

SESSION PMB

September 28, 14:30-16:30, Big Hall

Plenary Session II

Session Chair: **TBA**

PMB1 • 14:30-15:10 •

Metamaterials in optical spectral region: technologies, properties and perspectives of application, V.N. Belyi, B.I. Stepanov
Institute of Physics, Belarus.

The past ten years have seen the emergence of metamaterials in optical spectral region characterized by extraordinary properties. Their ability to manipulate parameters of light radiation in new ways has led to many novel applications. Examples include super resolution imaging, negative refraction, optical cloaking, enhance nonlinear interaction and others.

The state of affairs have been analyzed in theory of propagation and transformation of light fields (amplitude, polarization, directivity) in optical metamaterials having different structures and technologies of fabrication and possessing the potential for broadband manipulation of the density of photonic states and subwavelength confinement. A special attention is devoted to the appearance of a number of novel effects in optical metamaterials with extreme parameters (particularly, in metamaterials with close to zero dielectric permittivity (ENZ-materials)): tunneling through super narrow channel, formation of narrowband light beams, amplifying of optical nonlinearities. Also there have been analyzed the properties of a new class of metamaterials with extremely high optical anisotropy, which are perspective, for example, for creation of plasmonic, deep subwavelength bulk waveguides.

There have been investigated the peculiarities of excitation and properties of new types of plasmon-polaritons, so called Bessel, single and multiplasmons possessing the property of quasinondiffraction. Particularly, singular radiative plasmon-polariton in ENZ optical materials has been predicted.

On the basis of the fabricated hyperbolic metamaterials there have been proposed and realized new configurations of flat lenses (so called superlenses) of near and far field in a spectral region from ultraviolet up to infrared radiation. The developed superlenses of near field provide spatial resolution below the diffraction limit and allow achieving high local amplification of intensity (for example, at the wavelength of $\lambda = 365$ nm the resolution is $\lambda/5$ and the amplification is 30). There has been determined and proved experimentally the light focusing criterion, namely, the presence of negative curvature of flat lens phase characteristic. For the first time it has been established that for the incident on a superlens light filed with radial polarization the regime of focusing is realized and with the azimuthal polarization – regime of channeling, i.e. the formation of narrow nondivergent light beam. New ways have been proposed of application of near-field lens for formation of two-scale light field, for resonance-amplified nanolithography and so on.

The methods are discussed of fabrication and investigation of new types of optical metamaterials based on the use of i) nanoporous dielectric matrices with pores filled with metal; ii) nanosized metal-dielectric structures, iii) self-assembled and oriented metal nanoparticles. A special attention is devoted to fish-net metamaterials possessing optical magnetism and having two- and three-dimension structures with centimeter sizes. There are presented the results of the investigation of metamaterials obtained using the mentioned above technologies. New methods are developed and devices are created for characterization of optical properties of metamaterials.

It seems probable that over the next years optical metamaterials will continue to yield many fundamental results with potential for practical application.

PMB2 • 15:10-15:50 • plenary

On some problems of laser interferometers for the direct detection of gravitational waves, V. Pustovoit, *Scientific and Technological Ctr. of Unique Instrumentation*.

PMB3 • 15:50-16:30 • plenary

Lasers in modern refractive surgery, S. Vartapetov, *Prokhorov General Physics Institute, Russia*.

Motivated and driven by numerous applications and long-standing challenges in strong-field physics, molecular spectroscopy, semiconductor electronics, and standoff detection, ultrafast optical science is rapidly expanding toward longer wavelengths. Recent experiments reveal unique properties of filaments induced by ultrashort laser pulses in the mid-infrared, where the generation of

powerful supercontinuum radiation is accompanied by unusual scenarios of optical harmonic generation, giving rise to remarkably broad radiation spectra, stretching from the visible to the mid-infrared. Generation of few- and even single-cycle mid-infrared field waveforms with peak powers ranging from a few megawatts to hundreds of gigawatts has been demonstrated within a broad range of central wavelengths. Below-the-bandgap high-order harmonics generated by ultrashort mid-infrared laser pulses are shown to be ideally suited to probe the nonlinearities of electron bands, enabling an all-optical mapping of the electron band structure in bulk solids. This lecture will provide an overview of exciting new physics behind the recent achievements in this rapidly growing area of ultrafast optical science.

LAT-2016 Program Topics

1. Laser Systems and Materials

R&D of new type of solid-state lasers; applications of SSL; new active, passive and nonlinear materials of SSL; laser systems for Inertial Confinement Fusion (ICF); high-power gas and solid-state lasers; high-efficient diode pumping systems for high-power lasers; experimental methods for laser plasma diagnostics; fiber lasers and amplifiers; new materials and structures of optical fibers.

Chairs: Eugeny Dianov (Fiber Optics Research Center, Russia); Igor Bufetov (Prokhorov General Physics Inst., Russia); Nikolay Kuleshov (Belarusian National Technical University, Belarus); Irina Sorokina (Norwegian University of Science and Technology (NTNU), Norway)

SESSION LMB

September 26, 11:00-13:00, Hall 5

Laser System and Materials I (LAT-01/1)

Session Chair: **Nikolay Kuleshov**, *Belarusian National Technical University, Belarus.*

LMB1 • 11:00-11:45 • keynote

Recent developments in visible rare-earth-doped lasers, C. Kränkel, *Universität Hamburg, Institut für Laser-Physik, Germany.*

I will report on visible semiconductor-laser pumped Tb³⁺- and Pr³⁺-doped lasers. Routinely watt-level output powers at >50% efficiency are obtained at different visible wavelengths and a wide tuning range is covered in wavelength tuning experiments.

LMB2 • 11:45-12:15 • invited

Novel Red Europium Lasers Based on Monoclinic Double Tungstates, P. Loiko, V. Dashkevich, A. Pavlyuk, *Center for Optical Materials and Technologies, Belarusian National Technical University, Belarus.*

We report on recent progress in the development of red europium lasers (~702 nm, 5D₀ → 7F₄ transition) based on monoclinic double tungstates Eu³⁺:KRE(WO₄)₂ where RE = Gd, Y or Lu and operating at room-temperature.

LMB3 • 12:15-12:30 • oral

Ponderomotor Forces Impact on Properties of UV Solid-State Laser, V.V. Semashko, O.R. Akhtyamov, A.S. Nizamutdinov, M.A. Marisov, E. Sarantopoulou and A.C. Cefalas, *Kazan Federal University, Russia.*

Incident pumping laser radiation initiates diffusion of molecules and impurities particles adsorbed on surface of solid-state active media (SSAM) into the bulk and leads to laser properties degradation. In contrast, transmitted through the SSAM laser beam cleans the exit aperture.

LMB4 • 12:30-12:45 • oral

Excited - state absorption spectra of Pr³⁺ ions doped into LiY_{1-x}LuxF₄ mixed crystals, V. G. Gorieva, S. L. Korableva, V. V. Semashko, *Kazan Federal University, Russia.*

the UV/visible polarized excited – state absorption (ESA) spectra from the 1D₂ and 3P_j manifolds of 4f²-configuration of Pr³⁺ ions doped into LiY_{1-x}LuxF₄:Pr³⁺ mixed crystals were studied at room temperature. These data are necessary to estimate an efficiency of stepwise excitation of 4f⁵d-states of Pr³⁺ ions in these crystals

LMB5 • 12:45-13:00 • oral

High-power solid state lasers and spectral instruments in a variety of applications, I. Kalitukho, A. Protasenyia, *JSC SolarLS, Belarus.*

Presentation of modern laser systems and spectral equipment intended for a wide choice of different applications such as: LIBS, new materials spectroscopy, photovoltaics, plasma physics, raman spectroscopy, fluorometry, LIDAR.

SESSION LMD

September 26, 16:30-18:30, Hall 5

Laser System and Materials II (LAT-01/2)

Session Chair: **Igor Bufetov**, *Fiber Optics Research Center of RAS, Russia.*

LMD1 • 16:30-17:00 • invited

Mid-Infrared Femtosecond Solid-state and Fiber Laser Systems for Real-world Applications, N. Tolstik, E. Sorokin, I.T. Sorokina, *NTNU Norwegian University of Science and Technology, Norway.*

Recent progress in mid-infrared femtosecond solid-state and fiber lasers is reported. Last achievements include multi-watt output power, tens of nJ pulse energy, 20 MHz to 1 GHz repetition rate, and 30 to 200 fs pulse durations.

LMD2 • 17:00-17:30 • invited

A sub-picosecond Ho laser and its application as a driver for mid-IR parametric amplification, P. Malevich, T. Kanai, S. S. Kangaparambil, H. Hoogland, R. Holzwarth, A. Pugžlys, A. Baltuška, *Photonics Institute of Vienna University of Technology, Austria.*

We present a hybrid KTA / ZGP mid-infrared optical parametric amplifier, driven by a sub-ps multi-millijoule kilohertz 2.09- μm Ho:YAG chirped pulse amplifier.

LMD3 • 17:30-17:45 • oral

Pulsed Diode-Pumped Picosecond Lasers with the Dynamical Operation Control, N.G. Mikheev, V.B. Morozov, A.N. Olenin, I.V. Tulin, D.I. Ustinov, D.V. Yakovlev, *International Laser Centre & Faculty of Physics, Lomonosov Moscow State University, Russia.*

Pulsed-diode-pumped high-peak-power picosecond Nd:YAG and Nd:YLF lasers have been developed. The schemes operate at repetition rate up to 400 Hz and provide output radiation with single picosecond pulse energy up to 3 mJ. Theoretical modeling adequately describing evolution of time pulse profile is presented.

LMD4 • 17:45-18:00 • oral

Broadband Mid-Infrared Gas Laser Systems, A.A. Kotkov, O.V. Budilova, A.A. Ionin, I.O. Kinyaevskiy, Yu.M. Klimachev, A.Yu. Kozlov, P.N. Lebedev *Physical Institute of RAS, Russian Federation.*

Mid-infrared laser systems consisting of CO and CO₂ lasers with solid-state frequency converter were developed. The laser systems can emit within broadband wavelength range from 2.5 to 16.6 microns (2.7 octave).

LMD5 • 18:00-18:15 • oral

Long-Wavelength Carbon Monoxide Laser on the Highest Vibrational Transitions, A.A. Kotkov, O.V. Budilova, A.A. Ionin, I.O. Kinyaevskiy, Yu.M. Klimachev and A.Yu. Kozlov, *P.N. Lebedev Physical Institute of RAS, Russia.*

Carbon monoxide laser emitting on the highest ever observed vibrational transition 39 \Rightarrow 38 with wavelength up to 8.7 micron was for the first time launched. Influence of gas mixture content on CO laser spectrum is discussed.

LMD6 • 18:15-18:30 • oral

Silicon Based Modulator for Optical Control of Wide Band Terahertz Radiation, G.V. Sinitsyn, A.V. Lyakhnovich, V.L. Malevich, B.I. Stepanov *Institute of Physics of NASB, Belarus.*

We present optically controlled wide band terahertz modulator based on frustrated total internal reflection effect induced by electron-hole plasma optically excited at the surface of high resistivity silicon lens. The modulator is experimentally tested and high modulation efficiency is demonstrated.

SESSION LTuC

September 27, 09:00-11:00, Hall 5

Laser System and Materials III (LAT-01/3)

Session Chair: **Maxim Doroshenko**, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

LTuC1 • 09:00-09:30 • invited

Negative curvature hollow-core optical fibers for lasers, I.A. Bufetov, A.V. Gladyshev, A.F. Kosolapov, A.D. Pryamikov, *Fiber Optics Research Center of RAS, Russia.*

Various types of hollow-core microstructured optical fibers are reviewed with emphasis on fibers with negative curvature of the core-cladding boundary. Hydrogen Raman lasers based on three different types of such fibers (revolver fibers) are demonstrated.

LTuC2 • 09:30-10:00 • invited

High-Power Diode Pumped Raman Fiber Lasers Operating Below 1 Micron, E. A. Zlobina, S. I. Kablukov, S. A. Babin, *Institute of Automation and Electrometry SB RAS, Novosibirsk State University, Russia.*

A brief review of recent results on LD-pumped Raman fiber lasers (RFLs) is presented. Multimode graded-index fiber directly pumped by a 915-nm LD generates ~10W low-index transverse modes at 954 nm with slope efficiency >50%.

LTuC3 • 10:00-10:15 • oral

Two-dimensional temperature and power image over the growth zone of sapphire (Al₂O₃) single crystal fibers, G.A. Bufetova, S.Ya. Rusanov, V.F. Seregin, Yu.N. Pyrkov, V.B. Tsvetkov, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

Two-dimensional temperature and power image of sapphire single crystal molten zone being grown under CO₂-laser heating is determined from thermal radiation spectra measurements in the 1000-1300 nm spectral range.

LTuC4 • 10:15-10:30 • oral

Mid-Infrared segmented nano grains extruded fibers based on metal halides crystals and their applications, L.N. Butvina, A.L. Butvina, *Fiber Optics Research Center of RAS, Russia*.

Fundamentally low loss (0,05 dB/m) mid-infrared (3-15 μm) micro- and nano-structured segmented, Dy+3doped, extruded fibers, based on multi component metal (Ag, K, Na) halides (Cl, Br, I) crystals, and their optical, mechanical properties and applications will be discussed.

LTuC5 • 10:30-10:45 • oral

Investigation of Optical Structure Based on Double Cladding Fiber with Overlays, O.V. Ivanov, F. Yang, F. Tian, H. Du, *Ulyanovsk Branch of Kotelnikov Institute of Radio Engineering and Electronics of RAS, Russia*.

We investigate a fiber-optic structure based on a fiber section having a depressed inner cladding and thin overlay. We measure transmission spectra of the structure upon changes in the external refractive index and overlays thickness.

LTuC6 • 10:45-11:00 • oral

Photobleaching in Bi-Doped Germanosilicate Fibers at Different Laser Irradiation Wavelengths, S.V. Firstov, S.V. Alyshev, E.G. Firstova, M.A. Melkumov, A.M. Hegay, V.F. Khopin, A.N. Guryanov, E.M. Dianov, *Fiber Optics Research Center of RAS, Russia*.

Photobleaching in bismuth-doped high-germania silica-based optical fibers at 300 and 77 K was studied under various wavelengths and powers of laser irradiation. The valuable information regarding the nature of Bi-related active centers has been obtained.

SESSION LTuF

September 27, 11:30-13:00, Hall 5

Laser System and Materials IV (LAT-01/4)

Session Chair: **Christian Kränkel**, *Universität Hamburg / Institut für Laser-Physik, Germany*.

LTuF1 • 11:30-12:00 • invited

Spectroscopy and Highly Efficient Lasing in Tm-doped Waveguides, M. Pollnau, K. van Dalzen, P. Loiko, *Prof., Professor*.

This paper reviews our recent work on the spectroscopy, optical gain, and lasing in Tm-doped waveguides in amorphous aluminum oxide and monoclinic potassium double tungstates. Particularly, the influence of the well-known cross-relaxation process is quantified.

LTuF2 • 12:00-12:15 • oral

Random lasing of white light in mixture of ZnCdSSe powders, M. S. Leanenia, E. V. Lutsenko, E. V. Muravitskaya, D. I. Babuskin, A. Y. Alyamani, L. M. Alanazi, G. P. Yablonskii, *B.I. Stepanov Institute of Physics of NASB, Belarus*.

Random lasing of white light was achieved in a system of closely packed ZnCdSSe crystallites. Lasing simultaneously at 460 nm, 520 nm, 580 nm and 660 nm with threshold of 0.8 MW/cm² is due to an appearance of random feedback for amplified radiation in every system of active scattering crystallites forming in sum the white light emission spectrum

LTuF3 • 12:15-12:30 • oral

Wave processes in four-layered planar structure with nonlinear anisotropic-gradient media in case of falling of an optical beam with nongaussian complex structure., I.P. Rudenok, A.I. Kireeva, A.P. Pozdnyakov, *Volgograd State Technical University, Southern Federal District*.

The wave processes in structures with inner nonlinear anisotropic-gradient medium in the case of falling of optical non-Gaussian beams were investigated. We received and solved a non-linear wave equation to the cross-sectional components.

LTuF4 • 12:30-12:45 • oral

Scattering by Polymer-Dispersed Liquid Crystal Films, V. A. Loiko, V. Ya. Zyryanov, A. A. Miskevich, A. V. Konkolovich, *B.I. Stepanov Institute of Physics of NASB, Belarus*.

Scattering and transmittance of films containing liquid crystal droplets with homogeneous and inhomogeneous adhesion on the interface polymer-liquid crystal is investigated by the anomalous diffraction and interference approximations. Point asymmetry in angular pattern is discussed.

LTuF5 • 12:45-13:00 • oral

Time-Resolved Spectroscopy of Light-induced Refraction in Laser Materials: the Latest Results, E.V. Ivakin, I.G. Kisialiou, G.E. Malashkevich, O.L. Antipov, V.N. Sigaev, *B.I. Stepanov Institute of Physics of NASB, Belarus*.

The results of our investigation of new laser materials by the transient grating method are given. Some parameters of the materials affecting the generating properties of lasers are determined via kinetic and amplitude characteristics of the diffraction signals recorded.

SESSION LTuH

September 27, 14:30-16:30, Hall 5

Laser System and Materials V (LAT-01/5)

Session Chair: **Sergey Babin**, *Institute of Automation and Electrometry SB RAS, Novosibirsk State University, Russia*.

LTuH1 • 14:30-15:00 • invited

Yb-Doped Crystals For Ultrafast Lasers And Chirped-Pulse Regenerative Amplifiers, V. Kisel, A. Rudenkov, N. Kuleshov, *Center for Optical Materials and Technologies, Belarusian National Technical University, Belarus*.

The results of comparative study of Yb³⁺ doped KY(WO₄)₂ (KG(WO₄)₂), YVO₄, CaYAlO₄, LuAlO₃ laser crystals as a gain media for femtosecond lasers and chirped-pulse regenerative amplifiers will be presented during the report

LTuH2 • 15:00-15:15 • oral

Lasing on huntite-like glass activated with Yb³⁺ ions, G. E. Malashkevich, V. V. Kouhar, E. V. Pestryakov, M. A. Merzliakov, V. N. Sigaev, N. V. Golubev, M. Z. Ziyatdinova, *B.I. Stepanov Institute of Physics of NASB, Belarus*.

The lasing effect in glasses of the composition (mol. %) 2Yb₂O₃-8Y₂O₃-30Al₂O₃-60B₂O₃ has been demonstrated for the first time. The threshold of generation in weakly selective hemispherical resonator under laser diode pumping achieves about 1.5 W.

LTuH3 • 15:15-15:30 • oral

Upconversion Luminescence Of CsScF₄ Crystals Doped With Erbium And Ytterbium, D.A. Ikonnikov, V.N. Voronov, M.S. Molokeyev, A.S. Aleksandrovsky, *Siberian Federal University, Krasnoyarskiy kray*.

Bright visible upconversion luminescence with three bands of comparable intensity was observed in Er:CsScF₄ and Er/Yb:CsScF₄ crystals. Er/Yb occupying central inversion Sc sites under 970-980 nm pumping. Power and wavelength dependences' peculiarities are explained.

LTuH4 • 15:30-15:45 • oral

High-Efficiency Lasing and Optical Properties of Transparent Nd:YAG and Ho:YAG Ceramics, S.M. Vatnik, I.A. Vedin, V.V. Osipov, K.E. Luk'yashin, R.N. Maksimov, V.I. Solomonov, Yu.L. Kopylov, I.Sh. Steinberg, P.E. Tverdokhlebov, A.A. Pavlyuk., *Institute of Laser Physics SB RAS, Russia*.

We report on high-efficiency lasing and optical properties of YAG ceramics synthesized at IREE (Fryazino) and IEP (Ekaterinburg). The best slope efficiency is to be 36% for 1%Nd:YAG ceramics and ~ 40% for 1%Ho:YAG ceramics.

LTuH5 • 15:45-16:00 • oral

The Development of Amplification Channels of High-Intensity Laser System with 1 kHz Repetition Rate, G.V. Kuptsov, V.V. Petrov, V.A. Petrov, A.V. Kirpichnikov, A.V. Laptev and E.V. Pestryakov, *Institute of Laser Physics SB RAS, Russia*.

The calculation of parametric amplification unit based on nonlinear borate crystals for high-intensity femtosecond laser system has been done. A gain profile with a ~20% dip near the center is proposed to optimize the amplified signal spectral shape. An all diode-pumped multipass laser amplifier was optimized to improve both short-term and long-term angular stabilities, allowing one to use the output radiation as a pump for parametric amplifier mentioned above.

LTuH6 • 16:00-16:15 • oral

Perspectives of creating powerful solid-state optical amplifiers based on a Ce³⁺:LiCaAlF₆ crystal, A.I. Galiev, V.V. Semashko, O.R. Akhlyamov, M. A. Marisov, A. S. Nizamutdinov, A.A. Shavelev, *Kazan Federal University, Russia*.

Pump-induced photodynamic processes in Ce³⁺:LiCaAlF₆ (Ce:LiCAF) UV active media were studied by pump-probe technique. The modelling of a multipass optical amplifier testify the opportunity to design high-power UV laser system based on Ce:LiCAF media.

LTuH7 • 16:15-16:30 • oral

Thermally Induced Beam Distortions in CaF₂ and Other Elastically Anisotropic Crystals with Cubic Symmetry, A. G. Vyatkin and E. A. Khazanov, *Institute of Applied Physics of RAS, Russia*.

Thermally induced beam distortions in long rods and thin disks made of cubic single crystals with anisotropic elastic properties were calculated analytically and numerically. The expressions for birefringence and arithmetic mean phase have been generalized.

SESSION LTuJ

September 27, 17:00-18:30, Hall 5

Laser System and Materials VI (LAT-01/6)

Session Chair: **Nikolai Tolstik**, *NTNU Norwegian University of Science and Technology, Norway*.

LTuJ1 • 17:00-17:30 • invited

New trends in ultrafast diode-pumped solid-state lasers, T. Südmeyer, *Laboratoire Temps-Fréquence, Université de Neuchâtel, Neuchâtel*.

We review latest developments in ultrafast DPSSLs, discussing topics such as power scaling, frequency comb stabilization and direct green diode pumping of femtosecond Ti:Sapphire lasers.

LTuJ2 • 17:30-17:45 • oral

Er,Yb:GdAl₃(BO₃)₄ Laser Passively Q-Switched by MBE-grown Cr:ZnS/Cr,Co:ZnS Thin Films, K.N. Gorbachenya, V.E. Kisel, A.S. Yasukevich, N. Tolstik, E. Karhu, V. Furtula, E. Sorokin, V.V. Maltsev, N.I. Leonyuk, U. Gibson, I.T. Sorokina, N.V. Kuleshov, *Center for Optical Materials and Technologies, Belarusian National Technical University, Belarus*.

MBE-grown Cr:ZnS/Co,Cr:ZnS thin films were used for passive Q-switching of a diode-pumped Er,Yb:GdAl₃(BO₃)₄ laser at 1522 nm. Laser pulses with 10.7 μJ energy and 6 ns duration at 31 kHz repetition rate were obtained.

LTuJ3 • 17:45-18:00 • oral

LD-pumped 4 mJ passive Q-switched Yb,Er:glass laser with improved spatial, temporal and spectral properties, M.V. Bogdanovich, A.V. Grigor'ev, V.A. Dlugunovich, A.V. Isaevich, A.V. Holenkov, K.V. Lepchenkov, K.I. Lantsov, A.G. Ryabtsev, G.I. Ryabtsev, M.A. Shchemelev, U.S. Tsitovets, *B.I. Stepanov Institute of Physics of NASB, Belarus*.

Energy, spatial, spectral and temporal properties of ultra compact 4 mJ Yb,Er:glass laser developed on the base of improved unorthodox optical scheme has been measured using certified equipment in the ISO/IEC 17025 accredited laboratory.

LTuJ4 • 18:00-18:15 • oral

The Distortions of Laser Pulse Profile Caused by Multi-Pass Amplification, O.L. Vadimova, I.B. Mukhin, O.V. Palashov, *Institute of Applied Physics of the RAS, Russian Federation*.

The comparison of laser pulse amplification in long rod and multi-pass disk elements was carried out. It was demonstrated that using of multi-pass amplifiers allows reducing temporal profile distortion

LTuJ5 • 18:15-18:30 • oral

Laser-Induced Ignition of a Cryogenic Rocket Engine, R. Stützer, M. Büorner, M. Oschwald, *DLR - German Aerospace Center Institute of Space Propulsion, Germany*.

Using a pulsed Nd:YAG laser system and a research combustor, cryogenic rocket propellants have been ignited. The ignition spark and the subsequent combustion were analyzed. Optical measurements on well-defined gas mixtures served as calibration method for equivalent ratio determination.

SESSION LWB

September 28, 09:00-11:00, Hall 5

Laser System and Materials (LAT-01/7)

Session Chair: **Thomas Südmeyer**, *Laboratoire Temps-Fréquence, Université de Neuchâtel, Neuchâtel*.

LWB1 • 09:00-09:30 • invited

Spectroscopic and laser properties of Fe²⁺ doped Cd_{1-x}MnxTe crystals at low temperature., M.E. Doroshenko, V.V. Osiko, H. Jelinkova, M. Jelinek, N.O. Kovalenko, A.S. Gerasimenko, A.M. Prokhorov General Physics Institute, RAS, Russia.

Spectroscopic and laser properties of Fe²⁺ doped Cd_{1-x}MnxTe solid solutions in a wide range of Mn concentration x were investigated. First to our best knowledge lasing of Fe²⁺ ions in CdMnTe crystals at 77 K was demonstrated.

LWB2 • 09:30-09:45 • oral

Single crystal ZnSe:Fe²⁺ infrared luminescence with electron beam excitation, A.A. Gladilin, V.P. Kalinushkin, N.N. Ilichev, V.P. Danilov, V.A. Chapnin, E.S. Gulyamova, P.P. Pashinin, A.V. Sidorin, M.V. Chukichev, R.R. Rezvanov, I.N. Odin, A.M. Prokhorov General Physics Institute, RAS, Russia.

Cathodoluminescent spectral-kinetics parameters of monocrystal ZnSe:Fe²⁺ were studied. The present results correspond to optically excited IR-luminescent spectrum and kinetic of Fe²⁺ in ZnSe crystal. The findings offer the challenge of developing hot electrons excited Fe²⁺:ZnSe-laser.

LWB3 • 09:45-10:00 • oral

Terbium Aluminum Garnet Ceramics with Different Dopants for Faraday Isolators for High-power Radiation, A. Starobor, O. Palashov, Institute of Applied Physics RAS, Russia.

Thermooptical and magneto-optical properties of terbium aluminum garnet ceramics doped with titanium, silicon and cerium were studied. They are more than 1.5-times better at maximum radiation power than TGG ceramics as medium for Faraday isolators.

LWB4 • 10:00-10:15 • oral

Efficient IR, UV and VUV lasers pumped by run-away electron preionized discharge, A.N. Panchenko, N.A. Panchenko, D.A. Sorokin, M.I. Lomaev, A.I. Suslov, Institute of High Current Electronics SB RAS, Russia.

New technique of gas laser excitation based on run-away electron preionized diffuse discharges (REP DD) was suggested and realized. Efficient lasing in the IR, UV and VUV spectral ranges under REP DD pumping was demonstrated

LWB5 • 10:15-10:30 • oral

Amplification Gain Spectrum Control in Anisotropic Neodymium Doped Laser Crystals, G.V. Shilova, P.G. Zverev, A.A. Sirotkin, A.M. Prokhorov General Physics Institute, RAS, Russia.

The polarization dependencies of Nd³⁺ ions fluorescence bands in YLiF₄, YAlO₃, SrWO₄, YVO₄ and mixed Y_{0.3}Gd_{0.7}VO₄ anisotropic crystals at 1040-1080 nm were investigated. The crystals orientation for simultaneous dual wavelength oscillation was proposed.

LWB6 • 10:30-10:45 • oral

The shear lift force acting on microparticles actuated by magneto-optical tweezers, M.N. Romodina, N. M. Shchelkunov, E. V. Lyubin, A.A. Fedyanin, Lomonosov Moscow State University, Russia.

The shear lift force on a microparticle manipulated and actuated by magneto-optical tweezers is studied. The force is explained in terms of thermophoretic forces acting on microparticle due to non-uniform distribution of liquid's temperature.

LWB7 • 10:45-11:00 • oral

Optical manipulation of RBC in laser tweezers, S.H. Abdulrazak, Y.V. Rozhdestvensky, ITMO University, Russia.

We present in this article calculations of forces applying to RBC trapped in optical tweezers. To do so we used Fresnel equations only and ray optics to find values of forces effecting biological object.

SESSION LTuK

September 27, 18:30-20:00,

Laser System and Materials (LAT-01)

LTuK1

Influence of impurities on heat-mass transfer during laser cladding of metal powders, M.D. Khomenko, F.Kh. Mirzade, A.V. Dubrov, Institute on Laser and Information Technologies - Branch of the Federal Scientific Research Center "Crystallography and Photonics" of RAS, Moscow Region. Self-consistent model of heat-mass transfer is developed for numerical investigation of laser cladding with coaxial powder injection. The effect of impurity concentration on surface tension, material thermal properties and

buoyancy force is shown. 3D distributions of macroscopic fields are numerically investigated and verified for different process parameters and cladded materials.

LTuK2

The Matrix Effect on the Generation of Neodymium Laser with Quasi-Three-Level Scheme, V. Herasimenka, R. Navitskaya, I. Stashkevich, *Belarussian State University, Belarus*. The generation characteristics of a neodymium laser with a quasi-three-level scheme have been considered in the case of the most extensively used crystalline matrices. The threshold pump powers and the generation efficiencies have been compared. It has been shown that the emission and absorption cross-sections are critical for the generation efficiency.

LTuK3

Color Centers Transient Absorption and Ultra-short Pulse Lasing from LiLu_{0.7}Y_{0.3}F₄:Ce³⁺ Active Medium, I. I. Farukhshin, A. S. Nizamutdinov, V. V. Semashko, S. L. Korableva, M. A. Marisov, *Kazan Federal University, Russia, Tatarstan republic*. We have obtained the single pulse laser oscillation with 400 ps at 311 nm from LiLu_{0.7}Y_{0.3}F₄:Ce³⁺ crystal. Short pulse was obtained from intracavity loss modulation via pump-induced color centers bleaching. Modulation of intracavity losses is regulated via color centers concentrations.

LTuK4

Fold reduction in the lasers flash lamp discharge threshold at high frequency pumped, A.M. Valshin, S.M. Pershin, G.M. Mikheev, *A.M. Prokhorov General Physics Institute, RAS, Russia*. Abstract. Experimentally studied the processes controlling the parameters of the gas-discharge plasma in the standard cylindrical lasers flash lamp by varying the frequency of the supply voltage. It is shown that when the frequency is changed from 20 kHz to 3 MHz the fold reduction by factor of 5 in the discharge threshold is achieved.

LTuK5

Luminescence and stimulated emission in the heavily doped AlGa_{1-x}N:Si structures by optical pumping, I. V. Osinnykh, T. V. Malin, V.F. Plyusnin, K. S. Zhuravlev, P. A. Bokhan, Dm. E. Zakrevsky, N.V. Fateev, *Rzhanov Institute of Semiconductor Physics, SB RAS, Russia*. The intensive defect-related band in photoluminescence spectra of heavily doped Al_xGa_{1-x}N:Si layers grown by molecular beam epitaxy covering the whole visible and near-infrared region of the spectrum shifts from 600 nm to 405 nm with the increase of Al content from 0.47 to 1. The gain of the active medium was about 14.5 cm⁻¹.

LTuK6

Tunable Diode-Pumped Dye Laser, O.A. Burdukova, M.V. Gorbunkov, V.A. Petukhov, V.A. Povedailo, M.A. Semenov, *B.I. Stepanov Institute of Physics of NASB, Belarus*. We developed a tunable dye laser with astigmatism-compensated 3-mirror cavity pumped by semiconductor diode lasers. The widest obtained tunability was approximately 90 nm with pyrones family dye. The highest slope efficiency obtained was 18% in non-selective resonator with laser dye C540A.

LTuK7

Measurement Method of Thermo-Optical Characteristics of Cubic Crystals Using Samples of Arbitrary Orientation, E.A. Mironov, A.V. Vyatkin, O.V. Palashov, *Institute of Applied Physics of the RAS, Russia*. A method for measuring thermo-optical characteristics of cubic crystals having arbitrary orientation has been developed. Unlike the traditional techniques, it does not demand samples of specified orientation. It greatly expands the scope of method applications.

LTuK8

Spectroscopic Characterization of Er³⁺:K₂YF₅: a Novel Potential Laser Crystal, E. Vilejshikova, P. Loiko, N. Khaidukov, M. Brekhovskikh, X. Mateos, M. Aguiló, K. Yumashev, *Center for Optical Materials and Technologies, Belarussian National Technical University, Belarus*. Spectroscopic properties of Er³⁺ ions in K₂YF₅ crystals relevant for their applications in "eye-safe" lasers are studied. The Judd-Ofelt parameters for Er³⁺:K₂YF₅ are $\Omega_2 = 1.216$, $\Omega_4 = 0.647$ and $\Omega_6 = 0.459 \times 10^{-20}$ cm² and the radiative lifetimes of the 4I_{13/2} and 4I_{11/2} states are 14.9 ms and 17.4 ms, respectively. The absorption, stimulated-emission and gain cross-sections, as well as non-radiative relaxation rates are determined. The maximum σ_{SE} is 0.72×10^{-20} cm² at 1531 nm.

LTuK9

A femtosecond laser based on variable-cut YVO₄:Nd³⁺-YVO₄ crystal, A.A. Sirotkin, *A.M. Prokhorov General Physics Institute, RAS, Russia*. The method of optimizing the parameters of the luminescence spectra of crystals vanadate proposed. For the first time demonstrated the work of femtosecond laser-based on variable-cut ($\theta = 25^\circ$, $\varphi = 0$) YVO₄-Nd³⁺: YVO₄- crystal with passive mode locking in the SESAM. The minimum pulse duration of 780 fs reached.

LTuK10

Semiconductor laser diode into asymmetrical V-shaped cavity with spectrally- and phase- nonselective feedback mirror., V.V. Svetikov, V.I. Pustovoy, *A.M. Prokhorov General Physics Institute, RAS, Russia*. The broad area laser diode lasing into external asymmetrical V-shaped cavity with non spectral- and non phase-selective feedback mirror has been experimental investigated. The detection of phase synchronization ability of filaments was the main goal of experiments.

LTuK11

Phase field approach to solidification including stress effects at laser sintering of metal powders, F.Kh. Mirzade, *Institute on Laser and Information Technologies - Branch of the Federal Scientific Research Center "Crystallography and Photonics" of*

RAS, Russia. The influence of stresses on solidification microstructures during laser sintering of ultrafine powders is considered using a phase field approach. Coupling equations among phase, temperature, concentration and stress are derived based on thermodynamic laws. A linear stability analysis of solidification front is carried out, to find dispersion relations and a spectrum of wave numbers of unstable perturbations. It is shown that the strain field generated during microstructure evolution is important factor that affects the instability mode.

LTuK12

Effect of preferential solubility of a commercial LC mixture on the electro-optical properties of Polymer dispersed liquid crystal films, A. Bouriche, L. Alachaher-Bedjaoui, A.V. Konkolovich, A.A. Miskevich, V.A. Loiko, U. Maschke, *B.I. Stepanov Institute of Physics of NASB, Belarus*. The eutectic nematic Liquid Crystal (LC) mixture E7 presents preferential solubility effects towards Poly(2-ethylhexylacrylate), thus leading to composition changes of LC confined in phase separated domains, evidenced by several experimental techniques.

LTuK13

Improvement of output characteristics of yellow-green Cd(Zn)Se/ZnSe lasers using reflective and anti-reflective optical coatings, A. Alyamani, A.G. Vainilovich, V.N. Pavlovskii, E.V. Lutsenko, G.P. Yablonskii, S.V. Gronin, S.V. Sorokin, I.V. Sedova and S.V. Ivanov, *B.I. Stepanov Institute of Physics of NASB, Belarus*. Highly reflective and anti-reflective optical coatings were deposited on the working facets of the optically pumped green-emitting II-VI heterostructure laser. A blind mirror was formed on the one cleaved facet of the crystal by deposition of SiO₂/ZrO₂ DBR coating, while single Al₂O₃ layer AR coating was deposited on its top surface. As a result, the laser showed nearly two-fold reduction in the lasing threshold pumping power and an increase of the differential efficiency. These results are an important milestone to high efficiency microchip laser converters emitting in the green-yellow spectral range.

LTuK14

Raman Spectra of Double Crystals of Ca₁₀Me(VO₄)₇ (Me = Li, K, Na), S.V. Voitkov, I.A. Khodasevich, V.A. Orlovich, M.B. Kosmyna, A.N. Shekhovtsov, *A.M. Prokhorov General Physics Institute, RAS, Belarus*. The nonpolarized Raman spectra of double calcium orthovanadates Ca₁₀M(VO₄)₇ (M = Li, K, Na) crystals in the Raman shifts range of 150-1600 cm⁻¹ have been measured for the first time and decomposed into Voigt profiles

LTuK15

Influence of Diamond Nanoparticles on the electro-optical properties of Polymer Dispersed Liquid Crystal films, C. Beyens, F. Dubois, Z. Boubberka, M. Elouali, O. Yaroshchuk, A.V. Konkolovich, A.A. Miskevich, V.A. Loiko, U. Maschke, *B.I. Stepanov Institute of Physics of NASB, Belarus*. Small amounts of diamond nanoparticles lead to a strong decrease of the optical transmittance of Polymer Dispersed Liquid Crystal films under an applied electrical field, due to the formation of micron-sized aggregates.

LTuK16

The active medium of lasers based on inclusion complexes Phenalemine 160 α - and γ -cyclodextrins, S. Anufriuk, H. Sazonko, V. Tarkovsky, M. Asimov, *Yanka Kupala State University of Grodno, Belarus*. Abstract: Spectral-luminescent and generation properties of dye fenalemine 160 (FN160) in inclusion complexes with α - and γ - cyclodextrin were investigated. It is established that the inclusion complex with α -CD is more effective than γ -CD, despite the smaller size of an internal cavity of a cyclodextrin. Efficiency of generation of a fenalemin 160 with increase in a share of water in solution decreases, thus the increase in concentration of a cyclodextrin in the same solution leads to increase of energy of generation.

LTuK17

Spectroscopic study of oriented Tm:SSO crystal, Yu.D. Zavartsev, A.I. Zagumennyi, Yu.L. Kalachev, S.A. Kutovoi, V.A. Mikhailov, I.A. Scherbakov, *A.M. Prokhorov General Physics Institute, RAS, RUSSIA*. Six absorption bands of Tm:SSO crystal were analyzed on the basis of decomposition of each band to a number of Lorentz peaks. This analysis was applied to all possible combinations of crystal axis orientations and light polarization. The result is performed as a table of peak parameters: (wavelength, height, width).

LTuK18

The acousto-optically Q-switched Tm:Ho:YbAG laser pumped at 1678 nm, Yu.D. Zavartsev, A.I. Zagumennyi, Yu.L. Kalachev, S.A. Kutovoi, V.A. Mikhailov, I.A. Scherbakov, *A.M. Prokhorov General Physics Institute, RAS, Russia*. Lasing of the acousto-optically Q-switched Tm:Ho:YbAG laser was realized. Laser demonstrated a good slope ~ 30% and total 11% efficiencies and output power up to 80 mW at pulse repetition rate of 50 kHz. It was found a great influence of upconversion effects on laser efficiency

LTuK19

Optical and electro-optical characterization of electronbeam- and UV-cured polymer/liquid crystal systems, M. Bouchakour, Y. Derouiche, Z. Boubberka, F. Dubois, C. Beyens, L. Mechernène, F. Riahi, A.V. Konkolovich, A. A. Miskevich, V.A. Loiko, Ulrich Maschke, *B.I. Stepanov Institute of Physics of NASB, Belarus*. This work is focused on the relationship between the polymerization method, such as UV radiation and high voltage accelerated electron beams, and the physical properties, including morphologies and electro-optic responses, of polymer/liquid crystal systems.

LTuK20

Structural Parameters of Defects in the Interface of GaN/AlN Superlattices, Y.V. Lebiadok, T.V. Bezyazychnaya, K.S.

Zhuravlev, *SSPA "Optics, Optoelectronics & Laser Technology", Belarus*. The influence of point defects (nitrogen and aluminium vacancies) on characteristics of the heterointerface of GaN/AlN superlattices is discussed. The geometry of the defects obtained using the quantum chemistry calculation is compared with experimental one.

LTuK21

Transverse Mode Locking of Stimulated Raman Scattering in Diode End-Pumped Nd:YVO₄/Cr⁴⁺:YAG Laser, V.V. Bezotosnyia, M.V. Gorbyncov, V.I. Dashkevich, A.L. Koromyslov, V.A. Orlovich, Yu.M. Popov, V.G. Tunkin, E.A. Cheshev, R.V. Chulkov, *P.N. Lebedev Physical Institute of RAS, Russia*. Transverse mode locking of the Stokes component stimulated Raman scattering self-conversion by a pulse diodes end-pumped Nd:YVO₄/Cr:YAG laser is implemented for the first time under conditions of frequency degeneracy of cavity modes.

LTuK22

Laser excitation of ultrasound modes of nonlinear-optical crystals for optical absorption measurement, A. A. Molkov, A. V. Konyashkin, O. A. Ryabushkin, *Moscow Institute of Physics and Technology, Russia*. Novel method for measuring low optical absorption coefficients of crystals and glasses is introduced. It is based on measuring crystal equivalent temperature by registration of its temperature dependent acoustic resonances directly excited by laser radiation.

LTuK23

The module of laser illumination based on the powerful AlGaAs/GaAs laser diode matrix, D.V. Shabrov, V.V. Kabanov, Y.V. Lebiadok, *B.I. Stepanov Institute of Physics of NASB, Belarus*. The present paper is aimed to development of the powerful illumination module of short laser pulses with high repetition rate, the given direction characteristic and the stabilized radiation parameters.

LTuK24

Cryogenic Plasma Chemistry of Slab RF Discharge CO Laser Active Medium, A.A. Ionin, A.Yu. Kozlov, L.V. Seleznev, D.V. Sinitsyn, *P.N. Lebedev Physical Institute of the Russian Academy of Sciences, Russia*. The features of lasing in a sealed-off RF discharge CO laser with cryogenic cooling are discussed. Influence of addition of oxygen into active medium on the long-time stability of laser generation is analyzed. Phenomenological description of combination of electric plasma-chemical, gas dynamic and diffusion processes determining the behavior of the laser output characteristics over the entire operating cycle is presented.

LTuK25

Numerical investigation of multichannel laser beam phase locking in turbulent atmosphere, V.A. Volkov, M.V. Volkov, S.G. Garanin, F.A. Starikov, *Russian Federal Nuclear Center, All-Russian Research Institute for experimental physics, Russia*. The efficiency of coherent multichannel beam combining under focusing through a turbulent medium on a target in the cases of phase conjugation and target irradiation in the feedback loop is investigated numerically in various approximations. The conditions of efficient focusing of multichannel radiation on the target are found. It is shown that the coherent beam combining with target irradiation in the feedback loop, which does not require a reference beam and wavefront measurements, is as good as the phase conjugation approach in the efficiency of focusing. It is found that the main effect of focusing is provided by properly chosen phase shifts in the channels, whereas taking into account local wavefront tip tilts weakly affects the result.

LTuK26

Application of PLD to Obtain Solid Lubricant Coatings Containing Spherical Metal Nanoparticles, D.V. Fominski, R.I. Romanov, V.Yu. Fominski, A.G. Gnedovets, *National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia*. Pulsed laser deposition was used to obtain nanocomposite MoSe₂/Mo coatings (Mo nanoparticles in MoSe₂ matrix) with excellent tribological properties (friction coefficient 0.02–0.04). Concentration of nanoparticles was varied by changing the conditions of plume expansion.

LTuK27

Superluminescent diode seeding of parametric amplifier at picosecond pumping, K.A. Vereshchagin, S.N. Il'chenko, V.B. Morozov, A.N. Olenin, V.G. Tunkin, D.V. Yakovlev, S.D. Yakubovich, *International Laser Centre & Faculty of Physics, Lomonosov Moscow State University, Russia*. Broadband picosecond pulses are produced by dual-cascade parametric amplifiers based on BBO crystals seeded by cw superluminescent diodes with bandwidth ≈ 300 cm⁻¹, central wavelength 790 nm and high spatial coherence and pumped by second harmonic of Nd:YAG laser pulses of 20 ps pulse width.

LTuK28

Bessel Light Beam of the Second Order Formation with Uniaxial Crystal, I. V. Balykin, A. A. Ryzhevich, A. G. Mashchenko, V. E. Leparskii, N. A. Khilo, *B.I. Stepanov Institute of Physics of NASB, Belarus*. We investigate the effective method for shaping the Bessel light beam of the second order from the initial Gaussian beam using a uniaxial crystal. We propose optimal configuration of optical scheme for the method.

LTuK29

Theoretical Description of DFB Dye Lasing by Polarization Modulation, D.V. Novitsky, V.M. Katarkevich, T.Sh. Efendiev, *B.I. Stepanov Institute of Physics of NASB, Belarus*. We propose two approaches to theoretical description of DFB dye lasing by polarization modulation: the ones based on modified rate equations and on density matrix equations respectively. Results of numerical calculations are presented as well.

LTuK30

New efficient laser dyes for the red region. Periindenones, S.P. Belov, O.A. Burdukova, I.V. Komlev, V.A. Petukhov, V.A. Povedailo, M.A. Semenov, *B.I.Stepanov Institute of Physics of NASB, Belarus*. Lasing characteristics of 9 new dyes in ethanol were measured in the selective and broadband resonators. These dyes belong to periindenones including benzantrones and phenalemines. We measured the tuning curves and established the areas of wavelength tuning. Investigated dyes are lasing in the orange and red regions of the spectrum. Some substances are superior to commonly used laser dyes for energy efficiency and the tuning range width.

LTuK31

Phase locking of seven-channel continuous wave fiber laser system by using stochastic parallel gradient algorithm, M.V. Volkov, S.G. Garanin, U.V. Dolgoplov, A.V. Kopalkin, S.M. Kulikov, D.N. Sinyavin, F.A. Starikov, S.A. Sukharev, S.V. Tutin, S.V. Khohlov, D.A. Chaparin., *RFNC – VNIIEF, Russia*. The work is devoted to phase locking of seven-channel continuous wave fiber laser system based master oscillator+multichannel power amplifier scheme by stochastic parallel gradient (SPG) algorithm. The dynamic phase locking of laser system has been demonstrated at the system bandwidth 14 kHz, the time of phasing was 3-4 ms.

LTuK32

High-Efficiency Laser Based on 4.5%Tm:KLu(WO₄)₂ Octagon Rod, S.M. Vatnik, I.A. Vedin, P.F. Kurbatov, A.A. Pavlyuk, *Institute of Laser Physics SB RAS, Russia*. A diode-pumped laser based on Tm:KLu(WO₄)₂ octagon rod is realized. The maximum slope efficiency of 47% with respect to the absorbed pump power obtained with 4.5at.%Tm:KLu(WO₄)₂ corresponds to a maximum output power as high as 6 W at 1952 nm in CW operation.

LTuK33

Application of X-ray radiation for manufacturing of BBO optical samples with greater efficiency., I.I. Kalashnikova, V.S. Naumov, G.Yu. Orlova, *R&D Institute Polyus, Russia*. It was proposed the method of manufacturing of BBO optical samples with greater conversion efficiency by applying X-ray radiation

LTuK34

Application of laser to control the surface roughness based on nanoparticles luminescence effect., V.A. Bazylenko, L.V. Shaposhnikov, *Lomonosov Moscow State University, Russia*. Method for controlling the surface roughness involves probing the surface with laser radiation and recording photoluminescence intensity using photosensitive devices. The rough surface is covered with a layer of nanoparticles. The detected information feature used is characteristic photoluminescence of these particles, induced by the probing laser radiation. Roughness of the surface is controlled by changing the nature of photoluminescence intensity when the angle between the axis of the probing radiation and the normal to the rough surface is changed.

LTuK35

A way to control the authenticity of products based on reflected laser second harmonic generation., V.A. Bazylenko, L.V. Shaposhnikov, *Lomonosov Moscow State University, Russia*. The developed method makes it possible to detect secretly inflicted the security label using up a reflected laser's "giant" second harmonic and to judge the authenticity of a security under its presence or absence.

LTuK36

Connection between YVO₄ slope efficiency and reticular density of various crystallographic planes, I.I. Kalashnikova, V.S. Naumov, G.Yu. Orlova, A.A. Sirotkin, *R&D Institute Polyus, Russia*. We have received that the slope efficiency of Nd:YxR1-xVO₄ (R=Gd, Sc) crystals is depended on crystallographic orientation of active element. We have supposed that it was the connection between YVO₄ slope efficiency and reticular density of various crystallographic planes.

LTuK37

Semianalytical Method to Describe Small-Angle Scattering of Light by Monolayer of Polydisperse Nematic Droplets, A.V. Konkolovich, M.N. Krakhalev, A.A. Miskevich, O.O. Prishchepa, V.Y. Zyryanov, V.A. Loiko, *B.I.Stepanov Institute of Physics of NASB, Belarus*. The approach to describe light scattering by a monolayer of nematic droplets which takes into account shape, anisotropy, director configuration, size distribution, orientation of droplets is worked out and compared with the experimental data.

LTuK38

Simulation of Coherent Transmittance and Reflectance of Ordered Sequences of Particulate Monolayers with Imperfect Lattices, A.A. Miskevich, V.A. Loiko, A.M. Prokhorov *General Physics Institute, RAS, Belarus*. The coherent transmittance and reflectance of periodic, Fibonacci, and Thue-Morse sequences of ordered monolayers of spherical particles are simulated. It is shown that two last sequences provide more possibilities to control light than periodic one.

LTuK39

HIGH RESOLUTION SPECTROSCOPY OF Ho³⁺ ION IN THE MATRIX OF LiYF₄ CRYSTAL, PLACED IN EXTERNAL MAGNETIC FIELD, M.N. Popova, K.N. Boldyrev, *Institute of Spectroscopy, RAS, Russia*. We report on the first high-resolution optical spectroscopy study of LiYF₄:Ho in an external magnetic field. Peculiarities in the hyperfine structure of holmium spectral lines are discussed for the cases H||c and H⊥c (H = 0.53 and 0.87 T). The spectra reveal a strong interaction between crystal-field levels, mediated by Zeeman and hyperfine terms in the Hamiltonian.

LTuK40

Light-induced periodic structures and their characteristics in crystals $\text{CaF}_2\text{-LuF}_3$, activated by Ce^{3+} and Yb^{3+} ions, N. F. Rakhimov, A. S. Nizamutdinov, V. V. Semashko, M. A. Marisov, S. A. Shnaidman, *Kazan Federal University, Russian Federation*. Here we discuss the opportunity of using Ce-doped fluorite-type crystals as basis for amplitude photonic crystals with modulation of color centers absorption due to complex picture of the dynamic processes occurring in this medium under UV pump. The results of time resolved absorption saturation studies and key parameters of dynamic processes evaluation are presented. Also discuss the results of experiments of creating periodic inhomogeneities of the absorption coefficient of color centers and the gain in mixed crystals with the fluorite structure $\text{CaF}_2\text{-LuF}_3$, doped Ce^{3+} and Yb^{3+} .

LTuK41

Spectroscopic Properties of UV Active Media $\text{Ce}^{3+}:\text{LiCa}_{1-x}\text{Sr}_x\text{AlF}_6$, A. A. Shavelev, A. S. Nizamutdinov, V. V. Semashko, M. A. Marisov, *Kazan Federal University, Russian Federation*. Optical absorption spectroscopy studies have shown that mixed crystals $\text{Ce}^{3+}:\text{LiCa}_{0.2}\text{Sr}_{0.8}\text{AlF}_6$ grown by Bridgeman technique exhibit more than 3 times higher absorption coefficient compared to $\text{Ce}^{3+}:\text{LiCaAlF}_6$ sample. An important result is based on the fact that this enhancement was achieved for two types of Ce^{3+} centers in a multisite $\text{Ce}:\text{LiSr}_{0.8}\text{Ca}_{0.2}\text{AlF}_6$ system.

LTuK42

Photodynamic processes vs lasing in $\text{Ce,Yb:LiYXLu}_1\text{-XF}_4$ crystals, L.A. Nurtdinova, S.L. Korableva, *Kazan Federal University, Russian Federation*. Ce-doped fluoride crystals are promising active media for tunable solid-state UV lasers. Photoconductivity measurement, numerical modeling and laser test results in UV spectral range for $\text{Ce,Yb:LiYXLu}_1\text{-XF}_4$ ($x = 0..1$) crystals are presented

LTuK43

The Use of Laser Technology for Creation of Straw Type Ionizing Radiation Detectors, L.E. Batay, N.A. Bosak, A.N. Chumakov, N.A. Kuchinskiy, N.P. Kravchuk, *B.I.Stepanov Institute of Physics of NASB, Belarus*. Laser technology based on high frequency laser ablation of metal from a cathode surface can be effectively applied for manufacturing straw detectors of ionizing radiation with excellent characteristics.

LTuK44

Effect of Spectrum Condensation in a Two-Isotope Gas Laser, A. V. Gusev, T. V. Radina, *St. Petersburg State University, Russia*. Generation of a single-mode gas laser with intracavity absorbing cell is investigated. The usage of a mixture of two isotopes with a large isotopic shift as the active medium leads to a significant increase in contrast of the inverted Lamb dip.

LTuK45

Lighting and hygienic aspects of application of light emitting diode sources, V. Lapina, S. Trofimov, P. Zak, P., Pershukevich, T. Pavich, N. Trofimova, Yu. Tsaplev, *B.I.Stepanov Institute of Physics of NASB, Belarus*. In our work lighting and hygienic aspects of light emitting diodes (LED) illumination have been analyzed. There were analyzed powerful white light diodes and methods of white light formation, light-technical and light-hygienic advantages and disadvantages of light diode systems of illumination. New approaches to optimization of LED systems operation were estimated.

LTuK46

Spectroscopic investigation of $\text{Sm}^{3+}:\text{KY}(\text{WO}_4)_2$ crystal, M.P. Demesh, O.P. Dernovich, N.V. Gusakova, A.S. Yasukevich, N.V. Kuleshov, A.A. Pavlyuk, A.A. Kornienko, E.B. Dunina, *Center for Optical Materials and Technologies, Belarusian National Technical University, Belarus*. Polarized absorption and stimulated emission cross sections spectra of $\text{Sm}^{3+}:\text{KY}(\text{WO}_4)_2$ crystal have been determined. Calculations of spectroscopic parameters by the modified Judd-Ofelt method were performed.

LTuK47

Laser Beam Stabilization in the CNC Machines, Y. Fedosov, M. Afanasiev, A. Trifanov, *ITMO University, Russia*. Model and patent for laser CNC tool are analyzed. New optical stabilizing system utilizing modified Stewart platform is proposed. Mathematical model and features of controlling this system are examined. Band of allowed parameters is estimated.

LTuK48

Temperature Measurement of Laser Materials with Probe Piezoelectric Crystals, A.E. Korolkov, O.A. Ryabushkin, A.V. Konyashkin, *Moscow Institute of Physics and Technology, Moscow region*. Novel method of low optical absorption coefficient measurement is introduced. It is based on laser calorimetry and piezoelectric resonance impedance spectroscopy.

LTuK49

Energy Transfer in $\text{Tm,Ho:KY}(\text{WO}_4)_2$ Crystals with Different Doping Levels, S.V. Kurilchik, A.S. Yasukevich, N.V. Gusakova, N.V. Kuleshov, *Belarusian National Technical University/ Center for Optical Materials and Technologies, Belarus*. Energy transfer parameters for $\text{Tm,Ho:KY}(\text{WO}_4)_2$ crystal were evaluated by measuring fluorescence dynamics of Tm^{3+} and Ho^{3+} ions in the samples with different dopants concentrations and fitting by the numerical solutions of rate equations.

LTuK50

Optical Unit for Technological Equipment, M. Afanasiev, G. Romanova, Y. Fedosov, *ITMO University, Russia*. The optical unit design for transmitting power laser radiation through an optical fiber is considered. A simple construction unit with minimized reflection losses design is overviewed. The general functioning scheme and designing features are presented.

LTuK51

Methods to Optimize the Moving Trajectory During Laser Processing, Y. Fedosov, M. Afanasiev, S. Akimov, *ITMO University, Russia*. Optimization of the moving trajectory of the terminating device during laser processing of irregular shapes is considered. Terminator trajectory is represented as nodes, forming a processing trajectory. To reduce the number of auxiliary paths, a genetic algorithm is proposed.

LTuK52

Bend Sensor Based on a Section of Double-Cladding Optical Fiber and Two Wavelengths Interrogation, O. V. Ivanov, S.V. Vasin, *Ulyanovsk Branch of Kotel'nikov Institute of Radio Engineering and Electronics of RAS, Russia*. A fiber-optic bend sensor system based on a section of a double-clad fiber with depressed inner cladding interrogated with two wavelengths is investigated. The sensitivity of the sensor to the bend curvature is measured. The sensor characteristics are measured.

LTuK53

Multichannel fiber-optical sensory system for detecting weak acoustic fields, R. Romashko, M. Bezruk, S. Ermolaev, D. Storozhenko, Y. Kulchin, *Institute of Automation and Control Processes FE RAS, Russia*. Multichannel fiber-optical sensory system for detecting weak acoustic fields in solids is developed and studied. The system is based on 32-channel adaptive interferometer with dynamic holograms multiplexed in a single photorefractive crystal CdTe. Developed sensory system allows real-time reconstruction the spatial distribution of the acoustic field in solids.

LTuK54

Wide Temperature Range Diode Pumped Nd:YAG Laser Without Active Thermal Stabilization, A.E. Dormidonov, A.D. Savvin, E.S. Safronova, D.V. Shaulskii, *All-Russia Research Institute of Automatics, Russia*. Wide temperature operation range (-50 to +50 °C) of a compact passive Q-sw monolithic Nd:YAG 1.06- μ m laser was achieved by side pumping and the use of high-power diode stacks without active thermal stabilization. Output laser pulse parameters are stable in considered temperature range: energy value is 130 ± 10 mJ and pulse duration is 4.0 ± 0.5 ns (FWHM). The efficiency of optical conversion varies from 12 to 21 % depending on temperature. Pulse repetition rate can be varied from single shot up to 50 Hz.

LTuK55

Investigations of Capillary Polymer Terahertz Fibers, M.M. Nazarov, M.S. Kitai, V.I. Sokolov, K.A. Bzheumihov, Z.Ch. Margushev, A.B. Sotsky, A.V. Shilov, L.I. Sotskaya, A.M. Goncharenko, G.V. Sinitsyn, *State Institution of Higher Education "A.A. Kuleshov State University", Republic of Belarus*. The hollow-core fiber for terahertz applications formed by one hexagonal ring of polypropylene capillaries is studied both theoretically and experimentally. It is shown that the fiber has a quasi-periodic transmission spectrum and can be single mode with transmission losses less than 1dB/m.

LTuK56

Mitigation of Thermal Distortions in Longitudinally Diode Pumped Laser Rods, I.A. Gorbunov, O.V. Kulagin, N.F. Andreev, *Institute of Applied Physics RAS, Russia*. Thermal distortions and possibilities of their mitigation in diode end-pumped Nd:YAG laser amplifier are investigated both theoretically and experimentally. Ways of pump profile optimization are suggested to correct thermal aberrations. Calculation of output beam quality requires high-order aberration to be taken into account.

LTuK57

Analysis of Transmission Spectra of Double Cladding Fiber upon Etching, O.V. Ivanov, F. Tian, H. Du, *Ulyanovsk Branch of Kotel'nikov Institute of Radio Engineering and Electronics of RAS, Russia*. We analyze response of a double cladding fiber-optic structure to etching. We measure transmission spectra of the structure with decreasing thickness of the second cladding and show that the resonance dips shift to shorter wavelengths.

LTuK58

Laser irradiation diffusion in flame of burning hydrocarbons and the effectiveness of metals remote cutting, S.V. Gvozdev, A.F. Glova, V.Yu. Dubrovsky, S.T. Durmanov, A.G. Krasnyukov, A.Yu. Lysikov, G.V. Smirnov, V.M. Pleshkov, *Troitsk Institute for Innovation and Fusion Research (JSC «SSC RF TRINITY»), Russia*. This paper describes some experiments of study the possibility of using laser for remote metals cutting at the emergency oil and gas borings. Measurements a means of radiation absorption coefficient for continuous fiber laser in case of propagation through the flame of burning oil.

LTuK59

Wavelength and temperature dependences of the optical anisotropy parameter of CaF₂, BaF₂ and SrF₂ crystals, A. I. Yakovlev, I. L. Snetkov, O. V. Palashov, *Institute of Applied Physics RAS, Russia*. We obtained temperature and wavelength dependences of the material constant - optical anisotropy parameter of CaF₂, BaF₂ and SrF₂. The optimal orientation of the crystallographic axes in which depolarization vanishes was defined for each crystal.

2. Laser Remote Sensing and Tunable Diode

Laser Spectroscopy

Different laser techniques and applications for remote sensing of environmental objects and phenomena; new spectroscopic approaches for environmental applications; short laser pulse ranging; novel methods for soil and water surface characterization; laser induced plasma spectroscopy for chemical analysis of environmental objects.

Chairs: Vladislav Mikhalevich (Prokhorov General Physics Inst., Russia);
Anatoly Chaikovsky (B.I.Stepanov Insti. of Physics, Belarus)

SESSION LMA

September 26, 11:00-13:00, Hall 4

Laser Remote Sensing and Tunable Diode Laser Spectroscopy (LAT-02/1)

Session Chair: **Mikhalevich Vladislav, Pershin Sergey Mikhailovich, A.M. Prokhorov**
General Physics Institute, RAS, Russia.

LMA1 • 11:00-11:30 • invited

Characteristics of atmospheric dust and cirrus clouds derived from multiwavelength Raman lidar measurements during SHADOW campaign in Senegal., I. Veselovskii, P. Goloub, T. Podvin, D. Tanre, M. Korenskiy, Q. Hu, *Physics Instrumentation Centre by A.M. Prokhorov General Physics Institute, RAS, Moscow.*

West Africa is important locations for studying dust properties and their influence on weather and climate. In our presentation we provide the results of multiwavelength lidar measurements performed in Senegal in the frame of SHADOW campaign. The lidar observations performed in 2015-2016 allowed to accumulate significant amount of information about dust and cirrus clouds optical properties.

LMA2 • 11:30-12:00 • invited

Optical Studies of the Atmosphere and Surface in Antarctica, E. Zege, I. Katsev, M. Korol, F. Goloub, A. Ivanov, L. Blarel, S. Denisov, V. Dick, A. Malinka, F. Osipenko, T. Podvin, A. Prikhach, L. Chaikovskaya, A. Fedarenka, A. Lapyonok, V. Svidinsky, *B.I. Stepanov Institute of Physics of NASB, Belarus.*

The paper presents the techniques and results of lidar, spectral radiometric and satellite observations of atmosphere & surface properties in the Antarctic coastal zone obtained by team IP NASB (Belarus) from 2008 to 2016.

LMA3 • 12:00-12:15 • oral

Investigation of crater evolution during laser treating of materials, A.Yu. Ivanov, A.V. Kapytsky, V.I. Nedolugov, S.V. Vasil'ev, *Grodno State University, Belarus.*

Acoustic emission of a zone of the destruction formed during influence of pulse laser radiation on a surface of metal is considered. Dependence of the time form of acoustic fluctuations on parameters of an irradiated material and the law of increase in depth of a crater was estimated. It is revealed, that at action on a surface of the copper sample of a laser impulse duration ~ 20 mks time of growth of a zone of destruction makes approximately 40 mks.

LMA4 • 12:15-12:30 • oral

Multifrequency Lidar Sensing of Atmospheric Aerosol under Conditions of Information Uncertainty, S.S. Lisenko, M.M. Kugeiko, V.V. Khomich, *Belorussian State University, Belarus.*

A technique is considered for retrieving the spatial distributions of respirable fractions of aerosol in the lower atmosphere on the basis of multifrequency lidar sounding data without the use of a priori data on the optical and microphysical aerosol parameters along a sounding path.

LMA5 • 12:30-12:45 • oral

Sensitive, Time-Resolved and Broadband Measurements in Shock Tubes and Electric Discharges using Intracavity Absorption Spectroscopy with Home-Made Fiber Lasers, P. Fjodorow, M. Fikri, C. Schulz, V.M. Baev, *University of Duisburg-Essen, Institute for Combustion and Gas Dynamics - Reactive Fluids, Germany.*

Intracavity absorption spectroscopy is applied to sensitive, time-resolved and broadband measurements of (i) gain and absorption in xenon plasma, and (ii) simultaneous determination of temperature, partial pressure of C₂H₂ and total pressure of shock-heated C₂H₂/Ar-mixture.

LMA6 • 12:45-13:00 • oral

Laser-Induced Gratings in Probing Ionic Liquids, D.N. Kozlov, J. Kiefer, T. Seeger, A.P. Fröba, A. Leipertz, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

The four-wave mixing technique based on probe light diffraction by laser-induced gratings has been applied to simultaneous measurement of speed of sound, thermal diffusivity, and bulk viscosity of a number of 1-ethyl-3-methylimidazolium-based ionic liquids.

SESSION LMC

September 26, 16:30-18:30, Hall 4

Laser Remote Sensing and Tunable Diode Laser Spectroscopy (LAT-02/2)

Session Chair: **Alexei Malinka**, *B.I. Stepanov Institute of Physics of NASB, Belarus.*

LMC1 • 16:30-17:00 • invited

Remote Sensing of Arctic Fjords and freshwater reservoir by Raman Lidar, S. M. Pershin, A. F. Bunkin, M.Ya. Grishin, V.K.Klinkov, V. N. Lednev, E. G. Morozov, A.V. Marchenko, S.A. Ermakov, I.A. Kapustin⁶ and A.A. Molkov, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

The formation of an immiscible layer of relict thaw water from the glacier on the sea surface that screens of fjord water heat was discovered by lidar monitoring the Paulabreen glacier (arch. Svalbard).

LMC2 • 17:30-17:45 • oral

Temperature Dependent Line Broadening of the Liquid Water Raman Bands in Remote Sensing: Multimode Brownian Oscillator Model, R. Yu. Pishchalnikov, S. M. Pershin, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

Spectral density of the intermolecular and intramolecular degrees of freedom in the liquid state has been calculated in terms of a multimode Brownian oscillator model. Making a numerical fit of the Raman bands detected by a compact lidar, we have estimated the intensity of a coupling between nuclear degrees of freedom and the medium which gives us important information about a level of inhomogeneity of the hydrogen bonding network.

LMC3 • 17:45-18:00 • oral

Prototype Of Laser Gas Analyzer Of DIAL Technique For Track Measurements In Urban Conditions On The Basis Of Ce:LiCaAlF₆ Laser, A. S. Nizamutdinov, M. S. Zuev, V. V. Semashko, *Kazan Federal University, Russian Federation.*

A prototype of DIAL laser gas analyzer on the basis of tunable Ce:LiCaAlF₆ laser is discussed. The measured detection threshold appeared to be 2,52·10⁻⁶ g/m³ for NO₂, 0,30·10⁻⁶ g/m³ for SO₂, 0,03·10⁻⁶ g/m³ for O₃.

SESSION LTuB

September 27, 09:00-11:00, Hall 4

Laser Remote Sensing and Tunable Diode Laser Spectroscopy (LAT-02/3)

Session Chair: **Andrei Bril**, *B.I. Stepanov Institute of Physics of NASB, Belarus.*

LTuB1 • 09:00-09:45 • keynote

A new generation of super compact trouble free lidar, S. M. Pershin, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

Abstract. There are many types of lidar, but only some of them can be used for remote sensing in crowded places without eyes protection. Application gated quantum counters it possible to create a super compact eye-safe lidar (weighing less than a kg) for environmental monitoring.

LTuB2 • 09:45-10:00 • oral

Laser Induced Breakdown Spectroscopy by Picosecond Pulses Train vs Nanosecond Pulse, V.N. Lednev, S.M. Pershin, M.N. Filippov, *National University of Science and Technology MISiS, Moscow, Russia, Moscow.*

A comparison of laser ablation by picosecond pulses train and nanosecond pulse revealed a difference in laser craters, ablation thresholds, plasma sizes, spectra lines intensity as well as analytical capabilities of laser induced breakdown spectroscopy.

LTuB3 • 10:00-10:15 • oral

Temperature Measurement by Projection to Latent Structures of Fluorescence Spectra, V.A. Aseev, A.N. Babkina, M.A. Khodasevich, P.S. Shirshnev, Y.A.Varaksa, *B.I. Stepanov Institute of Physics, NAS Belarus, Belarus.*

Projection to latent structures is applied to determine the temperature using fluorescence spectra of erbium-doped lead fluoride glass ceramics and potassium-alumina-borate glasses with copper-containing molecular clusters. This method allows reducing the relative error of temperature measurement in comparison with the classical ones.

LTuB4 • 10:15-10:30 • oral

Measurements of temperature and positive gain of Oxygen-Iodine laser active media, Yu. A. Adamenkov, *RFNC-VNIIEF, Russia.*

We present results of measurements of temperature and small positive gain of supersonic chemical Oxygen-Iodine laser. We used tunable external cavity diode laser at 1315nm in our experiments.

SESSION LTuE

September 27, 11:30-13:30, Hall 4

Laser Remote Sensing and Tunable Diode Laser Spectroscopy (LAT-02/4)

Session Chair: **Mikhalevich Vladislav, Ponurovskiy Iakov Iakovlevich, A.M. Prokhorov General Physics Institute, RAS, Russia.**

LTuE1 • 11:30-12:00 • invited

The development of tunable diode laser spectroscopy in gas analysis and high resolution spectroscopy, I. Ponurovskiy, A.M. Prokhorov General Physics Institute, RAS, Russia.

The report describes the DL gas analyzers made in the A.M.Prokhorov General Physics Institute of RAS last years, also considers new methods of measurements the concentration of molecules in different buffer gases including air and estimation of isotopic composition for various molecules in the near and mid IR range.

LTuE2 • 12:00-12:15 • oral

Diode laser spectroscopy of trace gases in atmosphere with external resonator, I.V.Nikolaev, V.N.Ochkin, S.N.Tskhai, P.N. Lebedev Physical Institute RAS, Russia.

Some schemes of registration applied to diode laser spectroscopy with external optical resonator are discussed. Examples of measurements of small gas species in atmosphere are presented.

LTuE3 • 12:15-12:30 • oral

Measurement of pressure broadening coefficient of the Ar absorption line at 811.5 nm with a diode laser, A.R.Ghildina, P.A.Mikheyev, A.K.Chernyshov, N.I.Ufimtsev, V.N.Azyazov, M.C.Heaven, Samara National Research University, Russian Federation.

In this paper the new results of measurements of pressure broadening coefficient for argon 811.5 nm line by neon, using the tunable diode laser spectroscopy, are presented. The obtained value is $\xi_{Ar-Ne} = (1.1 \pm 0.2) \times 10^{-10} \text{ s}^{-1} \text{ cm}^3$.

LTuE4 • 12:30-12:45 • oral

Photoacoustic gas sensors based on tunable diode lasers, A.L. Ulasevich, A.A. Kouzmouk, B.I.Stepanov Institute of Physics of NASB, Belarus.

A new type of photoacoustic gas sensors is presented. Sensor contains near-infrared single-mode semiconductor laser and small resonant photoacoustic cell. Detection sensitivity of the sensors for absorption coefficient is 10^{-7} cm^{-1} . Volume of gas sample does not exceed 0.5 cm^3 .

SESSION LTuL

September 27, 18:30-20:30,

Poster Session: Laser Remote Sensing and Tunable Diode Laser Spectroscopy (LAT-02)

LTuL1

Reflection factors of mirrors for fiber optic sonar antenna, V.N. Sorokovikov, V.I. Pustovoy, A.M. Prokhorov General Physics Institute, RAS, Russia. In this work we obtain formulas allowing calculating the coefficients of the mirror reflection of fiber optic sensors and the separation between them in the fiber optical antenna with a time-multiplexed interferometric N sensors, as well as the calculations of the reflection coefficients of the mirrors and the energy balance for the antenna with 16 fiber optic sensors

LTuL2

Mach-Zehnder PLC sensor for measurement of refractive index changes in gas and liquid mediums, O.A. Podtelkina, V.V. Svetikov, N.A. Djuzhev, A.M. Prokhorov General Physics Institute, RAS, Russia. The results of numerical simulations of a planar lightwave circuit (PLC) sensor based on Mach-Zehnder interferometer with low contrast SiO₂ waveguides are presented. By the modeling method (BPM – Beam Propagation Method) was analyzed the sensitivity of the sensor to changes in refractive index of gas and liquid environments. The sensitivity of the sensor was analyzed for different geometries sensor windows and different polarization of the optical mode.

LTuL3

InAs/InAsSb/InAsSbP heterostructure for measurement concentration of carbon dioxide and monoxide, D.M. Kabanau, Y.V. Lebiadok, Y.P. Yakovlev, SSPA "Optics, Optoelectronics & Laser Technology", Belarus. The results of modeling of luminescence and gain spectra of InAs/InAsSb/InAsSbP heterostructure and comparison it with experimental data are discussed. The band gap energy, interband optical transition matrix element, amplified luminescence loss coefficient were obtained.

LTuL4

Application of Green Upconversion Fluorescence in Er-Doped Germanate Glass for Temperature Measurement, Y.A. Varaksa, M.A. Khodasevich, V.A. Aseev, G.V. Sinitsyn, G.E. Malashkevich, K. Akinshau, B.I. Stepanov Institute of Physics of NASB, Belarus. Temperature dependence of green upconversion fluorescence of an Er-doped germanate glass at 60-150°C is studied. The sensitivity of temperature measurement by means of fluorescence intensity ratio is shown to be comparable with other Er-doped optical materials.

LTuL5

Polarized fluorescence of carboxyfluorescein label conjugated with oligonucleotide, A. P. Blokhin, M.V. Kvach, V.A. Povedailo, V.V. Shmanai, D.L. Yakovlev, B.I. Stepanov Institute of Physics of NASB, Belarus. Rotational fluorescence depolarization of molecular systems, consist of covalently linked oligonucleotides and carboxyfluorescein, has been studied. Fluorescence anisotropy was measured for two nucleic acids depending on the temperature to the viscosity ratio in buffered solutions with different glycerol concentrations. It was shown that the experimental data can be satisfactorily explained within the diffusion model of an elongated molecular top with internal rotation. It was found that coefficients of internal rotational diffusion in all cases are 1.5 - 2 times higher than the corresponding coefficient for the rotation around the axis of the oligonucleotide.

LTuL6

Thermal quenching of luminescence of GaInAsSb and InAsSbP heterostructures, D.M. Kabanau, Y.V. Lebiadok, Y.P. Yakovlev, SSPA 'Optics, Optoelectronics & Laser Technology', Republic of Belarus. Thermal quenching of luminescence of GaInAsSb and AlGaAsSb based LEDs (1.7 – 4.3 μm) was investigated. The values of activation energy of non-radiative recombination centres for GaInAsSb structure is in the range 78-88 meV, for GaInAsSb – 14 meV.

LTuL7

Excitation of miniature photoacoustic cells by zero order Bessel beams, A.L. Ulasevich, A.A. Kouzmouk, B.I. Stepanov Institute of Physics of NASB, Belarus. The possibility is experimentally demonstrated of using zero order Bessel beams to pump miniature photoacoustic (PA) resonance cells by the example of detecting the concentration of water vapors in gaseous nitrogen. The water vapor detection threshold per unit laser PA cell pump power was attained at a level of 1.1×10^{-4} g/m³.

LTuL8

Reference Channel with the Controlled Intensity for a Remote Gas Analyzer, V.A. Gorobets, B.F. Kuntsevich, I.N. Puchkovsky, B.I. Stepanov Institute of Physics of NASB, Belarus. The new scheme of the reference channel of a remote gas analyzer has been offered and realized. Due to use of reflective elements with the low reflection factor the new scheme allows to receive full interception of laser radiation and to provide a linear operating mode of a photodetector.

LTuL9

New Approach to the Description of the Active-Pulse Vision Systems, B. F. Kuntsevich, V. P. Kabashnikov, V. A. Gorobets, B.I. Stepanov Institute of Physics of NASB, Belarus. A new approach is based on analyzing the temporal overlap of reflected laser pulse and strobe pulse in the receiver unit. The formulas to calculate the characteristic distances are obtained. The algorithms to determine distances to objects are proposed. The analytical dependences agree with the calculation results and experimental measurements.

LTuL10

Laser induced breakdown spectrometry for elemental analysis of high wear resistant coating produced by laser cladding, P.A. Sdvizhenskii, V.N. Lednev, M.Ya. Grishin, S.M. Pershin, M.N. Filippov, A.N. Fedorov, M.A. Davidov, R.S. Tretyakov, A.Ya. Staverty, National University of Science and Technology MISiS, Russia. High wear resistant coating (tungsten carbide in nickel matrix) produced by coaxial laser cladding was studied by laser induced breakdown spectrometry. Major components (W, Cr, Ni, etc.) were profiled for different layers of coating.

LTuL11

PRELIMINARY RESULTS OF MEASUREMENT OF METHANE AND CARBON DIOXIDE IN THE ARCHIPELAGO NEW EARTH AND IN MOSCOW REGION BY DIODE LASER SPECTROSCOPY FROM THE AIRCRAFT-LABORATORY YAK-42D "ROSHYDROMET", A. Kuzmichev, A. Nadezhdinskii, Ya. Ponurovskiy, D. Stavrovskii, Y. Shapovalov, V. Zaslavskii, V. Khattatov, V. Galaktionov, A.M. Prokhorov General Physics Institute, RAS, Moscow. In accordance with the monitoring program of the state of the environment program, approved by Roshydromet, in 2015-2016 held a regular monitoring of the atmosphere of the aircraft in order to study the possibility of identifying the results of the burning of associated gas flaring oil rigs located in the Khanty-Mansi Autonomous District, also in the field area Kalchinskoye oil Tyumen region and near the town of Berezniki, Perm region. In addition to the data on the distribution of the soot in the troposphere, it is necessary to obtain spatial and temporal profiles of methane and carbon dioxide for a full assessment of the extent of contamination. The report will present the results of determination of vertical profiles of methane and carbon dioxide concentrations, at wavelengths of 1.65 and 1.6 nm. The airborne laser diode spectrometer

[1]. In addition, it will be presented comparing the results of measurements of the main greenhouse gases produced by a diode laser spectrometer domestic and foreign gas analyzers are also installed on board the aircraft research laboratory. Figure 1 is a schematic view of the aircraft of the experiment:

3. Ultra-Fast Diagnostics in Laser Research

High-speed imaging & videography, CCD techniques, diagnostics and applications; pump-probe techniques; ultrafast spectroscopy, interferometry and holography; high-speed cameras, streak tubes, sensors and circuits; X-ray, visible and near IR image-tube high-speed photography; image processing, data analysis and visualization; computer modeling in charge particle imaging; application of laser-oriented high-speed instrumentation in biophysics, medicine, detonics, ballistics, impact, shock-waves investigation, flow visualization, plasma and laser fusion imaging, high-energy physics, airspace research, sport science.

Chairs: Mikhail Schelev (Prokhorov General Physics Inst., Russia); Konstantin Vereshchagin (Prokhorov General Physics Inst., Russia); Sergei Tikhomirov (B.I.Stepanov Inst. of Physics, Belarus)

SESSION LTuG
September 27, 14:30-16:30, Hall 4

Ultra-Fast Diagnostics in Laser Research (LAT-03/1)

Session Chair: **Michael Shchelev**, *A.M. Prokhorov General Physics Institute, RAS, .*

LTuG1 • 14:30-15:15 • keynote

Status of Novosibirsk Free Electron Lasers and Their Applications to Study of Fast Processes, G. Kulipanov, E. Chesnokov, Ya. Getmanov, V. Kubarev, O. Shevchenko, A. Vasiliev, N. Vinokurov., *G. I. Budker Institute of Nuclear Physics of SB RAS, Russian Federation.*

A description and parameters of free electron lasers, based of the four-track energy recovery linac, are given. The results on investigations of rapid processes are presented. The prospects of further work are discussed.

LTuG2 • 15:15-15:45 • invited

ULTRA Laser Facility Applications for Chemistry, Life Sciences and Catalysis, I.V. Sazanovich, G.M. Greetham, I.P. Clark, I. Lezcano-González, A. M. Beale, M. Delor, J. A. Weinstein, J.P. Hall, S.J. Quinn, P.I Matousek, A.W. Parker, M. Towrie, *Central Laser Facility Research Complex at Harwell STFC Rutherford Appleton Laboratory, .*

We describe ULTRA laser facility applications for chemistry, life sciences and catalysis, illustrated by vibrational control of electron transfer; photoinduced electron transfer in DNA crystals; and operando Kerr-gated Raman insight into catalytic hydrocarbon conversion with zeolites.

LTuG3 • 15:45-16:15 • invited

High-Voltage Pico- and Nanosecond Discharge Development in Gaseous and Liquid Media, N.L. Aleksandrov, E.M. Anokhin, I.N. Kosarev, A.Yu. Starikovskiy, *Moscow Institute of Physics and Technology, Russian Federation.*

Fast imaging study of high-voltage pulsed discharges in a wide density range is reviewed. Focus is on fast ionization waves, streamer and dielectric barrier discharges in gases and on pulsed discharges in liquids.

LTuG4 • 16:15-16:30 • oral

Study of Single Femtosecond Filamentation in Gas by Transverse Interferometry Method, P.A. Chizhov, V.V. Bukin, A.A. Ushakov, S.V. Garnov, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

Anisotropy of refractive index due to intense laser pulse propagation is observed. Nonlinear dependence of initial electron density in air and nitrogen on pressure is stated. Plasma decay is observed via hundreds of picoseconds.

SESSION LTuI
September 27, 17:00-18:45, Hall 4

Ultra-Fast Diagnostics in Laser Research (LAT-03/2)

Session Chair: **Oleg Meshkov**, *G. I. Budker Institute of Nuclear Physics of SB RAS, Novosibirsk National Research state university, Russia.*

LTuI1 • 17:00-17:30 • invited

Defects in Solid State Materials as a Result of Interaction with Charged Particles and High-Energy Photons and Their Applications for Radiation Detectors and Imaging on Nanometric Scale, A.P. Voitovich, R.M. Montereali, V.S. Kalinov, A.N. Novikov, L.P. Runets, A.P. Stupak, *Institute of Physics, National Academy of Sciences, Belarus.*

It is established that the peculiarities of the radiation imaging solid-state detectors can be exploited for X-ray micrograph and for observation of biological samples. It is shown that for many materials used in radiation dosimetry, nanocrystals have the larger range of linear response to dose compared with crystals of the same composition.

LTuI2 • 17:30-18:00 • invited

Electric field fast measurement in pulse discharges at elevated gas pressure, S.N.Tskhai, S. Yatom, Ya. E. Krasik, *P.N. Lebedev Physical Institute RAS, Russian Federation.*

The possibilities of measuring the intensity of the electric field in high-pressure plasma with non-linear optics methods are studied. The measurements of the electrical field intensities dynamics in impulse discharges are presented.

LTul3 • 18:00-18:30 • invited

"Femtosecond Pump-to-Probe Spectroscopy of primary events in photosynthesis", D. Cherepanov, F. Gostev, M. Mamedov, I. Shelaev, A. Semenov, V. Shuvalov, *N.N.Semenov Institute of Chemical Physics Russian Academy of Sciences,, Russian Federation.*

The femtosecond pump-probe spectroscopy revealed the ultrafast charge separation in photosystem 1 with time constant 100 fs. This reaction of the primary charge separation is one of the fastest reactions in photobiology.

LTul4 • 18:30-18:45 • oral

Dynamics of Photoinduced TICT-process for Thioflavin T in n-Alcohols, V. Stsiapura, O. Bouganov, S. Tikhomirov, *Yanka Kupala State University, Belarus.*

It has been established earlier that fluorescence quantum yield of Thioflavin T (ThT) – a probe widely used for amyloid fibrils detection – is viscosity-dependent and photophysical properties of ThT can be well-described by the fluorescent molecular rotor model, which associates twisted internal charge transfer (TICT) reaction with the main non-radiative decay process in the excited state of the dye. Solutions of ThT in 1-propanol, 1-pentanol, and 1-hexanol were studied using femtosecond transient absorption spectroscopy methods and we showed that solvent viscosity was the main factor that influenced TICT rate for ThT in alcohols.

SESSION LWD

September 28, 11:30-13:00, Hall 5

Ultra-Fast Diagnostics in Laser Research (LAT-03/3)

Session Chair: **Sergei Tikhomirov**, *Department of Physics, Mathematics and Informatics of NAS of Belarus, Belarus.*

LWD1 • 11:30-12:00 • invited

Pico-Femtosecond Image-Tube Instrumentation in Experimental Physics, M.Ya. Schelev, K.A. Vereshchagin, *A.M. Prokhorov General Physics Institute, RAS, Russian Federation.*

Analyzed are more than a half-century research experiences in the field of design and application the pico-femtosecond image-tube technologies intended for ultrafast phenomena recording in experimental physics.

LWD2 • 12:00-12:15 • oral

New generation of streak tubes producing by VNIIA, P.I. Konovalov, A.Yu. Sokolov, R.I. Nurtdinov, M.P.Vikulin, I.G.Pryanishnikov, A.S. Dolotov, *Dukhov Research Institute of Automatics (VNIIA), Russian Federation.*

The new generation streak tubes have smaller weight and dimensions and outperform their predecessors in almost all features, including time resolution, dynamic range and life time.

LWD3 • 12:15-12:45 • invited

Lasers and streak-cameras at physics of accelerators, O.I.Meshkov, *G. I. Budker Institute of Nuclear Physics of SB RAS, Russia.*

Ultra-relativistic beams of particles in modern linear and cyclic accelerators have a typical spatial longitudinal dimension between tenths of a millimeter up to tens of millimeters. This value needs of a constant monitoring. It means a necessity of measurement of time intervals lasting from ten to tens of picoseconds with an accuracy of a few percent. In recent years, along with the application for these purpose streak cameras, the methods of particle beam diagnostic based on the application of laser radiation are widely used. Lasers are applied for precise measurements of geometric dimensions and the energy of the beams as well as for generation of intense X-ray fluxes. Laser scattering is able to vary an energy spread of the particles in a beam. The report reviews the application of lasers, streak cameras and optical dissectors for measurements and operations of particle beams in modern electron and positron accelerators.

LWD4 • 12:45-13:15 • invited

X-ray diffractometry with synchrotron radiation for exploration of fast processes in solids with nanosecond time resolution, B.P.Tolochko, K.A.Ten, V.V.Zhulanov, L.I.Shehtman, A.S.Arakcheev, K.V.Zolotarev, *Institute of Solid State Chemistry and Mechanochemistry SB RAS, Russian Federation.*

A fast one-coordinate X-ray detector was developed for experiment to study the behavior of the crystal lattice of the material of the fusion reactor first wall during a plasma discharge on the diverter. The detector enables fast recording of 100 diffraction frames with an exposure time of 73 ps and a periodicity of 100 ns.

SESSION LWG

September 28, 17:00-18:30, Hall 5

Ultra-Fast Diagnostics in Laser Research (LAT-03/4)

Session Chair: **Mikhail Korjik**, *Research Institute for Nuclear Problems of Belarus State University, Belarus.*

LWG1 • 17:00-17:30 • invited

Two photon processes for a fast timing in nuclear instrumentation, M. Korjik, O. Bugnavov, A. Fedorov, V. Mechinsky, S. Tichomirov, G. Tamulaitis, E. Auffray, M. Lucchini, *Institute for Nuclear Problems of Belarus State University, Belarus.*

Here we report first results of the study by two photon absorption methods of the ultra-fast phenomena in inorganic scintillation materials with the purpose to develop new detecting techniques of ionizing radiation.

LWG2 • 17:30-18:00 • invited

Andor Technology: advanced and versatile camera technology for nanosecond gated imaging and spectroscopy, T. Pieper, Y. Zheleznov, *LOT-QuantumDesign GmbH, Germany.*

Scientific imaging in physics applications either requires a high sensitivity, high spatial or high temporal resolution. From Andor Technology there are cameras for each of these tasks. With special emphasize on the observation of fast processes we try to 'illuminate' the variety of available imaging cameras and simplify the choice. A clear distinction is made between intensified and non-intensified, gated and non-gated cameras. Starting from the level of CCD we compare the concept of ICCD cameras and introduce Andor Technology's new intensified sCMOS camera. Improvements in pixel resolution, read noise and frame rate are discussed.

LWG3 • 18:00-18:15 • oral

A new method of electron scrubbing of microchannel plates, P.I. Konovalov, A.S. Dolotov, R.I. Nurtdinov, M.P. Vikulin, *Dukhov Research Institute of Automatics (VNIIA), Russian Federation.*

It was proposed a new method of electron scrubbing of microchannel plates which can solve the problem of using the ion-barrier films in fast photoelectric devices.

LWG4 • 18:15-18:30 • oral

Ultrafast deactivation of excitation energy in rutin and quercetin via electron and proton transfers, S.L. Bondarev, S.A. Tikhomirov, V.N. Knyukshto, O.V. Buganov, A.D. Shirokanov, T.F. Raichenok, *B.I. Stepanov Institute of Physics of NASB, Belarus.*

Using femtosecond spectroscopy and steady-state luminescence methods, the mechanisms of very fast non-radiative deactivation ($k_{nr} \sim 5 \times 10^{11} \text{ s}^{-1}$) of the electronic excitation energy at room temperature in organic and buffer solutions of well-known natural antioxidants rutin and quercetin have been investigated.

SESSION LTuM

September 27, 18:30-20:00,

Ultra-Fast Diagnostics in Laser Research (LAT-03)

LTuM1

Speeded up lifetime testing technique for streak tubes, A.Yu. Sokolov, P.I. Konovalov, M.P. Vikulin, *Dukhov Research Institute of Automatics (VNIIA), Russian Federation.* Here presented the results of sensitivity variations during operational time of a streak tube. Sensitivity decrease can be characterized by an exponential function. Described speeded up testing technique and physical processes causing degradation of photocathode.

LTuM2

MCP PMT with high time response and linear output current for neutron time-of-flight detectors, A.S. Dolotov, P.I. Konovalov, R.I. Nurtdinov, M.P. Vikulin, *Dukhov Research Institute of Automatics (VNIIA), Russian Federation.* A microchannel plate photomultiplier tube with a subnanosecond time response and a high linear output current has been developed. Photomultiplier is designed for detection of weak pulses of radiation in UV-, visible and nearer-IR ranges.

LTuM3

Femtosecond Interferometry as a Tool for Optimal Control of Ions Photofragmentation., M. V. Korolkov, K.-M. Weitzel, B.I.Stepanov *Institute of Physics of NASB, Belarus*. The possibility to control of the ion photofragmentation process by means of varying of the time delay between two interfering femtosecond laser pulses with proper carrier envelope phases have been studied.

LTuM4

Numerical simulation of temperature dynamics in TiAlN thin films on Si substrate under nanosecond laser irradiation, G.D. Ivlev, O.R. Ludchik, E.I.Gatskevich, *Belarusian National Technical University, Belarus*. The description of the space-time evolution of the temperature has been carried out on the basis of numerical solution of thermal problem with regard to the experimental situation of ruby laser radiation effect on thin film system TiAlN/Si. The temperature regimes at which the changes in morphology of the thin film take place are determined.

LTuM5

Dynamics of nanopulsed laser annealing of thin film germanium, G.D. Ivlev, S.L. Prakopyev, E.I.Gatskevich, R.I. Batalov, R.M. Bayazitov, I.A. Faizrahmanov, *Belarusian National Technical University, Belarus*. The laser-induced processes in heavily doped germanium films on semiconducting and insulating substrates have been studied by the methods of time – resolved reflectivity measurements. The numerical simulation of laser heating, melt and solidification was carried out.

LTuM6

Stabilization CEO of Kilohertz Solid-State Laser System for Attosecond Pulses Generation Experiments, A.V. Kirpichnikov, V.V. Petrov, G.V. Kuptsov, A.V. Laptev, V.A. Petrov, E.V. Pestyakov, V.I. Trunov, *Institute of Laser Physics SB RAS, Russian Federation*. A carrier-envelope offset phase stabilization (CEO) system was developed and implemented. It is allowing one to achieve residual instability ~ 0.17 radian (rms) for the 30 fs-pulse. It is sufficient to generate attosecond pulses efficiently.

LTuM7

Processing of Fiber Optic Bragg Sensor Signal by Fiber Bragg Gratings Filters, O.V. Butov, A.A. Chertoriyskiy, O.V. Ivanov, A.M. Nizametdinov, V.L. Vesnin, *Ulyanovsk Branch of the Kotelnikov Institute of Radioengineering and Electronics of RAS, Russian Federation*. A system of signal processing for the fiber optic Bragg sensor using two Bragg gratings filters is proposed. The structural scheme of this system is described. The results of experiment with registration of metal plate oscillations excited by the impact of bullet are shown.

LTuM8

Dynamics of Photoinduced Processes in Copper(II) Mixed Halides, P.K. Olshin, A.V. Povolotskiy, A.S. Mereshchenko, *Saint Petersburg State University, Russia*. Copper(II) tetrahalocomplexes were studied using steady-state absorption spectroscopy and nanosecond transient absorption spectroscopy. Mechanisms of the relaxation of LMCT-excited $[\text{CuCl}_4]^{2-}$, $[\text{CuBr}_4]^{2-}$ and $[\text{CuClBr}_3]^{2-}$ complexes were proposed. Temperature and concentration effects were also investigated.

4. Biophotonics and Laser Biomedicine

NANOBIOPHOTONICS (Metal-enhanced fluorescence. IR-nanophotosensitizers. Ultrafast lasers and nanoparticle interaction. Nanoparticles contrast agents for medical diagnostics. Multiphoton spectroscopy, microscopy and imaging. Fluorescence lifetime and two-photon imaging.) CLINICAL TECHNOLOGIES AND SYSTEMS (Optical instrumentation and devices, including microscopes and endoscopes for fluorescence imaging. Optical fibers and waveguides. THz spectroscopy and imaging. Bioimplants for permanent tissue imaging and controlling) PHOTOTHERANOSTICS (Fluorescence-guided resection and therapy various neoplasms. Immunophotonics in theranostics. Phototherapy with Cerenkov radiation.) NEUROPHOTONICS (Neurosurgery navigation. Photodynamic therapy in neurosurgery. Stereotactic technology. Scaffolds for brain theranostics. Neural regeneration.)

Chairs: Viktor Loschenov (Prokhorov General Physics Inst., Russia); Rudolf Steiner (Institut für Lasertechnologien in der Medizin (ILM), Germany); Boris Dzhagarov (B.I.Stepanov Inst. of Physics, Belarus)

SESSION LWA

September 28, 09:00-11:00, Hall 4

Biophotonics and Laser Biomedicine (LAT-04/1)

Session Chair: **Victor Loshchenov**, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

LWA1 • 09:00-09:45 • keynote

On the estimation of tissue optical parameters from diffuse reflectance spectroscopy, W. Blondel, P. Rakotomanga, M. Kholodtsova, C. Daul, V.B. Loschenov, M. Amouroux, C. Soussen, *Université de Lorraine, France.*

This contribution is a state of the art overview on inverse problem solving for spatially resolved diffuse reflectance spectroscopy challenging the precise estimation of multi-layer biological tissue optical parameters.

LWA2 • 09:45-10:15 • invited

NEAR INFRARED IMAGING FOR ANGIOGRAPHY IN DIABETIC FOOT, Z. N. Abdulvapova, P.V. Grachev, O.N. Bondarenko, G.R. Galstyan, *Endocrinology Research Centre, Russia.*

Current Modern methods for lower limb ischemia (LLI) assessment have a number of limitations in the use in diabetic patients.. Indocyanine green (ICG) fluorescence angiography (ICGA) is a new technique in assessing the perfusion disturbance in LLI.

LWA3 • 10:15-10:45 • invited

Photodynamic Therapy of Gonarthrosis with Fotoditazin, T.A. Zharova, S.V. Ivannikov, A.M. Tonenkov, E.Ph. Stranadko, L.A. Semenova, M.M. Smorchkov, V.I. Makarov, I.D. Romanishkin, A.V. Ryabova, V.B. Loschenov, *I.M. Sechenov First Moscow State Medical University, A.M. Prokhorov Institute of General Physics, RAS, Russia.*

The experimental research is conducted with application of the model of posttraumatic gonarthrosis on 35 rabbits. Specific features of Chlorin e6 derivatives (Ce6) photosensitizer (PS) accumulation in tissues of a knee joint and efficiency of photodynamic therapy (PDT) at gonarthrosis treatment are studied experimentally. The analysis of results of clinical and morphological research shows that PDT is a low-invasive method of gonarthrosis treatment with a high degree of efficiency and selectivity of action.

LWA4 • 10:45-11:00 • oral

Spectral-Temporal Pulse Construction for Optimal Nonlinear Raman Brain Imaging, E.A. Stepanov, A.A. Lanin, D.A. Sidorov-Biryukov, A.B. Fedotov, A.M. Zheltikov, *International Laser Center & Faculty of Physics, Lomonosov Moscow State University, Russia.*

We propose efficient strategies of pulse-width optimization applicable for nonlinear Raman brain imaging. Ultrashort laser pulses with the spectral bandwidth, accurately matched against the bandwidth of molecular vibrations, are shown to provide a higher power of the total signal without reducing the sensitivity of tumor detection in brain tissues.

LWA5 • 11:00-11:15 • oral

Near-IR Laser Heating of Rare-Earth Doped Composite Nanoparticle Colloids, I.R. Romanishkin, Y.V. Orlovskii, I.A. Burmistrov, D.V. Pominova, A.S. Vanetsev, E.O. Orlovskaya, A.V. Ryabova, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

Hyperthermia is a potent method of cancer treatment. In this study we investigated the spatial heating effect of composite DyPO4-covered nanogold and Nd³⁺-doped LaF₃ nanoparticles under continuous-wave and repeating-pulse laser excitation. The results showed higher laser-to-temperature conversion effectiveness for nanoparticles with gold core.

SESSION LWC

September 28, 11:30-13:00, Hall 4

Biophotonics and Laser Biomedicine (LAT-04/2)

Session Chair: **Rudolf W. Steiner**, *Institut für Lasertechnologien in der Medizin und Messtechnik an der Universität Ulm, Germany.*

LWC1 • 11:30-12:00 • invited

Combined Spectroscopic Technique in Low-grade Glioma Neurosurgery Navigation, T.A. Savelieva, A.A. Goryainov, A.A. Potapov, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

The method for the simultaneous in vivo analysis of fluorescence, scattering and absorption of brain tissues in adjacent spectral ranges from 500 to 800 nm is proposed.

LWC2 • 12:00-12:30 • invited

The Development of methods for fluorescence imaging in theranostics oncological disease, E.V. Filonenko, A.D. Kaprin, A.N. Urlova, M.V. Loschenov, *National Medical Research Radiological Centre of the Ministry of Health of RF, Russia*.

In the presented work we have described main methods for fluorescence imaging in theranostics oncological disease, which are as follows: visually assessed fluorescence diagnosis, fluorescence spectroscopy and fluorescence navigation

LWC3 • 12:30-12:45 • oral

Developing algorithms and software for fluorescence imaging of intracavitary organs, A. A. Anam, M. V. Loshchenov, *National Research Nuclear University "MEPhI", Russian Federation*.

The program developed for fluorescence imaging of biotissue will be present in this work.

LWC4 • 12:45-13:00 • oral

The Spectral Fluorescence Method of the Bacteriochlorin Accumulation Dynamic Estimation in the Mice Skin with Superficial Wound Staphylococcus Infection, E.V. Akhlyustina, Yu.S. Maklygina, A.V. Borodkin, A.V. Ryabova, A.A. Kuneva, P.A. Rybakova, D.V. Yakovlev, G.A. Meerovich, E.V. Filonenko, *National Research Nuclear University "MEPhI", Russia*.

Derivatives of bacteriochlorins are promising for use for photodynamic therapy. The research results showed that the developed fluorescent spectroscopic approaches are promising in order to study pharmacokinetics and biodistribution on mice of superficial wound Staphylococcus infection.

LWC5 • 13:00-13:15 • oral

Study of the fluorescence intensity decay of nanophotosensitizers using time-resolved spectroscopy methods, F.G. Bystrov, V.I. Makarov, V.B. Loschenov, *A.M. Prokhorov General Physics Institute, RAS, Russia*.

The effect of the biological environment on the fluorescence properties of aluminum phthalocyanine nanoparticles (nan-AIPc) was studied. The measurements were carried out using registration system based on Hamamatsu streak camera C10627 with picosecond temporal resolution and picosecond laser with 637 nm wavelength and 65 ps pulse duration. The presence of two fluorescence lifetimes 5 ns and 10 ns was registered for nan-AIPc incubated with macrophages. The significant change in fluorescence kinetics of nan-AIPc, deposited under mice skin autografts, was observed after photodynamic treatment. Obtained information on nan-AIPc fluorescence kinetics is fundamental for building up a model of AIPc – biological environment interactions.

SESSION LWF

September 28, 17:00-18:30, Hall 4

Biophotonics and Laser Biomedicine (LAT-04/3)

Session Chair: **Boris Dzhagarov**, *B.I. Stepanov Institute of Physics of NASB, Belarus*.

LWF1 • 17:00-17:15 • oral

Broadband Terahertz in-line Phase Contrast Imaging, A.A. Ushakov, P.A. Chizhov, V.V. Bukin, A.B. Savel'ev, S.V. Garnov, *A.M. Prokhorov General Physics Institute, RAS, Lomonosov Moscow State University, Russia*.

We demonstrate a pulse broadband (from 0.1 to 1.5 THz) terahertz phase contrast imaging system by using the electro-optical crystal ZnTe. This system allows studying the depth information, refractive index and absorption of the objects

LWF2 • 17:15-17:30 • oral

The Study of Aluminum Phthalocyanine Nanoparticle Fluorescent Properties Changes in Tissue Engraftment for the Small Laboratory Animals Cross Skin Transplantation, D.S. Farrakhova, E.V. Akhlyustina, V.I. Makarov, D.V. Pominova, A.V. Ryabova, *National Research Nuclear University "MEPhI", Russia*.

The possibility of aluminum phthalocyanine nanoparticles (nAIPc) application for evaluation of skin engraftment was studied. The analysis of fluorescent properties dynamic of tissue engraftment for cross skin transplantation of small laboratory animals was produced.

LWF3 • 17:30-17:45 • oral

Raman and FTIR spectroscopy in the THz frequency range in the study of protein structure, A. A. Mankova, N. N. Brandt, and A. Yu. Chikishev, *Lomonosov Moscow State University, Russia*.

Structural changes of proteins resulting from violation of optimal conditions for functioning are studied using low-frequency Raman and FTIR spectroscopy. Effects of thermal denaturation, cleavage of disulfide bonds, and inhibition on protein structure are analyzed

LWF4 • 17:45-18:00 • oral

Aluminum phthalocyanine nanoparticles as a contrast agent for the detection of tooth enamel microdamage, J.O. Kuznetsova, D.S. Farrakhova, M.G. Yassin, *National Research Nuclear University "MEPhI", Russia*.

The possibility of aluminum phthalocyanine nanoparticles (nAIPc) application for diagnosis, prevention and therapy of inflammatory diseases in dentistry is presented. It was detected that nAIPc fluoresces in the nanoparticle form in the presence of pathologic microflora. It will make possible to detect the local accumulation of pathological microflora in the tooth enamel microdamage. Experimental studies of interaction of nAIPc with tooth enamel and in the presence of different components of toothpaste.

LWF5 • 18:00-18:15 • oral

Joint Application of Fluorescence Imaging and Local Fluorescence Spectroscopy for PD and PDT of Skin Cancer, A.E. Mukhin, A.V. Borodkin, P.V. Grachev, E.F. Stranadko, *National Research Nuclear University "MEPhI", Russian Federation*.

In this paper the results of PD of the patient with skin cancer of the ear is discussed. By "LESA-01-Biospec" and by fluorescent video system were held fluorescent spectra analysis and fluorescence imaging of the general dynamics of photosensitizer accumulation after 3 hours after drug injection before, during and after PDT.

LWF6 • 18:15-18:30 • oral

ADAPTIVE OPTICS MULTISPECTRAL FUNDUS-CAMERA (AOMFC) FOR DETECTION OF RETINAL PATHOLOGY, A.V. Bolshunov, E.A. Katalevskaya, A.V. Larichev, N.G. Iroshnikov, *Research Institute for Eye Diseases, Russia*.

High-resolution adaptive optics multispectral fundus-camera imaging enables early detecting of dry age-related macular degeneration (AMD), nonproliferative and proliferative diabetic retinopathy, epiretinal membranes, idiopathic macular holes.

SESSION LThA

September 29, 09:00-11:00, Hall 4

Biophotonics and Laser Biomedicine (LAT-04/4)

Session Chair: **Tatiana Savelieva**, *A.M. Prokhorov General Physics Institute, RAS, Russia*.

LThA1 • 09:00-09:45 • keynote

Optical Coherence Tomography: Technology and Applications, J.G. Fujimoto, *Massachusetts Institute of Technology (MIT), USA*.

Optical coherence tomography (OCT) uses photonics to enable micron-resolution 3D structural and functional imaging in tissues. It is a standard ophthalmic diagnostic and is being developed for many clinical applications. We review technology and applications

LThA2 • 09:45-10:15 • invited

AFTEREFFECT OF LOW-INTENSITY OF HE-NE LASER IRRADIATION ON THE ACTIVATION OF ATP SYNTHESIS AND REPROGRAMMING OF THE GENOME, T. I. Karu, V. M. Manteifel, L. V. Pyatibrat, *Institute of Crystallography and Photonics of RAS, Russia*.

Aftereffect of low-intensity laser radiation (LILI) on the structure of mitochondria was revealed. Changes of mitochondria reflect activation of oxidative phosphorylation, which may be the result of genome reprogramming.

LThA3 • 10:15-10:45 • invited

Noninvasive blood glucose monitoring with THz reflection spectroscopy, O. P. Cherkasova, M.M. Nazarov, A. P. Shkurinov, *Institute of Laser Physics of SB RAS, Russia*.

Human skin optical properties were studied in vivo using terahertz time-domain spectroscopy with silicon Dove prism in the attenuated total internal reflection (ATR) configuration. The measurements were carried out on volunteers with normal blood glucose concentration and after glucose intake. The variations of the reflection spectra of human skin were correlated with the changes in blood glucose level. Our results demonstrate the possibility of a non-invasive real-time measurement of blood glucose concentration.

LThA4 • 10:45-11:00 • oral

High efficiency stimulated low-frequency Raman scattering in water/buffer suspension of potato viruses (PVX&PVA), A.F.

Bunkin, M.Ya. Grishin, O.V. Karpova, A.D. Kudryavtseva, V.N. Lednev, T.V. Mironova, S.M. Pershin, E.K. Petrova, M.A. Stokov, N.V. Tcherniega, K.I. Zemskov, P.N. Lebedev *Physical Institute of RAS, Russia.*

Stimulated low-frequency Raman scattering (SLFRS), caused by Ruby laser pulses interaction with the vibration modes of potato viruses X (PVX) in Tris-HCl pH7,5 buffer and A (PVA) in water suspension was registered. Frequency shift (in GHz scale), efficiency conversion (up to 10%) and SLFRS threshold are measured.

LThA5 • 11:00-11:15 • oral

Optimization of Spectral Range of Radiation to Enhance the Efficiency of Phototherapy for Neonatal Jaundice, V.Yu. Plavskii, A.V. Mikulich, I.A. Leusenko, A.I. Tretyakova, L.G. Plavskaya, N.S. Serdyuchenko, J. Gao, D. Xiong, X. Wu, B.I. Stepanov *Institute of Physics of NASB, Belarus.*

It is shown that efficiency of phototherapy for hyperbilirubinemia of newborns using LEDs depends not only on position of maximum in emission spectrum within the absorption band of bilirubin but also on width of spectrum of incident radiation.

SESSION LThB

September 29, 11:30-13:00, Hall 4

Biophotonics and Laser Biomedicine (LAT-04/5)

Session Chair: **Boris Dzhagarov**, *B.I. Stepanov Institute of Physics of NASB, Belarus.*

LThB1 • 11:30-12:-- • invited

Sensitizer-nanoparticles for tissue diagnostics and PDT, R. Steiner, C. Scalfi-Happ, R. Wittig, A. Ryabova, S. Gräfe and V. Loschenov, *Institut für Lasertechnologien in der Medizin und Messtechnik an der Universität Ulm, Germany.*

Nanoparticles of sensitizer raw materials like chlorins, phthalocyanines or porphyrins are non fluorescent. They will be taken up especially by macrophages. In the cells molecules dissolve, become fluorescent and photoactive. Therefore, such nanoparticles are well suited for specific fluorescence diagnosis of inflamed or cancerous tissue and for PDT.

LThB2 • 12:00-12:30 • invited

Multiphoton Fluorescence Microscopy and Real Time Rendering for Rapid Evaluation of Surgical Cancer Specimens, M.G. Giacomelli, T. Yoshitake, L. Cahill, Y. Sheykin, H. Vardeh, J. Connolly, and J.G. Fujimoto, *Massachusetts Institute of Technology (MIT), USA.*

Surgical cancer specimens can be imaged by rapid staining and multiphoton fluorescence microscopy. GPU accelerated color re-mapping generates images similar to H&E histology. These methods promise to enable real time evaluation of surgical cancer margins.

LThB3 • 12:30-12:45 • oral

Spectral luminescent properties of bacteriochlorin and aluminum phthalocyanine nanoparticles as hydroxyapatite implant surface coating., A.S. Sharova, Yu. S. Maklygina, B. Kundu, V.K. Balla, R. Steiner, V.B. Loschenov, *National Research Nuclear University "MEPhI", Russia.*

The spectral luminescent properties of developed by us coating for the hydroxyapatite implants were experimentally investigated in this study. Crystalline bacteriochlorin and aluminum phthalocyanine nanoparticles with photobactericidal properties were used as an implant coating. This research opens the prospect of such technology application in order to provide the local inflammatory and autoimmune reactions prevention in the area of implantation.

LThB4 • 12:45-13:00 • oral

Infrared (3-15 μm) fiber skin in vivo spectroscopy and physiotherapy, L.N. Butvina, A.L. Butvina, V.D. Bitsoev, *Fiber Optics Research Center of RAS, Russian Federation.*

Evanescent infrared spectroscopy by touch of the infrared fiber is a unique, non-traumatic method, does not require special preparation of the skin, is the method of optical biopsy. We have developed new fibers from silver halides with low optical losses in a wide spectral wavelength range of 3-15 μm , which allowed us to obtain spectra of skin in vivo from mild physiotherapy.

LThB5 • 13:00-13:15 • oral

Dissection of biological tissues under the influence of pulsed and quasi-continuous laser radiation, G.I. Zheltov, V.D. Burko, O.G. Romanov, *Belarusian State University Faculty of Physics Department of Computer Modeling, Belarus.*

Physical basis of low-temperature laser ablation of biological tissues under pulsed and quasi-continuous laser radiation have been developed. The physical and mathematical models of thermo-mechanical effect of pulsed radiation on absorbing tissues are presented, and numerical modeling has been performed for typical laser systems used in laser surgery.

LThB6 • 13:15-13:30 • oral

Laser Induced Relaxation of Triplet States for Sterically Distorted Metalloporphyrins, E. Zenkevich, A. Starukhin, V. Knyuksho, A. Gorski, M. Kijak, J. Solarski, A. Semeikin, T. Lyubimova, J. Waluk, *National Technical University of Belarus, Belarus*.

Based on laser time-resolved, steady-state measurements (293-77 K) and quantum chemical calculations the detailed picture of steric interactions as well as the reasons of T-state drastic shortening have been evaluated for non-planar meso-phenyl substituted Pd-octaethylporphyrins.

SESSION LThC

September 29, 14:30-16:30, Hall 4

Biophotonics and Laser Biomedicine (LAT-04/6)

Session Chair: **Victor Loshchenov**, *A.M. Prokhorov General Physics Institute, RAS, Russia*.

LThC1 • 14:30-14:45 • oral

Spectroscopic Evaluation Method of Angiogenesis in the Healing of Skin Grafts Using Spectrally Sensitive to Inflammatory Reactions Aluminum Phthalocyanine Nanoparticles, V.I. Makarov, D.V. Pominova, M.N. Kholostsova, A.V. Ryabova, V.B. Loschenov, *A.M. Prokhorov General Physics Institute, RAS, Russian Federation*.

The development of express method for assessing the state of skin graft by the spectroscopic properties of tissue components involved in the healing of the affected skin or healing of skin grafts was carried out in present work.

LThC2 • 14:45-15:00 • oral

Terahertz Irradiation of Parent Drosophila Accelerates an Achieving the Adult State in Offspring of the First Generation, V.I. Fedorov, N.Ya. Weisman, E.F. Nemova, *Institute of Laser Physics of SB RAS, Russia*.

An adulthood achievement of offspring obtained from irradiated females mating with irradiated or non-irradiated males is shortened by a few days. Maximal maturation of individuals occurs for one day earlier than the control. In the offspring of irradiated males and nonirradiated females a development to the adult stage differs significantly on a number of parameters.

LThC3 • 15:15-15:30 • oral

The study of chromatin organization in germinal mammalian oocyte by optical tweezers., M.S. Syrchina, A.V. Aybush, A.A. Ocychenko, A.D. Zalesskiy, G.A. Serobyanyan, A.N. Kostrov, A.A. Titov, V. A. Nadochenko, *Semenov Institute of Chemical Physics, RAS, Russian Federation*.

laser tweezers was applied to examine viscoelastic properties of chromatin in germinal vesicles of mammalian oocyte.

LThC4 • 15:30-15:45 • oral

Fiber-optic cell-resolved online thermometry in laser-assisted thermogenetics, A.A. Lanin, I.V. Fedotov, Y.G. Ermakova, D.A. Sidorov-Biryukov, A.B. Fedotov, V.V. Belousov, and A.M. Zheltikov, *Lomonosov Moscow State University, Russia*.

Nitrogen–vacancy centers of diamond coupled with an optical fiber are shown to enable online fiber-format cell-resolved thermometry of thermogenetically activated neurons, facilitating a quantitative analysis of thermogenetic effects, characterization of thermosensitive ion channels, and optimization of laser neurostimulation.

LThC5 • 15:45-16:00 • oral

Optical Tweezer on the Base of 4-channel LC modulator for Trapping of Biological Objects, A.V. Korobtsov, S.P. Kotova, N.N. Losevsky, A.M. Mayorova, S.A. Samagin, P.N. Lebedev *Physical Institute of RAS, Samara Branch, Russia*.

The techniques of contour optical traps generation with the use of LC focusator are proposed. Such traps minimize laser radiation effect on the cells center. Results of trapping experiments with biological objects are presented.

LThC6 • 16:00-16:15 • oral

QUANTUM MEDICINE: MOLECULAR APPEARANCE, G. A. Zalesskaya, L.G. Astafieva, *B.I. Stepanov Institute of Physics of NASB, Belarus*.

The effect of phototherapy on blood oxygenation and metabolic processes were studied. It was shown that blood irradiation exerts influence on oxygen exchange and formation of reactive oxygen species regulating many processes in living organism.

LThC7 • 16:15-16:30 • oral

Simulation of Thermographic IR Images of a Localized Heat Source Hidden in Biological Tissue, A. P. Ivanov, V. V. Barun, *B.I. Stepanov Institute of Physics of NASB, Belarus*.

Thermal imager data are simulated at varying power, depth, and dimensions of an internal heat source. The main idea of the paper is to get insight into tissue depth by using observations of tissue surface. The observed quantities are discussed as applied to various inverse problems of source parameters retrieval.

SESSION LThD

September 29, 17:00-18:30, Hall 4

Biophotonics and Laser Biomedicine (LAT-04/7)

Session Chair: **Tatiana Savelieva, A.M. Prokhorov General Physics Institute, RAS, Russia.**

LThD1 • 17:00-17:15 • oral

The development of fiber-optic scaffold for the glioblastoma diagnosis and prevention., Yu. S. Maklygina, A.V. Borodkin, G.M. Yusubalieva, V.B. Loschenov, *A.M. Prokhorov General Physics Institute RAS, Russia.*

The developed fiber-optical scaffolds promote the setting of the glial cells growth and act as a port for delivery of photosensitizers and laser radiation for the purpose of cellular processes monitoring.

LThD2 • 17:15-17:30 • oral

The temperature and thermal stresses fields at cornea shape alterations under the ring-shaped laser source., O.I. Baum, A.I. Omelchenko, E.M. Kasianenko, A.V. Bolshunov, V.I. Sipliviy, E.N. Sobol, *Institute Photonic Technologies of Federal Scientific Research Centre "Crystallography and Photonics" of RAS, 142190, Moscow(Troitsk), Pionerskaya 2, Troitsk, Russia., Russia.*

The new laser method for non-ablative correction of cornea shape and eye refraction is presented. For correction of the eye refraction the special ring-shaped laser beam with various ring diameters allows obtaining controllable alterations of the eye refraction. The alteration in the cornea shape in vitro on minipig eyes and in vivo on rabbit eyes have been obtained with the help of ring-shaped source of laser radiation with wave length 1,56 mm. These alterations have axial symmetry without any pathological changes in central part of cornea. At ring-shaped distribution of intensity of laser radiation, the tension and temperature of cornea surface has also ring-shaped distribution that results in deformation of cornea in central part and heating only on periphery. This leads to the absence of any pathological changes in central part of cornea. Theoretical model for calculation of eye refraction has developed to estimate laser settings for desirable changes in the eye refraction.

LThD3 • 17:30-17:45 • oral

Thermo mechanical processes at laser normalization of intraocular pressure., O.I. Baum, A.V. Bolshunov, O.V. Khomchik, G.I. Zheltov, O.G. Romanov, E.N. Sobol, *Institute of Crystallography and Photonics of RAS, Russia.*

The theoretical calculations of thermo mechanical stress at novel and innovative technique for IOP normalization based on enhancing role of sclera outflow is presented. This technique creates permeable pathways for water transport as a result of pore system formation under nondestructive thermo mechanical effect of pulsed laser irradiation. The theoretical calculations of thermo mechanical stress showed the area of maximum stress concentration. Space-distribution of stress have confirmed by atomic force microscopy. The experimental results of in vivo experiments in rabbit eye sclera have shown twenty times increase of water permeability. The results of numerical modeling with this newly developed theoretical model are in satisfactory agreement with the experimental data. Clinical trials performed for 36 eyes of 36 patients with primary open angle glaucoma (resistant form) have demonstrated stable normalization of the IOP with one year follow-up observations. The prospects of novel non-invasive technique for glaucoma treatment have been demonstrated.

LThD4 • 17:45-18:30 • oral

Dual channel video fluorescence diagnostic system for intraoperative navigation during protoporphyrin IX photosensitized malignant tumor resection in central neural system, M.V. Loshchenov, A.V. Borodkin, D.A. Golbin, S.A. Gorjainov, P.V. Zelenkov, A.A. Potapov, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

In the presented work we have developed a novel neurosurgery fluorescence diagnostic system for navigation in photosensitized neural tissues during neurosurgery operations on neural malignant tumors in patients. This system contains a beamsplitter adapter based on a dichroic mirror where white light image goes to a high sensitivity monochrome camera and color image goes to a color camera. Both images are spectrally resolved. Then both images go to processor unit and then displayed on the monitor. In the clinical conditions the presented system indicated all the residual tumors including meningioma, neurinoma, and glioblastoma.

LThD5 • 18:00-18:15 • oral

Light Fields in Skin Tissue with Rough Surface, A. P. Ivanov, V. V. Barun, *B.I. Stepanov Institute of Physics of NASB, Belarus.*

Fluence rate inside skin tissue and its diffuse reflectance are analytically simulated. The roughness of skin surface and light refraction at the epidermis and stratum corneum interface are accounted for. Light penetration depth is shown to be independent of the skin relief, whereas the reflectance to increase with roughness variance.

LThD6 • 18:15-18:30 • oral

Multicomponent diode laser gas analyzer for medical screening diagnostics: Qualitative and quantitative feature of biomarkers of human exhaled air at different functional states, A. Karabinenko, A. Bogomolova, S. Shastun, A. Nadezhdenskii, Ya. Ponurovskii, M. Spiridonov, V. Zaslavskii, *Pirogov Russian National Research Medical University (RNRMU), A.M. Prokhorov General Physics Institute, RAS, Russian Federation.*

Screening tests are effective methods of assessing the functional state of the organism. The screening study in medicine is understood as a set of measures aimed at identifying the diseases in a large group of patients in the absence of pronounced symptoms. The main requirements for a screening test is its simplicity, noninvasiveness, and safety of the testing procedures, as well as high processing speed and the ability to detect diseases at an early stage. An experimental prototype of multi-channel analyzer for non-invasive screening and biomedical research was developed on the basis of fiber coupled the near-IR range diode lasers. Device enables to measure 12CO_2 , 13CO_2 , CH_4 , NH_3 and H_2S biomarkers of the exhaled air. Detection of CH_4 was carried out in the wavelength range of $1.65\ \mu\text{m}$, ammonium NH_3 in the $1.51\ \mu\text{m}$ and the 12CO_2 , 13CO_2 and H_2S in the range $1.60\ \mu\text{m}$. Measuring the concentrations of the five molecules simultaneously were carried out in Herriot type multipass cell with full optical path length of 26 m and a volume of 2.5 liters. All measurements were made in real time. Fig. 1 presents photo multi-channel diode laser analyzer for non-invasive screening and biomedical research. Clinical tests of the diode laser spectrometer were performed in the Moscow City Clinical Hospital No 12. The measurements were performed in 162 patients with various diseases in phase and remission at rest, during exercise, recovery and after meals. Identified biomarkers of exhaled air, allowing to assess the state of the cardiorespiratory function, gaseous Ingredients, reflecting the intensity of the digestive system and the degree of infestation B. *Helicobacter pylori*, the nature of the food regime. Identified deviations biomarkers of exhaled air levels have diagnostic and prognostic value during mass screening.

LThD7 • 12:00-12:30 • invited

Sapphire Shaped Crystals for Phototheranostics and Combined Anticancer Therapy, I.A. Shikunova, V.V. Volkov, V.N. Kurlov, *Institute of Solid State Physics RAS (ISSP RAS), Russia.*

A new kind of medical instruments and devices for combined laser photodynamic therapy and thermal therapy, laser surgery, fluorescent diagnostics, and cryosurgery based on sapphire shaped crystals are developed.

SESSION LThE

September 29, 18:30-20:00,

Poster Session: Biophotonics and Laser Biomedicine (LAT-04)

LThE1

Fluorescence meter for diagnostic purpose with reference channel, V.N. Grishanov, D.V. Kornilin, D.S. Burkov, *Samara National Research University, Russia.* Proposed fluorescence meter estimates skin autofluorescence made in vivo for advanced glycation endproduct evaluation. This instrument is helpful for prognosis of chronic diseases. Light emitting diode with a peak wavelength of 365 nm was utilized.

LThE2

Development of intraoperative videosystem for fluorescence diagnostics and photodynamic therapy monitoring of malignant tumors, A.V. Borodkin, K.G. Linkov, P.V. Grachev, M.V. Loshchenov, *A.M. Prokhorov General Physics Institute, RAS, Russian Federation.* The primary goal of this development is to increase the efficacy of the intraoperative visualization of malignant tumors with development of fluorescence diagnostics methods. Fluorescence diagnostics allows precise determining of tumor boundaries. Also we developed a technique for assessment of photosensitizer(PS) concentration and dosimetry and control of photodynamic therapy (PDT) efficacy. The developed system uses 635nm laser light for the fluorescence excitation to achieve deeper penetration depth.

LThE3

Biological Activity of Low-Intensity Continuous, Quasi-Continuous and Pulsed Laser Radiation of Nano- and Picosecond Ranges, V.Yu. Plavskii, N.V. Barulin, A.V. Mikulich, A.I. Vodchits, I.A. Khadasevich, L.E. Batay, A.S. Grabchikov, A.I. Tretyakova, L.G. Plavskaya, V.A. Orlovich, *B.I. Stepanov Institute of Physics of NASB, Belarus.* It is established that biological effect of laser radiation controlled on functional activity of zooplankton and sturgeon sperm is strongly dependent on the mode of acting radiation under conditions with equal average power density.

LThE4

The Use of Semiconductor Lasers and LEDs as Fungicidal Factor, A.V. Mikulich, A.I. Tretyakova, L.G. Plavskaya, I.A. Leusenko, V.S. Ulashchik, V.Yu. Plavskii, *B.I. Stepanov Institute of Physics of NASB, Belarus*. The ability of polyene antibiotic amphotericin B to act as photosensitizer and to enhance its fungicidal action upon exposure to radiation (semiconductor lasers and LEDs) corresponding to absorption band of amphotericin B has been shown.

LThE5

Photostability of bilirubin and the mechanism of its photosensitizing effect on animal cells in culture, O.A. Kozlenkova, L.G. Plavskaya, O.N. Dydinova, A.V. Mikulich, I.A. Leusenko, A.I. Tretyakova, V.Yu. Plavskii, J. Gao, D. Xiong, X. Wu, *B.I. Stepanov Institute of Physics of NASB, Belarus*. The exposure to radiation of LED sources with $\lambda_{em} = 465$ and 520 nm causes identical damaging effects on animal cells that may be due to significant change in the spectral characteristics of bilirubin upon entering into the cells.

LThE6

Time-Resolved Laser-Induced Fluorescence Spectroscopy for Identification of Pituitary Adenoma, A. N. Sobchuk, N. A. Nemkovich, Yu.V. Kruchenok, Yu. G. Shanko, A. I. Chuhonsky, *B.I. Stepanov Institute of Physics of NASB, Belarus*. Rapid and high-sensitivity identification of pituitary adenoma can be carried out by measuring the autofluorescence decays. It is found that a significant difference is observed in the autofluorescence mean lifetime of tumorous and healthy tissues in the 380–600-nm spectral range.

LThE7

The Investigation of Tubulins Intracellular Distribution in Healthy and Cancerous Colon Tissue, S.B. Bushuk, A.S. Portyanko, Ju.A. Kalvinkovskaya, B.A. Bushuk, *B.I. Stepanov Institute of Physics of NASB, Belarus*. The distribution of β -tubulins, acetyl-tubulins and tyrosin-tubulins in microtubules of healthy and cancerous cells has been investigated by FRET-FLIM method. It has been shown that in healthy tissue unlike the cancerous one the microtubules structure contains colocalized tubulins.

LThE8

Depth independent Cerenkov radiation mediated therapy with 5-ALA photosensitizer, Yu.S. Maklygina, A.V. Ryabova, V.B. Loschenov, E.N. Sokolov, D.I. Nevzorov, E.Yu. Grigoreva, M.B. Dolgushin, B.I. Dolgushin, A.M. Prokhorov *General Physics Institute, RAS, Russian Federation*. The main goal of the research is the photosensitizer activation using Cerenkov radiation from radionuclides. Histological analysis of tumor sections showed possibility to achieve depth independent Cerenkov radiation mediated therapy using different types of photosensitizers.

LThE9

Spectroscopic diagnostics of laser-induced change of structure of ascorbic acid solution, Y.S. Danyaeva, S.A. Kutsenko, *Volgograd State University, Russia*. The results of research of effect of powerful laser radiation on the structure of the electronic spectra of ascorbic acid are presented. Changes in the molecule's structures are defined by comparing the results of experiments and quantum chemical calculations.

LThE10

Laser Systems and Fiber Optic Tools for Photodynamic Therapy, K.G. Linkov, V.V. Volkov, A.M. Prokhorov *General Physics Institute, RAS, Russian Federation*. New therapeutic laser systems and fiber-optic light delivery tools were designed for further development of fluorescence diagnosis and photodynamic therapy. Features and advantages of developed laser equipment and possible applications of fiber-optic instruments are considered.

LThE11

Singlet Oxygen Generation by Zeolite-Porphyrin Complexes, M.V. Parkhats, S.V. Lepeshkevich, A.S. Stasheuski, B.M. Dzhagarov, H.H. Sargsyan, R.K. Ghazaryan, A.G. Gyulkhanyan, G.V. Gyulkhanyan, *B.I. Stepanov Institute of Physics of NASB, Belarus*. The investigated zeolite-porphyrin complexes generate singlet oxygen with low quantum yields and can not be used as photosensitizers for photodynamic therapy

LThE12

Molecular Oxygen Migration Through the Xenon Docking Sites of Human Hemoglobin and Its Isolated Chains, S.V. Lepeshkevich, *B.I. Stepanov Institute of Physics of NASB, Belarus*. In the alpha subunits of human hemoglobin, in addition to the direct His(E7) channel, there is at least one alternative ligand escape route leading to the exterior via the xenon docking sites.

LThE13

Highly Stable and Widely Tunable Ultrashort Pulse Distributed Feedback Dye Laser for Biomedical Applications, T.Sh.Efendiev, V.M.Katarkevich, Yu.V.Kruchenok, V.Yu.Plavskii, A.N.Sobchuk, *B.I. Stepanov Institute of Physics of NASB, Belarus*. Highly stable and widely tunable ultrashort pulse distributed feedback dye laser excited by a diode-pumped solid-state Nd:YLF micro laser is reported. The realized laser source is especially suitable for the time-resolved spectroscopic studies of biomedical objects.

LThE14

The nanostructure formation via laser ablation of porous silicon for biomedical applications, F.V. Kashaev, T.P. Kaminskaya, S.V. Zaboltnov, D.A. Loginova, P.D. Agrba, M.Yu. Kirillin, L.A. Golovan, *Lomonosov Moscow State University*,

Russia. The investigation of structural and optical properties of the nanoparticles formed via laser ablation of porous silicon in helium and water, confirms a possibility of their application in optical coherence tomography and photodynamic therapy.

LThE15

Laser Scanning Microscope Usage for Investigation of the Dynamics of a Chemical Agent Penetration into the Skin, T.A. Zheleznyakova, A.A. Ryzhevich, S.V. Solonevich, S.B. Bushuk, *B.I. Stepanov Institute of Physics of NASB, State University, Belarus*. We investigated the preparation concentration dependence on the depth by luminescence microscopy after locating preparation on skin. We found out a temporary depot of the preparation between the horny layer and the underlying epidermis layer.

LThE16

Laser impact monitoring during photocoagulation using optoacoustic technique, A. Lytkin, A. Larichev, S. Shmeleva, V. Simonova, V. Sipliviy, A. Bolshunov, A. Ardamakova, *Lomonosov Moscow State University, Russian Federation*. Method aimed at temperature control during lasercoagulation is based on optoacoustic technique that includes experimental determination of laser absorption coefficient and following numerical calculations. Values for different series of chorioretinal samples ex vivo were obtained in range from 1300 to 12000 1/m. Three-dimensional model of chorioretinal thermal heating is developed.

LThE17

Ablation treatment of dental tissue by 1060 nm radiation, S. Anufrick, A. Volodenkov, K. Znosko, *Grodno State University, Belarus*. The treatment of dental tissue is executed by 1060 nm radiation and dependence of value of specific energy of evaporation from density of peak power of laser radiation is determined. It is established, that threshold of ablation of dental enamel is 12 J/cm² and it is found that at density of energy more then 3 J/cm² the efficient removal of dental calcium takes place without ablation of dental enamel.

LThE18

Ablation treatment of dental tissue by 530 nm radiation, S. Anufrick, A. Volodenkov, K. Znosko, *Grodno State University, Belarus*. The treatment of dental enamel is executed by 530 nm radiation and dependence of value of specific energy of evaporation from density of peak power of laser radiation is determined. It is established, that threshold of ablation of dental enamel is 4,1 J/cm² and it is found that at density of energy more then 1 J/cm² the efficient removal of dental calcium takes place without ablation of dental enamel.

LThE19

The influence of various factors on the interaction mechanism of collagen and collagenase molecules in water solutions by dynamic light scattering, I.A. Sergeeva, K.A. Anenkova, A.D. Maslennikova, A.V. Shlenskaya, G.P. Petrova, *Lomonosov Moscow State University, Russia*. Enzyme based drugs are commonly used in medicine. Bacterial collagenase (for example from *Clostridium histolyticum*) is one of them. Collagenase main feature is its ability to break the peptide bonds in collagen. Optical methods, like dynamic light scattering (DLS), enable to investigate "collagen + collagenase" water solutions in conditions close to physiological. Varying the solution's parameters (pH, temperature, solvent type) and adding of collagenase activators/inhibitors enables to simulate different diseases in living organisms.

LThE20

Reconnectable fiberscopes for long-term, subcellular-resolution in vivo deep-brain imaging, M.S. Pochechuev, I.V. Fedotov, O.I. Ivashkina, M.A. Roshchina, A.B. Fedotov, K.V. Anokhin, and A.M. Zheltikov, *Kurchatov Institute, Russia*. Reconnectable bundles consisting of thousands of optical fibers are shown to enable high-quality image transmission, offering a platform for the creation of implantable fiberscopes for minimally invasive, long-term in vivo brain imaging with subcellular resolution.

LThE21

Detection of flavin fluorescence in lung adenocarcinoma cells by FLIM, E. A. Boruleva, V. V. Zherdeva, A. P. Savitsky, *National Research Nuclear University "MEPhI" Bach Institute of Biochemistry, Research Center of Biotechnology of RAS, Russia*. The work evaluated the conditions of endogenous fluorescence detection in tumor cells by the FLIM method for determining the flavin fluorescence.

LThE22

Femtosecond laser surgery of mammalian embryo and oocytes., A.A. Osychenko, A.A. Astafiev, A.M. Shakhov, A.D. Zalessky, A.A. Titov, V.A. Nadtochenko, *Semenov Institute of Chemical Physics, RAS, Russia*. The work reports the study of the size and dynamics cavitation bubbles produced by focused femtosecond laser pulse when laser irradiation is focused at different components (organelles) in the mammalian oocyte.

LThE23

UV VANADATE LASERS FOR MEDICINE APPLICATIONS, A.A. Sirotkin, G.P.Kuzmin, A.M. Prokhorov *General Physics Institute, RAS, Russia*. We have demonstrated a low-cost, compact, high-efficiency passively Q-switched UV-VIS-IR laser for medicine systems based on the variable-cut Nd:GdVO₄ laser with Cr⁴⁺:YAG saturable absorber crystal. The average power of visible and UV radiation up to 310 and 7 mW has been obtained in crystals PPLN and BBO, respectively.

LThE24

Clinical application of the multiwavelength laser medical installation with antibacterial and therapeutic effect., A.G.Kuzmina, K.K.Baranov, N.E.Gorbatova, V.P.Kurilov, G.P.Kuzmin, A.A.Sirotkin, O.V.Tikhonovich, S.A.Zolotov, A.M.Prokhorov *General Physics Institute, RAS, Russia*. Multiwavelength laser medical device "Livadia" is created on the basis of the laser on YVO4-Nd: YVO4 with subsequent conversion of the infrared radiation in the visible and ultraviolet regions of the spectrum. The radiation device is used with antibacterial and anti-inflammatory target for treatment a range of infectious and inflammatory diseases of external and intracavitary sites.

LThE25

Electrostatic interaction in biopolimer water solutions investigated by Laser light scattering., K.V. Fedorova, G.P. Petrova, *Lomonosov Moscow State University, Russia*. In this paper we consider electrostatic interaction of lysozyme molecules in aqueous solution in the presence of the third component - the metallic ions. This paper deals with the most suitable methods for measurement of these parameters - laser light scattering.

5. Nanomaterials for Lasers

Quantum dots (0D); carbon nanotubes, carbon nanoribbons (1D); graphene, transition metal dichalcogenides and other materials (2D) for ultrafast photonics; ultrafast modulators of laser beams: dynamics of electronic excitations, optical non-linearities, optical gain.

Chairs: Elena Obraztsova (Prokhorov General Physics Inst., Russia); Sergey Gaponenko (B.I.Stepanov Insti. of Physics, Belarus); Sergey Maksimenko (Belarusian State Univ., Inst. for Nuclear Problems, Belarus)

SESSION LTuA
September 27, 09:00-11:00, Hall 3

Nanomaterials for Lasers (LAT-05/1)

Session Chair: **Elena Obratsova**, *A.M. Prokhorov General Physics Institute, RAS, Russia.*

LTuA1 • 09:00-09:45 • keynote

Nanocarbon materials for short pulse lasers, S. Yamashita, *Research Center for Advanced Science and Technology (RCAST), The University of Tokyo, .*

We review the optical properties of carbon nanotubes (CNTs) and graphene, and describe how those properties have been used for the implementation of various nonlinear fiber optic applications.

LTuA2 • 09:45-10:30 • invited

s-SWNT coupling with active silicon photonic devices, N. Izard, *Laboratoire Charles Coulomb, Univ. Montpellier, France.*

We report on the strong photoluminescence enhancement from carbon nanotubes integrated in silicon microring resonators under two pumping configuration: surface-illuminated pumping and collinear pumping. Extremely efficient rejection of non-resonant photoluminescence is observed.

LTuA3 • 10:30-11:00 • invited

Hybridly mode-locked ultrafast fiber lasers and their application, , , .

SESSION LTuD
September 27, 11:30-13:00, Hall 3

Nanomaterials for Lasers (LAT-05/2)

Session Chair: **Shinji Yamashita**, *Research Center for Advanced Science and Technology (RCAST), The University of Tokyo, Japan.*

LTuD1 • 11:30-12:00 • invited

Design considerations in the fabrication of nano-carbon saturable absorbers, A. Martinez, *Aston Institute of Photonic Technologies, Aston University, United Kingdom.*

We review the various available nanomaterial-based saturable absorber designs, discussing in particular, requirements of specific regimes in terms of their insertion losses, polarization properties, strength of nonlinear interaction and long term stability.

LTuD2 • 12:00-12:30 • invited

Laser active regions based on CdZnSe/ZnSe QDs and GaN/AlGaIn submonolayers for yellow-green and ultraviolet spectral ranges, E.V. Lutsenko, G.P. Yablonskii, S.V. Sorokin, V.N. Jmerik, S.V. Ivanov, *B.I. Stepanov Institute of Physics of NASB, Belarus.*

Internal laser characteristics of heterostructures with CdZnSe/ZnSe QD active regions emitting in the yellow-green region were determined. The values of QDs material gain are discussed. Low threshold TE polarized stimulated emission was obtained in GaN submonolayer active regions in spectral range of 250-310 nm.

LTuD3 • 12:30-13:00 • invited

Light-induced anisotropy of the glass-metal nanocomposites under irradiation with femtosecond laser pulses, M. Halonen, A. A. Lipovsky and Yu. P. Svirko, *University of Eastern Finland, Finland.*

We report a femtosecond laser shaping of silver nanoparticles embedded in soda-lime glass via the fast excitation of the electronic system of metal followed by the electron and ion emission into glass matrix.

SESSION LWE

September 28, 17:00-18:30, Hall 1

Nanomaterials for Lasers (LAT-05/3)

Session Chair: **Evgenii Lutsenko**, *B.I. Stepanov Institute of Physics of NASB, Belarus.*

LWE1 • 17:00-17:30 • invited

Optical Effects in Self-Assembled Organic Frustum Shaped Microstructures, E.A. Mamonov, I.A. Kolmychek, A.I. Maydykovskiy, V.B. Novikov, T.V. Murzina, D. Venkatakrishnarao, YSLV Narayana, R. Chandrasekar, *Lomonosov Moscow State University, Russia.*

We discuss photonic effects in self-assembled organic microstructures prepared by self-assembly technique. It is shown that particle composition and geometry brings about a number of unique shape and size dependent optical properties of the structures.

LWE2 • 17:30-18:00 • invited

Laser ablation: from nanoparticles to nanostructures, E. V. Barmina, *Wave Research Center of A.M. Prokhorov General Physics Institute, RAS, Russia.*

The talk summarizes the characteristics and formation mechanisms of different kinds of nanoobjects fabricated by means of laser ablation in liquids. Two distinct approaches are reviewed as a function of laser parameters: laser surface nanostructuring and nanoparticles generation.

LWE3 • 18:30-18:15 • oral

Carbon nanotube based composites as materials for terahertz application, M. V. Shuba, S. A. Maksimenko, *Institute for Nuclear Problem, Belarus State University, Belarus.*

Length dependent localized plasmon resonance contributes to the terahertz response of single-walled carbon nanotubes. It has been shown that terahertz effective permittivity of the carbon nanotubes based composite strongly depends on the nanotube length.

SESSION LThF

September 29, 18:30-20:00,

Nanomaterials for Lasers (LAT-05)

LThF1

Photoluminescence of CdSe nanoplatelets through surface states, A.O. Muravitskaya, L.I. Gurinovich, A.V. Prudnikau, M.V. Artemyev, S.V. Gaponenko, *B.I. Stepanov Institute of Physics of NASB, Belarus.* The photoluminescence (PL) of colloidal CdSe nanoplatelets in external electric field has been studied experimentally. It was shown, that the low-energy PL band consists of two peaks of the Gaussian form with various amplitude and half-width, which can correspond to radiative recombination on defects of a crystal lattice or on surface traps.

LThF2

Optical properties of laser-deposited zinc oxide films doped with holmium fluoride, A.N. Chumakov, A. V. Gulay, A. A. Shevchenok, L. V. Baran, T. F. Raichyonok, A. G. Karoza, A. S. Matsukovich, N.A. Bosak, *B.I. Stepanov Institute of Physics of NASB, Belarus.* Holmium fluoride-doped zinc oxide films were deposited on a silicon substrate by multi-pulse high-frequency (5-50 kHz) laser evaporation of a ceramic target. The structure of the films was investigated with an atomic force microscope, and their spectra of photoluminescence, absorption, and Raman scattering were examined. It is shown that the doping of zinc oxide with holmium fluoride causes a significant increase in spectral transmittance of the films in a 1–10 μm range.

LThF3

Nonlinear Properties Of Photopolymer Nanocomposites Based On The Laser Ablation In Liquid Monomer Synthesized AgNPs And AuNPs, I.M. Pavlovets, N.A. Zulina, I.Yu. Denisyuk, *ITMO University, Russia.* AgNPs and AuNPs stable colloids were synthesized by laser ablation in liquid monomer. Solid film nanocomposites based on these colloids are prepared by photocuring and their optical and nonlinear optical properties are investigated

LThF4

Laser Assisted Synthesis of Composite Nanostructures in Liquid, V.S. Burakov, A.V. Butsen, N.N. Tarasenko, N.V. Tarasenko, *B.I. Stepanov Institute of Physics of NASB, Belarus.* Several approaches of pulsed laser ablation in liquids, such as the

sequential ablation of targets in the same solution, ablation of combined targets, as well as post irradiation are discussed for preparing composites nanoparticles.

LThF5

Phase retardation properties of the porous nanocomposite alumina films, V. Dlugunovich, A. Zhumar, N. Mukhurov, B.I. Stepanov Institute of Physics of NASB, Belarus. The methodology of Stokes-polarimetry and coherence matrix has been suggested for determination of the phase shift between the orthogonally polarized components of light transmitted by a nanoporous alumina film taking into account diattenuation of the films and depolarization of the transmitted radiation.