, ITMO University, Russia
H. pylori infection is one of the most common global infectious diseases and is associated with a high frequency of complications and morbidity. Current diagnostic tools have limitations, such as low specificity and sensitivity, and require time-consuming procedures. The present study aimed to develop a diagnostic tool based on near-infrared (NIR) Raman spectroscopy using blood samples.

TuSYA-p01  15:00-18:30
IR spectroscopy for hematology
L.V. Plotnikova1, A.D. Garfullin1, A.Y. Kuvshinov1, S.V. Voloshin1, R.V. Butyrev1, A.D. Kartashova1, A.M. Polyanchikov1, St. Petersburg State University, 2 Russian Research Institute of Hematology and Transfusiology, 2 Kirov Military Medical Academy, 2 Mechnikov Northwestern State Medical University, 1 Institute of Cytology TuSYA-p02  15:00-18:30
Fiber pyrometer based on AgCl2.5Br–AgI fiber for measuring temperature in hard-to-reach places
A.E. Lef, A.A. Yuzhakova, D.D. Salimgareev, P.V. Pestereva, A.S. Konsakov, L.V. Zhukova, Ural Federal University, Russia
The work is devoted to the manufacture of a fiber pyrometer based on AgCl2.5Br0.75 – AgI fibers and using it to measure the temperature of objects in the range of 36-50 °C.
TuSYA-p03  15:00-18:30
Studying thermal effects of infrared femtosecond laser pulses applied for laser assisted hatching procedure on mouse embryos
D.S. Sitnikov, M.A. Filatov, M.V. Kubekina, Y.Y. Sileava, 1 JiHT RAS; 2 Center for Precision Genome Editing and Genetic Technologies for Biomedicine, IGB RAS; 3 Core Facility Centre, IGB RAS, Russia
Infrared femtosecond laser pulses are used for microsurgery of zona pel lucida of mouse embryos at late stages of preimplantation development. Safety of the procedure is studied through embryo viability and heat shock proteins (HSP) gene expression assessment methods. Expression levels of the genes encoding HSPs were shown to increase slightly compared to the negative control group.
TuSYB-p04  15:00-18:30
Validation and comparative analysis of off-axis digital holographic microscopy and SLIM for biological applications
I.V. Semenova1, A.V. Belashov1, A.A. Zhihoreva1, M.V. Belashov1, P.S. Butorin1; ‘’Ioffe Inst., ‘’ITMO Univ., Russia
The paper presents an analysis of the performance of two quantitative phase imaging methods implemented on the model object of polystyrene beads dissolved in water. Phase images obtained using two realizations of SLIM technique and off-axis digital holographic microscopy were compared with the expected phase shift image from spherical transparent phase objects.

TuSYB-p05  15:00-18:30
Fast Spectroscopic Technique of Optical Biopsy of Intracranial Tumors
I.D. Romanishkin1, T.A. Savelieva1, A. Ospanov1, S.V. Shugai1, S.A. Goryainov1, G.V. Pavlova1, I.N. Pronin1, V.B. Loschenov1,2; ‘’Prokhorov General Physics Institute RAS, ‘’National Research Nuclear University MEPhI, ‘’N.N. Burdenko National Medical Research Center of Neurosurgery, ‘’Institute of Higher Active Neurology and Neuropsychology RAS, Russia
The possibility of differentiation of glial and meningeal tumors on the basis of the proposed method of optical-spectral analysis was shown. For non-fluorescing tumors, the most significant indicators were the intensity of elastic light scattering, carotenoid content, and the change in lipid/protein ratio.

TuSYB-p06  15:00-18:30
Advanced optoacoustic imaging capabilities using piezopolymer detectors: increased sensitivity, wide reception bandwidth, high numerical aperture
A.A. Kurnikov1, A.A. Sanin1, G.P. Volkov1, A.G. Orlova1, A.V. Kovalchuk1, D. Razansky1, P.V. Subochev1; ‘’Inst. of Applied Physics RAS, Russia; ‘’ETH Zurich, Switzerland
Optoacoustic (OA) angiography is a non-invasive imaging technique that involves probing tissue with laser pulses and recording ultrasound signals. This study focuses on analyzing the sensitivity, reception bandwidth, and numerical aperture of piezoelectric transducers used for ultrasound detection. Through numerical simulations and experiments, the effectiveness of piezopolymer detectors in providing detailed OA visualization of complex vascular networks has been demonstrated.

TuSYB-p07  15:00-18:30
Monte Carlo modeling of the red blood cell aggregation in photoplethysmography
D.G. Lapitan, A.P. Tarasov; Moscow Regional Research and Clinical Institute (‘’MONIKI’’), Russia
The effect of red blood cell (RBC) aggregation on the photoplethysmography (PPG) signal at a wavelength of 810 nm was investigated using the Monte Carlo method. It was found that the main contribution to the formation of the PPG signal is made by scattering variations due to changes in the rouleaux size (84% versus 16% absorption, respectively).

TuSYB-p08  15:00-18:30
OCT monitoring of scattering kinetics in tissue phantoms at optical clearing with depth resolution
I.A. Seredrybakova1, I.R. Surkov1, E.A. Genina2, V.V. Tuchin3,4, ‘’Optics and Biophotonics Department, Saratov State University; ‘’Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University; ‘’Laboratory of Laser Diagnostics of Technical and Living Systems, Institute of Precision Mechanics and Control RAS, Russia
A method for reconstructing and monitoring the scattering coefficient with a depth resolution of homogeneous samples with optical clearing of the sample has been developed and tested on a gelatin phantom. The proposed method makes it possible to track changes in the scattering coefficient at different depths.

TuSYB-p09  15:00-18:30
Channel shape inside sapphire capillary needles and its impact on transmitted laser beam
I.A. Shikunova, D.O. Strukov, Yu.N. Zubareva, I.N. Dolganova, V.N. Kurov, Osipyan Institute of Solid State Physics RAS, Russia
In sapphire needle capillaries, we analyze the form of the internal channel and the needle tip and their influence on the shape of the outgoing beam. We propose some methods of alteration of the capillary shape via growth conditions that contribute to obtaining the required geometry.

TuSYB-p10  15:00-18:30
Development of optical modules to existing laboratory devices for biomarker detection in vivo
M.A. Makhortov, O.V. Grishin, S.A. Perko, O.I. Gusliakova, D.N. Bratashov, E.S. Prikhozhdenko; ‘’Science Medical Center, Saratov State University; ‘’Photons Center, Skolkovo Institute of Science and Technology; ‘’Vladimir Zelman Center for Neurobiology and Brain Rehabilitation, Skolkovo Institute of Science and Technology, Russia
Usually, existing laboratory devices for conducting in vitro studies require modification to carry out in vivo measurements. We have developed the fiber probe connected to Raman spectrometer Renishaw inVia and the external optical circuit for in vivo photoacoustics cytometer which allows measuring photoacoustics signal of biological fluids either in laboratory tubes, or in vivo in laboratory animals.

TuSYB-p11  15:00-18:30
129Xe nuclear spin laser hyperpolarizer
V.M. Vodovozov, R.F. Kurunov, A.V. Pavlenok, V.M. Baev, M.V. Kuleshov, V.A. Chumichev, V.V. Eremin, A.A. Baturina, JSC ‘’NIIIFA’’, Russia
The experimental model of the 129Xe laser hyperpolarizer for MRI diagnostics of human organs inaccessible for examination by classical proton tomography is presented. Spin Exchange Optical Pumping (SEOP) is used to develop the hyperpolarized state of 129Xe. A polarization level of 40% has been achieved with a gas capacity of ~1.2 l/hour.

TuSYB-p12  15:00-18:30
Mathematical simulation of uniform heating of biological tissues by laser radiation
K.V. Sovin1, N.V. Kovalenko1, V.S. Anpilov1, O.A. Ryabushkin1; ‘’Moscow Inst. of Physics and Technology (National Research University); ‘’Fryazino branch of Kotel'nikov Inst. of Radio-Engineering and Electronics, Russia
The description of thermal damage to biological tissues is based on the Arrhenius formalism. Measurements of Arrhenius parameters are conducted under the assumption of homogeneously degraded samples. We simulated the degradation processes under conditions of heating with air, water and optical radiation. Optical heating demonstrated high accuracy in the retrieving degradation kinetics parameters at different sample thicknesses and degradation times.
WeSYB-16  09:00-09:30
Microcirculatory-tissue systems of the human body as an object of study in space research (Invited paper)
A.V. Dunaev, Orel State University, Russia
This paper presents the results of the study of changes in microcirculatory-tissue systems under spaceflight and isolation experiment conditions. For the first time, a technique has been developed for measuring microcirculatory-tissue systems in the limbs of cosmonauts during the period of acute adaptation to microgravity conditions and readaptation after the completion of a spaceflight.

WeSYB-17  09:30-10:00
The problem of data reproducibility in laser diffractionometry of erythrocytes (Invited paper)
S.Yu. Nikitin; Physics Faculty of Lomonosov Moscow State University, Russia
Two algorithms for measuring the red blood cell mean radius and red blood cell distribution width (RDW) are proposed, based on the analysis of the diffraction pattern that occurs when a laser beam is scattered on a blood smear.

WeSYB-18  10:00-10:30
Experimental comparison of imaging photoplethysmography and laser speckle contrast imaging for blood flow assessment (Invited paper)
A.A. Kamshilin; Institute of Automation and Control Processes FEB RAS, Russia
In this work, responses of cortical vessels to administration of a metabolic agent were measured in rats using contactless imaging photoplethysmography and laser speckle contrast imaging systems providing full-field of view visualization of blood flow. It was found that blood-flow changes detected by two systems are significantly different due to different nature of light interaction with tissues underlying these methods.

WeSYB-19  10:30-10:45
Optically measured blood microcirculation parameters and their correlation with endothelium function in healthy volunteers and patients suffering from cardiovascular diseases.
A.V. Priezzhev, P.B. Ermolinsky, Yu.I. Gurfinkel, E. Sovetnikov, A.E. Lugovtsov; Lomonosov Moscow State University, Russia
The objective of this work was to examine and compare the microcirculation in healthy volunteers and two groups of patients suffering from cardiovascular diseases, specifically coronary heart disease (CHD) and atrial fibrillation (AF).

WeSYB-20  10:45-11:00
Imaging of microcirculation enhanced with optical clearing agents and evaluation of their effect on blood microcirculation
A.E. Lugovtsov, P.B. Ermolinsky, P.A. Moldon, D.A. Umerenkov, Yu.I. Gurfinkel, P.A. Timoshina, P.V. Vetshev, A.V. Priezzhev; Lomonosov Moscow State University, Russia; Saratov State University, Russia; Huazhong University of Science and Technology, China
The efficiency of 15 optical clearing agents (OCAs) that are widely used for enhancement of imaging of tissues was investigated. We show a significant impact on elevating the transparency and improving the visualization of the nail bed capillaries. A significant effect of OCAs on microcirculatory parameters of blood was shown.

- Coffee Break -
Wearable multimodal laser analyzers in the microcirculatory-tissue systems monitoring during different sleep stages

Y.I. Loktionova1, E.V. Zharkikh1, D.F. Kleeva2, V.S. Yanushin3, V.V. Sidirov3, A.I. Krupatkin4, A.V. Dunaev1; 1 Research & Development Center of Biomedical Photonics, Orel State University; 2 National Research University Higher School of Economics; 3 SPE "LAZMA" Ltd.; 4 Priorov Central Research Institute of Traumatology and Orthopaedics, Russia

This paper presents the first results of the study of changes in microcirculatory-tissue systems functioning during different sleep stages. Wearable multimodal devices were used to monitor the microcirculatory-tissue systems during night sleep simultaneously with electroencephalography to separate the sleep stages.

WeSYC-17  09:00-09:30
Multispectral fluorescence lifetime imaging microscopy of endogenous fluorophores at a single excitation wavelength (Invited paper)
B. Yakimov2, A. Komarova2, E. Nikonova1, A. Mozherov1, L. Shimolina1, M. Shirmanova1, W. Becker1, E. Shirshin1, V. Shcheslavskiy1,4, Sechenov First Moscow State Medical University, Russia; 2Lomonosov Moscow State University, Russia; 3Privolzhsky Research Medical University, Russia; 4Becker&Hickl GmbH, Germany

We present experiments on multi-wavelength fluorescence lifetime imaging microscopy of NAD(P)H and flavins at a single wavelength of 750 nm. We show the advantages and limitations of using single photon counting spectral detectors for metabolic imaging of cells and tumor spheroids.

WeSYB-24  12:30-12:45
Wearable multimodal analyzers in the microcirculatory-tissue systems monitoring during different sleep stages

Y.I. Loktionova1, E.V. Zharkikh1, D.F. Kleeva2, V.S. Yanushin3, V.V. Sidirov3, A.I. Krupatkin4, A.V. Dunaev1; 1 Research & Development Center of Biomedical Photonics, Orel State University; 2 National Research University Higher School of Economics; 3 SPE "LAZMA" Ltd.; 4 Priorov Central Research Institute of Traumatology and Orthopaedics, Russia

We present experiments on multi-wavelength fluorescence lifetime imaging microscopy of NAD(P)H and flavins at a single wavelength of 750 nm. We show the advantages and limitations of using single photon counting spectral detectors for metabolic imaging of cells and tumor spheroids.

WeSYC-18  09:30-10:00
Time-resolved fluorescence microscopy of QDs in investigations of endolysosome acidification (Invited paper)
E.S. Kornilova1,2, I.K. Ulkinov1, A.V. Salova1, T.N. Belyaeva1; 1 Institute of Cytology RAS; 2Peter the Great St. Petersburg Polytechnic Univ.; 3St. Petersburg State Univ., Russia

Endolysosome acidification was assessed by time-resolved fluorescence microscopy (FLIM) using quantum dots targeted by EGF (EGF-QDs). It has been shown that the interpretation of the results of changes in the QD lifetime using the proton pump inhibitor BafA1 depends on the method of its administration. Also, some additional factors in endolysosomes can affect lifetime of QDs besides pH.

SYC: PHOTONICS AND NANOBIOTECHNOLOGY

Location: Petrov-Vodkin 1 Room, Floor 2; Date: Wednesday, July 03, 2024
SYC: PHOTONICS AND NANOBIOTECHNOLOGY 4
Session Chair: Dmitry Gorin, Skolkovo Inst. of Science and Technology, Russia

WeSYC-19  09:00-09:30
A reduction in the required laser energy for optical resolution photoacoustic microscopy using PVDF-TrFe piezopolymer ultrasonic detectors
D.A. Voitovich, A.A. Kurnikov, A.G. Orlova, P.V. Subochev; Institute of Applied Physics RAS, Russia

Optical resolution photoacoustic microscopy (OR-PAM) is a high-resolution in-vivo imaging that based on the photoacoustic effect. This study introduces OR-PAM setup incorporating a PVDF-TrFe film in the ultrasonic detector. By employing this film, the sensitivity of the piezoelectric detector is enhanced. Additionally, it allows for a reduction in the required laser radiation energy for safety reasons.
WeSYC-19  10:00-10:15
Targeted magnetic nanoparticles for cancer diagnosis and treatment
O.A. Kolesnikova1, E.N. Komedchikova1, M.A. Yurchenko1, D.A. Maed1, A.M. Skirda1; 1 Moscow Institute of Physics and Technology, 2 Sirius University of Science and Technology, 3 Prokhorov General Physics Institute RAS, Russia
Over the past few years, nanomaterials have garnered considerable attention, in particular, targeted nanofluidulations due to their high specificity of delivery to molecular targets and reduced systemic toxicity for the organism. Here we report the study of the cellular delivery of targeted fluorescent magnetic nanoparticles to human epidermal growth factor receptor 2, clinically significant oncomarker.

WeSYC-20  10:15-10:30
Ir(III) complexes - sensors for hypoxia detection
I.S. Kritchenkov1,2, M. Samandari, N.A. Zharzakal1, S.A. Silionov, E.E. Galenko, D.O. Karpitskaia1, S.P. Tunk1; 1 Institute of Chemistry, St Petersburg State University, 2 Faculty of Science, Peoples’ Friendship University of Russia (RUDN University), 3 Institute of Cytology RAS, Russia
In this work, two new Ir(III) complexes were synthesized. All complexes exhibit efficient phosphorescence with pronounced sensitivity to the presence of oxygen. For the most promising complex the phosphorescence lifetime imaging experiments were conducted, revealing that this sensor markedly changes the phosphorescence lifetime values in cells from 1.8 to 4.1 μs upon transition from normoxia to simulated hypoxia.

Design and interactions of luminescent nanoparticles in analytical systems (Invited paper)
I.Y. Goryacheva, D.D. Drozd, P.D. Strokin, D.A. Kornilov, Y.A. Podkolodnaya, O.A. Goryacheva; Saratov State University, Russia
Luminescent nanoparticles and nanoclusters represent a promising tool for imaging and bioanalysis. The sophisticated design of nanoparticles allows them to be used as active and passive labels to detect the presence of various components. The potential of nanoparticles to alter the fitness of delivery to molecular targets and reduced systemic toxicity for the organism. Here we report the study of the cellular delivery of targeted fluorescent magnetic nanoparticles to human epidermal growth factor receptor 2, clinically significant oncomarker.

WeSYC-23  11:30-12:00
Upconversion nanoparticles for diagnosis and targeted treatment of cancer (Invited paper)
N.Yu. Shilyagina1, E.L. Guryev1, D.K. Baushova1, L.V. Krylova1, A.B. Voloveckiy2, V.A. Vodeneev1, I.V. Balalaeva2, S.M. Deyev3 and A.V. Zvyagin1,2,3; 1 Lobachevsky State University of Nizhny Novgorod, 2 Pavlov First Saint Petersburg State Medical University, Russia
Chronic carbon dots are promising nanoparticles for sensing and bio-imaging. Herein, the green and red emissive chiral CDs are fabricated via surface modification treatment of achiral CDs at room temperature. The treated CDs demonstrate an intense chiral signal in the region of 200–300 nm with dissymmetry factor up to 2.3×10^4.

Effect of administration route on biodistribution of PLGA nanoparticles
E.N. Komedchikova1, O.A. Kolesnikova1, E.N. Mochalova1, A.S. Drozdov1, J.A. Malkirov1, V.R. Cherkasov1, V.O. Shipunova1; 1 Moscow Institute of Physics and Technology, 2 Sirius University of Science and Technology, 3 Prokhorov General Physics Institute RAS, Russia
In this study, we compared the biodistribution of PLGA nanoparticles 4h after intravenous or intraperitoneal injections – two commonly used administration routes.

WeSYC-24  12:00-12:30
Multifunctional hybrid nanoparticles as vectors for regulating the expression of target genes
P.I. Nikitin1, A.M. Skirda1,2; 1 Prokhorov General Physics Inst. RAS, 2 Moscow Inst. of Physics and Technology, Russia
Multifunctional hybrid nanoparticles have been developed for gene therapy and addresses the need for carriers of minimal cytotoxicity. The obtained nanoparticles exhibit optical and superparamagnetic properties, biomolecule binding, form stable complexes with therapeutic nucleic acids, and can serve as carriers for gene regulation. They demonstrate high efficiency in targeted siRNA delivery and offer biocompatibility and potential for controlled intracellular applications.

WeSYC-25  12:30-13:00
Metabolic and oxygen measurements in tumors in vivo using fluorescence and phosphorescence lifetime imaging (Invited paper)
M.V. Shironanova1, A.D. Komarova1, A.M. Mozherov1, A.A. Plekhanov1, M.A. Sirotikina1, L.E. Shimolina1, M. Lukina1, L.N. Bochkarev1, V.I. Shcheslavskiy1, Privolzhsky Research Medical University, 2 Razuvaev Institute of Organometallic Chemistry RAS, Russia
Glycolysis and hypoxia are the critical features of solid tumors, however the relationships between oxygenation and the metabolic state of tumor cells are not entirely clear. We present the results of in vivo fluorescence and phosphorescence lifetime imaging to probe metabolic state and oxygen level in tumor models upon natural growth and anti-cancer therapy.

WeSYC-26  13:00-13:15
Monitoring cellular uptake of gold nanoparticles by stationary absorption spectroscopy
A.V. Kochakov1, A.A. Mitsuova1, D.R. Dadadzhanov1, D.V. Kononov2, N.S. Petrov2, 1 ITMO University, 2 Pavlov First Saint Petersburg State Medical University, Russia
Gold plasmonic nanoparticles were synthesized by the reduction of chloroauric acid (HAuCl4) followed by surface modification using a bioocompatible polymer (PEG). Nanoparticles were introduced into tumor cells of leukemia and melanoma lines. Verification of endocytosis of nanoparticles by cancer cells is approved by stationary absorbance spectroscopy.

WeSYC-27  13:15-13:30
Green and red emissive N, O-doped chiral carbon dots functionalized with L-cysteine
A.A. Vedemkova1, S.A. Shipilovskikh1, E.V. Ushakova1, 1International Research and Education Center for Physics of Nanostructures, ITMO University, 2School of Physics and Engineering, ITMO University, Russia
Chiral carbon dots (CDs) are promising nanoparticles for sensing and bio-imaging. Herein, the green and red emissive chiral CDs are fabricated via surface modification treatment of achiral CDs at room temperature. The treated CDs demonstrate an intense chiral signal in the region of 200–300 nm with dissymmetry factor up to 2.3×10^4.

- Coffee Break -
Rigidochromic porphyrine dyes: smart molecules for sensing and cancer treatment (Invited paper)

I.V. Balalaeva, N.N. Peskova, L.N. Shestrakova, N.Yu. Shilyagina, V.I. Plekhanov, S.A. Lermontova, L.G. Klapshina; Lobachevsky State Univ. of Nizhny Novgorod, 1Gaponov-Grekhov Inst. of Applied Physics RAS, 1Razuvaev Inst. of Organometallic Chemistry RAS, Russia

Tetracyanotetraarylporphyrines are a unique group of dyes combining properties of molecular rotors and photodynamic agents. The fluorescence lifetime and quantum yield of these compounds are highly dependent on local viscosity, so they can be used as sensors of intracellular viscosity. The rigidochromic behaviour of the compounds provides a tool to quantify cell damage in real time during photodynamic cancer treatment.

WeSYC-28 15:00-15:30

Polymer optic fiber photoluminescent probe for cortisol continuous monitoring with metal-enhanced displacement fluororimmunoassay (Invited paper)

P.A. Kusov, Yu.V. Kotelevtsev, V.P. Drachev; Skolkovo Institute of Science and Technology, Russia

The application and optimization of the surface-specific fluororimmunoassay for real-time cortisol monitoring to novel substrate and setup – polymer optic fiber probe functionalized by gold nanoparticles and immobilized antibodies was achieved by our group. Free cortisol and fluoroescintently labelled carrier protein conjugated with cortisol hapten compete in binding with limited sites of surface-immobilized antibodies.

WeSYC-29 15:30-16:00

Immunofluorescence module for liquid biopathogen analysis in an aerosol sampler


A prototype of an optical module for immunofluorescence analysis based on evanescent waves under laser excitation of an antigen-antibody complex on the surface of the fiber core was developed and tested. The optical scheme, a fiber sensing element, a high-sensitivity photodetector and natural biological materials, along with fabrication methods of droplets using both artificial physical mechanisms of interaction between Gaussian beams and droplet interfaces, were elaborated, and algorithms for the prototype operation were tested. The limit of detection was found.

WeSYC-30 16:00-16:15

Detection and analysis of protein compounds based on Raman scattering and machine learning

E.Y. Ponkratova, A.S. Shitump, I.I. Fatkhutdinova, G.I. Bikaeva, A.Y. Kokhanovsky, A.A. Bogdanov, A.A. Marshina, D.A. Zuev; Faculty of Physics, ITMO Univ., 1Institute of Chemistry, St. Petersburg State Univ., Russia

Proteins are integral to cellular function within the human body. However, conventional techniques such as immunoassay and chromatography may not always provide accurate results in detecting biological compounds. This study proposes the utilization of Raman spectroscopy for the identification of individual amino acids and protein compounds, followed by machine learning-based quantitative and qualitative analysis of the acquired data.

WeSYC-31 16:15-16:30

Optical manipulation of microdroplets for precise imaging and manipulation of nanostructures

X. Chen; Jinan University, China

Optical manipulation has emerged as a pivotal tool in soft matter research. This presentation focuses on its research on precise formation/dissolution, shaping, and repositioning of microdroplets, enabling accurate imaging and manipulation of nanostructures. It also covers the physical mechanisms of interaction between Gaussian beams and droplet materials, along with fabrication methods of droplets using both artificial and natural biological materials.

- Coffee Break -
WeSYD-03  10:00-10:15
Sub-nanosecond excited state relaxation in FAD bound with bacterial diaphorase
I.A. Gorbunova, D.A. Volkov, D.V. Yashkov, M.E. Sasin, O.S. Vyasutinskij; Ioffe Institute, Russia
We present the results of analysis of polarized fluorescence decay in FAD bound with enzyme diaphorase. The analysis revealed isotropic and anisotropic fluorescence depolarization processes related with sub-nanosecond relaxation in FAD excited states. The significant differences in excited state dynamics in free FAD and FAD-diaphorase complexes was found.
WeSYD-04  10:15-10:30
AlPcS Cl is effective against Squamous cell carcinomas
A. Cruz; Laser Research Centre, University of Johannesburg, South Africa
Squamous cell carcinomas, or SCCs, are frequently occurring cancers. SCCs are caused by both non-squamous and squamous epithelial tissues. This study investigated the impact of gold nanoparticles (AuNPs)-based AlPcS4Cl - nanoPDT on melanoma, oesophageal, lung, and cervical cancers. The findings show that therapeutic chemical is more extensively absorbed and localised in cancer cells.

WeSYD-05  10:30-11:00
Spectroscopic intraoperative diagnostics of tumors during photodynamic therapy (Invited paper)
K.T. Efendiev1,2, P.M. Aleksieva1, A.A. Shlyareva, T.N. Pisareva1, V.B. Loschenov1,2,3
We present the results of analysis of polarized fluorescence decay in FAD bound with enzyme diaphorase. The analysis revealed isotropic and anisotropic fluorescence depolarization processes related with sub-nanosecond relaxation in FAD excited states. The significant differences in excited state dynamics in free FAD and FAD-diaphorase complexes was found.

WeSYD-06  11:30-11:45
Synthesis of core-shell ternary quantum dots - porphyrin conjugates and its photodynamic therapy application
O.S. Oluwafemi; Department of Chemical Sciences (formerly Applied Chemistry), University of Johannesburg; Centre for Nanomaterials Science Research, University of Johannesburg, South Africa
In this presentation, a large-scale aqueous synthesis of ternary quantum dots (QDs) and its conjugation to porphyrin as an efficient way to overcome photosensitizer shortcomings will be discussed. The singlet oxygen generation of this highly aqueous soluble novel conjugate and its cell viability against different cancer cell lines, which shows its potential for PDT applications, will be discussed.

WeSYD-07  11:45-12:15
Impacts of quantum dots in photodynamic processes (Invited paper)
A.O. Orlova; ITMO University, Russia
Luminescent quantum dots (QDs) and their composites are currently being widely studied as generators of reactive oxygen species (ROS). Binary and ternary QDs with different chemical compositions have been shown to be efficient energy or charge donors in QD-based composites. A method to enhance the energy or charge transfer efficiency because of photoinduced modification of the QD surface is proposed.

WeSYD-08  12:15-12:45
Cannabidiol enhances photodynamic therapy effects on breast cancer cells (Invited paper)
B.P. George, D.R. Mokoena, H. Abrahamse; Laser Research Centre, Faculty of Health Sciences, University of Johannesburg, South Africa
Cannabidiol (CBD) is a derivative of Cannabis sativa with several therapeutic applications. In this study, hypericin photosensitizer was adsorbed on gold nanoparticles. CBD was utilized to treat MCF-7 breast cancer cells, followed by in vitro photodynamic combination therapy. This study proposes that the CBD and PDT combination is effective in killing breast cancer cells in vitro by inducing apoptosis.

WeSYD-09  12:45-13:15
Effect of microenvironment on photophysical properties of Radachlorin photosensitizer (Invited paper)
I.V. Semenova, A.V. Belashov, A.A. Zhikhoreva; Ioffe Institute, Russia
The paper presents an analysis of the dependence of major photophysical properties of Radachlorin photosensitizer on such microenvironment properties as acidity, viscosity and polarity, as well as on the presence of albumin molecules. Experiments were performed in solutions and in living cells of five established lines.

WeSYD-10  13:15-13:45
Mechanisms of the photodynamic effect with polycationic photosensitizers on the foci of bacterial and oncological diseases (Invited paper)
G.A. Meerovich1,2, E.V. Akhlyustina1, E.A. Makarova1, E.A. Kogan1, S.S. Karshieva4, I.D. Romanishkin1, I.G. Tiganova1, Y.R. Romanova1, Zhi-Long Chen1,2, V.B. Loschenov1,2,3, I.V. Reshetov1,2, Prokhorov General Physics Institute RAS, 2National Research Nuclear University MEPhI, 3Sechenov First Moscow State Medical University, Russia
We present the results of analysis of polarized fluorescence decay in FAD bound with enzyme diaphorase. The analysis revealed isotropic and anisotropic fluorescence depolarization processes related with sub-nanosecond relaxation in FAD excited states. The significant differences in excited state dynamics in free FAD and FAD-diaphorase complexes was found.
**WeSYD-11**

**Intraoperative fluorescent imaging of peripheral pulmonary nodules (Invited paper)**
A. Akopov, G. Papayan, D. Fedotova, A. Gerasin; Pavlov First St. Petersburg State Medical Univ., Russia

This presentation is devoted to the discussion of various aspects of the intraoperative fluorescent imaging of lung cancer. The current situation based on the use of indocyanine green, the issues of using new targeted drugs are examined, as well as the possibility of increasing the depth of probing and combining with related treatment methods.

**WeSYD-12**

**Robot-assisted photodynamic therapy (Invited paper)**
T.G. Grishacheva, A.S. Vasiliev, A.V. Grabovskiy, S.A. Nikitin, V.V. Kharlamov, N.N. Potrakov, A.D. Obornev, N.N. Petrishichev; Laser Medicine Center, Pavlov First St. Petersburg State Medical University; LLC Renomed; LLC Medical Robotics; Department of Electronic Instruments and Devices, St. Petersburg Electrotechnical University «LETI»; Department of Thoracic Surgery, St. Petersburg State Research Institute of Phthisiopulmonology, Russia

Medical robot assisted fluorescence diagnostics (FD) and photodynamic therapy (PDT) of malignant lesions of external localizations, as well as intraoperative PDT is presented. This technique provides accuracy and uniformity of laser radiation distribution on the object and safety of treatment protocol.

**WeSYD-13**

**Clinical and immunologic results of photodynamic therapy for HPV-associated cervical diseases**
M.S. Afanasiev, A.D. Rzhikin, T.G. Grishacheva, O. Svitich, P. Kukina, A. Avagyan, E. Biryukova, A. Khangeldie, A. Karaulov; Sechenov University, Clinical Immunology and Allergology; Moscow City Oncology Hospital No62; Pavlov First State Medical University; Mechnikov Research Institute of Vaccines and Sera, Russia; NJSC “Astana Medical University”, Kazakhstan

Chlorine E6 photodynamic therapy (PDT) was used to treat 183 patients with HPV-related cervical diseases. The main of this study was to characterize the local immune response during treatment with PDT in patients with persistent HPV infection, LSIL, HSIL and cervical cancer. PDT is able to stimulate antiviral innate immune response, being important to treatment effectiveness.

**WeSYD-14**

**Metabolic stress of tumor microenvironment during photothermal therapy: activation of an immune antitumor response (Invited paper)**
A.V. Ryabova, D.V. Pominova, I.V. Markova, I.D. Romanishkin, V.B. Loschenov; Prokhorov General Physics Institute RAS, Russia

The work presents a study of intracellular temperature and metabolic stress during photothermal therapy, affecting the triggered cell death processes of different types. The obtained data will make it possible to optimize the laser exposure parameters for photothermal therapy, increasing the thermosensitivity of cancer and immune cells triggering the process of immunogenic cell death.
WeSYC-p01 10:00-13:30
On-chip multisensor array based on phosphorylated graphene for the alcohols selective detection
V.S. Gabrelian1, N.S. Struchkov2, M.A. Solomatin3, S.D. Saveliev4, S.A. Ryzhkov1, P.D. Cherviakov1, A.S. Varezhnikov4, S.I. Pavlov1, D.A. Kirilenko5, V.V. Sysoev6, M.K. Rabchinski6
1Ioffe Institute, National Research University of Electronic Technology, Yuri Gagarin State Technical University of Saratov, Russia
Herein, we consider the fabrication and gas-sensing properties of On-chip multisensor arrays based on a phosphorylated graphene (Gr-P) film with a gradually changed thickness. Selective detection of the alcohols, from methanol to butanol, mixed with air to match permissible exposure OSHA limits is demonstrated for the chip operating at room temperature.

WeSYC-p02 10:00-13:30
Dynamic of the absorption spectra of biological active substances of Tagetes flowers extract in visible wavelength region
E.S. Zemlyakova1,2, A.V. Tisbulnikova1, V.A. Slezhkin1,2, I.G. Samusev1, V.V. Bryukhanov1, D.A. Kiselev1,2, D. Palacin1,3,4,5
1Institute of Forensic Sciences, National University of Science and Technology MISIS; 2National Research Nuclear University MEPhI; 3Moscow Institute of Physics and Technology, 4Moscow State University, Russia
We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.

WeSYC-p03 10:00-13:30
Enhancement of magnetic dipole emission in the presence of a spherical particle
A.D. Utyushev1, R. Gaponenko1, S. Sun2, A.A. Shcherbakov1, A. Moroz2, I. L. Rasskazov1, School of Physics and Engineering, ITMO University, Russia
We discover regimes for promoting fluorescence of magnetic light by four orders of magnitude due to magnetic dipole (MD) transitions of trivalent rare-earth ions Eu3+ located inside or near dielectric homogeneous spheres.

WeSYC-p04 10:00-13:30
Study of the temperature stability of the parameters of a fiber-optic resonator with preservation of polarization
A.A. Ovchinnikov1, D.G. Gilev1, V.V. Krishkop1,2, Perm Scientific-Industrial Instrument Making Company, 1Perm National Research Polytechnic University, Russia
We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.

WeSYC-p05 10:00-13:30
Laser-pumping attack on QKD sources
M. Faddeev1, A.A. Ponomova1, R. Shakhovoy1, V. Makarov1,2, Russian Quantum Center, Skolkovo; 1TIMO University; 2NTI Center for Quantum Communications, National University of Science and Technology MISIS, Moscow Technical University of Communications and Informatics, Russia, 1University of Science and Technology of China, China
We demonstrate a new type of attack on QKD systems based on laser pumping of a photon source. It includes injection of cw laser emission into a source at a wavelength that shorter than the system operating one. Particularly, we show that laser emission at 1310 nm induces increase in pumping of a photon source. It includes injection of cw laser emission from methanol to butanol, mixed with air to match permissible exposure OSHA limits is demonstrated for the chip operating at room temperature.

WeSYC-p06 10:00-13:30
Particle characterization by analyzing light scattering signals with a machine learning approach
W. Schaefer1, V. Dulin2, S. Abdurakipov3, 1ai-quantum GmbH, Germany, 2Kutateladze Institute of Thermophysics, SB RAS, Novosibirsk State University, Russia
We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.

WeSYC-p07 10:00-13:30
Nanocomposite coatings to improve the hemocompatibility of medical devices
K.D. Popovich1,2, V.S. Selitschek1, A.Yu. Gerasimenko1,2, E.A. Gerasimenko1,2
1Inst. of Biomedical Systems, National Research Univ. of Electronic Technology, MIET; 2Inst. for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical Univ., Russia
This paper presents a method for the formation of nanocomposite hemocompatible coatings based on carbon nanotubes in a collagen polymer matrix using laser radiation. A microfluidic system was developed as a tool for in vitro testing of the coatings under dynamic flow conditions. Optical profilometry and Raman spectroscopy were used to evaluate the stability and hemocompatibility of the fabricated coatings.

WeSYC-p07 10:00-13:30
Low-coherence interferometry biosensors: real-time molecular detection with glass sensor chips
D.O. Novichikin1, M.N. Zaikina1, Z.G. Zaitseva1, N.A. Belyakov1,2, Prokhorov General Physics Institute Institute RAS, 1National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia
We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.

WeSYC-p08 10:00-13:30
Nanocomposite coatings to improve the hemocompatibility of medical devices
K.D. Popovich1,2, V.S. Selitschek1, A.Yu. Gerasimenko1,2, E.A. Gerasimenko1,2
1Inst. of Biomedical Systems, National Research Univ. of Electronic Technology, MIET; 2Inst. for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical Univ., Russia
We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.

WeSYC-p09 10:00-13:30
Low-coherence interferometry biosensors: real-time molecular detection with glass sensor chips
D.O. Novichikin1, M.N. Zaikina1, Z.G. Zaitseva1, N.A. Belyakov1,2, Prokhorov General Physics Institute Institute RAS, 1National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia
We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.

WeSYC-p10 10:00-13:30
Investigation of NV center ensemble in dense carbon-13 diamond for quantum sensing
V.V. Soshenko1,2, O.R. Rubins4, I.S. Coccojara5,6, S.V. Boshedvorskii1,2, P.G. Vlyuzhanina5,6, E.A. Primak1,2, S.M. Drofa1,2, A.M. Kozodaev1,2, V.G. Vinn5, V.N. Sorokin1,2, A.M. Smolyaninov1, A.V. Akimov1,2
1Sensor Spin Technologies; 2Lebedev Physical Institute RAS, Russia; 3IMEC, Belgium; 4MO, Hasselt University, Belgium; 5Russian Quantum Center; 6NRNU "MEPhI"; 7Moscow Institute of Physics and Technology; 8Moscow State University, Russia
We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.
Temperature stabilized microfluidic chip for plasmonic fiber biosensor

L.T. Fakhtudinova, D.O. Gagarinova, A.F. Cherednikova, A. Kokhanovskiy, M.V. Zyzuin; School of Physics and Engineering, ITMO University, Russia

We developed a plasmonic fiber biosensor with microfluidic chip with thermostabilization. The biosensor includes a tilted fiber Bragg grating covered in gold to generate surface plasmon resonance. Temperature stability is ensured using a Peltier cell with an active PID-controller. Specific proteins are immobilized to the fiber’s surface to selectively detect biomarkers in biofluids, based on changes in refractive index.

10:00-13:30

Surface-enhanced Raman scattering of electrospun non-woven fibers: synthesis of silver nanoparticles and their effect on the properties of SERS materials

V. Bakal, A.M. Kartashova, P.A. Demina, I.O. Kozhevnikov, E.S. Prikozhdenko; Science Medical Center, Saratov State University, Russia

In this study, electrospun non-wovens were used as the templates for SERS sensors. The functionalization of sensor surface was performed by either in situ synthesis of AgNP or using of pre-synthesized AgNP. Then, SERS substrates were modified with glucose oxidase enzyme to provide the sensitivity and specificity for glucose detection. Machine learning approaches was implemented in spectra analysis.

15:00-18:30
WeSYC-p21  15:00-18:30
Silver nanoparticles for therapy HER2-positive breast cancers
T.V. Rozhnikova1, A.M. Skirda1, A.O. Antonova, V.O. Shipunova1; 1Moscow Institute of Physics and Technology, 2Sirius University of Science and Technology, 3Prokhorov General Physics Institute RAS, Russia
The research is directed toward the development of HER2-targeted silver nanoparticles for breast cancer treatment.

WeSYC-p22  15:00-18:30
Evaluating carbon dots as trace element detection systems
L.I. Fatkhutdinova1, H. Barhum1, E.N. Gerasimova1, D.S. Kolchanov2, I.I. Vazhenin1, P. Ginzburg2, M.V. Zyuzin1; 1School of Physics and Engineering, ITMO University, Russia; 2Department of Physical Electronics, Tel Aviv University, Israel
Trace elements like Fe2+, Fe3+, and Co2+ are vital for body function. Fe2+, Fe3+ distribute oxygen, Co2+ aids metabolism and nervous system function. Health monitoring requires detecting these ions. Carbon dots (CDs) with stable fluorescence and water solubility can detect them. This study explored CDs’ optical properties and their sensitivity to Fe2+, Fe3+, Co2+, aiding selective detection in medical diagnostics.

WeSYC-p23  15:00-18:30
Fluorescently controlled investigation of super-enhancers with CRISPR interference and CRISPR prime editing systems
N.N. Orlova1, M.G. Gladkova1, G.A. Ashniev1, A.V. Orlov1; 1Prokhorov General Physics Institute RAS, 2Faculty of Bioengineering and Bioinformatics, Lomonosov Moscow State University, Russia
In the evolving landscape of genomic research, our study delves into the intricate exploration of super-enhancers, pivotal and controversial elements exerting profound influence over gene expression. Utilizing CRISPR interference and CRISPR prime editing systems, our work yields promising results and opens avenues for future research to refine and expand these approaches across diverse cell types.

WeSYC-p24  15:00-18:30
Method for measuring pairwise affinity of substantially non-complementary oligonucleotides
V.I. Arkhipova1, E.S. Korenkov2, M.Sh. Makhmuryan1, M.A. Gubaidullina, Y.P. Chebotareva1, E.N. Mochalova1, D.O. Novichikhin1, M.P. Nikitin1; 1Nanobiomedicine Division, Sirius University of Science and Technology, 2Moscow Institute of Physics and Technology, 3Prokhorov General Physics Institute RAS, Russia
Strand commutation based on low-affinity interactions of non-complementary nucleic acids is a unique tool for data processing through DNA. Here we demonstrate a method for measuring pairwise oligonucleotide affinity, which allows us to create accurate predictive resources. We used a range of optical techniques, including UV- and fluorescence spectroscopy, to determine the binding constant in DNA duplex of non-complementary strands.

WeSYC-p25  15:00-18:30
Biocompatible composite material for the regeneration of large tissue defects
U.E. Kurilova1,2, E.A. Gerasimenko1, I.A. Suetina1, M.V. Mezentseva1, L.I. Russu1, G.Yu. Galechyan1, A.Yu. Gerasimenko2,4; 1World-Class Research Center “Digital Biodesign and Personalized Healthcare”, I.M. Sechenov First Moscow State Medical University, 2Inst. of Biomedical Systems, National Research Univ. of Electronic Technology, 3Inst. of Virology, National Research Center for Epidemiology and Microbiology Named after the Honorary Academician N.F. Gamaleya, 4Inst. for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical Univ., Russia
This paper presents a technology for formation of biocompatible material for bone defect regeneration based on carbon nanotubes and biopolymers. Studies of the structure of the formed samples indicate the presence of the necessary characteristics. Biocompatibility studies have shown the applicability of the developed material for the regeneration of large tissue defects.
ThSYB-30  09:00-09:30
Terahertz-wave scattering in turbid biological tissues (Invited paper)
K.I. Zaytsev1, A.S. Kucheryavenko1, N.V. Chernomyrdin1, D.R. Il'enkova1, I.N. Dolganova2, V.V. Tuchin3,4,5; 1 Institute of Solid State Physics RAS, 2 Institute of Physics and Science Medical Center, Saratov State University, 3 Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University; 4 Institute of Precision Mechanics and Control, FRC “Saratov Scientific Centre RAS”, Russia

In our research, we combine the terahertz (THz) pulsed spectroscopy, superresolution THz solid immersion microscopy with methods of the Lorentz-Mie scattering theory and radiation transfer theory to shine the light on the THz-wave – turbid tissue interactions.

ThSYB-31  09:30-10:00
Terahertz spectroscopy of blood plasma for cancer diagnosis (Invited paper)
Q. Cherkasova1,2, N. Nikolau2; 1 Laboratory of Terahertz Photonics, Institute of Automation and Electrometry SB RAS, 2 Department of Data Acquisition and Processing Systems, Novosibirsk State Technical University; 3 Laboratory of Laser Biophysics, Institute of Laser Physics SB RAS, Russia

Cancer is one of the major diseases that seriously affect human health. The early cancer diagnosis has of great significance and can be achieved by analyzing blood plasma. In the report, we will consider ways to increase the sensitivity of THz pulsed spectroscopy to cancer diagnosis.

ThSYB-34  11:30-12:00
Antibacterial photodynamic therapy. Role of endogenous Zn-coprotoporphyrin in the sterilization of M. tuberculosis (Invited paper)
A. Savitsky1, M.O. Shleeva1, I.A. Ling1, A.S. Apf1, A.S. Kaprelyants1; 1 Federal Research Centre of Biotechnology RAS, 2 Central Tuberculosis Research Institute, Russia

In the live and dormant forms of M. tuberculosis, the synthesis Zn-porphyrins significantly increased in the presence of 5-aminolevulinic acid and viability of dormant Mtbs reduced by more than 99.99% under illumination with 565 nm as well accumulation of active Mtbs cells in lung macrophages cells give the same results. These findings create a perspective for the treatment multidrug-resistant tuberculosis.

ThSYB-35  12:00-12:30
Combined photodynamic/photothermal cancer therapy accompanied by optical clearing (Invited paper)
E.A. Genina1,2, A.B. Bucharskaya1, V.D. Genin1,2, N.A. Navolokin1, D.A. Mudrak1, G.N. Maslyakova1, B.N. Khlebtsov1, N.G. Khlebtsov1, V.V. Tuchin1,2; 1 Saratov State University, 2 Tomsk State University, 3 Saratov State Medical University named after V. I. Razumovsky, 4 Institute of Biochemistry and Physiology of Plants and Microorganisms RAS; 5 Institute of Precision Mechanics and Control RAS, Russia

The paper presents the results of the study of the effect of singlet oxygen induced by 1267 nm laser exposure without the use of photosensitizers on the bioenergetics of rat insulinoma RINm5F. Differences in changes of analysed parameters of the investigated cells after laser treatment were revealed in comparison with the control group that were not exposed to laser.
Plasmonic agents for bioimaging and photothermal therapy with red and NIR lasers
E.V. Solovyeva, V.O. Svinko, A.I. Demenshin, A.N. Smimov; St. Petersburg State University, Russia
This work is addressed to the development of hybrid systems which are considered as new means of imaging and therapy of malignant neoplasms. We represent here the study of a wide range of combinations of morphologically different gold nanoparticles and various molecular probes (fluorophores or Raman reporters).

Lunch Break -

Optical coherence elastography with osmotically-induced strains for assessing degradation of cartilage samples (Invited paper)
Y.M. Alexandrovskaya1,2, A.A. Sovetsky1, E.M. Kasinenko1,2, A.L. Matveyev2, D.A. Atyakashin, O.I. Patsap1, M.A. Ignatkin1, A.V. Volodkin1, V.Y. Zaitsev1, A.V. Gaponov-Grekho1n Institute of Applied Physics RAS, Russia; Terra Quantum AG, Switzerland; National Research Center Kurchatov Institute, Russia; Scientific and Educational Resource Center “Molecular Morphology”, RUDN University, Russia
A new variant of Optical Coherence Elastography is presented, in which osmotically-induced strains are used instead of such auxiliary stimuli as compression or elastic-wave excitation. The method efficiency is demonstrated to differentiate cartilage samples with various stages of proteoglycan-component degradation. The method also looks promising for utilization with other tissue types, e.g., for express assessment of biopsy-sample needles.

New mechanisms in stem cells differentiation and tissue regeneration discovered by optical imaging (Invited paper)
E. Zagaynova1,2, A. Meleshina1, D. Kuznetsova1, S. Rodimova1, A. Kashirina1, P. Ermakova1, V. Zagaynov1, V. Shcheslavsky1; Institute of Biomedical Technologies, Pirogovsky Medical Research University; Lopukhin FRCC PCM, Nizhny Novgorod Regional Clinical Oncological Dispensary, Russia; BeckerHickl GmbH, Germany
Using FLIM and multiphoton fluorescence microscopy we have made investigation of metabolic status in mesenchymal stem cell during adipogenic, osteogenic and chondrogenic differentiation, metabolic activity and intracellular pH in iPSC differentiating in dermal, epidermal, neuronal directions, in 3D neurospheres from iPSCs, in neural spheroids with Down syndrome, metabolic changes in living islets of Langerhans, and during liver regeneration.

Adapting laser microscopy to life sciences (Invited paper)
H. Schneckenburger; Aalen University, Germany
Transmission, scattering and fluorescence microscopy are adapted to various requirements of life sciences, e.g. angular resolution, 3D resolution and limitation of light exposure to a non-phototoxic level. Applications include scattering microscopy, Light Sheet Fluorescence Microscopy (LSFM), Structured Illumination Microscopy (SIM) in combination with TIRFM, Axial Tomography and laser-assisted micromanipulation.

SYC: PHOTONICS AND NANOBIOENGINEERING
Location: Petrov-Vodkin 2 Room, Floor 2; Date: Thursday, July 04, 2024
SYC: PHOTONICS AND NANOBIOENGINEERING 7
Session Chair: Petr Nikitin, Prokhorov General Physics Inst. RAS, Russia

Laser engineering of microbial systems: a new tool for microbiology (Invited paper)
N.V. Minayev1, V.S. Zhigarkov1, V.S. Cheptsov1,2, V.I. Yusupov1; Institute of Photon Technologies of Kurchatov Complex Crystallography and Photonics, NRC “Kurchatov Institute”; Soil Science Faculty, Lomonosov Moscow State University, Russia
We present laser engineering of microbial systems (LIMS) technology - a new promising tool which allows significant progress towards solving the ambitious task of microbiology associated with expanding the base of cultivable microorganisms. The technology is based on laser-induced forward transfer (LIFT) of microscale gel droplets with living microorganisms from various natural environments while preserving their natural microenvironment.

Optical sorting via surface and volumetric modes of periodic structures
N.A. Kostina, M.P. Petrov, Faculty of Physics, ITMO University, Russia
In this work we consider the auxiliary layered structure to provide optical pulling of the nanoparticle placed above. The structure providing both optical force direction switching (inherent to the photonic crystals) and enhanced magnitude of the optical pulling (inherent to the hyperbolic metamaterials) is described. We also demonstrate the optimized geometry and permittivities for experimental realization of the particles’ sorting.
Wettability control on glass surface by laser-induced nanostructures for nanoparticles self-assembly
Chunyu Li, M.A. Gremilov, E.I. Ageev, D.A. Zuev; ITMO Univ., Russia
To control the self-organized assembly of nanoparticles on substrate, which are distributed in solution, the LIPISS technology is used for the wettability controllable template fabrication. The template with adjustable period and morphology of nanostructures will help organize the alignment of nanoparticles. And these will provide an important step for development of metasurfaces.

Water transportation across membrane aquaporin channels by monomer H2O
S.M. Pershin1, E.V. Stepanov1, D.G. Artemova1, B.G. Katsnelson1; 1Prokhorov General Physics Institute RAS, Russia; 2University of Haifa, Israel
P. Agre (Nobel Prize, 2003) said that water transportation across membrane aquaporin channel by monomer H2O occurs with intensity around 3.9 monomer/s. It's still unknown till now where this monomer amount may storage? We have observed that water-air interface layer consists of a two water fraction: it has high/low meniscus height when capillary touch the surface/bulk water.

Optical-magnetic characterization of IgG and nanoparticles in biosensor development. Using label-free low-coherence interferometry and magnetic lateral flow immunoassay, it enables kinetic studies, IgG sorption density quantification, and functional nanoparticle characterization. Demonstrating efficacy in sensitive assays for mycotoxins and cardiovascular biomarkers underscores its potential. Promising results in analytical characteristics highlight versatility for rapid biosensor advancement.

Fluorescence polarization immunoassay for detection of pesticides in food products (Invited paper)
S.A. Eremin1,2, M.K. Kolokolova1; 1AN. Bach Institute of Biochemistry, Research Centre of Biotechnology RAS, 2Faculty of Chemistry, Lomonosov Moscow State University, Russia
Fluorescence Polarization Immunoassay (FPIA) is immunochemical method based on the application of antibodies as recognition element and fluorophore as label for detection by measurement of fluorescence polarization. FPIA is simple method for organic compounds monitoring. Development of FPIA for detection of pesticides 2,4-Dichlorophenoxyacetic acid and Glyphosate in food stuffs will be presented. The study was supported by RSF grant No24-43-00196.

Optical-magnetic characterization of IgG and nanoparticles for rapid biosensor development: detection of cardiac markers and mycotoxins
J.A. Malkov1, S.L. Znoyko1, V.A. Bragina1, B.G. Gorshkov1; 1Prokhorov General Physics Institute RAS, National Research Nuclear University MEPhI, Russia
This study introduces a novel method for characterizing IgG and nanoparticles in biosensor development. Using label-free low-coherence interferometry and magnetic lateral flow immunoassay, it enables kinetic studies, IgG sorption density quantification, and functional nanoparticle characterization. Demonstrating efficacy in sensitive assays for mycotoxins and cardiovascular biomarkers underscores its potential. Promising results in analytical characteristics highlight versatility for rapid biosensor advancement.
ThSYD-16
09:00-09:30
Picosecond anisotropic relaxation in biomolecules studied by polarization-modulation pump-and-probe spectroscopy (Invited paper)
O.S. Vasyutinskii; Ioffe Institute, Russia
Transient monitoring and Stimulated Raman Scattering attract much attention as effective methods for investigation of the dynamics of biologically relevant molecules in solutions and living cells. The lecture presents the results of experimental and theoretical studies of ultrafast relaxation and energy transfer in biologically relevant molecules using a novel polarization-modulation pump-and-probe femtosecond spectroscopy developed recently by the authors.

ThSYD-17
09:30-10:00
Microscopy techniques for the enhancement of localized photodynamical processes (Invited paper)
Meisam Sadeghpour Karimi, Lishin Thottathi, Gabriele Ferrini; Università Cattolica del Sacro Cuore, Italy
We report on progress regarding light localization, light collection, and scanning capabilities of microscope objectives aided by single dielectric microspheres. Selective enhancement of photodynamic and thermo-mechanical processes at surfaces will be discussed.

ThSYD-18
10:00-10:15
Method of deep joint formation at laser welding of biological tissues
D.I. Ryabkin12, V.V. Suchkova12, E.A. Gerasimenko1, A.Yu. Gerasimenko12, 1Institute of Biomedical Systems, National Research Univ. of Electronic Technology, 3Institute of Bionic Technology and Engineering, Sechenov First Moscow State Medical Univ., Russia
A new method of weld irradiation in the process of laser soldering of biological tissues is proposed. The method will allow transporting laser radiation to the area of weld formation with fewer losses, which allows minimizing the formation of temperature necrosis of the tissue. Modelling has shown the possibility of forming deeper welds compared to stationary irradiation methods.

ThSYD-19
10:15-10:45
Spectral properties of crystalline aluminum phthalocyanine nanoparticles and the possibility of their use in biophotonics (Invited paper)
V.I. Makarov12, D.V. Pominova12, A.V. Ryabova12, I.D. Romanishkin1, V.B. Loschenov12, 1Prokhorov General Physics Institute RAS, 2National Research Nuclear University MEPhI, Russia
The use of AlPc nanoparticles as photosensitizers makes it possible to significantly increase the selectivity of the procedure. Using time-resolved laser spectroscopy, analysis of multispectral fluorescence microimages, microstructural and X-ray diffraction methods, we studied the occurrence of optical effects manifested in the interaction of crystalline AlPc NPs with the microenvironment and laser radiation.

ThSYD-20
10:45-11:00
Feasibility of photodynamic effect assessment by means of microcirculation optical monitoring during laser activation
A.S. Machikhin1, A.V. Gunyleva1, T.G. Grishacheva2, N.N. Petrishchev2, 1Acousto-Optic Spectroscopy Lab. STC UI RAS, 2Department of Pathophysiology, Pavlov University, Russia
Conventional non-invasive in vivo methods for studying photodynamic therapy mechanisms do not implement monitoring directly during photoactivation. Our study was aimed at evaluating the feasibility of such monitoring using videocapillaroscopy and photoplethysmography. We proposed an approach, designed its hardware and software, and approved it when studying the response of skin microcirculation in rats under various modes of laser activation.

- Lunch Break -
ThSYD-21 11:30-11:45
Methylene blue-mediated photodynamic therapy and tissue oxygen saturation control of postoperative mammary gland scars
D.M. Kustov1, P.M. Alekseeva1, A.S. Moskaliev2, L.Yu. Loschenova2, A.V. Voitova2, P.V. Pimanchev2, A.A. Shiryaev3, V.B. Loschenov31; 1 Prokhorov General Physics Institute RAS, Biospec LTD, 2 National Research Nuclear University MEPhI, Russia

Wounds are major health care problem. Photodynamic therapy (PDT) is a non-invasive procedure, can be applied to stimulate healing of skin wounds resulting from mammary gland surgery. The development of approaches to treatment of postoperative scars with PDT and simultaneous tissue oxygen saturation control will reduce the time of tissue healing and decrease the incidence of postoperative scars inflammation.

ThSYD-22 11:45-12:15
Method for rapid intraoperative analysis of the optical properties of multilayered walls of hollow organs (Invited paper)
T.A. Savelieva1,2, A.A. Krivetskaya1,2, V.V. Levin1, D.M. Kustov1, A.S. Gorbonov1, A.A. Shiryaev1, S.S. Hamas1, K.G. Linkov1, V.B. Loschenov21; 1 Prokhorov General Physics Institute RAS, 2 Institute of Engineering Physics for Biomedicine, National Research Nuclear University MEPhI, Germany

The optical properties of tissues are important information that allows planning various types of laser-induced effects on biological tissues. In this work, we propose an approach to simultaneous intraoperative measurements of the spectra of diffuse reflectance and transmittance of light through intestinal wall tissue to restore the optical properties of these tissues with customized variant of Kubelka-Munk model.

ThSYD-23 12:15-12:45
Experimental models of photodynamically-induced thrombi in blood vessels (Invited paper)
I.A. Mikhailova, N.N. Petrishchev, T.G. Grishchacheva, S.G. Meloyan, S.G. Chefu, G.Yu. Yukina; Pavlov First State Medical University, Russia

The review of commonly used experimental in vivo models of photodynamic thrombosis of vascular bed is presented. Herein we discuss some of their advantages and disadvantages of these models being applied to different areas of vascular bed.

ThSYD-24 12:45-13:15
The use of mid-infrared lasers in ophthalmology: prospects and advantages, a look at a future development (Invited paper)
Yu.N. Yusef1, D.V. Petrochkov1, E.N. Korobov1, I.M. Belousova2, A.P. Zhevlakov1, A.S. Narivonchik2; 1 Dept. Innovation Vitreoretinal Technology, Krasnov Research Institute of Eye Diseases, 2 Nanophotonics Department, Vavilov Optical Institute, Russia

We are evaluate the effect of laser radiation with a wavelength of 3 μm on the tissues of cadaver eyes and compare it under similar parameters with the 532-nm laser. The impact of laser radiation on eye tissues was assessed using a scanning electron microscope.

ThSYD-25 13:15-13:45
Singlet and triplet oxygen detection by time-correlated single photon counting (Invited paper)
P. Morozov1, V.S. Andreiev2, M.V. Shirmanova2, V.I. Shcheslavskiy1, G.N. Goltsman1; 1 Center for Nanotechnology, Krasnov Research Institute of Eye Diseases, Russia; 2 Becker & Hickl GmbH, Germany

We present the technique for molecular oxygen measurements both in ground and excited states. It is based on time-correlated single photon counting technique and use of a superconducting nanowire single-photon detector that has a high quantum efficiency and an extremely low dark count rate.

ThSYD-26 15:00-15:30
The role of water in the biological activity of shungite carbon nanoparticles (Invited paper)
N.N. Rozhkova1, S.P. Rozhkova1; 1 Institute of Geology Karp RAS, 2 Institute of Biology Karp RAS, Russia

The role of the network of water hydrogen bonds in the regulation of intermolecular interaction responsible for colloidal stability of dispersions has been studied in order to search for general patterns of interaction between water, nanoparticles and biomacromolecules. Raman spectra for dispersions of bovine serum albumin and its hybrids with shungite carbon nanoparticles were analyzed in the high wavenumber region.

ThSYD-27 15:30-15:45
New materials for photodynamic inactivation of viruses
I.M. Belousova1, I.V. Bagrov1, V.V. Zarubova2, V.M. Kiselev1, I.M. Kislyakov1, T.K. Kristo1, A.M. Starodubtsev1; 1 Joint Stock Company «Scientific and Production Association S.I. Vavilov State Optical Institute», Russia; 2 St. Petersburg Pasteur Research Institute of Epidemiology and Microbiology, Russia; 3 Photonic Integrated Circuits Center, Shanghai Institute of Optics and Fine Mechanics CAS, China

The studies carried out in this work on the effective generation of singlet oxygen in the volume and on the surface of polytetrafluoroethylene (fluoroplastic-4, also known under the trade mark as Teflon) when irradiated with ultraviolet and visible radiation made it possible to clarify the mechanisms and features of the antiviral action of this fluoropolymer under specific experimental conditions.

ThSYD-28 15:45-16:00
The combined use of methylene blue and chlorin E6 photosensitizers for photodynamic therapy and correction of the tumor microenvironment
D.V. Pominova1, A.V. Ryabova1, A.S. Skobeltsin1, I.V. Markova2, I.D. Romanishkin2; 1 Prokhorov General Physics Institute RAS, 2 National Research Nuclear University MEPhI, Russia

In this work we report the results of the study of combined use of methylene blue with chlorin e6 photosensitizer for tumor oxygenation control and the tumor microenvironment correction during photodynamic therapy in vitro and in vivo. Targeted destruction of macrophage cells of tumor-associated phenotype and synergistic effects due to the influence of methylene blue on tumor oxygenation were studied.

ThSYD-29 16:00-16:15
Photodynamic therapy and photodiagnosis of glioblastomas with combined use of 5-ALA and Chlorin e6
E.I. Kozlikina, I.S. Trifonov, O.V. Levchenko; Pavlov First State Medical University, Russia

The study presents the preliminary results of the combined use of 5-ALA and Chlorin e6 photosensitizers for photodiagnosis and photodynamic therapy of glial brain tumors.
Spectroscopic verification of contrast enhancement methods in fluorescence diagnostics of basal cell carcinoma with scar tissue

A.A. Febenchukova¹, A.M. Udennev¹², A.M. Kulichenko¹³, N.A. Kalyagina¹³, K.T. Efendiev¹³, M.V. Loshchenov¹
¹National Research Nuclear University MEPhI,
²Federal State Budgetary «Federal Scientific and Clinical Center for Medical Rehabilitation and Balneology of the Federal Medical and Biological Agency», 
³Prokhorov General Physics Institute RAS, Russia

Fluorescent diagnosis of skin malignancies requires contrast enhancement of fluorescent images. The contrast enhancement methods of dividing the chlorine e6 fluorescence by the auto fluorescence and subtracting the auto fluorescence from the drug fluorescence were tested spectrometrically. Both methods have shown the possibility of enhancing tumor-healthy tissue contrast, with localization more easily determined by subtraction and accumulation assessed by division.

Photodynamic therapy for cancer of external and visceral localizations in Russia

E.Ph. Stranadko¹, A.V. Baranov¹, T.I. Malova¹, M.V. Riabov¹, M.A. Andreeva¹; ¹Skobelkin Scientific and Practical Center for Laser Medicine FMBA; ²“VETA-GRAND” LLC, Russia

Photodynamic Therapy (PDT) for cancer at various stages and locations has been practiced in Russia for 32 years. PDT is utilized in the majority of oncology clinics. The effectiveness of PDT reached 95-96%. PDT fundamentally changes the status of a significant group of inoperable patients with various cancer localizations.

Endoscopic photodynamic recanalization for inoperable obstructive esophageal cancer

E.Ph. Stranadko¹, V.A. Duvansky², V.L. Shabarov³, M.V. Riabov¹, T.I. Malova¹, M.A. Andreeva¹; ¹Skobelkin Scientific and Practical Center for Laser Medicine FMBA, ²RUDN University, ³Moscow Regional Research and Clinical Institute (“MONIKI”), ⁴“VETA-GRAND” LLC, Russia

PDT is effective in advanced obstructive esophageal cancer, improving the outcomes for this challenging group of patients and enhancing their quality and duration of life. The recanalization effect lasts for 6-7 months. In cases of dysphagia recurrence after stenting, PDT is the only possible method for eliminating the tumor stricture.

- Coffee Break -
Singlet oxygen generation by Radachlorin photosensitizer in albumin-containing solutions

D.M. Betukova, V.P. Belik, K.A. Chudakov, V.V. Smimov, I.V. Sementova, O.S. Vasyutinski;
1 Ioffe Inst.; 2 Peter the Great Polytechnic Univ., Russia

We present experimental analysis of singlet oxygen (SO) generation by Radachlorin photosensitizer (PS) in solutions with human serum albumin (HSA) at different relative concentrations of PS and HSA molecules. The gradual decrease of the SO phosphorescence signal with rising amount of albumin molecules has been observed and interpreted.

Study of photo-oxidation of tetrahydrobiopterin with the addition of Pt - Pd nanoparticles

D.A. Makarova, A.S. Nizamutdinov, T.A. Telegina, Yu.I. Vechtomova, A.A. Bugla;
1 Institute of Physics, Kazan Federal University; 2 A.A. Bukh University, Faculty of Physics, St. Petersburg State University, Russia

In the work, it was shown that the addition of platinum and palladium nanoparticle suspension promotes the formation of dihydropterin dimers when irradiated with ultraviolet light (325 nm) in the presence of oxygen.

Picosecond to millisecond transient absorption spectroscopy of carboxy- and oxyhemoglobin in the visible and mid-infrared spectral region

S.V. Lepeshkevich, I.V. Suzanovich, M.V. Parkhats, S.N. Gilevich, B.M. Dzhagarov;
1 Stepanov Institute of Physics NAS Belarus, Belarus; 2 Central Laser Facility, Research Complex at Hanwell, STFC Rutherford Appleton Laboratory, UK; 3 Institute of Bioorganic Chemistry NAS Belarus, Belarus

Picosecond to millisecond laser time-resolved transient absorption spectroscopy in the visible and mid-infrared spectral region was used to study carbon monoxide and molecular oxygen rebinding as well as conformational relaxation following ligand photodissociation in human hemoglobin. Significant functional non-equivalence of the alpha and beta subunits of hemoglobin in both the geminate ligand rebinding and concomitant structural relaxation was revealed.

Optimization of energy parameters for laser-induced photodynamic therapy of cervical tissues using numerical simulation and fluorescent monitoring

P.M. Alekseeva, K.T. Elendiev, T.A. Savelieva, A.S. Moskaliev, A.V. Gilyadova, V.B. Loschenov;
1 Prokhorov General Physics Institute RAS; 2 National Research Nuclear University MEPhI; 3 Sechenov First Moscow State Medical University, Russia

The main problem in the photodynamic therapy of tumors is insufficient light exposure to tissue depth or the appearance of undesirable surface effects. It is required to investigate the influence of energy density and radiation spot diameter on the photosensitizer photobleaching efficiency by depth.
Wireless chronic electrical stimulation of peripheral nerves via organic optoelectronic device.

E.A. Iusupovskaia1, G.A. Piavchenko1, A.N. Konovalov1,2, D.V. Telyshev2, A.G. Markov1; 1Institute for Bionic Technologies and Engineering, I. M. Sechenov First Moscow State Medical University, Russia; 2Department of Histology, Cytology and Embryology, I.M. Sechenov First Moscow State Medical University (Sechenov University), Russia; 3National Medical Research Center of Neurosurgery named after N.N. Burdenko, Russia; 4Institute of Biomedical Systems, National Research University of Electronic Technology, Russia

Here we report chronic wireless electrical stimulation of the sciatic nerve in rats by an implanted multilayered organic semiconductor optoelectronic device that transduces deep-red light (625 nm) into electrical signals. In freely moving rats, fixation of the cuff around the sciatic nerve, 10 mm below the surface of the skin, allowed stimulation of the nerve for over 90 days.
SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY

FrSYB-43 09:00-09:30
Made-to-order organ: the common future of biophotonics and biofabrication (Invited paper)
Peter Timashev, Science and Technology Park for Biomedicine of the Sechenov Medical University; Faculty of Chemistry, Lomonosov Moscow State University, Russia
Various strategies have been developed to produce biocompatible tissue-engineered constructs, including the use of natural biomaterials like collagen or functionalization of synthetic biomaterials. There is a trend towards bioactive constructs that stimulate tissue remodeling and integration. Challenges include quality control and imaging without destructiveness. Biophotonics offers instant tissue visualization. These approaches hold promise for revolutionizing regenerative medicine.

FrSYB-45 09:45-10:00
Singlet oxygen prevents the mitochondrial NADH depletion in β-amyloid induced neurotoxicity
O.A. Stelmaskhchuk, V.V. Dremin, A.Y. Abramov; Research & Development Center of Biomedical Photonics, Orel State University, Russia; Department of Clinical and Movement Neurosciences, UCL Queen Square Institute of Neurology, UK
This paper demonstrates the results of the application of singlet oxygen in β-amyloid induced neurotoxicity. The experimental results of the use of 1267 nm laser for generating singlet oxygen in primary co-culture of cortical cells addition β-amyloid peptide fragment 25-35 (5 μM) are described.

FrSYB-46 10:00-10:30
Advanced Monte Carlo simulations in spectral and fluorescence optical diagnostics (Invited paper)
M.Yu. Kirillin, D.A. Kukushkin, A.A. Getmanskaya, A.V. Khilov, V.V. Perekatova, V.A. Shishkova, I.V. Turchin, E.A. Sergeeva; A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia
We report on the development of Monte Carlo based models of signal formation in systems of spectral and fluorescence imaging. Numerical simulations allow tracking photon trajectories providing imaging volume analysis, while parallel processor architecture allows to significantly speed up calculations.

FrSYB-47 10:30-10:45
Simulation of infrared radiation backscattering in multilayer tissue models
V.L. Kuzmin, Yu.A. Zhavoronkov; Peter the Great St. Petersburg Polytechnic University, St. Petersburg State University, Russia
Calculating and studying the characteristics of infrared radiation scattered by multilayer systems expands the possibilities of noninvasive diagnostics. We present Monte Carlo simulation results of backscattering from a four-layer bio-tissue model based on the solution of the Bethe-Salpeter equation. The calculations reveal that backscatter intensity are extremely sensitive to the penetration of blood into the cerebrospinal fluid layer.

FrSYB-48 11:30-12:00
Human serum SERS analysis for non-infectious diseases detection: avoiding overestimation of classification models (Invited paper)
I.A. Bratchenko, Yu.A. Khrissoforova, P.A. Lebedev, M.A. Skuratova, L.A. Bratchenko; Laser and Biobtech Dept., Samara National Research University; Therapy Dept, Samara State Medical University; Samara Regional Clinical Hospital named after VD Seredavin, Russia
The in vitro analysis of human serum was performed for more than 500 subjects for the detection of chronic heart failure, chronic kidney failure and other non-communicable diseases. Analyzed groups separation was performed based on deep learning was implemented using a separate one-dimensional convolutional neural network, projection on latent structures combined with discriminant analysis and other machine learning approaches.

FrSYB-49 12:00-12:30
Development of SERS-active substrates for Raman investigations of microorganisms (Invited paper)
V.V. Tregulov, E.V. Perevedentseva, A.I. Ivanov, D.S. Kostsov, N.N. Melnik; Ryazan State University named after S. Yesenin; Lebedev Physical Institute RAS, Russia
The developing of active substrates for surface enhancement Raman scattering (SERS) based on porous silicon with Fano resonance is presented. Such structures provide both high amplification of the Raman signal and obtaining reproducible and clearly interpretable results for using SERS like a tool for detection, identification and research of pathogenic and non-pathogenic microorganisms.
FrSYB-50 12:30-12:45
Assignment of low-frequency bands in micro-Raman spectra of hair keratins
E.I. Travkina, N.N. Brandt; Faculty of Physics, Lomonosov Moscow State University, Russia
We identify conformation-sensitive bands in the low-frequency micro-Raman spectra of human hair keratins. A comparison of hair spectra measured at different orientations of the sample relative to the exciting radiation reveals changes in an interval of 110-190 cm\(^{-1}\), corresponding to vibrations of polarization sensitive \(\alpha\)-helical structures. It was also shown that spectral interval of 235-353 cm\(^{-1}\) characterizes vibrations of \(\beta\)-structures.

FrSYB-51 12:45-13:00
Plasmon based tags for Raman bioimaging in silent region
A.I. Demenshin, V.N. Sorokoumov, E.V. Solovyeva; St. Petersburg State University, Russia
Surface-enhanced Raman scattering is characterized by high specificity, spatial resolution and signal-to-noise ratio which make it attractive for bioimaging purposes. The use of alkynes in combination with plasmonic materials opens up the possibility of multifunctional diagnostic agents. In this work, the tags based on gold nanorods functionalized with 4-amino-tolane via covalent conjugation are developed for alkyne-targeted bioimaging and photothermal therapy.

- Lunch Break -
A1. EXHIBITION WORKSHOP

Зал Пьемонт, 3 этаж
3 Июля 2024, 15:00–17:00
Язык мероприятия: Русский
Модератор: Андрей Е. Чупров,
ООО «Специальные Системы. Фотоника», Россия

Piedmonte Room, 3rd floor
July 3, 2024, 15:00–17:00
Language of the event is Russian
Moderator: A.E. Chuprov,
Special Systems. Photonics, LLC, Russia

15:00–15:15
Обзор современных лазерных решений для научных и промышленных задач
A. Е. Чупров, ООО «Специальные Системы. Фотоника», Россия
Overview of modern laser solutions for scientific and industrial tasks
A. E. Chuprov, Special Systems. Photonics, LLC, Russia

15:15–15:30
Актуальные разработки лазерных источников и компонентов фотоники в ЛАССАРД
А. С. Щекин, ООО «Лассард», Россия
Latest innovations in laser sources and photonics components at LASSARD
A. S. Schekin, LASSARD, LLC, Russia

15:30–15:45
Лазеры для решения специальных задач
Д. А. Вельтберг, ООО «Лазерные компоненты», Россия
Lasers for specialized purposes
D. A. Weltberg, Laser Components Ltd., Russia

15:45–16:00
Современные тенденции в области конфокальной микроскопии и доступные технологии в области фотоники
А. М. Козьмин, ООО «Криотрейд Инжениринг», Россия
Current trends in confocal microscopy and available technologies in photonics
A. M. Kozmin, Cryotrade Engineering, LLC, Russia

16:00–16:15
Лазерные оптоакустические томографы медицинского назначения на основе высокочувствительных ультразвуковых гидрофонов
П. В. Субоchez, ООО «БАРИ - НН», Россия
Laser optoacoustic tomography systems for biomedical applications based on highly sensitive ultrasound hydrophones
P. V. Subochev, BARI-NN Ltd., Russia

16:15–16:30
Новые разработки в семействе лазеров УКИ компании «АВЕСТА», в том числе титан-сапфировые осцилляторы со средней выходной мощностью более 1 Вт с прямой дiodeной накачкой
И. И. Курицын, К.Е. Резников, ООО «Авеста-Проект», Россия
Recent developments in Avesta's ultrafast laser family including direct diode-pumped Ti:Al₂O₃ oscillators with >1 W output average power
I. I. Kuritsyn, K.E. Reznikov, Avesta Project Ltd., Russia

16:30–16:45
Современные нанометровые и оптические методы измерений с помощью зондовых, спектральных и лазерных технологий
Н. М. Толкач, ООО «Активная фотоника», Россия
Modern nanometer and optical measurement methods using probe, spectral and laser technologies
N. M. Tolkach, ActivePhotonics, LLC, Russia
LASSARD LLC, RUSSIA
26/11 Varshavskoye hwy.
117105, Moscow, Russia
Phone: +7 495 120 68 86
E-mail: sales@lassard.ru
https://lassard.ru/

LASSARD, LLC is a Russian vertically integrated company which independently conducts all production cycles. Since 2015 it has been developing, manufacturing and selling optomechanical products, lasers, laser systems and lasure machinery.

LASSARD is part of the Varton Group, which has been in the industrial production market since 2008.

The company designs and manufactures equipment, systems and components for various industries and activities: microelectronics, medicine, energy industry, automotive and aircraft manufacturing, oil and gas industry, communication systems and telecommunications.

AVESTA PROJECT, RUSSIA
11 Fizicheskaya str.
108840, Troitsk, Moscow, Russia
Phone: +7 495 241 00 92
E-mail: fs@avesta.ru
www.avesta.ru

Avesta Project Ltd. produces femtosecond lasers and relevant measurement equipment and accessories. We offer Ti:S, Yb and Cr:F solid-state fs and CW lasers, Ti:S, Yb and Cr:F fs mJ-level amplifiers up to multi-TW level, fiber lasers (Er-, Yb-doped and frequency-doubled, frequency combs and supercontinuum systems), as well as optical parametric oscillators and amplifiers.

The diagnostics include autocorrelators, VIS and IR spectrometers, cross-correlators, SPIDER. Additional components like pulse pickers, pulse compressors, Faraday isolators and rotators, THz generators, attenuators and harmonic generators are also available.

We also develop customized systems based on requirements. Our optomechanics division produces a broad range of optomechanical products like adjustable mirror mounts, translation stages, rotation stages, motorized components.
LASER COMPONENTS Ltd., RUSSIA
1B/9 Varshavskoe Rd.
117105, Moscow, Russia
Phone/Fax: +7 495 845 12 10
E-mail: sales@lasercomponents.ru
www.lasercomponents.ru

Laser Components LLC is a big Russian supplier of optics, laser, navigation, thermal imaging, measuring, vacuum and semiconductor equipment, as well as a wide range of highly reliable electronic components and ready-made solutions for building complex security systems from leading manufacturers in China.

The company is constantly increasing the range and volume of supplies, providing organizations and enterprises in critical sectors of the economy, incl. carrying out state defense orders, with modern and reliable instruments and components, analogues that successfully replace Western products. All products are characterized by high reliability, impeccable quality, safety and ease of operation and are provided with warranty and service. Laser Components LLC has a quality management system certificate according to GOST ISO 9001-2001 (ISO 9001:2008), as well as GOST RV 0015-002-2012.

Among our clients are more than 50 organizations that are part of the Rosatom and Rostec state corporations, more than 10 organizations of the rocket and space industry, as well as about 30 research institutes.

HANGZHOU YONG HEE PHOTONICS Co., Ltd., CHINA
No.39, Xiang Yuan Road, Gong Shu District, Hangzhou, China. P.C.310011
Phone: +8 613 968 08 68 93
E-mail: sales@lphotonics.com
www.lphotonics.com

Hangzhou Yong Hee Photonics Co., Ltd. was established in 2001, the company is located in the beautiful city of Hangzhou. We have been committed to the development and manufacture of laser crystals, laser cavity parts, laser modules, optical lenses, infrared crystals, nonlinear crystals and Q-switches parts, electro/acoustic-optical crystals; meantime actively provide users with value-added services such as product design, customization, maintenance, coating services etc.

We have gone through 22 years and have an excellent entrepreneurial team and advanced production lines. We are widely involved in industrial laser systems, medical and cosmetic laser systems, optical communications, scientific research and military industry. Efficiency comes from diligence, tirelessness, continuous pursuit of science and technology, for domestic and foreign high-tech manufacturing enterprises and R&D colleges to provide first-class products and services.
PHOTONIC TECHNOLOGY SYSTEMS LLC, RUSSIA
8 Stroitelnaya str.
430030, Saransk, Republic of Mordovia, Russia
Phone: +7 964 853 00 05
E-mail: info@phts.ru
www.phts.ru

The research and production company PhotonTechSystem LLC was founded by a group of scientists in 2017. We manufacture educational photonics kits, laser beam visualizers, optical table, laminar flow box, laser safety systems and other high-tech products. Our goal is to integrate the results of scientific and educational activities in the field of photonics and business. PhotonTechSystem are based on the spirit of partnership, continuous development and high quality.

AZIMUTH PHOTONICS, RUSSIA
Saint Petersburg office:
7A Rentgena str.,
197101, St. Petersburg, Russia
Phone:+7 812 407 10 47
Moscow office:
10-1, Shabolovka str.,
119049, Moscow, Russia
Phone: 8 800 551 20 97
Fax: 8 800 551 20 97
E-mail: info@azimp.ru
www.azimp.ru

AZIMUTH PHOTONICS specializes in the distribution and promotion of leading international manufacturers optoelectronic components on the Russian market. Our company is actively involved in the development new projects with OEMs and research organizations. Our aim is introduction of state-of-the-art technologies and innovative solutions in the field of optoelectronics into production to encourage development and support projects of Russian OEM companies.

We supply optoelectronic components such as X-ray modules, photodiodes, photomultiplier tubes, detectors, CCD/CMOS, IR arrays, IR emitters, scintillation materials, laser diodes and laser modules, DPSS lasers.
SLS PRIME TECHNOLOGY, BELARUS
110 off. 3A Tolbuhina str.,
220012, Minsk, Republic of Belarus
Phone: +375 740 740 95 55
E-mail: sales@sls-prime.com
www.sls-prime.com

SLS Prime Technology is a manufacturer of lasers & laser systems for solving scientific and industrial tasks of any complexity.
The company’s main specialization is development and production of pulsed solid-state lasers that generate laser radiation with specified characteristics in various spectral ranges from UV to IR.

We offer solutions in the following product lines:
- DPSS Lasers
- Flash Lamp Lasers
- OPOs & Tunable Laser Systems
- Custom Laser Systems

SPECIAL SYSTEMS. PHOTONICS LLC, RUSSIA
64, B. Sampsonievskiy pr.,
194044, St. Petersburg, Russia
Phone: +7 812 385 58 24
E-mail: info@sphotonics.ru
www.sphotonics.ru

Special Systems. Photonics, LLC, specializes in the distribution of photonics solutions for various applications. Our team consists of professionals and rests primarily on engineering support in the implementation of products from leading world manufacturers.

We are dedicated to develop long-term and mutually beneficial partnerships with Russian and CIS customers. We have own test lab and service center with various equipment and components, so we are ready to provide technical support in the following areas:
- Pulsed lasers: nanosecond, picosecond, femtosecond;
- Laser diode stacks and pumping modules;
- Single-frequency fiber lasers, DPSS and diode lasers;
- Laser components and polarization optics;
- Spatial light modulators SLM (LCOS, DMD);
- RF and optical measurement equipment;
- Quantum technology;
- Technology station for fiber optic;
- Integrated photonics;
- High-precision positioners and stages;
- Optomechanics and optical tables;
- Educational kits.
State Scientific and Production Association of Optics, Optoelectronics and Laser Technology has been created by National Academy of Sciences of Belarus in 2011. SSPA “Optics, Optoelectronics and Laser Technology” includes such well-known organizations as B.I. Stepanov Institute of Physics of National Academy of Sciences of Belarus, Center of LED and Optoelectronic Technologies of National Academy of Sciences of Belarus, Centre of Geophysical Monitoring of National Academy of Sciences of Belarus etc. Main research and development activity of the SSPA “Optics, Optoelectronics and Laser Technology” belongs to the fields of laser physics, nonlinear optics and laser spectroscopy, microwave photonics, photoelectronics, robotic systems and sensors. Own mechanical and optical departments enable manufacturing of lasers and optics with required characteristics in the shortest time periods. One of the main directions is development and manufacturing of compact eye-safe pulsed erbium glass lasers, powerful diode-pumped Nd:YAG lasers, and optical parametric oscillators for wide temperature range.
SOLAR LS, BELARUS
4 Stebenev lane
220024, Minsk, Belarus
Phone: +375 17 347 95 90
E-mail: info@solarls.eu
www.solar-laser.com

SOLAR LS CJSC is one of the major companies in Belarus in the field of development and production of laser systems and spectral instruments for scientific, industrial and medical applications. SOLAR LS product line includes:
- nanosecond and sub nanosecond lamp and diode pumped lasers with harmonic generators;
- lasers with a kHz repetition rate with harmonic generators in visible, UV and IR spectral regions;
- diode pumped picosecond and femtosecond lasers with harmonic generators;
- tunable nanosecond laser systems with a tuning range 200nm - 20μm;
- modular spectrofluorometers for measuring stationary fluorescence;
- high-precision wavelength meters in the range of 190 nm-1.7 μm;
- spectrometers, monochromators, spectrographs, including customized products;
- powerful Xe light sources, tunable in the range of 250 nm-2.5 μm;
- medical aesthetic devices based on Nd:YAG, Alexandrite and CO2 lasers.

FEMTOVISION LLC, RUSSIA
44/1 Krasnobogatyrskaya str.,
Moscow, Russia
Phone: +7 495 280 12 91
E-mail:enquiries@femtovision.ru
https://en.femtovision.ru/

Femtovision, LLC is a manufacturer of innovative femtosecond laser equipment, unique pumping system and educational equipment for universities. Our solid-state titanium doped sapphire laser “TiS-Quantum” can generate pulses shorter than 30 femtoseconds at 100 MHz repetition rate. We have developed and patented multi-diode laser modules and used them to build the first Russian Ti:sapphire femtosecond laser employing multi-diode pump. Pumping femtosecond laser with our diode modules greatly reduces costs and power consumption of the system and makes it easier to run. The products we design are going to be more mobile, smaller in size and several times cheaper than similar lasers available today.
Cryotrade Engineering was founded in 2008 in Moscow. The company has two different directions of the business – production of cryogenic equipment and sales of photonics and cryogenics equipment from foreign manufacturers. The company has been operating in the Russian market for more than 10 years. During this time, we delivered hundreds of items of imported equipment and several more than a hundred systems of our own production. Production is based in Moscow on an area of more than 700 m².

We offer comprehensive confocal microscopes for different applications, any possible optics and optomechanics, analytical equipment, optical tables, DPSS and fiber lasers, Raman spectrometers, photon counting systems, etc.

SC «LLS», RUSSIA
off. 401,16 Birzhevaya line
Technopark of ITMO University
199034, St. Petersburg, Russia
Phone: +7 812 507 81 00
E-mail: info@lenlasers.ru
www.lenlasers.ru

SC «LLS» the largest Optics and Photonics distributor in Russia. Resident of ITMO University Technopark, member of the Laser Association. Headquarter is located in St. Petersburg. Branch offices are located in Moscow, Novosibirsk and Vladivostok.

LLS offers a wide range of fiber-optic and laser components, including:
- Optics and optomechanics;
- Test and measurement equipment;
- Laser systems and jets;
- Fiber-optic components;
- Optical fibers;
- RF photonics;
- Quantum technologies;
- Telecommunication systems;
- High-power lasers for material processing.

The company has its own research and engineering laboratory and production site, which covers the following areas:
- Laser repair and service;
- Demonstration and testing of equipment;
- Equipment and components for fiber laser systems assembly and testing;
- Measurement of fiber-optic components characteristics and laser radiation parameters.
ETM PHOTONICS LLC, RUSSIA
Saint Petersburg office:
off. 300, 7A Rentgena str.
197101, St. Petersburg, Russia
Phone: +7 812 670 44 19
Moscow office:
off. 121, 8, 2nd Roshchinsky dr.
115419, Moscow, Russia
Phone: +7 495 789 49 78
E-mail: info@etm-p.ru
www.etm-p.ru

ETM Photonics, LLC supplies equipment for scientific research in the fields of photonics, laser physics and quantum optics. Founded in 2021 in St. Petersburg, with a branch in Moscow. All company employees have higher technical education or specialized education related to direct job responsibilities.

Since 2021, the company has been a member of the Lomonosov Moscow State University Quantum Technology Center. We directly work with manufacturers and independently carry out customs clearance of imported products, which ensures fulfillment of warranty obligations and high-speed delivery at reasonable prices. At the same time, the company is constantly working to find new manufacturers of high-quality products, create new logistics chains and additional hubs in the most important regions for supplies, and establish financial and business relationships that allow us to maintain stability and uninterrupted supply of complex scientific equipment.

LASERS AND OPTICAL SYSTEMS, RUSSIA
199053, P.O. Box 606, Saint Petersburg, Russia
Phone/Fax: +7 812 323 19 08
E-mail: los_spb@mail.ru
www.los.su

«Lasers & Optical Systems» Co. Ltd. is an industrial company producing solid state lasers and systems. We combine science and industrial experience to meet consumer demand and to innovate cutting-edge technologies into commercial products. We produce diode pumped solid state lasers, eye-safe lasers, environmental lidars and laser systems for various applications. We have been in the market for over 25 years and our brand is well-recognized both in Russia and abroad. LOS participates in the ITER Project in the European Fusion Programme.
BUREAU OF ACOUSTIC DEVELOPMENTS AND INNOVATIONS OF NIZHNY NOVGOROD LTD.,
RUSSIA
27, 28a Lenin av.,
603140, Nizhny Novgorod, Russia
Phone: +7 904 399 79 16
E-mail: bari-nn@yandex.ru
www.photoacoustics.ru

BARI-NN Ltd. offers custom-made piezo-polymer ultrasonic detectors for optoacoustic imaging. Our antennas have a record reception bandwidth from 100 kHz to 100 MHz and a receiving sensitivity of about 1 μV/Pa, making them ideal for biomedical applications. The acoustic impedance of PVDF antennas is close to the acoustic impedance of water and biological tissue, making them practically sound-transparent and not introducing impedance distortions into the measured acoustic fields.

We offer complete freedom in terms of geometric characteristics of your ultrasonic detector, with options including flat, cylindrical, conical, spherical, with frequencies from 100 kHz to 100 MHz, with the number of elements from 1 to 512, and with apertures from 0.5 mm to 10 cm. For ordering single element antennas, we recommend using the product code PVDF-Thickness-Focal distance-Aperture-Diameter-Length.

FEDAL, RUSSIA
346780, Azov, Russia
Phone: +7 812 326 07 48
E-mail: office@fedal.com
https://Fedal.com

FEDAL develops and produces laser electronics and accessories. FEDAL was founded in 2002. Working hard these years our specialists have got unique experience, that allows us to solve a wide range of technical tasks.
Our product line includes:
Laser diode drivers (power supplies) – CW, QCW or CW/QCW modes for lamp-, diode-pumping lasers;
Charging modules;
Multichannel systems;
Accessories (low-power electronics for laser systems).

We are developers, manufacturers, integrators. We supply our products all over the world. And we are always open to cooperation.
**T8, RUSSIA**
44/1, Krasnobogatyrskaya str.
107076, Moscow, Russia
Phone: +7 499 271 61 61
E-mail: info@t8.ru
https://t8.ru

T8 is the leading Russian vendor of wavelength-division Multiplexing telecommunication equipment (DWDM). Headquartered in Moscow, the company is one of a few companies in the world, designing and manufacturing a line equipment with channel rate up to 800 Gbit/s. T8 also specializes in the development:

- 10 mW sub-kHz linewidth single frequency laser in butterfly-type package
- Narrowband external cavity laser. Russian laser with an instantaneous linewidth of less than 2 kHz.

T8 offers integrated solutions for building DWDM systems for metro or long-haul core networks, data-center interconnections and other carrier-grade high capacity bandwidth networks including the infrastructure of 5G networks.

For many years T8 is listed among Russian high-tech innovative leaders, provides expertise to clients in network optimization and analytics for most efficient use or scalability of network resources.

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**POLARUS LLC, RUSSIA**
2B Promyshlennaya str.
108840, Troitsk, Moscow
Phone: +7 499 271 71 75 (ex. 1118), +7 916 849 34 94
E-mail: info@polaruslaser.ru
www.polaruslaser.ru

Polarus LLC is the developer and manufacturer of picosecond fiber lasers. We offer picosecond lasers with an average power of 5 to 50 W at a wavelength of 1030/1064 nm. The key feature of lasers manufactured by Polarus is a narrow optical spectrum of the output radiation. Our lasers can be used for cold ablation micromachining of various materials. We can design a laboratory micromachining laser system based on our lasers for your unique needs.

The product line of Polarus also includes a picosecond master laser and a set of electronic control units named “Laser Control System”, which can be used for high-power pulsed lasers and research purposes.

Laser Control System is designed to control a laser and power electronic components of medium and low output power pulsed lasers, in particular to control pump laser diodes and a master laser diode source (SEED), as well as to synchronize and stabilize temperatures of laser component.
AUTHOR INDEX
AUTHOR INDEX

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A.Yu.

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**21ST INTERNATIONAL CONFERENCE LASER OPTICS**

| I | GENERAL INFORMATION |
| III | PROGRAM AT A GLANCE |

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1 ICLO 2024 PLENARY SESSION

### TUESDAY, JULY 2

#### TECHNICAL SESSION

2 R02: HIGH POWER LASERS: SOLID STATE, GAS AND HYBRID
4 R04: LASER BEAM CONTROL
6 R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES
8 R06: LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY
9 R07: FREE ELECTRON LASERS
10 R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS
11 R10: NONLINEAR QUANTUM PHOTONICS
13 R11: LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION AND GLOBAL NAVIGATION

**POSTER SESSION**

15 R07: FREE ELECTRON LASERS
15 R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

### WEDNESDAY, JULY 3

#### TECHNICAL SESSION

22 R01: SOLID-STATE LASERS
23 R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS
25 R04: LASER BEAM CONTROL
27 R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS
30 R09: OPTICAL NANOMATERIALS
31 R10: NONLINEAR QUANTUM PHOTONICS
32 POSTDEADLINE SESSION

**POSTER SESSION**

37 R02: HIGH POWER LASERS: SOLID STATE, GAS AND HYBRID
40 R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES
42 R06: LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY
47 R11: LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION

### THURSDAY, JULY 4

#### TECHNICAL SESSION

49 R01: SOLID-STATE LASERS
51 R02: HIGH POWER LASERS: SOLID STATE, GAS AND HYBRID
53 R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES
55 R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS
58 R09: OPTICAL NANOMATERIALS

**POSTER SESSION**

60 R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS
64 R04: LASER BEAM CONTROL
66 R09: OPTICAL NANOMATERIALS
# 8th International A. M. Prokhorov Symposium on Biophotonics

## MONDAY, JULY 1

| 75 | PLENARY SESSION |

## TUESDAY, JULY 2

### TECHNICAL SESSION

| 76 | SYA: ADVANCED LASER MEDICAL SYSTEMS & TECHNOLOGIES |
| 78 | SYB: LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY |
| 80 | SYC: PHOTONICS AND NANOBIOENGINEERING |

### POSTER SESSION

| 82 | SYA: ADVANCED LASER MEDICAL SYSTEMS & TECHNOLOGIES |
| 82 | SYB: LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY |

## WEDNESDAY, JULY 3

### TECHNICAL SESSION

| 84 | SYB: LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY |
| 85 | SYC: PHOTONICS AND NANOBIOENGINEERING |
| 87 | SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE |

### POSTER SESSION

| 90 | SYC: PHOTONICS AND NANOBIOENGINEERING |

## THURSDAY, JULY 4

### TECHNICAL SESSION

| 93 | SYB: LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY |
| 94 | SYC: PHOTONICS AND NANOBIOENGINEERING |
| 96 | SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE |

### POSTER SESSION

| 99 | SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE |

## FRIDAY, JULY 5

### TECHNICAL SESSION

| 101 | SYB: LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY |

## EXHIBITION “LASERS AND PHOTONICS”

### TUESDAY, JULY 2 - THURSDAY, JULY 4

| 103 | EXHIBITION WORKSHOP |
| 104 | EXHIBITION |

| 114 | AUTHOR INDEX |