21st International Conference Laser Optics
ICLO 2024

is organized by
FUND FOR LASER PHYSICS

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We wish to thank the following for their contribution
to the success of this conference:
21ST INTERNATIONAL CONFERENCE
LASER OPTICS ICLO 2024

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LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY
P. Loza-Alvarez, ICFO, Spain
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FREE ELECTRON LASERS
M. Kiskinova, FERMI Elettra-SincrotroneTrieste, Italy
V. L. Nosik, Shubnikov Inst. of Crystallography, Russia
N. A. Vinokurov, Budker Inst. of Nuclear Physics, Russia

NONLINEAR PHOTOONICS: FUNDAMENTALS AND APPLICATIONS
A. Bednyakova, Novosibirsk State Univ., Russia
Ya. Kartashov, Inst. of Spectroscopy, Russia
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N. N. Rosanov, Vavilov State Optical Inst., Russia
Zhang Yiqi, Xi'an Jiaotong Univ., China

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F. Glas, CNRS and Université Paris-Saclay, France

NONLINEAR QUANTUM PHOTONICS
F. P. Laussy, Univ. of Wolverhampton, UK

LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION AND GLOBAL NAVIGATION
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N. M. Skornyakova, National Research Univ. MPEI, Russia
A. L. Sokolov, JSC RPC “PSI”, Russia
8TH INTERNATIONAL A. M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS

will be held as a part of 21ST CONFERENCE LASER OPTICS ICLO 2024,
and is organized by
PROKHOROV GENERAL PHYSICS INSTITUTE OF RAS

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21ST INTERNATIONAL CONFERENCE
LASER OPTICS ICLO 2024

TOPICS

R1 Solid State Lasers
- Ultrafast • Mid-IR • CW and pulsed • Compact sources • Emerging applications • Guided wave lasers • Fiber lasers (excluding high power) • Tunable lasers • Parametric amplifiers • Visible and UV lasers

R2 High Power Lasers: Fiber, Solid State, Gas and Hybrid
- Advances in high-power fiber, solid state, gas and hybrid lasers • High-power laser architectures including hybrid systems • Novel optical materials for high power applications and systems • Thermal and thermo-optical effects in lasers • High power multichannel laser systems • Fusion lasers and terawatt science • CO₂/CO lasers • Iodine lasers • Chemical lasers • Excimer lasers • Alkali vapor lasers

R3 Semiconductor Lasers, Materials and Applications
- Quantum-well, wire, dash and dot lasers and devices • Laser dynamics • MID-IR and Quantum Cascade lasers • Ultrashort pulse lasers • VCSELs and superlattice structures • Semiconductor disk lasers • UV and visible diode lasers and LEDs • Compact THz sources and applications • Nonlinear phenomena • Silicon photonics • Group IV Photonics • Novel semiconductor-based devices and applications • Biophotonics and emerging applications

R4 Laser Beam Control
- Wavefront correction • Adaptive optics • Phase conjugation • Dynamic holography • Holographic optical elements • Laser cavities • Stabilization and control of laser beam direction • Laser imaging • Coherent and non-coherent summation of laser beams • Singular laser optics • Structured light • Optical limiting • Optical and laser elements based on nanostructured materials • Optics and electrooptics of liquid crystals

R5 Super-Intense Light Fields and Ultra-Fast Processes
- Generation of high-power, super short pulses • Problems of «Fast Ignition» for the ICF • Laser plasma X-ray sources • Fast particle generation and acceleration by laser pulses • Femtosecond laser technology and applications • Physics of ultrafast phenomena • Ultrafast devices and measurements

R6 Lasers and Systems for Imaging, Green Photonics and Sustainability
- Remote and point sensing, including water and food safety monitoring • Ground, air, and space-borne LIDARs for vegetation, greenhouse gasses, wind measurements • Vehicle, aircraft, and spacecraft safety, including guide-star systems • Solar energy harvesting • Photochemistry and photobiology • Novel plasmon based sensors and lab-on-chip devices • Single molecule imaging • Super resolution microscopy • Multimodal and multi-scale imaging • Hyperspectral imaging • Mesoscopic imaging • Adaptive optics-based imaging • Novel imaging systems, reconstruction and processing algorithms

R7 Free Electron Lasers
- X-ray and other free electron lasers (FELs) • Theory of FEL radiation • Linear electron accelerators • Undulators • Optics at photon-beam transport systems • Electron- and photon-beam diagnostics • Photon detectors • Data acquisition systems • Experimental stations and science at FELs

R8 Nonlinear Photonics: Fundamentals and Applications
- Self-focusing, collapse, and applications • Conservative and dissipative optical spatial and spatio-temporal solitons • Nonlinear optics with structured light, optical vortices • Self-modulation and nonlinear temporal effects • Supercontinuum and frequency comb generation • High-harmonic generation • Nonlinear optics of few- and half-cycle pulses • Fiber optics and telecommunications • Nonlinear effects in multimode fibres • Machine learning • Nonlinear nanophotonics and plasmonics • Nonlinear meta-optics and metamaterials • Nonlinear optical devices, including microresonators, waveguides, and PT-symmetric systems • Nonlinear optomechanics • Nonlinear optics of low-dimensional materials • Nonlinear topological photonics • Topological lasers • Nonlinear photonics with surfaces and interfaces • Nonlinear polaritonics • Nonlinear THz optics
R9 Optical Nanomaterials
Modeling of nanostructures • Advanced methods of nanostructure synthesis • One-dimensional growth of semiconductor nanowires • Wide band gap nanostructures • Epitaxial quantum dots and related structures • Nanostructures for single photon devices • Nanostructures for THz radiation • Nanostructures for solar cells • Microcavities and photonic crystals • Hybrid nanostructures with pre-defined properties

R10 Nonlinear Quantum Photonics
Chip- and fiber-based nonlinear optics, frequency mixing processes, nonlinear dynamics, supercontinuum generation • Novel materials for optical gain and frequency conversion • Optical storage and quantum memories • Cavity quantum electrodynamics • Waveguide quantum electrodynamics • Single-photon lasers • Generation and control of entanglement and non-classical states of light • Quantum imaging and quantum metrology • Ultrafast phenomena, ultrafast measurements • Frequency combs and optical clocks • Single-photon nonlinear optics • Multiphoton physics • Quantum computing and communication • Integrated optical resonators & applications • Raman and Brillouin scattering & applications • Multimode integrated and fiber-based devices and systems • Applications of artificial intelligence in nonlinear photonics • Machine learning in integrated and/or fiber-based systems

Advanced picosecond lasers for satellite laser ranging • High power solid-state lasers for space junk monitoring • Atmospheric effects on laser ranging • Laser ranging retroreflector systems • Single-electron photodetectors • Lasers for space communication and cryptography systems • Time transfer via one-way laser ranging

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8TH INTERNATIONAL A. M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS

TOPICS

SYA Advanced laser medical systems and technologies
New medical applications and advanced laser medical systems for ophthalmology, dermatology, urology, endoscopic and micro surgery, dentistry, and other specialties

SYB Laser interaction with cells and tissues: clinical imaging and spectroscopy
Optical clearing and light transport in cells and tissues • Laser trapping and manipulation of biological particles; nonlinear interactions of light and tissues • Speckle phenomena in tissues • Quantification and imaging of cells, blood and lymph flows • Terahertz waves interaction with cells and tissues, autofluorescence and photodynamic diagnosis • Optical coherence tomography and diffuse optical imaging • New developments in non-invasive optical technologies, laser microscopy and spectroscopy of tissues

SYC Photonics and nanobiotechnology
Analytical biophotonics • Chemical and biosensing principles and instrumentation • Nanomaterials, methods and systems for diagnostics and therapy

SYD Photodynamic processes in biology and medicine
Photosensitizers for biology and medicine • Direct optical single oxygen generation • Photodynamic therapy • Photothermal action of laser radiation on bio-objects • Protection of organs and tissues against powerful and laser radiation • Photodynamic diagnosis • New photosensitizers for theranostic • Photodynamic action on pathogenic microflora
### MONDAY, 1 JULY

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<td>ICLO 2024 - PLENARY SESSION</td>
<td>PIEDMONT ROOM, FLOOR 3, P.1</td>
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<td>14:15-16:45</td>
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<td>NIKOLSKY + LEVINSON FOYER, P. 36, 39, 41, 46, 88</td>
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### MONDAY, 1 JULY

**ICLO 2024**

**PLENARY SESSION**

**PIEDMONTE ROOM**

**FLOOR 3, P.1**

**8TH INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS**

**PLENARY SESSION**

**PIEDMONTE ROOM**

**FLOOR 3, P.73**

**WELCOME RECEPTION**

**TOSKANA RESTAURANT**

**FLOOR 3**

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**A1** EXHIBITORS WORKSHOP

**PIEDMONTE**

**P.101**

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## THURSDAY, 4 JULY

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## FRIDAY, 5 JULY

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## EXHIBITION “LASERS AND PHOTONICS”

Nikolsky/Levinson Foyer - floor 2  
July 2-4, 10:00-18:30  
Exhibition manager: Olga P. Vinogradova, Fund for Laser Physics, Russia  
Exhibitors: see p.102

**A1. Exhibitors Workshop**  
Official Language: Russian  
Piedmonte Room, Floor 3  
July 3, 2024 15:00-17:00  
Moderator: Andrey Chuprov, Special Systems. Photonics, LLC, Russia  
see p.101

The venue of the Conference ICLO 2024 is the Hotel “Moskovskie Vorota”
### THURSDAY, 4 JULY

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### A2. Open meeting of the Technical committee for standardization 296 “Optics and photonics”

**Official Language: Russian**

**July 4, 2024 15:00-18:00 - Pudovkin Room, Floor 3**

**Moderator: Irina V. Khloponina, Institute PhOOLIOS RC “Vavilov SOI”, Russia**

1. The first two letters of the code indicate the day of the week:
   - Tu = Tuesday,
   - We = Wednesday,
   - Th = Thursday,
   - Fr = Friday.

2. The next characters indicate code of the session:
   - R = regular session,
   - W = workshop,
   - SY = Symposium

3. The number at the end of the code gives the position of the paper within the session (first, second, third, etc.).

4. Index «p» before the number indicates the poster session.

For example, a session numbered ThR1-p04 would indicate that this paper is to be presented at Thursday, at session R1, it is a poster paper and is the fourth paper presented during the session.
ICLO 2024 Venue:
Moskovskiy Vorota Hotel – St. Petersburg

SECOND FLOOR

- Petrov-Vodkin 3
- Petrov-Vodkin 2
- Petrov-Vodkin 1
- Registration
- LIFTS
- TO LOBBY
- Levinson foyer
- Nikolsky foyer

THIRD FLOOR

- Molinary room
- Gabo room
- Stenberg 2
- Stenberg 1
- Richter 1, 2
- Pudovkin 1, 2

Registration

12 Richter
12 Pudovkin
12 Piedmonte

Moskovskiy Vorota Hotel – St. Petersburg

ICLO 2024 Venue:
**R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID**

**MoPL-01**
11:15-12:00

**Ultrafast magnetism - terra incognita beyond the classical approximations (Plenary)**
A. Kimel; Radboud University, The Netherlands

Abstract is not available.

**MoPL-02**
12:00-12:45

**Light as a factor in controlling plant growth and development (Plenary)**
Yu.N. Kulchin; Institute of Automation and Control Processes FEB RAS, Russia

Abstract is not available.

**MoPL-03**
12:45-13:30

**Semiconductor colloidal quantum dots: benefits and challenges for optoelectronic applications (Plenary)**
A.V. Rodina; Ioffe Institute, Russia

A brief review on the colloidal quantum dots (semiconductor nanocrystals) discovery, research directions and applications will be presented. Benefits and challenges of colloidal nanocrystals for optoelectronic applications will be discussed. The modeling results of nanocrystal surface effect on the electronic structure and radiative recombination efficiency will be presented. The work was supported by the RFS grant No. 23-12-00300.

- Lunch Break -
**TuR02-07**  
11:30-12:00  
**Efficient gas lasers pumped by diffuse discharges initiated by runaway electrons (Invited paper)**  
A.N. Panchenko, V.F. Tarasenko; Institute of High Current Electronics SB RAS, Russia  
New method for pumping gas lasers based on diffuse discharges initiated by runaway electrons in gaps with an inhomogeneous electric field was proposed and realized. Efficient lasing in spectral ranges from IR to VUV was obtained. Ultimate efficiency of nitrogen, HF(DF) and VUV F2 lasers had been achieved. New operation modes of VUV H2 laser on Lyman band were obtained.

**TuR02-08**  
12:00-12:30  
**Broadband hybrid laser systems based on mid-IR multiline gas lasers and nonlinear crystals (Review) (Invited paper)**  
Frequency conversion of CO and CO2 lasers emission in nonlinear crystals resulted in significant expansion of their output spectral range up to ~20 μm and the increase of the number of spectral lines generated by these hybrid systems.

**TuR02-09**  
12:30-13:00  
**Planar IR lasers with RF and microwave pumping (Invited paper)**  
A.P. Mineev, S.M. Nefedov, P.A. Goncharov; Prokhorov General Physics Institute RAS, Russia  
The output power and spectral characteristics of radiation were studied during RF or MW gas-discharge excitation of planar IR-lasers depending on the composition and pressure of the gas mixture, pump pulse parameters. In new experiments we studied a (CO2-Xe) laser with MW pumping and RF exited CO2 laser with an unstable resonator and additional optical elements located outside the laser.

---

**TuR02-10**  
13:00-13:15  
**Yellow neon laser pumped by a pulsed inductive longitudinal discharge**  
A.M. Razhev1, D.S. Churkin2, R.A. Tkachenko1,2; Institute of Laser Physics SB RAS, Novosibirsk State University, Russia  
The experimental studies results of the energy, temporal and spatial lasing characteristics of Penning neon laser (λ = 585.3 nm) pumped by a pulsed inductive longitudinal discharge are presented. The maximum lasing energy of about 0.14 mJ was achieved. The average generation duration was 200 ns (FWHM) which corresponds to pulse power of 700 W.

---

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

- Lunch Break -

---

**TuR02-12**  
16:00-16:15  
**Thermally induced distortions of radiation in multipass Faraday isolators**  
A.V. Starobor, O.V. Palashov; Federal Research Center A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia  
We investigated thermally induced depolarization in multi-pass Faraday isolators schemes, that are inevitable for low Verdet constant media. It is shown theoretically and experimentally that it is possible to increase isolation ratio 1.6 times by choosing the optimal distance between beams in "linear" arrangement and there is no optimum for the arrangement of beams along a circle.

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

**TuR02-14**  
16:30-16:45  
**New scheme of Faraday isolator with dV/dT distortions compensation**  
I.L. Snetkov; FRC A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Lobachevsky State University of Nizhny Novgorod, Russia  
A new scheme of a Faraday isolator with compensation of the contributions to thermally induced depolarization from the temperature dependence of the Verdet constant was proposed. The efficiency of using the proposed scheme and comparison with known schemes is analyzed analytically and numerically at two cases: a cryogenic isolator and an isolator on crystalline material cut in a critical orientation.
Enhanced stability of SHG in PPLN incorporated in the Pierce oscillator circuit

K.V. Zotov¹, N.V. Tereshchenko¹, A.Yu. Ostapiv¹, G.Yu. Ivanov¹, V.P. Surovtseva¹, A.V. Konyashkin², O.A. Ryabushkin²; ¹Moscow Institute of Physics and Technology (National Research University), Russia; ²Kotelnikov FIRE RAS, Russia

We introduce a novel approach to temperature stabilization of nonlinear-optical crystals. The crystal is turned into a temperature sensor by measuring its piezoelectric resonance frequency related to the average temperature. We achieve stable second harmonic generation in periodically poled lithium niobate crystal at 30% more power compared to the standard approach. Long-term stability of SH power was also enhanced.

- Coffee Break -

R04: LASER BEAM CONTROL
Location: Pudovkin 1+2 Room, Floor 3; Date: Tuesday, July 02, 2024

Session Chair:

TuR04-01 09:00-09:30
Adaptive optical image correction system for the Large Solar Vacuum Telescope (Invited paper)
A.G. Borzilov, P.A. Konyaev, V.P. Lukin; V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia
The report presents an analysis of the results of processing experimental data obtained during the expedition of the LCAO IOA SB RAS in August 2023 at the LSIT of the Baikal Astrophysical Observatory of the Institute of Solar-Terrestrial Physics SB RAS.

TuR04-02 09:30-10:00
Axially symmetric Hermite-Gaussian beams for the space-earth quantum cryptography channel (Invited paper)
D.D. Reshetnikov, A.L. Sokolov, V.Yu. Venediktov, V.M. Petrov; ¹Faculty of Physics, St. Petersburg State University, ²IC “Research-and-production corporation “Precision system and Instruments” (RPC PSI), Russia
The work provides a description of Hermite–Gaussian beams with an axially symmetric polarization structure, suitable for quantum space communication and cryptography systems. The possible creation and detection of such beams within the framework of a communication and cryptography protocols using the devices with a radial polarizer is discussed.

TuR04-03 10:00-10:15
Imaging of a natural star under the angular anisoplanatism effect
V.A. Bogachev¹, A.V. Nemtseva¹, F.A. Starikov¹; ¹FSUE “RFNC-VNIIEF”, ²Lomonosov Moscow State Univ., ³Saratov Physics and Technology Institute of the National Research Nuclear University MEPhI, Russia
The results of numerical simulation of light propagation from a natural star through the turbulent atmosphere to the ground-based telescope and obtaining star image using adaptive optical system are presented taking into account the effect of angular anisoplanatism.

TuR04-04 10:15-10:30
Wavefront correction with conformal and holographic optical elements
V.P. Korolkov¹, R.I. Kuts¹, D.A. Belousov¹, A.R. Sametov¹, S.K. Golubtsov¹, A.I. Malyshev; ¹IA&E SB RAS, Russia
The results of the development of technologies for the manufacture of static conformal refractive and computer-generated holographic correctors of laser beam wavefronts are presented. The results of the practical application of the manufactured wavefront correctors are shown.

TuR04-05 10:30-11:00
An alternative wavefront sensing technique for free-space optical communication (Invited paper)
Huizhe Yang, Yonghui Liang, Jin Liu, Yukuan Zhou; College of Advanced Interdisciplinary Studies, National University of Defense Technology, China
Aiming at the problem caused by the point-ahead angle in free-space optical communication systems, this paper adopts an alternative wavefront sensing technique termed PPPP. The feasibility of PPPP is verified through both the numerical simulations and laboratory experiments. The results demonstrate that PPPP and the commonly-used Shack-Hartman wavefront-sensor achieve similar wavefront reconstruction accuracy.

- Coffee Break -
these modes up to 7th order inclusive gives the improvement of focusing radius are proposed. Calculations indicate that sequential correction of minimizing the residual geometrical root-mean squared focal spot statistics new "Karhunen-Loève-Lukosz" aberration modes with a property of changing atmospheric turbulence and the choice of an optimal set of communication channels and cryptographic channels under conditions of hybrid polarization. The polarization of these beams combines azimuthal polarization and circular polarization.

- Lunch Break -
Numerical simulation of coherent summation of laser beams in the presence of non-idealities in the dipole focusing system

D.N. Bulanov, A.V. Korzhimanov, E.A. Khazanov, A.A. Shaikin; Inst. of Applied Physics RAS, Russia

A programming library was developed, using Stratton-Chu diffraction integrals for calculating reflected fields. Focusing schemes with tunable number of beams and mirrors placement were studied, considering the influence of phase distortion and aberrations. The intensity above $3 \times 10^{26} \text{ W/cm}^2$ was found theoretically attainable in a system of 12 beams of 50 PW each with about 90% of that value realistically achievable.

- Coffee Break -

TuR04-18 17:30-17:45

Broadband thin-film lithium niobate waveguide modulator with high-order mode suppression

M.V. Parfenov, A.V. Varlamov, I.V. Ilchen; A.A. Usikova, Yu.M. Zadiranov, A.V. Tronev, P.M. Agruzov, A.V. Shamrai; Ioffe Institute, Russia

A high-frequency modulator based on a multimode optical waveguide made of thin-film lithium niobate was designed and studied. The modulator was fabricated in a topology with electrodes placed near edges of the waveguide to suppress higher-order waveguide modes and provide quasi-single-mode light propagation. Efficient modulation with voltage-length product $V_{\pi L} = 4 \text{ Vcm}$ and bandwidth of more than 30GHz have been demonstrated.

TuR04-19 17:45-18:00

Controllable formation of giant nonlinearities in integrated optical travelling wave modulators

V.S. Gerasimenko1,2, N.O. Gerasimenko1,2, V.M. Petrov1,2; Research and Educational Center for Photonics and OptoInformatics, ITMO University, 1QuantTelecom, 2Dept. of General Physics, St. Petersburg State University, Russia

Optical frequency combs formed by phase modulator can be used in many physical applications. In this paper we experimentally demonstrate, that simple scheme containing a phase modulator and an optical fiber back-coupling loop can be used to increase the optical frequency comb spectral width several times.

TuR04-20 18:00-18:15

Development and research of an angular metasurface scale and a new method for measuring the rotation angle

E.A. Efremova1,2, I.R. Krylov1,2, U.V. Prokhorova1,2, E.V. Shalymov1,2, V.I. Shoev1,2, V.Yu. Venediktov1,2, A.A. Zinchik1; ITMO University; 1St. Petersburg State University; 2St. Petersburg Electrotechnical University "LETI"; Russia

A new optical method for measuring the rotation angle is considered, based on the sensitivity of the resonant response of a metasurface scale to its orientation. The scale prototype was made of tantalum oxide on a quartz glass substrate. The prototype spectrum and the dependence of the optical response on the rotation angle are consistent with the simulation results.

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

TuR05-01 09:00-09:30

Laser sources of ultrarelativistic electrons, positrons and MeV gammas (Invited paper)

N.E. Andreev1,2, I.R. Umarov1,2, V.S. Popov1,2; Joint Institute of High Temperatures RAS; 1Moscow Institute of Physics and Technology, Russia

An efficient concept for creating sources of γ-radiation and positron based on the generation of relativistic electrons in the regime of direct laser acceleration is discussed. The dependences of the parameters of laser-generated electron bunches and hard radiation on the laser and plasma parameters for subpicosecond and femtosecond laser pulses are obtained and analyzed for current and future experiments.

TuR05-02 09:30-09:45

Breit-Wheeler pair production by circularly polarized ultra-intense laser pulses in a noble gas

I.A. Aleksandrov1,2, E.D. Akimkina1, A.A. Andreev1,2; 1St. Petersburg State University; 2Ioffe Institute RAS, Russia

We investigate conditions for Breit-Wheeler pair production within the interaction of a circularly polarized ultra-intense laser pulse with gamma photons emitted by seed particles. In the initial state, we consider neutral xenon, the electrons of which get ionized. We examine the magnetic field effects and enhancement of the pair-production process due to the circular polarization of the laser field.
A series of hydrodynamic calculations of target irradiation with a nano-second laser pulse were carried out, describing the plasma density profiles that arise during target expansion, depending on the parameters of the laser prepulse/additional pulse. The results obtained make it possible to increase the efficiency of ion acceleration during the interaction of short laser pulses with a plasma target.

TuR05-04  10:00-10:30
Electron accelerator driven by ITW femtosecond laser pulses: target, principles and prospects (Invited paper)
K.A. Ivanov1,2; I.N. Tsyymbalov1,2; D.A. Gorlova1,2; S.A. Shulyapov1; I.P. Tsygintsev1; I.Yu. Vichev1, Yu.V. Kochetkov1, R.V. Volkov1, A.B. Savel’ev2,3; 1Physics Faculty, Lomonosov Moscow State University, 2Lebedev Physical Institute, 3Institute for Nuclear Research, Russia

We described the self-trapping regime of super-intense laser pulse propagation in a near-critical density plasma that is favorable for generation of multi-nC high energy electron bunch. The latter is of strong demand for numerous applications. The properties of the generated electrons and their different radiation-nuclear applications will be discussed.

TuR05-08  12:00-12:15
High-brilliance synchrotron radiation in relativistic self-trapping regime
O.E. Vass1,2; M.G. Lobok3; V.Yu. Bichenkov1,2; VNIIA, LPI, Russia

Synchrotron radiation source based on the laser-plasma acceleration of electrons in the relativistic self-trapping regime of the laser pulse propagation has a small size, short duration and low divergence that provides a high brightness. We discuss angular-spectral characteristics of this secondary radiation, which can be generated using the high-power laser facilities that already exist or are under construction in Russia.

TuR05-09  12:15-12:30
Bremsstrahlung gamma-ray source for prompt gamma-ray activation analysis based on the regime of relativistic self-trapping of light
M.G. Lobok1,2; V.Yu. Bichenkov1,2; VNIIA, LPI, Russia
A numerical GEANT4 experiment on gamma-activation of thin plates made of natural gold and depleted uranium was carried out as a first-principles experiment. A comparison between bunch of monoenergetic collimated electrons with energy 15 MeV and a PIC (VSIM) simulation showed that one from relativistic self-trapping electron source, which interacted with a bremsstrahlung converter preceding gamma-activation and nuclear-spectra analysis, was performed.

TuR05-11  13:00-13:15
Electron acceleration and THz emission during laser-cluster interaction
N.A. Kuzechkin1; A.A. Angeluts1,2; A.V. Balakin2; P.M. Solyankin2; A.P. Shkurinov2; 1Faculty of Physics, Lomonosov Moscow State University, 2Department of Physics, Lomonosov Moscow State University, Russia

We have studied the processes of electron acceleration and THz emission, undergoing simultaneously during laser excitation of the gas-cluster jet. The properties of the electron beam and THz radiation power were measured under various conditions of the cluster excitation and parameters of the laser radiation.

TuR05-12  13:15-13:30
Efficient generation of low-frequency radiation at back-reflection of intense laser pulses from near-critical-density targets
A.V. Koshchinanov; Gaponov-Grekhov Institute of Applied Physics RAS; Lobachevsky University of Nizhny Novgorod, Russia
It is shown that when intense laser pulses are reflected from a near-critical density plasma, the Doppler shift leads to generation of intense radiation in both the high-frequency (ultraviolet and x-ray) and low-frequency (mid-infrared) ranges. The efficiency of energy conversion into the wave-length range above 3 μm can reach several percent, which allows to obtain relativistically intense mid-infrared pulses.
Coherent and incoherent scattering of a counter-propagating laser pulse at a relativistic electron mirror (Invited paper)

V.V. Kulagin\(^1\), V.N. Kornienko\(^2\), V.A. Cherepennik\(^3\), H. Suk\(^4\), Sternberg State Astronomical Institute, Lomonosov Moscow State University; \(^5\)Kotelnikov Institute of Radioengineering and Electronics RAS, Russia; \(^6\)Department of Physics and Photon Science, Gwangju Institute of Science and Technology, South Korea

Using 2D numerical simulations, interaction of counter-propagating probe laser pulse with a relativistic electron mirror formed by accelerating laser from plasma layer is investigated. It is shown that both coherent and incoherent parts in the scattered radiation can be formed and their characteristics are studied. The incoherent radiation frequency can be considerably larger than that for coherent part.

Study of electron acceleration dynamics by modifying a gas target with a shock wave

I.N. Tsyymbalov\(^1\), D.A. Gorlova\(^1\), K.A. Ivanov\(^1\), A.B. Savel’ev\(^1\); \(^1\)Faculty of Physics, M.V. Lomonosov Moscow State University, \(^2\)Institute for Nuclear Research RAS, Russia

We present a method for studying the dynamics of electron acceleration, based on interrupting the acceleration process by the shock wave front created by an additional nanosecond laser pulse. Experimentally obtained electron spectra at various stages of acceleration are provided, as well as confirming results from PIC modeling.

A numerical study of power KrF laser pulse interaction with condensed targets.

I.G. Lebo; Russian Technological University - MIREA, Russia

The physico-mathematical models and codes, which adequately describe the data from experiments performed at the KrF laser facility, provide a basis for reactor scale target design. We have discussed the opportunity of fusion-fission reactor creation.

Simulation of bunching process and radiation of electrons beams in undulators with plasma by the particle-in-cell technique in relativistic boosted frames (Invited paper)

A. Zhidkov; Quantum Beam Physics Dept., Sanken, Osaka University, Japan

A.A. Serdobintsev\(^2\), P.K. Kashkarov\(^1\); \(^1\)Lomonosov Moscow State University, \(^2\)Saratov State University, Russia

We created a laser-plasma X-ray source based on the femtosecond fiber laser with high yield \(\sim 2 \times 10^9\) phot/s/2\(\pi\) (3-12 keV), and with a source size diameter of approximately 10 microns. The X-ray yield and the source size were optimized by using artificial intelligence, the He flow and nanosecond pre-pulse.

Femtosecond laser pulses fabrication of polarization-sensitive structures in silicon films

S.V. Zabotnov\(^1\), D.V. Shuleiko\(^1\), E.V. Kuzmin\(^1\), P.P. Pakholchuk\(^1\), L.D. Volkovynova\(^1\), \(^1\)Saratov State University, Russia

Femtosecond laser irradiation of amorphous silicon films makes it possible to fabricate the laser-induced periodic surface structures which provide noticeable dichroism and birefringence of the films in the infrared range.

On the spectroscopic properties of biological entities and ecosystems and the definition of metric and spectral identifiers (Invited paper)

A. Reyes, M. Preciado, A. Argüelles, C. A. Galindez, E. Solarte; Quantum Optics Group, Univ. del Valle, Colombia

Diffuse reflectance and fluorescence (UV-VIS-NIR) measurements, their utility to characterize biological entities, as well as our advances in methods for characterization of plants, water quality diagnosis and the state of the closest troposphere are presented.

Integrated Application of Laser Technologies of Sustainable development Energy

Sch. Maignan\(^1\), E.R. Kozhanova\(^1\), A.A. Volodina\(^1\), O. V. Novoselova\(^1\); \(^1\)Department of General and Applied Physics, Moscow State University of Civil Engineering (National Research University), \(^2\)Department of Information Security of Automated Systems, Yuri Gagarin State Technical University, \(^3\)Department of Housing and Utilities Sector of Organization, Moscow State University of Civil Engineering (National Research University), Russia

Sustainable development of cities in countries is largely determined by the global state of the environment. Integrated Application Laser Technologies is the one of sustainable development to increase energy needs for sustainable development of mankind.
Towards all-fiber chalcogenide system for spectroscopic remote sensing in mid-IR
E.A. Romanova,1,2 N.D. Parshina,1 A.P. Velumzhov,1 M.V. Sukhanova,1 T.V. Koterева,1 V.S. Shiryaev;2 Institute of Physics, Saratov State University; 2 Institute of Chemistry of North Carolina at Charlotte, USA

Functionality of an analytical system on the base of chalcogenide fibers for remote mid-IR spectroscopy of liquids and gases in real time has been studied in theory and experiment. Creation of such compact sensors is in demand in industries, ecology, medicine for chemical analysis of various substances. Design of the system is discussed together with experimental and technological peculiarities.

Increase the data acquisition rate of a ghost polarimetry system via deep learning
V.S. Shumigai, P.E. Moreva, V.S. Tuchin, A.M. Startseva, B.A. Nasedkin, A.N. Tsyupkin; ITMO Univ., Russia

Application of ghost polarimetry is significantly limited due to the low data acquisition rate. We present the integration of deep learning into a ghost polarimetry to analyze the intensity correlation function and subsequent formation of improved patterns with a modified spectrum of spatial frequencies. Proposed modification makes ghost polarimetry more attractive for biological researches, where the object is often dynamic.

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

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

Measuring anatomy of vascular structures: workflow for analysis of 3D optoacoustic angiographic data
A.Yu. Korobov,1,2 Z.V. Besedovskaya,1 E.A. Petrov,1 A.A. Kurnikov,1 A.M. Glyavina,1 I.N. Druzhkova,1 M.A. Sirotkina,1 S.V. Nemirova,1 A.G. Orlova,1 D.A. Gorin,1 D. Razansky,1 P.V. Subochev,1 Ultrasonic and Opto-Acoustic Diagnostics Laboratory, Institute of Applied Physics RAS, IAP RAS, 2 CBIR, Skolkovo Institute of Science and Technology, 3 Privolzhsky Research Medical University, Russia

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

6-wavelength VIS-SWIR laser with acousto-optic attenuation
M.O. Shirkova, A.S. Machikhin, A.I. Lyashenko; STC UI RAS, Russia

We propose a technique for simultaneous selection and attenuation of up to eight spectral components through smooth tuning the frequencies and amplitudes of acoustic waves in acousto-optic crystal equipped with two piezoelectric transducers.
R07: FREE ELECTRON LASERS

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

R07: FREE ELECTRON LASERS 1
Session Chair:

TuR07-01  17:30-18:00
Experimental stations of the Novosibirsk free-electron laser facility and research on them (Invited paper)
The most significant research results achieved at the terahertz radiation of the Novosibirsk free-electron laser in recent years will be presented.

TuR07-02  18:00-18:15
High-temperature continuous terahertz laser discharge at NovoFEL: parameters and applications
V.V. Kubarev1, O.A. Shevchenko1, Ya.V. Gorbachev1, A.V. Sidirov1, A.V. Vodopianov1, A.P. Veselov1; Budker Institute of Nuclear Physics, 2Gaponov-Grekhov Institute of Applied Physics, Russia
A stable point-like thermodynamically-equilibrium plasma with density of \(3 \times 1 \times 10^{17} \text{ cm}^{-3}\) and temperature of 4-4.5 eV was obtained in a continuous laser discharge at NovoFEL at an average power of 180 W. Such plasma is a bright source of VUV radiation, and when its temperature reaches 10-12 eV, it can be a bright source of EVUV radiation.

TuR07-03  18:15-18:30
Target design for high-pressure temperature matter using inelastic x-ray scattering at the HED Instrument at the European XFEL
D. Bespalov1, K. Appel2, E. Brambrink3, D. Kraus3, R. Redmer3, U. Zastrau3; 1High-Energy Density Science, European XFEL, 2Institut für Physik, Universität Rostock, Germany
This work presents an optimized target design for high-resolution inelastic x-ray scattering at the HED instrument, European XFEL. Utilizing hydrodynamics simulations and preliminary tests, the laser-irradiated aluminum target exhibits enhanced capabilities for studying WDM under extreme conditions.

TuR07-04  18:30-18:45
Side-band modes in open optical resonators of pulse-periodic free electron lasers
V.V. Kubarev; Budker Institute of Nuclear Physics; Voevodsky Institute of Chemical Kinetics and Combustion, Russia
Using the examples of terahertz and far-infrared Novosibirsk free electron lasers, a new cavity type of side-band modes that arise for certain periodic cavity geometries when the pump and cavity axes do not coincide is described.

TuR07-05  18:45-19:15
Recent developments in the applications of X-ray Free Electron Lasers Invited
M. Cherghi; Elettra Sincrotrone Trieste S.C.p.A., Italy; Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne (EPFL), Switzerland
X-ray Free Electron Lasers (XFELs) have been a game changer in time-resolved X-ray spectroscopic studies of matter thanks to their ultrashort pulses, high photon flux/pulse and photon energy range. I will briefly present some of the most representative studies carried out on chemical, biological systems and solid materials. I will then dwell on trends that aim at exploiting the high photon fluxes and coherent properties of the XFEL beams, in order to implement non-linear X-ray spectroscopies, akin to what happened in the 1960s, after the birth of the laser. Indeed, techniques such as multiphoton absorption, second-harmonic generation and four-wave mixing have been implemented, and in the case of Transient Grating core-level spectroscopy, now routinely used.

TuR07-06  19:15-19:45
Magnetic measurements, pole tuning, landmark measurements and shimming process of hybrid X-ray undulators Invited
B. Ketenoglu; Ankara University, Türkiye

TuR07-07  19:45-20:15
Status and future of the Novosibirsk free electron laser facility Invited
O.A. Shevchenko; Budker Inst. of Nuclear Physics SB RAS, Russia

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Location: Stenberg 2 Room, Floor 3; Date: Tuesday, July 02, 2024

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 1
Session Chair:

TuR08-01  09:00-09:30
Machine learning control of complex nonlinear dynamics in fibre lasers (Invited paper)
S. Boscolo1, J. Peng2, X. Wu2, Y. Zhang2, C. Finot3; 1Aston Institute of Photonic Technologies, Aston University, United Kingdom; 2State Key Laboratory of Precision Spectroscopy, East China Normal University, China; 3Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-Université de Bourgogne, France
We review our recent work on the use of genetic algorithms to assist in the control and study of non-stationary nonlinear wave dynamics in ultrafast fibre lasers. These include repetitive patterns, such as breathing solitons and breather molecular complexes, and non-repetitive rare events.

TuR08-02  09:30-10:00
Beam self-cleaning and wave thermalization in multimode fibers (Invited paper)
F. Mangini1, M. Ferraro2, W.A. Gremchuk1, M.D. Gervaziev4, D.S. Kharenko4, S.A. Babin4, S. Wabnitz4; DIET, Sapienza University of Rome, Italy; 2Department of Physics, University of Calabria, Italy; 3Department of Physics, Novosibirsk State University, Russia; 4Institute of Automation and Electrometry SB RAS, Russia
Spatial beam self-cleaning in multimode optical fibers may be described as a result of wave thermalization. Our mode decomposition experiments confirm the validity of this approach, but also point to open questions.
Integrated microresonator as a nonlinear reflecting mirror in fiber laser cavity for optical frequency comb generation

A.A. Mirtchyan¹, Z. Ali¹, M.S. Mischkevsky¹, N. Dmitriev¹, A. Nasibulin¹, I. Bilenko¹, Yu.G. Gladush¹, ¹Skolkovo Institute of Science and Technology; ²Russian Quantum Center, Russia

We introduce integrated microring cavity within the fiber laser resonator as both a source for cavity solitons and a nonlinear reflecting mirror. We showcase a self-starting and robust soliton frequency comb generation with a spectral width surpassing 400 nm, far exceeding the erbium amplification window.

Dynamics of long period pulsations when intra-cavity loss change

A.V. Sudin¹, S.N. Ushakov¹,², I.A. Volkov¹, K.N. Nishchev¹, M.Y. Vlasov¹,², ¹National Research Mordovia State Univ.; ²Prokhorov General Physics Inst. RAS; ³Joint-Stock Company "The Engineering Centre of Fiber Optics", Russia

We report on the dynamics of laser generation during the transition from quasi-stable mode-locking to mode-locking accompanied by long period pulsations. In this case, the optical spectrum in the long period pulsation regime is accompanied by emission in three spectral regions with maximum at three wavelengths: 1562, 1598 and 1623 nm.

Modulation instability threshold increase in phase-sensitive optical time-domain reflectometer by narrowband optical filtration

D.R. Kharasov¹,², E.A. Fomiryakov¹,², D.M. Bengalskii¹, S.P. Nikitin¹, O.E. Nanií¹,², V.N. Treshchikov¹, T8 Sensor LLC; ¹Lomonosov Moscow State University, Russia

We demonstrate the threshold increase of Modulation Instability in phase-sensitive optical time-domain reflectometer by implementing 10 GHz-bandwidth optical filter.

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

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

In this work, experimental studies of the important characteristics of plasma channels generated by fs-laser pulses with wavelengths of 0.36-1.7 μm in distilled water have been completed. We confirmed the quadratic dependence of the critical self-focusing power on the fs-pump wavelength and determined the nonlinear refractive index of water in the visible-mid-IR range. This research was funded by the Russian Science Foundation (project no. 23-22-00453); https://rsfc.ru/en/proj ect/23-22-00453/.

Optoacoustic effects on laser breakdown in a liquid

A.V. Bulanov; V.I. Fichev Pacific Oceanological Institute FEB RAS, Russia

The work is devoted to the study of acoustic effects accompanying an optical breakdown in a liquid generated by focused laser radiation during interaction with the liquid surface. It is proposed to use an optical-acoustic method associated with the use of laser radiation that causes optical breakdown - optical cavitation, accompanied by a strong sound generation effect.
Emission induced by an energy transfer from electronic excitations in SiO₂ to N₂ molecules
T. Jessewitsch 3, U. Scherf 3, D.G. Lidzey 2, P.G. Lagoudakis 1
1 Hybrid Photonics
Theoretical and Applied Electromagnetics, Russia
2 Moscow Institute of Physics and Technology; 3 Institute for Polymer Technology, Bergische Universität Wuppertal, Germany

When the flow of uncorrelated photons exceeds the flow of correlated photons, cross-correlations remain nonclassical. We show that cross-correlations are important in natural systems of nonclassical light and that they have been long-time proposed, but also harness or enhance N-photon correlations for quantum engineering of light. This requires the alteration of the light statistics under spectral filters. In natural systems of nonclassical light is produced by spontaneous Raman scattering, and we consider cross-correlations even when the flow of correlated photons exceeds the flow of correlated photons in the scattered Raman light by an order of magnitude.

Shaping energy landscape of organic polariton condensates in double dye cavities
A.D. Putintsev1, K.E. McGhee2, D.A. Sannikov1, A.V. Zasedatelev1, J.D. Topfer1, T. Jessewitsch1, U. Scherf1, D.G. Lidzey2, P.G. Lagoudakis3
1 Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, Russia; 2Department of Physics and Astronomy, University of Sheffield, UK; 3Macromolecular Chemistry Group and Institute for Polymer Technology, Bergische Universität Wuppertal, Germany

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

Emission induced by an energy transfer from electronic excitations in SiO₂ to N₂ molecules
V.Y. Panyukov1,2, V.Yu. Shishkov1,2,3, E.S. Andrianov1,2,3
1 Dukhov Research Institute for Automatics (VNIIA); 2 Moscow Institute of Physics and Technology; 3 Laboratory of Quantum Engineering of Light, South Ural State University, Russia

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

Shaping energy landscape of organic polariton condensates in double dye cavities
A.D. Putintsev1, K.E. McGhee2, D.A. Sannikov1, A.V. Zasedatelev1, J.D. Topfer1, T. Jessewitsch1, U. Scherf1, D.G. Lidzey2, P.G. Lagoudakis3
1 Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, Russia; 2Department of Physics and Astronomy, University of Sheffield, UK; 3Macromolecular Chemistry Group and Institute for Polymer Technology, Bergische Universität Wuppertal, Germany

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

Tuning quantum emission with frequency filtering and homodyning (Invited paper)
E. del Valle, Física Teórica de la Materia Condensada-IFIMAC, Universidad Autónoma de Madrid, Spain; Institute for Advanced Study, Technische Universität München, Germany

Paying attention to the dressed-state structure at the multiphoton level, we can select photons from the spectral sidebands only, that form a cascaded emission, obtaining frequency-time entangled pairs, as has been long-time proposed, but also harness or enhance N-photon emission from non-emitting parts of the spectrum.

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

The alteration of the light statistics under spectral filters is a fundamental problem that defines the range of applications of non-classical light sources. In this talk, I will showcase the influence of the spectral filters on the statistics of light for some particular problems, including an incoherently pumped two-level system, Mollow triplet, and Raman scattering light.

Statistical properties of light produced by spontaneous Raman scattering
I.V. Panyukov1,2, V.Yu. Shishkov1,2,3, E.S. Andrianov1,2,3
1 Dukhov Research Institute of Automation (VNIIA); 2 Moscow Institute of Physics and Technology; 3 Institute for Theoretical and Applied Electromagnetics, Russia

In natural systems of nonclassical light is produced by spontaneous Raman scattering on an ensemble of molecules. We consider cross-correlations between Stokes and anti-Stokes signals produced by spontaneous Raman scattering. We show that cross-correlations remain nonclassical even when the flow of uncorrelated photons exceeds the flow of correlated photons in the scattered Raman light by an order of magnitude.
TuR10-07 11:30-12:00

Multiphoton processes from single-photon emitters (Invited paper)

E. Zubizarreta Casalengua; Technical University of Munich, Germany

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

TuR10-08 12:00-12:30

Photon-number encoding for quantum optical applications (Invited paper)

C.A. Solanas; Univ. Autonoma de Madrid, Spain

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

TuR10-09 12:30-13:00

Non-classical resonance fluorescence of a semiconductor quantum dot (Invited paper)

Juan Loredo; University of Vienna, Austria

I will discuss the experimental implementation of a genuine quantum light-matter interface: quantized light interacting with a quantum emitter. The first part describes the resonant excitation of a quantum dot using a single photon, where coherent scattering is observed. The second part describes the effective interaction between two photons, mediated by a quantum dot, where processes of stimulated emission are observed.

TuR10-10 13:00-13:15

Generalized Ramsey methods in precision laser spectroscopy: from atomic clocks to interferometers

A.V. Taichenachev1, V.I. Yudin1,2, T. Zanon-Willette4; Institute of Laser Physics SB RAS, ‘Novosibirsk State Univ., ‘Novosibirsk State Tech. Univ., Russia; ‘Sorbonne Univ., France

This report provides an overview of methods for suppressing field shifts in atomic clocks and interferometers using various generalized Ramsey schemes.

TuR10-11 13:15-13:30

Quantum ghost polarimetry with correlated photons

E.F. Bityaev, D.M. Agapov, D.N. Frolosov, A.S. Chirkin; Faculty of Physics, Moscow State University, Russia

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

- Lunch Break -

TuR11-00 14:30-15:00

Key problems of creating a solar aerospace energy complex with remote energy transfer

A.S. Sigov, V.F. Matyukhin; MIREA - Russian Technological University, Russia

Abstract is not available.

TuR11-01 15:00-15:30

Coherent laser systems for remote atmosphere sensing (Invited paper)

A.S. Boreysho1,2, M.A. Konyaev1,2; BSTU «VOENMEH» named after D.F. Ustinov; ‘Laser Systems Ltd., Russia

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

TuR11-02 15:30-16:00

Lasers for satellite and lunar ranging (Invited paper)

A.F. Kornev; ‘Lasers & Optical Systems’ Co., Ltd., Russia

A review of lasers for satellite and lunar ranging is made. The requirements for such lasers and the basic principles of their design are discussed. The lasers we have developed are described, in particular the Nd:YAG 3 J, 330 Hz, 7 ns laser for location of various space objects, including space debris, and 250 ml picosecond laser for lunar ranging.
TuR11-05
Design and systems characteristics for free-space laser communication terminals
K.V. Alybin, D.A. Boyarov, V.N. Grigoriev, I.V. Kuzmin, S.V. Petushkov, D.A. Safaev, V.V. Murashkin, R.K. Lozov; JSC RPC “PSI”, Moscow, Russia
The design of a low-orbit on-board terminal for high-speed space laser communication has been examined, and its systems characteristics have been presented.

TuR11-06
14.7Gbit/s visible light laser communication over 100m free-space transmission utilizing Huffman coding based probabilistic shaping
Yuning Zhou, Zengyi Xu, Zhilan Lu, Junwen Zhang, Chao Shen, Jianyang Shi, Ziwei Li, Nan Chi; Key Laboratory for Information Science of Electromagnetic Waves (MoE), Department of Communication Science and Engineering, Fudan University, China
We demonstrate 14.7Gb/s free-space visible light communication over 100m utilizing probabilistic constellation shaping with GaN blue laser diode. The resulting data rate is the highest reported in 100m free-space single-carried VLLC system.

TuR11-07
Free-space laser communication terminals
D.A. Boyarov1,2, V.N. Grigoriev1, I.V. Kuzmin1, S.V. Petushkov1, V.V. Murashkin1, S.V. Polkanov1, R.K. Lozov1; 1 SC Scientific and Production Corporation Precision Instrument Engineering Systems; 2 National Research University “Moscow Power Engineering Institute”, Russia
A low-orbit laser communication terminal designed to transmit data both to a similar low-orbit correspondent terminal and to a ground station is considered.

TuR11-08
Experimental research of an on-board laser acceleration measurements for the gravitational field parameters estimation on cubesate nanosatellite
F.V. Fateev, S.S. Donchenko, R.A. Davlatov; FSUE Scientific Research Institute for Physical-Engineering and Radiotechnical Metrology (VNIIFTRI), Russia
The paper considers the possibility of constructing an accelerometer for a space mission for gravitational field parameters measurement based on an optical interferometer instead of a capacitive measuring system. The layout of the accelerometer sensing element and a bench for measuring its sensitivity are described.

TuR11-09
Features of the diffraction pattern formation of the laser radiation, reflected from the CCRs in automatic system for docking the space transport vehicle and orbital station
The optical cube reflectors (CRs) of the automatic docking systems of the space transport vehicles (STV) and orbital stations (OSS) are observed. The influence of CRs edges chamfers and offset of three dihedral angles of the CRs on the energy distribution of the radiation reflected from the CRs for different distances between the STV and the OSSs has been determined.

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

TuR11-11
The protocol of quantum key distribution on beams with space structured polarization
D.D. Reshetnikov1, A.L. Sokolov2, E.A. Vashukevich1, V.M. Petrov2, T.Yu. Golubeva1; 1 St. Petersburg State University, 2 National Research University ‘Moscow Power Engineering Institute’, Russia
The work proposes a protocol for quantum key distribution using Laguerre-Gaussian beams with space structured polarization invariant to rotation of the radial coordinate in a plane normal to the beam propagation axis.

TuR11-12
Object detection by a microjoule-pulse LiDAR through a 18-m water layer: docking & navigation
S.M. Pershin1, M.Ya. Grishin1, V.A. Zavozin1, P.A. Titovets2, M.O. Fedyuk2; 1 Prokhorov General Physics Institute RAS, 2 Moscow Technical University of Communications and Informatics, Russia
The LiDAR backscattering signal (3 ns, 532 nm, 2 μJ) was recorded for the first time through 18 m of water and 7 m of air. Reflectors placed on the target surface are found to multiply the backscattering signal. Underwater maneuvering of unmanned robots, docking and navigation in flooded areas using a LiDAR with eye-safe radiation level is discussed.
Simulation of the evolution of an electron bunch in a vacuum laser photodiode

I.V. Danilova¹, P.V. Tomashevich¹, S.A. Smirnov¹, A.P. Broyko²; ‘NTC “SYNTEZ”, AO NIIEFA, “Department of Micro- and Nanelectronics, ETU “LETI”, Russia

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

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS - POSTERS

Location: Nikolsky + Levinson Foyer, Floor 2; Date: Tuesday, July 02, 2024

TuR08-p01 15:00-18:30

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

K.N. Min’kov¹, D.D. Ruzhitskaya¹, P.O. Kapralov², O.V. Borovkova¹;²; ‘Russian Quantum Center, Skolkovo; ¹ Faculty of Physics, Lomonosov Moscow State University, Russia

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

TuR08-p02 15:00-18:30

Harmonic generation in a gas jet under the variation of the wave vectors mismatch during laser pulse propagation

K.V. Lvov¹, S.Yu. Streomoukhov¹;²; ‘Lomonosov Moscow State University; ¹ ‘National Research Center “Kurchatov Institute”, Russia

An alternative approach for determining phase matching conditions during the generation of harmonics in gases is proposed, which makes it possible to account the change in the wave vectors mismatch during the propagation of intense laser field. The possibility of increasing the third harmonic signal by increasing the gas jet pressure while maintaining absorption at a low level was investigated.

TuR08-p03 15:00-18:30

Random lasing in suspension of ZnO nanoparticles during a phase transition

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

This work shows that during the transition from the liquid to the solid phase of an aqueous suspension of ZnO nanoparticles, the concentration of particles on the ice surface increases (i.e., the scattering mean free path between particles decreases), which leads to a decrease in the random lasing threshold.

TuR08-p04 15:00-18:30

Analytical approximation for light bullets in multi-core fibers

G.A. Patrin, I.S. Chekhovskoy, O.V. Shlyrina, M.P. Fedoruk; Novosibirsk State University, Russia

We propose a theoretical approach to study the multicore fiber propagation dynamics of optical pulses near a stationary solution known as “light bullet”. A system of coupled non-conservative nonlinear Schrödinger equations is used as a mathematical model. An approximate analytical stationary solution for this system of equations is found and studied.

TuR08-p05 15:00-18:30

Optomechanics of nanoparticles in the hybrid anapole state

S.R. Rozental¹,², N.S. Babich¹, D.A. Kislov¹; ¹ Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, ²ITMO University, Russia

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

TuR08-p06 15:00-18:30

Identification of up-conversion luminescence lines of fluorophosphate glass doped with ytterbium and thulium ions by respective nonlinearity of the up-conversion process

M.V. Korolkov¹, I.A. Khodasevich¹, A.S. Piotukh¹, A.S. Grabchikov¹, E.V. Kolobkova¹, T.V. Nguyen¹, D.S. Mogilevsky¹;²; ‘B.I. Stepanov Institute of Physics NASB, Belarus; ²ITMO University, Russia; ‘Institute of Material Sciences VAST, Vietnam

The up-conversion (UC) luminescence spectra of fluorophosphate glasses doped with ytterbium and thulium ions in different concentrations combinations were studied by continuous excitation at 975 nm. We have established that analysis of the respective nonlinearities of spectrally overlapping UC processes allows one not only identifying the nature of contributing transitions, but also inferring spectral shape of the corresponding process.

TuR08-p07 15:00-18:30

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

S.B. Bodrov¹,², N.A. Abramovskiy¹, M.V. Platonova¹, A.N. Stepanov¹, M.I. Bakunov¹; ¹ University of Nizhny Novgorod; ² Institute of Applied Physics RAS, Russia

We report experimental results on generating terahertz Cherenkov radiation in a 1-mm thick LiTaO₃ slab glued to a Si prism and pumped by a femtosecond Ti:sapphire laser with a tens of microjoules pulse energy. The optical-to-terahertz conversion efficiency ~0.15%, a focused terahertz field strength of 70 kV/cm, and the spectral bandwidth up to 4.5 THz are demonstrated.
Poster Session July 2

TuR08-p08 15:00-18:30
Vortex-generating light-induced phase converter in azobenzene polymer
I.A. Budagovskiy1, M.P. Smayev1, A.S. Zolotkov1, A.Yu. Bobrovsky1; Lebedev Physical Inst. RAS, Lomonosov Moscow State Univ., Russia

The formation of the modified area, which acts as phase converter for vortex generation, in the amorphous thin layer of the azo-containing polymer under the action of structured light beam is considered. The beam with radial polarization induces the axially-symmetric optical axis distribution which convert the probe Gaussian beam into optical vortex with the topological charge 2.

TuR08-p09 15:00-18:30
Tunable broadband polariton lasing from perovskite nano crystals at room temperature
M.D. Kolker1, D.A. Sannikov1, A.D. Putintsev1, L. Krasionov1, T. Cookson1, A.P. Pushkarev2, P.G. Lagoudakis3; Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, ITMO University, Russia

We investigate the potential of perovskite nanocrystals to serve as a platform for tunable and broadband exciton-polariton lasing at room temperature. A novel DBR-PVSKCrystal-Air-DBR system with a locally variable mode volume allows to attain a 20-nm-range spectral tuning of the lasing mode, promising a way for an automated mechanical adjustment of emission properties in all-optical polariton logic.

TuR08-p10 15:00-18:30
A comparison of the sensitivity of two temperature sensing devices, designed in fiber optics
G.E. Sandoval-Romero1, F. Velazquez-Carreon1, A. Perez-Alonzo2, E.E. Garcia-Unzueta3; Instituto de Ciencias Aplicadas y Tecnología, Universidad Nacional Autónoma de México; Programa de Maestría y Doctorado en Ingeniería, Universidad Nacional Autónoma de México, México

In this work the practical comparison of the sensitivity to temperature changes of a sensor fabricated in fiber Bragg grating (FBG) immersed in a cross-sectional area of 45 mm^2 polydimethylsiloxane (PDMS) which is 2 times larger than when the FBG is in conventional form is performed.

TuR08-p11 15:00-18:30
Plasma characterization in liquid jets through third harmonic reflection
S. Hilal, M.V. Mešnik, A.O. Ismagilov, A.N. Tsypkin; ITMO University, Russia

This study estimates plasma properties in water, isopropyl, and ethanol liquid jets using the double pump technique and time-resolved experiments on third harmonic (TH) reflection dynamics. Isopropyl demonstrates the highest plasma frequency, followed by ethanol, and water exhibits the lowest. Findings are validated through a theoretical model based on Keldysh theory.

TuR08-p12 15:00-18:30
Modification of amorphous Ge,Sb,Te film by XZ femtosecond laser scanning
M.P. Smayev1, I.A. Budagovskiy2, D.O. Kuzovkov1,2, P. Lazarenko2; Lebedev Physical Institute RAS, National Research Unv. of Electronic Technology, SPb Lasers and Equipment TM, Russia

The modification of an amorphous Ge2Sb2Te5 film under femtosecond pulses at two-coordinate scanning was studied. During the movement of the obliquely oriented sample with respect to the beam axis, the parameters of the acting radiation changed, providing a change in regimes of modification: formation of amorphous-crystalline periodic structures, crystallization of the irradiated area, appearance of pre-ablative structures, and ablation.

TuR08-p13 15:00-18:30
Cherenkov self-synchronized ultrashort Raman solitons on the whispering gallery modes of silica microspheres
E. Anashkina1, A.V. Yulin1, A. Osipov2, A.V. Gaponov-Grekov Inst. of Applied Physics RAS, Lobachevsky State Univ., ITMO Univ., Russia

We demonstrate a new regime of generation of the ultra-short optical pulses on the whispering gallery modes of the spherical silica micro-resonators. This regime appear when the pump frequency is close to the Cherenkov resonance position of the generated Raman soliton. Demonstrated regime is promising for the generation of broadband robust frequency combs on the chip-scale micro-resonators.

TuR08-p14 15:00-18:30
The trajectory of the propagation of oblique rays in optical fibers with a stepped profile of the reflective index
D.V. Ryakhovskii, A.A. Makovetskii, S.M. Popov, A.A. Zamyrin; Kotel'nikov Institute of Radio Engineering and Electronics RAS, Russia

The latest results on calculation of trajectory of propagation of oblique rays in optical fibers. First algorithm is based on reducing sequential calculation of the coordinates of the ray reflection points in vector form. The second algorithm is reduced to an independent calculation of the transverse coordinates of the reflection points. The formula was obtained for the calculation.

TuR08-p15 15:00-18:30
Highly transient Raman conversion in SrMoO4 under ultrafast double-pulse pumping
Yu.A. Kochukov1,2, D.P. Tereshchenko1, S.N. Smetanin1, A.G. Papashvili2, K.A. Gubina2, V.V. Bulgakova1, A.A. Ushakov1, V.E. Shukshin1, E.E. Dunea1, I.S. Voronina1, L.I. Ileva1, Prokhorov General Physics Institute RAS, National University of Science and Technology MISIS, Russia

Highly transient stimulated Raman scattering in a SrMoO4 crystal on both stretching (888 cm⁻¹) and bending (327 cm⁻¹) Raman modes under ultrafast double-pulse pumping by orthogonally polarized pump pulses at 1030 nm with a controllable chirp and a different delay between them was investigated.

TuR08-p16 15:00-18:30
Metal capillaries: new prospects for application in Raman spectroscopy
V.V. Vitkin1, A.P. Kouzov2, E.E. Popov1, N.N. Filippov1, I.K. Chubchenko2, ITMO University, St. Petersburg State University, Mendeleev Institute for Metrology, Russia

The use of thin metal capillaries can significantly enhance the Raman signals due to the increase of the photon-molecule interaction volume and thus qualitatively improves the capabilities of Raman spectroscopy. Furthermore, studying Raman scattering in metallic capillaries can open the way to detect three-wave mixing in isotropic media and to develop new approaches to molecular chirality.

TuR08-p17 15:00-18:30
Periodically poled waveguides in lithium niobate
A.R.akhmatkanov1, E.S. savelyev1, A.V. sosunov1, A.R. Kornilcyn1, V.S. Shur1, Ural Federal University, Perm State University, Russia

Lithium niobate crystals with periodical domain structure within a waveguide allow realization of effective confined nonlinear optical interaction. Creation of such structure requires deep knowledge about domain structure kinetics in material and its stability during waveguide creation. We present the study of these phenomena in congruent lithium niobate with waveguides created by soft proton exchange and annealed proton exchange methods.

TuR08-p18 15:00-18:30
Hidden photon detection
K.S. Gochelashvili1, V.N. Goryachev1, G.N. Golitsman1, V.N. Evdokimov1, S.V. Erin2, A.V. Semenov3, A.A. Sysoliatin1, Prokhorov General Physics Institute RAS, NRC "Kurchatov institute" - IHEP, Moscow Pedagogical State University, Russia

The report discusses a proposal to search for hidden photons (dark matter candidate) using an experimental setup "ERA" installation. The source of the creation of hidden photons is a powerful source of laser radiation. The search for hidden photons is the first option of the research program in the experiment to test the predictions of the Standard Model.
Second harmonic generation with two noncollinear passage walk-off compensation
S. Grechin, E. Shashkov; Prokhorov General Physics Institute RAS, Russia
The results of experimental investigations for the walk-off compensation second harmonic generation with non-collinear propagation on direct and reverse passage in a single crystal are presented.
TuR08-p26 15:00-18:30

Fiber femtosecond frequency comb for measuring the dispersion of optical elements
Y.G. Isaeva1,2, N.A. Koliada1,2, A.A. Filonov3, S.V. Pivtsov3, S.V. Chepurov3; Institute of Laser Physics SB RAS, Institute of Automation and Electrometry SB RAS, Russia
A new approach to measuring the dispersion parameter using a three-wave single-arm interferometer and a femtosecond fiber frequency comb stabilized to a Yb+ single-ion optical frequency standard are presented. In addition, the second-order group velocity dispersion was taken into account for the first time. This approach can be applied to any optical fibers and bulk optical elements.
TuR08-p27 15:00-18:30

Self-action of structured light beams in amorphous azobenzene-containing polymer
I.A. Budagovskiy1, M.P. Smyayev1, A.I. Baranov1, A.A. Kuznetsov1, A.S. Zotol'ko1, A.Yu. Bobrovsky2; Lebedev Physical Inst. RAS, National Research Univ. of Electronic Technology, Lomonosov Moscow State Univ., Russia
The action of the light beams of various structure and their transformation in a thin layer of the polymethacrylate azobenzene-containing polymer is studied. Depending on the beam structure, it is possible to induce negative or positive anisotropy in an initially amorphous sample, as well as to create a complex spatial distribution of optical axes, similar to that of vortex converters.
TuR08-p28 15:00-18:30

Monitoring optical fiber parameters using stimulated Brillouin scattering
D.P. Andreev1, O.D. Nesterov2, E.I. Andreeva2; Peter the Great St. Petersburg Polytechnic University; St. Petersburg State University of Telecommunications prof. M.A. Bonch-Bruevich, Russia
The effect of the stimulated Brillouin scattering (SBS) in the optical fibers was experimentally studied. It has been shown that this effect can be used to monitor parameters and early diagnosis of changes in the state of optical fiber. This control method is suitable for DWDM systems.
TuR08-p29 15:00-18:30

New fast exponential splitting schemes for nonlinear Fourier transform
S.B. Medvedev1,2, D.I. Kachalin1,2, I.S. Chekhovskiy1, I.A. Vasev1, M.P. Fedoruk2,3; Novosibirsk State University, Institute of Computational Technologies SB RAS, Skolkovo Institute of Science and Technology, Russia
The nonlinear Fourier transform (NFT) is an approach that allows to analyze the structure of a signal governed by the nonlinear Schrodinger equation. We present an approach that allows to find all variants of symmetric exponential splitting schemes suitable for the fast NFT (FNFT) algorithms. We obtained schemes which showed good numerical results comparing with other fast 4th order schemes.
TuR08-p30 15:00-18:30

Lyapunov exponents approach to creating ring fiber cavity regime charts
V.A. Razakov, L.A. Melnikov, P.V. Kuptsov; Yuri Gagarin State Technical University of Saratov, Russia
Lyapunov exponents method is used to unambiguously determine the dynamical state of the ring fiber cavity systems. Two-dimensional charts are then created to provide visual representation of the areas in given phase space, which clearly demonstrate how a certain nonlinear effect or instability in the cavity depends on its physical parameters. Mode prediction probability using the obtained charts is discussed.
TuR08-p32  15:00-18:30

Two-photon absorption in Na₂Mo₂O₇ crystal excited by TuR08-p35

The nonmagnetic substate was carried out. of around 6 μK was obtained. An effective selection of rubidium atoms in ferometer-gravimeter. A cloud of 10⁷ - 10⁸ atoms with the temperature of magnetic resonance is studied. These studies have application in optical crystals with RF oscillator.

Optical absorption in Na₂Mo₂O₇ was identified as an effective NLO material by correlation model. Limiting, the radiation transfer equation for rectangular pulse shape was derived. A new technique for obtaining the complex refractive index of metamaterials was proposed and experimentally confirmed. Optical activity and circular dichroism in the experimentally confirmed. Optical activity and circular dichroism in the stimulating THz field characteristics were developed. A new technique for obtaining the complex refractive index of metamaterials was proposed and experimentally confirmed. Optical activity and circular dichroism in the interaction of THz field with active metamaterials were investigated.

TuR08-p39  15:00-18:30

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

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

TuR08-p40  15:00-18:30

TuR08-p41  15:00-18:30

Stimulated Raman scattering in sodium dimolybdate crystal

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

TuR08-p42  15:00-18:30

TuR08-p43  15:00-18:30

Influence of cascaded processes on frequency doubling process

We show that weak third harmonic generation causes cascaded processes that may influence frequency doubling processes both in negative and positive ways. Two cases of serious influence of weak third harmonic generation on second harmonic intensity evolution are discussed.

TuR08-p44  15:00-18:30

Transition oscillations in the dynamics of molecules with a large Raman scattering cross section

The nonstationary dynamics of a quantum dot with a strong coupling of vibrational and electronic degrees of freedom is considered. It is shown that in the dynamics of the quantum dot dipole moment collapses and revivals are observed and appear in the emission spectrum as splitting of the spectral line near the exciton transition frequency.
TuR08-p45

15:00-18:30

LIBS efficiency increase via plasmonic nanoparticles in the study of synthetic opal matrices

A. Sintsov1,2, A.V. Baranikov1, A.D. Putintsev1, M. Misko1, A.V. Zasedatelev1, U. Scherf1, P.G. Lagoudakis1, Hybrid Photonics Laboratory, Skolkovo Inst. of Science and Technology, Russia; 2Macromolecular Chemistry Group and Inst. for Polymer Technology, Germany

We realize a universal polariton multi-input NOR gate operational at room temperature and high speed utilizing the concept of non-ground-state polariton amplification. The logic gate provides the basic building block for a complete all-optical logic circuitry platform pinpointing a substantial decrease in the required transistor footprint.

TuR08-p52

15:00-18:30

Dynamics of radiation in chain of a large number of pump-coupled lasers

E.V. Grigorieva1, S.A. Kaschenko2, 1Belarus State Economic University, Belarus; 2Yaroslavl State University, Russia

Radiation dynamics of a ring of lasers with optoelectronic delayed coupling is analyzed. Assuming that the number of lasers is sufficiently large, we propose the phenomenological spatially distributed model and get its solutions by normal form method. As a result we describe radiation oscillations which can be phase synchronized, anti-phase or in-phase in dependence on time delay.

TuR08-p53

15:00-18:30

Optical limiting using spatial self-phase modulation in liquid dispersions with carbon nanotubes

P.N. Vasilevskiy1, M.S. Saveyrev1, A.Yu. Gerasimenko1, National Research University of Electronic Technology, Institute of Nanotechnology of Microelectronics RAS, Russia

Spatial self-phase modulation (SSPM) is the phenomenon of changing the spatial beam shape. It is expressed in the beam expansion and the formation of diffraction rings pattern. This work demonstrates the possibility of limiting laser power using SSPM in a liquid dispersion with carbon nanotubes. A model for estimating the attenuation coefficient based on the Fresnel-Kirchhoff diffraction integral is presented.

TuR08-p54

15:00-18:30

High efficient single frequency fiber random laser operating in the telecommunication band

S.M. Popov1, O.V. Butov1, A.A. Rybaltskovskii2, D.V. Ryakhovskii1, A.O. Kolosovskii1, V.V. Voloshin1, I.L. Vorobyev1, D.S. Lipatov1, A.A. Fodtia1, Yu.K. Chamarovskii2, 1Kotelnikov Inst. of Radio Engineering and Electronics RAS (Fryazino Branch); 2Kotelnikov Inst. of Radio Engineering and Electronics RAS (Moscow Branch); 3Prokhorov General Physics Inst. RAS; 4Devyatkyn Inst. of Chemistry of High-Purity Substances RAS; 5Ulyanovsk State Univ., Russia

The report concerned high efficient single frequency «random» fiber laser with cavity based on erbium doped optical fiber (OF) with an array of fiber Bragg gratings (FBG) inscribed during OF’s drawing process. Lasing with a maximum efficiency of 33% and linewidth of about 500 Hz was obtained at wavelengths of 1548 nm with pumping at a wavelength of 975 nm.

TuR08-p55

15:00-18:30

Photodynamic processes in prospective downconversion luminophores NaLa(MoO4)2:Yb3+

A.S. Nizamutdinov1, A.V. Astrakhantseva1, K.S. Tsui1, S.V. Kuznetsov1, K.A. Subbotin1, 1Kazan (Volga Region) Federal University, Prokhorov General Physics Institute RAS, Russia

Luminescence characteristics of prospective downconversion material NaLa(MoO4)2:Yb3+ were investigated by means of selective laser spectroscopy. The luminescence quantum yield for Yb3+ ions was measured as 12%. Photodynamic processes and energy transfer mechanisms responsible for efficient energy transfer are discussed.
Optimization of degenerate four-wave mixing threshold parameters in dual-pumped microresonator

Optimization of degenerate four-wave mixing threshold parameters in dual-pumped microresonator

Photoluminescent microbit inscription inside dielectric crystals by ultrashort laser pulses for archival applications

Measurement of dispersion characteristics and quality factors of optical microresonators

Suspension freezing as a novel approach for increasing the efficiency of the laser-induced breakdown spectroscopy method in the study of nano and submicron particles

Parallel beam pumped picosecond Raman laser on water with a preamplifier

Time-dependent polarization measurements of ultrashort pulses at 1.9 μm based on GRENOLILE

Second harmonic generation with joint scalar and vector phase matching in biaxial crystal LBO

Spectral and energy characteristics of picosecond SRS in heavy water

New method for finding the temporal soliton at three waves interaction

Picoscopic SRS in water excited by Bessel beams

Temperature noncritical frequency conversion in ZnGeP₂ crystal
Delay measurement in fiber optic devices using a tunable delay line
O.V. Kolmogorov, S.S. Donchenko, D.V. Prokhorov, B.R. Alekperova; FSUE “VNIIFTRI”, Russia
The diagram and principle of operation of an installation for measuring signal propagation delays in fiber-optic devices, built on the basis of a reference tunable optical delay line, are presented. The results of estimating the uncertainty of measurements performed using the installation are presented.

Transmission bistability of high-intensity THz radiation propagation in a nonlinear LiNbO3 Fabry-Perot interferometer
A.O. Nabilkova1, E.N. Oparin1, M.V. Melnik1, A.P. Fokin2, A.S. Sedov2, A.N. Tsypkin1, S.A. Kozlov2; 1Laboratory of Quantum Processes and Measurements, ITMO University; 2Laboratory of Femtosecond Optics and Femtotechnologies, ITMO University; 1Institute of Applied Physics RAS, Russia
This study examines the bistability characteristics of a “mirrorless” Fabry-Perot interferometer by combination of analytical modeling and experimental investigation. The research reveals that the use of a nonlinear LiNbO3 crystal as the medium leads to noticeable optical hysteresis under input intensities of up to 3.5x10^9 W/cm2 at a frequency of 0.25 THz.

Glass modification by backside irradiation using nano-second laser pulses
H. Saleh, Y.A. Konin, A.A. Petrov; Institute of Laser Technologies, ITMO University, Russia
The fiber fuse effect was successfully initiated in various bulk glass materials using backside irradiation with a nanosecond pulsed laser, employing different metallic foils as absorbers. The study reveals unique resultant structures within the glass, which vary depending on the initiation conditions and laser parameters used.
Near and mid infrared channeled waveguide lasers in rare-earth ion-doped fluoride crystals (Invited paper)

A. Sennaroglu1,2, Y. Morova3, B. Ayev1, M. Tonelli2, B. Morova4, H. Jahangiri1, I. Bayram1, A.D. Lieto3, G. Citrino1, E. Damiano1, I.I. Korel1, S.V. Smirnov2; 1 Laser Research Laboratory, Departments of Physics and Electrical- Electronics Engineering, Koç University, Türkiye; 2 Koç University Surface Science and Technology Center (KUYTAM), Türkiye; 3 Department of Physics, Koç University, Türkiye; 4 MEGAMATERIALS s.r.l and Dipartimento di Fisica dell’Università di Pisa, Italy; 5 Department of Physics, Koç University, Türkiye

Femtosecond laser written waveguide lasers operating in the near and mid infrared region at 1318 nm and 2700-2800 nm were investigated by using Nd3+:BaY2F8 and Er3+:YLF4 crystals.

Self-sweeping fiber laser for application in BOTDA system

N.R. Poddubrovskii, I.A. Lobach, S.I. Kablukov; Institute of Automation and Electrometry SB RAS, Russia

We present here an Er-doped self-sweeping fiber laser developed for Brillouin optical time domain analysis systems. The laser has passive wavefront sweeping in range of 2 GHz with tuning step of 6.25 MHz. The laser based distributed sensing system with spatial resolution, sensing line length and sensitivity of 5 m, 25 km and 2 MHz, respectively, is experimentally demonstrated.

Ultra-long fiber laser with split pulse shaping for secure key generation and distribution

B.N. Nyushkov1,2, I.I. Korel1, S.V. Smirnov1; Novosibirsk State Technical University, Russia; 2 Novosibirsk State University, Russia

We report an ultra-long pulsed Erbium fiber laser in which pulse shaping is split between two communicating parties. They contribute random binary values to the secure key generation and distribution by making independent choices of their states in the split pulse shaping. The key exchange is secured whenever different choices lead to the same pulse duration, thereby confusing an eavesdropper.

Hard excitation mode in optomechanical systems

A.A. Zybablovsky1,2, E.S. Andrianov1,2; Dukhov Research Institute of Automatics (VNIIA); Institute Theoretical and Applied Electro Dynamics RAS, Russia

We predict an existence of hard excitation mode in an optomechanical system of two optical modes interacting with each other via a phonon mode. We demonstrate that the hard excitation mode arises due to an additional phase condition for nonzero solutions. We propose a concept of highly sensitive sensor based on the optomechanical system operating in the hard excitation mode.
PM Tm-doped fiber laser harmonically mode-locked using single-walled carbon nanotubes
V.A. Belova1, E.S. Iashkina1, S.I. Migurev1, D.T. Batov1, V.S. Voropaev1, A.A. Mkrtchyan2, Yu.G. Gladush3, D.V. Krasnikov3, A.G. Nasibulin3, V.A. Lazarev3, M.K. Tarabrin3, 1Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical University; 2Center for Photonic Science and Engineering, Skolkovo Institute of Science and Technology, Russia
A polarization maintaining thulium-doped fiber laser mode-locked by single-walled carbon nanotubes has been developed. The fundamental pulse repetition frequency of the laser is 84 MHz. Harmonic mode-locking is observed with a maximum pulse repetition frequency of 504 MHz. Following pulse parameters are achieved: pulse duration of 440 fs, center wavelength of 1912 nm, maximum average power of 600 mW.

Features of high-order soliton molecule amplification in an Er-doped fiber amplifier
I.O. Orekhov4, A. Ismaeel1,2, S.G. Sazonkin4, D.V. Dvoretsky4, A.A. Krylov2,3, V.E. Karasik4, 1Bauman Moscow State Technical University; 2Center for Photonic Science and Engineering, Skolkovo Institute of Science and Technology, Russia; 3Russian State Agrarian University; 4Institute of Physics and Technology, 5Prokhorov General Physics Institute RAS, Dnepropetrovsk Institute of Science and Technology, Russia
We report on the generation high-order soliton molecule and its amplification in single-cascade amplifier based on erbium-doped fiber. The amplification of 15 pulses regime with 432 fs pulses duration and 46 mW average power in 1 m long erbium-doped fiber amplifier led to the generation of 20 pulses regime with 449 fs pulses duration and 102 mW average power.

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

R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS
Location: Stenberg 1 Room, Floor 3; Date: Wednesday, July 03, 2024
Session Chair:
Single-mode MBE-grown 1550 nm wafer-fused VCSELs for high-speed PAM4 data transmission (Invited paper)
S.C. Tian, G.A. Sagunov, S.B. Blokhin, I.N. Kovach, L.Ya. Karachinsky, I.I. Novikov, A.V. Babichev, K.O. Voropaev, A.Yu. Egorov, D. Bimberg, Bimberg Chinese-German Center for Green Photonics, CIOMP CAS, Changchun, China; Technical University of Berlin, Germany; L'Institute, Russia; ITMO University, Russia
We study high-power, high bit rate, single-mode 1550 nm vertical-cavity surface-emitting lasers fabricated using wafer-fusion. We achieved a 34 Gbps non-return-to-zero data rate by applying 16 mA bias current and 1.4 V modulation voltage. Using 4-Level Pulse Amplitude Modulation we achieved 42 Gbps data rate by employing the same bias current and 1.6 V modulation voltage.

- Coffee Break -

Auger recombination in mid-Infrared lasers based on group IV SiGeSn MQW (Invited paper)
Detailed calculations of Auger recombination in direct-bandgap GeSn QWs show very unusual Auger rate dependence on the emission wavelength and temperature. Unlike in most III-V materials, the Auger rate decreases with the increase of wavelength or temperature. The obtained results suggest that GeSn materials offer a great potential for optoelectronics and integrated photonics.

High-power QCL for 8-μm spectral range
We study quantum-cascade lasers with active region designs based on strained and lattice-matched heterostructures. Lasers based on strained well/barrier pairs demonstrate improved efficiency, temperature stability and record-high optical power.

Four-wave mixing in a laser diode gain media due to resonant backreflection from the microresonator
D.M. Sokol, N.Yu. Dmitriev, D.A. Cheremisinov, A.V. Masalov, V.E. Lobanov, I.A. Bilenko, A.E. Shitikov, Russian Quantum Center, Moscow Institute of Physics and Technology, Skolkovo Inst. of Science and Technology, Lebedev Physical Inst., Faculty of Physics, Lomonosov Moscow State Univ., Russia
Semiconductor laser diodes integrated with ring microresonators show potential for improving stable laser sources, comb sources, and quantum state generation. The complex dynamics of this system must be considered for diverse applications. When the microresonator’s mode is excited, it imposes its frequency on the laser diode, causing strong nonlinear interactions within the laser gain medium and leading to self-oscillations.
**WeR03-13**  15:00-15:30
Use of plasma sources in the epitaxy of III-V compounds *(Invited paper)*
P. Bulkin; LPICM CNRS Ecole Polytechnique IP Paris, Palaiseau, France
The talk will describe the evolution of plasma sources used for epitaxy, both for MBE and CBE and MOCVD machines and current state of technology. Different types of plasma sources available on the market will be considered. Design criteria, evaluation tests and ways of performance improvements will be discussed.

**WeR03-14**  15:30-15:45
Wavelength switching in low-dimensional structures at high current densities
A.A. Beckman¹, G.O. Kornyshev¹, A.S. Payusov¹, Yu.M. Shernyakov¹, N.Yu. Gordeev¹, M.V. Maximov²; ¹Ioffe Institute; ²Alferov University, Russia
We study lasing switching from ground to excited states transition (two-state lasing) at high injection currents in lasers with active region based on quantum well-dots (QWDs). Pure ground state lasing is maintained in the QWD devices up to higher currents than in QW ones. The use of broad waveguide results in a decrease in the threshold of two-state lasing.

**WeR03-15**  15:45-16:00
Scientific journals rating: a game with no rules *(Invited Lecture)*
N.L. Istomina¹, O.L. Levchenko²; ¹Department of physics RAS, ²Inst. of Solid State Physics RAS, Russia
The scientific journal industry has many similarities with the sports industry. Competition in scientific periodicals is characterized by a very strong interweaving of sports, politics, business and ideology. Is the increase in the rating of one of the opponents equal to the decrease in the rating of the other? What period of competition is rated?

**R04: LASER BEAM CONTROL**
*Location: Richter Room, Floor 3; Date: Wednesday, July 03, 2024*

**WeR04-22**  09:00-09:30
Frequency analysis of a auto-tuning system for multistage laser complex *(Invited paper)*
A.V. Kirsanov, I.V. Kuz’min, I.B. Mukhin, V.V. Chernov, A.V. Gaponov-Grekhov; A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia
One of problems of multistage power lasers are radiation deviations from a given direction during its transmission between cascades. An automatic radiation direction correction system based on piezoelectric actuators with feedback via a four-section photodiode has been assembled. It is shown that the auto-tuning complex works reliably at low frequencies of disturbances and performs worse at high frequencies.

**WeR04-24**  10:00-10:30
Lasers with cavities coupled by a Bragg grating *(Invited paper)*
A.P. Pogoda¹, V.M. Petrov², N.L. Istomina¹, A.S. Boreysho¹; ¹Baltic State Technical University "VOENMEH", ²St. Petersburg State University, ³Moscow State University of Geodesy and Cartography, Russia
A comprehensive view of the problem of optical interaction of radiation developing in systems with several cavities is presented. Static and dynamic gratings in the lasers based on narrowband and broadband active media are considered. A number of practically implemented systems are shown and fundamental limitations are indicated.

**WeR04-25**  10:30-11:00
Nonlinear multiplexing of optical second harmonic in high-dimensional nonlinear photonic crystals *(Invited paper)*
A.M. Vyunishev¹,², V.G. Arkhipkin¹,²; ¹Kirensky Institute of Physics, FRC KSC SB RAS, ²Siberian Federal University, Russia
The results of second harmonic generation (SHG) in one-(1D), two-(2D) and three-dimensional (3D) nonlinear photonic crystals (NPCs) are presented. The theory of second harmonic generation of femtosecond laser pulses in high-dimensional periodic nonlinear photonic crystals is developed. High-dimensional NPCs are shown to be promising for nonlinear multiplexing and discrete angular spectrum formation.

- Coffee Break -
Holographic interferometers for optical digital medical tomography *(Invited paper)*

V.M. Petrov, D.V. Masygin, A.A. Sevyugin, E.V. Shalymov, D.V. Venediktov, V.Yu. Venediktov

Faculty of Physics, St. Petersburg State University, Department of Laser Measurement and Navigation Systems, St. Petersburg Electrotechnical University “LETI”, Russia

He reports on recent achievements in holographic interferometry for digital optical tomographs used in biomedical applications. The most common practical techniques are considered: sample rotating, single-shot, phase-shifting, and the technique adaptive holographic interferometers. Estimates of technical parameters are given and the advantages and disadvantages of various schemes. The basic concepts of coding of the studied objects are given.

**WeR04-27** 12:00-12:30

**Laser propulsion of 2D nanomaterials on flat surfaces** *(Invited paper)*

Ivan M. Kislyakov, Shanghai Inst. of Optics and Fine Mechanics, China

Mechanical manipulation of nanoblocks is becoming an important task in connection with the development of nanotechnology and nanoeengineering. Mechanisms of movement of two-dimensional nanosheets by a femtosecond laser beam over flat surfaces in a dry environment are considered in connection with the latest discoveries in the laser-induced motion of VSe2 and TeSe2 nanosheets firmly attached to a flat sapphire substrate.

**WeR04-28** 12:30-13:00

**Photonics of liquid crystal droplets in isotropic environment** *(Invited paper)*

K.D. Baklanova, P.V. Dolganov; Osipyan Institute of Solid State Physics RAS, Russia

We report investigations of optical properties of liquid crystal droplets embedded in isotropic liquid. Emphasis is made on droplets formed by cholesteric liquid crystals. The dynamic behavior of droplets in the process of their coalescence is studied.

**WeR04-29** 13:00-13:30

**Physico-chemical and nonlinear optical properties of aqueous polymer media containing carbon and inorganic nanoparticles** *(Invited paper)*

A.V. Venediktov, L.M. Kislyakov, P.V. Ivanov, A.Yu. Vlasov; St. Petersburg State University, Russia; Shanghai Institute of Optics and Fine Mechanics, CAS, China

We considered aqueous-polymer mixtures containing carbon nano-particles: liquid matrices “Polyvinyl alcohol-water-stabilizing surfactant”; system “Pluronic F-127-water” able to form physical hydro-gel; thin films with alternating layers of polyvinyl alcohol and polycarbazole. We present the data on the phase behavior of aqueous-polymer matrices and those containing a surfactant, and discuss the nonlinear optical properties of the above-mentioned systems.

- Lunch Break -

**WeR04-30** 15:00-15:30

**Recent advances in nonlinear optics and ultrafast dynamics of 2D materials** *(Invited paper)*

Jun Wang, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Science, China

2D materials significantly enhance nonlinear optical phenomena which makes them in demand for optical switching. Further optimization for needs of optical signal processing and laser beam control is developed in the direction of layer numbers and substrate modifications and defect engineering. Here we review our recent progress in this area, which we believe will be desirable for optoelectronics and photonics.

**WeR04-31** 15:30-15:45

**Reconfigurable optical traps based on acousto-optic spatial filters**

K.B. Yushkov, D.V. Obydenkov, V.Ya. Molchanov, Univ. MISIS, Lomonosov Moscow State Univ., Russia

We designed and fabricated acousto-optic spatial filters (AOSFs) for applications in laser beam shaping (LBS) and optical trapping. Several advanced LBS modes have been experimentally studied including multifrequency monochromatic beam shaping and polychromatic femtosecond beam shaping. We also demonstrated generation of dark bottle beams with a novel configuration of a phase-controlled AOSF.
Stability analysis of platicons in optical microresonators (Invited paper)

V.E. Lobanov, O.V. Borovkova; 1, A.K. Vorobyev; 2, D.A. Chermoshentsev; 1, I.A. Bilenko; 1,2; 1 Russian Quantum Center, 2 Faculty of Physics, Lomonosov Moscow State University, 3 Moscow Institute of Physics and Technology

Stability domains of platicons in high-Q Kerr optical microresonators with normal group velocity dispersion are studied numerically for a wide range of pump intensities. The effect of pronounced stability domain fragmentation at high pump amplitudes is observed. The existence of stable drifting platicons at high pump intensities is revealed. The influence of thermal effects on platicon stability is addressed.

Design of a Micro Ring Resonator as a nonlinear computational unit for neural networks accelerator

E. Protsenko, E. Volkova, A. Shipulin; ScolTech, Russia

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

External control of “symmetry broken” CW/CCW states in bidirectionally pumped nonlinear microspheres

E.A. Anashkina, A.V. Andrianov; A.V. Gaponov-Grekhov Inst. of Applied Physics RAS, Russia

Kerr microresonators with bidirectional pumping demonstrate complex dynamics including multistability and spontaneous symmetry breaking even for two CW/CCW waves. We found that taking into account a relative phase between CW/CCW pumps provides additional control of CW/CCW states and their “symmetry breaking”. Moreover, in glass microspheres with sufficiently strong Raman nonlinearity, states with broken symmetry of CW/CCW Raman waves are demonstrated.

Dual -laser self-injection locking microcomb regime switching

V.I. Pavlov; 1, A.R. Gatadlinov; 1, N.P. Khatyrev; 1, M.L. Galkin; 1, A.E. Shitikov; 1, V.E. Lobanov; 1, I.A. Bilenko; 2,3; 1 Russian Metrological Institute of Technical Physics and Radio Engineering, 2 Faculty of Physics, Lomonosov Moscow State University, 3 Russian Quantum Center, Russia

Numerical modeling and direct measurement of thermal frequency shift in optical microresonators was performed. Numerical results were compared with experimental data that provided information on methods accuracy. Thermal relaxation time and frequency shift of magnesium fluoride microresonator was defined. Proposed methods are original, easy to implement and can be applied to for other types of microresonators.

Solitons in SNAP microresonator with various shape

A.Yu. Kolesnikova, I.D. Vatulin; Novosibirsk State University, Russia

We show that in cylindrical microcavities, regardless of the shape of the effective radius variation, the geometric anomalous group velocities dispersion of the axial mode predominates. In this regard, a soliton solution will exist in the system for any microcavity shape. We simulated the field dynamics in a microcavity with a rectangular radius variation and obtained an optical frequency comb.

Lightwave breathers (Invited paper)

A. Gelash; École Polytechnique Fédérale de Lausanne (EPFL), Switzerland

This is a summary of propagation of waves in fractional media. Parallel to the originally proposed fractional quantum mechanics, Recently, much interest has been drawn by the proposal to emulate fractional diffraction in optical cavities. This possibility suggests to include the nonlinearity of optical media. Many results have been reported for solitons, vortices and other modes supported by optical nonlinearities.

A review: basic fractional nonlinear-wave models and solitons (Invited paper)

B. A. Malomed; Tel Aviv University, Israel

WeR08-16  09:00-09:30
WeR08-17  09:30-09:45
WeR08-18  09:45-10:00
WeR08-19  10:00-10:15
WeR08-20  10:15-10:30
WeR08-21  10:30-10:45
WeR08-22  10:45-11:00
WeR08-23  11:30-12:00
WeR08-24  12:00-12:30

- Coffee Break -
Periodic and quasiperiodic arrays of coupled exciton-polariton condensates (Invited paper)
S.Yu. Aalyakin1, H. Sigurdsson1, Y.V. Kartashov2, K.A. Sitnik1, I.S. Grusov1, J.D. Töpfer1, P.G. Lagoudakis1; Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, Russia; 2Science Institute, University of Iceland, Iceland; 3Institute of Condensates
We predict a new type of 3D optical dissipative vector solitons in a homogeneous isotropic medium with laser amplification and saturable absorption. Both circular polarization components have the toroidal intensity distribution and a unit topological charge. Soliton properties and polarization structure depend on the angle between toroidal circular components.

Nonlinear components of energy, momentum and angular momentum of Gaussian beams in self-focusing in isotropic gyrotropic media
P.S. Rythikov, V.A. Makarov, Lomonosov Moscow State University, Russia
The magnitudes of contributions of the related to local and nonlocal parts of nonlinear optical response of the medium terms of the expressions for the electromagnetic energy density, momentum density, angular momentum density and the corresponding flux densities in self-focusing of elliptically polarized light beam in nonabsorbing isotropic gyrotropic medium is determined.

Frequency control of oscillating vortex cluster spontaneously arising in the trapped polariton condensate
K.A. Sitnik, I. Gnusov, M. Misko, H. Sigurdsson, J.D. Topfer, S. Alyatkin, P.G. Lagoudakis; Skolkovo Inst. of Science and Technology, Russia
We demonstrate that optically trapped polariton condensate occupying two energy levels forms vortex cluster with periodically oscillating topological charges with a frequency around 5 GHz. This frequency is precisely controlled in the range of 300 MHz by scanning the ellipticity of the optically induced trapping potential. The presented results are qualitatively supported by the particle in the box-based theoretical model.

New mode of a steady-state superradiant lasing
V.I. Kucharovskiy1, E.R. Kucharovskaya2; 1Plasma Physics and High-Power Electronics Division, Institute of Applied Physics RAS, Russia; 2Nonlinear Dynamics and Optics Division, Institute of Applied Physics RAS, Russia
For a superradiant laser with low-Q slightly asymmetric Fabry-Perot cavity, there is strongly-asymmetric single-mode lasing defined by an inhomogeneous self-consistent half-wavelength population-inversion grating. We find analytically the universal profiles of this grating and the counter-propagating waves which form the grating. We outline the ways of control of the superradiant polarization mode and demonstrate its stability far above the lasing threshold.

PECVD-fabricated microresonators for nonlinear photonics
N.Yu. Dmitriev1, A.M. Murnyakov2, M.V. Shibakov1, I.V. Trofimov2, I.A. Filipov2, A.A. Anikanov1, M.A. Tarkhov2, I.A. Bilenko1,3; 1Russian Quantum Center, 2Institute of Nanotechnology of Microelectronics RAS, 3Faculty of Physics, Lomonosov Moscow State University, Russia
We demonstrate characteristics of high-Q ring silicon nitride microresonators fabricated with novel PECVD process. Proposed process allows to fabricate silicon nitride waveguides with thickness over 1 um. Studied 1um-thick silicon nitride ring microresonators features anomalous GVD and loaded Q factor over 1 million.

- Lunch Break -
WeR08-35
16:15-16:30
High-Q crystalline germanium microresonators for Mid-IR
T.S. Tebeneva1, A.E. Shitikov1, K.N. Min’kov1, V.E. Lobanov1, I.A. Bilenko1,2; 1Russian Quantum Center; 2Faculty of Physics, Lomonosov Moscow State University, Russia
We report on the whispering gallery modes microresonators fabrication from crystalline germanium. The resulting Q-factor exceeding $10^7$ is the highest ever recorded for Ge microresonators measured at the 2.68 μm pump wavelength. Self-injection locking of a laser diode to germanium microresonator, which is one of the ways to stabilize the laser frequency is achieved.

WeR08-36
16:30-16:45
Laser beam structure influence on optical and structural modification of phase-change materials
M.P. Smayev1, P.A. Smirnov1,2, I.A. Budagovsky1, M.E. Fedyanina1, V.B. Glukhenkaya1, A.V. Romashkin1, P.I. Lazarenko1, S.A. Kozyukhin1,2; 1Lebedev Physical Institute RAS; 2National Research Univ. of Electronic Technology; 3Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia
We studied a transition of amorphous Ge2Sb2Te5 thin films into the crystalline state under the action of structured cw laser beams. Light beams with an annular intensity profile are significantly more efficient for Ge2Sb2Te5 crystallization compared to the fundamental Hermite-Gaussian HG00 mode due to a more uniform temperature distribution inside the irradiated region.

R09: OPTICAL NANOMATERIALS
Location: Pudovkin 1+2 Room, Floor 3; Date: Wednesday, July 03, 2024
Session Chair:

WeR09-01 09:00-09:30
Energy transfer processes involving colloidal perovskite nanocrystals (Invited paper)
H. Mattoussi; Florida State University, Department of Chemistry and Biochemistry, USA
We exploit the ionic nature of CsPbBr3 QDs to achieve controlled coupling to sulfo-Cyanine dyes. We combine steady-state and time-resolved photoluminescence experiments to measure highly efficient energy transfer interactions, manifesting in pronounced losses in QD emission along with shortening of the lifetime. We will detail our synthetic approach and compare our findings to available theories on energy transfer process

WeR09-02 09:30-10:00
Exciton dynamics in semiconductor nanocrystals (Invited paper)
Prajit Kumar Singh, Gourab Rana, Priya Bhandari Anindyaa Datta; Department of Chemistry, Indian Institute of Technology Bombay, India
Ultrafast pump probe spectroscopy as well as Single Particle Microscopy have been used to decipher the ultrafast dynamics in water soluble cadmium chalcogenide and organic soluble perovskite nanocrystals. A unified picture of exciton dynamics in these systems have been thus developed.

WeR09-03 10:00-10:30
Light-matter interactions at nanoscale leading to chemical change (Invited paper)
P.P. Pillai; Department of Chemistry, Indian Institute of Science Education and Research (IISER) Pune, India
A photoexcited nanoparticle (NP) can initiate a series of relaxation pathways via radiative and non-radiative processes, resulting in unique outcomes. The non-radiative relaxation processes are mainly responsible for bringing-out chemical transformations. Specifically, both hot charge-carriers and heat dissipated from a photoexcited NP can be used for breaking and making of chemical bonds, which will be the focus of the presentation.

WeR08-37 16:45-17:15
Kerr squeezed solitons for metrology (Invited paper)
Gerd Leuchs1, Nikolay A. Kalinin1,2, Arseny A. Sorokin1, Thomas Dirmeier1,2, Elena A. Anashkina1,4, Alexey V. Andrianov1, Joel F. Corney1, Luis L. Sánchez-Soto1,2; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; 3Institute of Applied Physics, RAS, Nizhny Novgorod, Russia; 4Advanced School of General and Applied Physics, Lobachevsky State University of Nizhny Novgorod, Russia; 5School of Mathematics and Physics, University of Queensland, Brisbane, QLD4072, Australia; 6Departamento de Óptica, Facultad de Física, Universidad Complutense, Madrid28040, Spain
A particularly robust source of squeezed quantum light is provided by the optical Kerr effect in a fibre. Using soliton pulses, the nonlinear interaction is effectively increased. The development of Kerr squeezing towards sensing applications advanced with the demonstration of interferometric phase sensitivity enhancement, N. Kalinin et al., Nanophotonics 12, 2945 (2023). We report on the status of the project.

- Coffee Break -
**WeR09-05**

**11:30-12:00**

**Ternary N-based nanostructures: growth and properties (Invited paper)**

G.E. Cirlin¹, R.R. Reznik¹,², V.O. Gridchin¹,²,³; ¹St. Petersburg State University; ²Afferov University; ³Institute for Analytical Instrumentation RAS, Russia

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

**WeR09-06**

**12:00-12:30**

**MBE growth and properties of III-V hybrid nanostructures on silicon for quantum applications (Invited paper)**

R.R. Reznik¹, K.P. Kotlyar¹,², A.I. Khrbetov¹,², I.V. Il’kiv¹,², V.T. Gridchin¹,²,³; ¹Budker Institute of Nuclear Physics SB RAS; ²Novosibirsk State University; ³Institute for Analytical Instrumentation RAS, Russia; ⁴TU Electro, Technical University of Denmark, Denmark; ⁵Department of Electronic Engineering, Università degli Studi di Napoli Federico II, Italy

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

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**WeR09-09**

**15:00-15:30**

**Terahertz surface plasmon refractometry of composite graphene nanolayers (Invited paper)**

V.V. Gerasimov¹,², V.D. Kukotenko¹, A.I. Ivanov¹,², I.V. Antonova¹,², I.Sh. Khasanov³; ¹Budker Institute of Nuclear Physics SB RAS; ²Novosibirsk State University; ³Institute for Analytical Instrumentation RAS, Russia

Graphene and composite thin graphene layers are of great interest for plasmonic interferometry and surface plasmon resonance methods of plasmonic interferometry and surface plasmon resonance refractometry will be presented.

**WeR09-10**

**15:30-16:00**

**Size-dependent lanthanide energy transfer amplifies upconversion luminescence quantum yields (Invited paper)**

Guanying Chen, Harbin Institute of Technology, China

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

**WeR09-11**

**16:00-16:15**

**Wide bandgap nanostructured β-Ga2O3-GaN for UV applications**

L.A. Mochalov¹, M.A. Kudryashov¹, I.O. Prokhorov¹, Yu.P. Kudryashova¹, S.V. Telegin¹, E.U. Rafailov², A.N. Baranov³, A.V. Knyazes²; ¹Lobachevsky University, Russia; ²Aston University, United Kingdom; ³University of Montpellier, France

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

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**WeR09-07**

**12:30-13:00**

**Chiral manganese (II) halides with efficient circularly polarized luminescence (Invited paper)**

Jing Li, Qi Pang; School of Chemistry and Chemical Engineering/State Key Laboratory of Featured Metal Materials and Life-cycle Safety for Composite Structures, Guangxi University, China

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

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**WeR09-08**

**13:00-13:30**

**Synthesis, characterization, and application of cane molasses-derived carbon quantum dots (Invited paper)**

Armin Qin, Gulin University of Technology, China

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

- **Lunch Break -**
**WEDNESDAY**

**R10: NONLINEAR QUANTUM PHOTONICS**

*Location: Deyneka 1+2 Room, Floor 2; Date: Wednesday, July 03, 2024*

**R10: NONLINEAR QUANTUM PHOTONICS 3**

*Session Chair:*

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

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

- **WeR10-13**
  - **15:30-15:45**
  - Benchmarking of 8-qubit quantum processor based on optical transition in 171Yb⁺ ions
    - I. Zalivako¹,², A. Borisenko¹,², I. Semerikov¹,², A. Korolkov¹,², P. Sidorenkó¹,², K. Galtstyan¹,², N. Semenin¹,², V. Smirnov¹,², M. Aksenov¹, A. Nikolayeva¹, E. Klietken¹, A. Fedorov¹, K. Khabarova¹,², N. Kolachevsky¹,², Russian Quantum Center, Russia

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

**PD: POSTDEADLINE**

*Location: Petrov-Vodkin 1+2+3 Room, Floor 2; Date: Wednesday, July 03, 2024*

**PD: POSTDEADLINE 1**

*Session Chair:*

- **WePD-01**
  - **17:30-17:40**
  - An enhanced modeling approach for quantum cascade structures and superlattices
    - D.A. Barykin¹,², A.R. Kostromin¹,², A.S. Dashkov¹,², L.I. Goray¹,²,³, A. Alferov University, St. Petersburg Polytechnic University, St. Petersburg Electrotechnical University, Institute for Analytical Instrumentation, University associated with IA EAE, Russia

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

- **WePD-02**
  - **17:40-17:50**
  - Multi-GHz repetition-rate pulse generation by gain instability in a semiconductor -based all-fiber laser
    - A.V. Ivanenko¹, A.E. Bednyakova¹, S.V. Smirnov¹, B.N. Nyushkov², Vosibinsk State University, Russia

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

- **WePD-03**
  - **17:50-18:00**
  - Design of multimode optical fibers based on optimization of harmonically-tempered refractive Index profiles
    - V.M. Gololobov, E.A. Milikov, P.S. Anisimov, V.V. Zemlyakov, J. Gao; Russian Research Institute, Huawei Technologies Co. Ltd, Russia

  We introduce a new design approach for multimode fibers. We demonstrate modified graded-index multimode fibers with substantially reduced differential mode group delay for fifteen LP modes. Finally, we show the impact of the optimization parameters on the resulting optical fiber profile.
Terahertz emission in a Co/IrMn heterostructure with exchange bias
E.D. Lebedeva, P.Yu. Avdeev, A.V. Gorbatova, I.Yu. Pashenkin, M.V. Sapoznikov, A.M. Buryakov; MIREA - Russian Technological University, Institute for Physics of Microstructures RAS, Russia
A spintronic emitter, made of layers of ferromagnetic Co and antiferromagnetic IrMn, was studied for exchange bias field using THz-TDS method. Laser heating and weak magnetic fields were found to alter exchange bias direction. Mechanism of THz radiation generation in emitter was examined.

Kilowatt-class multi-element first cladding fiber laser
D.V. Kulakov, A.V. Bochkov, Yu.V. Ivchenko; Federal State Unitary Enterprise «Russian Federal Nuclear Center – All-Russia Research Institute of Technical Physics named after Academician E.I. Zababakhin», Russia
The article presents the results on experimental elaboration of a fiber laser technology with multi-element first cladding (MFC) manufactured at RFNC – VNIITF. A mockup of ytterbium single-mode fiber laser of 1000 W maximum output power has been designed and implemented.

Quantum electrodynamics cascade arising at reflection of a multipetawatt laser pulse from a solid plasma target
M.A. Serebryakov, E.N. Nerush, I.Yu. Kostyukov; Federal Research Center A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia
Quantum electrodynamics (QED) cascade arising in a superposition of incident multipetawatt laser pulse and its reflection from a solid target were studied numerically and analytically.

Photoconvertible polymer labels for macrophages tracking
Zh.V. Kozyreva, P.A. Demina, A.Yu. Sapach, D.A. Terentyeva, G.B. Sukhorukov; Skolkovo Institute of Science and Technology, Russia; Saratov State University, Russia; Queen Mary University of London, UK
Cell tracking is conventionally performed using fluorescent green proteins. As an alternative, photoconvertible microcapsules were proposed for macrophage labeling, as transfection is unacceptable for this cell type. The capsules’ fluorescence intensity, photostability, photocconversion ability and mechanism were investigated. RAW 264.7 and bone marrow-derived macrophages were labeled with capsules, that demonstrated minimal cytotoxicity and negligible effects on cell mobility.

Application of deep neural network in wavefront detection based on intensity transmission
Zhang Haoran, Liang Yonghui, Liu Jin, Yang Huizhe; College of Advanced Interdisciplinary Studies, National University of Defense Technology, Nanhu Laser Laboratory, National University of Defense Technology, China
The utilization of the Transport of Intensity Equation (TIE) to reconstruct the phase information at different propagation distances represents a novel wavefront sensing method. We propose a Deep Neural Network (DNN) model for TIE wavefront sensing. Simulation results indicate that, compared to traditional linear reconstruction methods, DNN significantly reduces the laser power requirements while effectively improving wavefront sensing accuracy.

Laser speckle contrast imaging for intraoperative blood flow monitoring during neurovascular surgery
D.D. Stavtsev, A.N. Konovalov, F.V. Grebenev, I.O. Kozlov, G.A. Piavchenko, E.V. Bilonov; Sechenov Univ., Russia; MIET, Russia; Burdenko Neurosurgical Center, Russia
Laser speckle contrast imaging is promising for intraoperative real-time blood flow monitoring during neurovascular interventions. In this study, we showcased the utility of this technique in evaluating cerebral blood flow reactivity during asystole and cardiac resuscitation, as well as in assessing blood flow variations during simulated neurovascular procedures, including in comparison with ICG angiography.

Non-adiabatic polariton condensation in annular optical traps
I. Chestnov, E. Cherotchenko, A. Nalitov; ITMO Univ., Ioffe Institute, MIPT, Russia
We explore formation and dynamics of nonequilibrium bosonic exciton-polariton condensates in annular optical traps. Near the condensation threshold, we develop the two-mode model, accounting for counter-rotating quantized vortices and corresponding angular harmonics in the incoherent excitonic reservoir density. Identifying the range of validity for adiabatic reservoir elimination, we extend the analytic model beyond the adiabatic approximation.
Development 515 nm Q-switched thin disk laser
A.B. Kozlov, N.P. Badalyan, E.V. Kuznetsov, M.M. Zemlyanov, A.V. Shhestakov; RDI Polyus, Russia
This paper discusses the results of the development of SHG 515 nm Q-switched thin disk lasers in the Research and Development Institute Polyus of M.F. Stelmakh. The main constructive elements of the thin disk laser, abilities of SHG and the demands to its technical characteristics are considered too.

Spectral, lasing and mechanical strength characteristics of crystals Yb:Li2ZnWO4, K.V. Kuleshov2,3, K.A. Subbotin1,2, P.A. Loiko2, Yu.I. Zimina1,2, A.I. Titov1,2, Ya.S. Didenko1,2, D.A. Lis1, S.K. Pavlov1,2, P. Camy2, A. Braud2, R.M. Solé3, M. Aguilo3, F. Díaz4, W. Chen5,6, X. Mateos4, V. Petrov5, G.Z. Elabedine4, P.A. Volkov6; 1 Prokhorov General Physics Institute RAS, 2 Mendeleev University of Chemical Technology, Russia; 3 Centre de Recherche sur les Ions, les Matériaux et la Photonique, Université de Caen Normandie, France; 4 Tomsk State University; 5 Institute of High Current Electronics SB RAS, Russia
Spectral and mechanical strength properties of Yb:Li2ZnWO4 crystals were investigated, diode-pumped ZnW4O laser with an output power of 2.41 W was demonstrated.

Stimulated emission and amplification in NV− centers of diamond with CW pumping
A.D. Savvin1, V.P. Mitrokhin1, A.E. Dormidinov1, E.I. Lipatov2, V.G. Vins2; 1 Dukhov Research Institute of Radio Engineering and Electronics, Russia; 2 Institute of Nuclear Physics, National Research Tomsk State University, Russia
Up to 1 % amplification CW irradiation with wavelength 730 nm in diamond with CW pumping is demonstrated. The absorption and fluorescence spectra maxima shift towards higher energies in the Cr-Fe co-doped samples, negatively affecting the nonradiative energy transfer process between Cr2+ and Fe2+.

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

WeR01-p07 15:00-18:30
Resonator for diamond NV− laser based on one-dimensional photonic crystal structures
V.V. Chashchin1,2, E.I. Lipatov1,2, S.V. Rabotkin1; 1 Tomsk State University; 2 Institute of High Current Electronics SB RAS, Russia
A model of multilayer reflective coatings for the wavelength of diamond laser generation has been created. The results of the creation of reflective nanostructures at the end of diamond samples are presented, the transmission and photoluminescence spectra of the samples (before and after the application of mirrors) are presented.

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

WeR01-p09 15:00-18:30
Growth, spectroscopy and multi-site behavior of monolonic Eu:MgWO4 crystal
K.A. Subbotin2, A. Baillard, A.I. Titov, D.A. Lis2, Yu.I. Zimina1,2, Ya.S. Didenko1,2, G.Z. Elabedine4, R.M. Solé3, M. Aguilo3, F. Díaz4, W. Chen5,6, X. Mateos4, P.A. Loiko3; 1 Prokhorov General Physics Institute RAS, 2 Mendeleev University of Chemical Technology, Russia; 3 Centre de Recherche sur les Ions, les Matériaux et la Photonique, Université de Caen Normandie, France; 4 Tomsk State University; 5 Institute of High Current Electronics SB RAS, Russia
Monolonic Eu3+-doped MgWO4 crystal is grown from the flux using Na2WO4 as a solvent and its polarized emission properties in the visible are studied revealing a multi-site behavior of this promising laser material.

WeR01-p10 15:00-18:30
Influence of Fe3+ -co-doping on Cr3+ ion spectroscopic properties in Zn.7Mn.3Se and Zn.7Mg.3Se crystals at room-temperature
M.E. Dorochenko1, K.A. Pierpoint1, H. Jelinková1, A. Riha2; 1 Prokhorov General Physics Institute RAS, Russia; 2 Czech Technical University in Prague, Czech Republic
The influence of Fe2+ -co-doping on the room-temperature spectroscopic properties of Cr2+ ions in Zn0.7Mn0.3Se and Zn0.7Mg0.3Se crystals is demonstrated. The absorption and fluorescence spectra maxima shift towards higher energies in the Cr-Fe co-doped samples, negatively affecting the nonradiative energy transfer process between Cr2+ and Fe2+ ions.

WeR01-p11 15:00-18:30
Growth, structure, thermal properties and spectroscopy of Tm3+-doped MgMoO4 laser crystal
A.I. Titov2, K.A. Subbotin2, Y.S. Didenko2, D.A. Lis2, Yu.I. Zimina1,2, G.Z. Elabedine3, K. Ereemenko1, R.Maria Solé3, M. Aguilo3, P.A. Volkov1, P.A. Popov1, E.V. Chernova1, F. Díaz4, P. Camy2, P.A. Loiko3, X. Mateos3; 1 Prokhorov General Physics Institute RAS, 2 Mendeleev University of Chemical Technology, Russia; 3 Centre de Recherche sur les Ions, les Matériaux et la Photonique, Université de Caen Normandie, France; 4 Tomsk State University; 5 Institute of High Current Electronics SB RAS, Russia
Tm3+-doped MgMoO4 crystal was grown by Czochralski. The actual Tm3+ concentration in the crystal, the tensor of thermal expansion coefficients and thermal conductivity was determined. Spectroscopic studies were shown broad emission band extending beyond 2 µm (the 3F4 → 3H6 transition) and a long 3F4 excited-state lifetime that makes this crystal promising for broadly tunable and mode-locked lasers.
Development of a new crystalline scintillation single crystal based on silver and thallium halides

V.M. Kondrashin, P.V. Pestereva, T.M. Kucherenko, I.V. Yuzhakov, L.V. Zhukova; Urals Federal University, Russia

A new scintillation single crystal based on silver and monovalent thallium halides for scintillation optics has been designed, synthesized and studied for the detection and measurement of ionizing radiation.

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

S.V. Gagarinsky, S.G. Grechin, P.Y. Druzhinin, J.R. Istangulova, V.A. Ruskov, A.N. Sergeev; 1 ITMO University, 2 Prokhorov General Physics Institute RAS, Russia;

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

Increasing the average and peak power of thin slab based amplifier


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

We present study on optical properties of β-BBO crystals grown from three different melt solutions: visible and infrared spectral range

D.M. Ezhev, E.A. Simonova, A.A. Goreyavcheva, V.A. Svetlichnyi, A.E. Koikh; 1 Tomsk State University, 2 Sobolev Institute of Geology and Mineralogy SB RAS, Russia

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

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

M.D. Cheban, S.A. Filatova, K.A. Scherbakov, D.N. Mamontov, 1 Prokhorov General Physics Institute RAS, 2 IRUDN University; 3 National Research Nuclear University MEPhI, Russia

We present the development and study results of a special cleaning technique for stainless steel surfaces with a coating simulating radioactive contamination. Laser radiation at a wavelength of 1 μm with pulse duration of 8 ns and 270 fs was used to remove the simulated contamination.

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

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

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

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

K.A. Subbotin, A. Baillard, A.I. Titov, S.K. Pavlov, E.V. Zharkov, P.Camy, M.D. Cheban, O.A. Filatova, K.A. Scherbakova, D.N. Mamontov; 1 Prokhorov General Physics Institute RAS, Russia

The work is devoted to the preparation of a luminescent crystalline substance based on AgBr0.8I0.2 : NdCl3 and obtaining its luminescence spectra.
Gain-switched single-frequency ytterbium fiber laser
A.V. Shirmanin1, A.I. Trikhev1, V.A. Kamynin1, D.S. Lipatov1, A.A. Rybaltovski1, V.B. Tsvetkov1, M.V. Yashkov2, Prokhorov General Physics Institute RAS, 2 GG Devyatkykh Institute of Chemistry of High-Purity Substances RAS, Russia
We have investigated the generation characteristics of a distributed Bragg reflector (DBR) short cavity ytterbium fiber laser. Due to pulse pumping, the laser with an emission wavelength of 1066 nm was operated in gain switch mode with pulse durations ranging from 32 ns to 83 ns.

Dispersion properties of composite Erbium-Ytterbium doped optical fibers
V.V. Velmiskin, B.I. Denker, A.D. Zverev, V.A. Kamynin, S.E. Sverchikh, V.B. Tsvetkov, Prokhorov General Physics Institute RAS, Russia
The dispersion parameter of composite optical fiber doped with ytterbium-erbium complex has been experimentally investigated using Kelly sideband analysis. The dispersion values in the spectral range of 1542-1564 nm were obtained. The maximum dispersion value was 308 ps/km at the wavelength of 1542 nm.

Temperature dynamics of laser generation spectra at NV centers in diamond
A.V. Samolov1, D.E. Genin2, A.P. Eliseev2, V.G. Vins3, National Research Tomsk State University, 2 Institute of High-CURRENT Electronics SB RAS, 3 V.S. Sobolev Institute of Geology and Mineralogy SB RAS, Veliym Ltd, Russia
Currently, there is a problem of rapid degradation of equipment in outer space, where there is strong radiation. A promising solution to this problem is the creation of a diamond-based laser. The report presents the results of an experimental study of artificial diamond samples laser generation in the temperature range from 80K to 300K. Laser generation was obtained on NV-centers.

Temperature-dependence of spectral and kinetic characteristics of 8.3(3) at. % Yb:YSAG laser ceramics
V.Yu. Zhymkov1, E.A. Dobretsova1, V.S. Tsvetkov1, Yu.N. Pyrkov1, Prokhorov General Physics Institute RAS, Russia
The results were supported by the Russian Scientific Fund (No 23-22-00416).

Spectroscopic properties of different cobalt ions optical centers in calcium orthovanadate crystals
M.E. Doroshenko, L.I. Ileva, A.G. Papashvili, I.S. Voronina, E.E. Dunaeva, K.A. Pierpoint, Prokhorov General Physics Institute RAS, Russia
Calcium orthovanadate crystals doped with cobalt ions via thermal diffusion and during Czochralski growth process are studied. The spectroscopic properties of M1 and M2 Co2+ optical centers are presented. Nonlinear transmission and efficient absorption cross-sections are measured for Co2+ M2 centers. A narrow fluorescence line at 1170 nm is attributed to trivalent Co ions.
Numerical study of mid-infrared lasing in rare-earth-doped chalcogenide fibers with pump intensities below the fiber damage power can be achieved for an out-of-phase supermode of chalcogenide rare-earth-doped fibers with pump intensities below the fiber damage threshold.

WeR01-p36 15:00-18:30

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

D.M. Bengalskiǐ, D.R. Kharasov, E.A. Fomityakov 1, S.P. Nikitin 1, O.E. Naniǐ 2, V.N. Treshikov 1, TB LLC, "Lomonosov Moscow State University, Department of Physics, Center RAS, Russia

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

WeR01-p37 15:00-18:30

Numerical study of mid-IR fiber lasers based on Tb, Nd, or Pr-doped engineered optical fibers

N.I. Salnikov, A.V. Andrianov, E.A. Anashkina, A.V. Gaponov-Grekhov Institute of Physics, Kazan Federal University; D.F. Ustinov Baltic State Technical University "VOENMEH", Russia

We report about spectral and luminescence characteristics of the concentration series of LiYLu_xF_{4-x} crystals doped with Tm^3+ and Ho^3+ ions. The sensitized luminescence and polarization dependent spectral characteristics of crystals where some broadening of spectral lines are evidenced are presented and discussed. Measured data allowed us to estimate the Förster radius for the system of Tm^3+–Ho^3+ ions in LiYLu_xF_{4-x} crystals.

WeR01-p43 15:00-18:30

Spectral properties of Tb ions in SrF_2 crystal doped with Yb

A.V. Nekhoroshikh, P.G. Zverev, V.A. Konyskun; Prokhorov General Physics Institute, Kazan Federal University, Russia

We report about spectral and luminescence characteristics of the concentration series of LiYLu_xF_{4-x} crystals doped with Tm^3+ and Ho^3+ ions. The sensitized luminescence and polarization dependent spectral characteristics of crystals where some broadening of spectral lines are evidenced are presented and discussed. Measured data allowed us to estimate the Förster radius for the system of Tm^3+–Ho^3+ ions in LiYLu_xF_{4-x} crystals.

WeR01-p44 15:00-18:30

Anti-Stokes pumping of Yb:Er:YAB Q-switch laser

A.V. Polischuk, A.S. Rybich, D.P. Shcherbinin, M.A. Fedorov, V.V. Vitkin, A.V. Ivanov; ITMO University, Russia

This research is devoted to finding ways to optimize optical pumping of a solid-state laser in order to obtain a thermally stabilized lasing mode. Here, we investigate the possibility of generating 1.5 μm laser pulses for the Yb: Er:YAB active medium under optical pumping conditions with a radiation wavelength of 1035 nm, which is unusual for lasers of this type.

WeR01-p45 15:00-18:30

Multi-wavelength lamp pumped LiSrAlF_6:Cr laser with Bragg grating

M.V. Gavrish, P.K. Rozanov, E.A. Gavrish, A.A. Sergeev, A.P. Pogoda, A.S. Boreysho, D.F. Ustinov Baltic State Technical University "VOENMEH", "The First Pavlov State Medical University of St. Petersburg, Russia

The research presents a multi-wavelength pulse generation mode in a Cr:LiSrAF laser using optically coupled resonators. An intra-cavity Bragg grating facilitates wavelength control, achieving two non-commensurate wavelengths in free and passive Q-switch modes. Experimental results show a tunable range of 795 nm to 930 nm, minimal tuning step of 0.1 nm, and a 1.4 nm separation gap in Q-switch mode.
Optical centers of Yb\(^{3+}\) ion in YScO\(_3\) crystal fiber

O.K. Alimov, M.E. Doroshenko, E.A. Dobretsova, K.A. Pierpont, S.Ya. Rusanov, V.V. Kashin, V.B. Tsvetkov; General Physics Institute RAS, Russia

The spectral-kinetic properties of Yb\(^{3+}\) optical centers in YScO\(_3\) crystal fiber were studied using selective laser spectroscopy. Three distinct types of Yb\(^{3+}\) optical centers were identified. Here we discuss nature of Yb\(^{3+}\) optical centers formation.

YAG crystal gradient-doped with Yb\(^{3+}\) ions: growth and properties

V.V. Petrov\(^{1,2}\), V.A. Petrov\(^{1,2}\), G.V. Kuptsov\(^{1,2}\), A.O. Kuptsova\(^{1,2}\), V.V. Galutskiy\(^{1}\), E.V. Stroganova\(^{1}\); Institute of Laser Physics SB RAS; Novosibirsk State Technical University; Novosibirsk State University, Russia

Yttrium-aluminum garnet crystals with a gradient distribution of Yb\(^{3+}\) ions (Yb:YAG) were grown using the Czochralski method with liquid recharge. The concentration of Yb\(^{3+}\) ions along the length of the crystal boule varied from 0 to 4 at.%. The subsequent studies showed the existence of a limiting gradient along the length of the crystals connected with formation of the impurities.

Spatial-angular scattering of laser radiation by plasma of tungsten, aluminum, sulfur, copper and tantalum

A.T. Sahakyan, M.M. Zakharchuk, V.N. Puzyre, T.T. Kondratenko, A.N. Starodub; Lebedev Physical Institute RAS, Russia

A technology has been developed for producing step-index fibers based on the AgBr – Ag system single crystals. The fiber cladding is made of 8 mol. % AgI in AgBr, core 12 mol. % AgI in AgBr. The fiber diameter was 1120 μm, core diameter 550 μm. The fiber is suitable for IR lasers and pyrometry.

Theoretical research of a potassium diode-pumped alkali laser

A.V. Samsonov\(^{1,2}\), V.M. Yamshchikov\(^{1}\), G.N. Kachalin\(^{1,2}\), A.A. Tarakanovsky\(^{1}\), D.A. Elkhimov\(^{1,2}\); RFNC - VNIIEF, Branch of Lomonosov Moscow State Univ. in Sarov, Russia

The results of computational and theoretical studies of diode-pumped alkali laser parameters are presented. A mathematical model is constructed, a numerical simulation of the equations of kinetics and laser radiation transfer considering the width of the pumping spectrum is given, and the optimal parameters of the laser installation were obtained, at which the calculated “light-to-light” efficiency is more than 50%.

Optical compressor as a spatial filter of PW laser beams before nonlinear temporal compression stage

S.Yu. Mironov, E.A. Khazanov; Institute of Applied Physics RAS, Russia

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

WeR02-p09
10:00-13:30

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

WeR02-p10
10:00-13:30

A graded-index confined bismuth-doped fiber for cladding-pumped E+S-band high-power amplifiers
A multimode double-clad graded-index fiber with the confined Bi-doped germanosilicate glass core was fabricated by all-gas-phase MCVD technology. The bismuth-doped fiber as an active medium exhibited good performance characteristics in the developed E+S-band power amplifier, which provided a maximum output power of 1W at an input signal of 150 mW under pumping by multimode laser diodes at 808 nm.

WeR02-p11
10:00-13:30

Measurement of optical absorption coefficient of lithium-sodium molybdate crystals
We introduce the measurement results of the optical absorption coefficient of the nonlinear-optical crystal lithium-sodium molybdate LiNa-Sm9030 (LNM). The absorption coefficient of LNM at 1070 nm wavelength was determined using piezoelectric resonance laser calorimetry.

WeR02-p12
10:00-13:30

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

WeR02-p13
10:00-13:30

Temperature-induced distortions redistribution of the stacked-actuator deformable mirrors with various apertures under different cooling regimes
V.V. Toporovskiy, P.M. Kuzmiksky, I.V. Galaktionov, A.V. Kudryashov; 1Sadovsky Institute of Geosphere Dynamics RAS; 2Moscow Polytechnic University, Russia
The behavior of the stacked-actuator deformable mirrors under 10kW power was simulated with finite element method. Thermomechanical analysis of the wavefront correctors was performed in three main cases: without thermostatabilization, cooling through actuators and with applying periphery thermostabilization. The simulation showed that the best cooling is achieved with heat dissipation along the periphery of the mirror substrate.

WeR02-p14
10:00-13:30

Calculation of a frequency of laser beam parameter changes in a turbulent medium
Yu. Grikunov, F. Kaner, A. Rukhovets, I. Galaktionov; 1Tompolytechnic University, 2V.E. Zuev Institute of Atmospheric Optics SB RAS, 3Sadovsky Institute of Geosphere Dynamics RAS, Russia
Results of a laboratory and numerical experiments are analysed and compared in the paper. In experiments a laser radiation propagated in a randomly inhomogeneous medium.

WeR02-p15
10:00-13:30

Linear errors of radiation guidance in the laser communication channel due to atmospheric inhomogeneities
S.Yu. Strakhov, A.V. Savin, N.V. Sotnikova; Baltic State Technical University «Voenmeh», Russia
The paper proposes a method for calculating linear errors and discusses the results of its evaluation for a real atmospheric route.

WeR02-p16
10:00-13:30

Compact TEA-CO2 laser with pulse repetition rate up to 2.5 kHz
B.A. Kozlov, V.Z. Shvet; Ryazan State Radio Engineering Univ., 15SC “NIIETA”, Russia
The influence of the parameters of high-voltage pulses on the formation of stable volume discharges in the gap 34 cm3 in CO2-laser mixtures with a high content of carbon dioxide at pulse repetition frequencies up to 2.5 kHz has been studied. Laser pulses with an energy of 80–120 mJ with duration of 25–35 nanoseconds were obtained.

WeR02-p17
10:00-13:30

Deactivating coatings of the discharge channel walls and average radiation power of a nitrogen laser
B.A. Kozlov, Z.V. Shvet; Ryazan State Radio Engineering Univ., Russia
The influence of deactivating coatings of the discharge channel walls on average radiation power of a nitrogen laser pumped by a longitudinal discharge has been studied. Graphite, boric acid and chromium oxide have the most efficiency. Graphite, boric acid and chromium oxide provide an increase in the pulse repetition rate and average radiation power by 1.8–2 times.

WeR02-p18
10:00-13:30

Stimulated Brillouin scattering threshold increase in narrow-band fiber systems
K.G. Aksyonov, O.L. Techko, S.M. Kulikov, RFNC-VNIIEF, Sarov, Russia
This paper presents results of an experimental and numerical study of the thermal method of stimulated Brillouin scattering (SBS) threshold increasing in narrow-band fiber systems. Novel model for calculating the influence of temperature distribution along the fiber on SBS threshold is developed.

WeR02-p19
10:00-13:30

Study of spectral-temporal characteristics of optical radiation during sputtering of cadmium into gas medium under nanosecond electron beam irradiation
K. Samarkhanov, M. Khasenov, E. Batyrbekov, Yu. Gordinenko, Yu. Ponkratov, Ye. Tulubayev, V. Bochkov; 1Institute of Atomic Energy of the National Nuclear Center of the Republic of Kazakhstan, IAE NNC RK; 2Sansen Armanzhakov East Kazakhstan University, 3National Nuclear Center of the Republic of Kazakhstan, NNC RK, Kazakhstan
The optical radiation in a gaseous medium was investigated by irradiating a cadmium foil with a 150 keV electron beam and a 5 ns pulse duration. The foil was positioned 30 mm from the cathode, heated to 550 K, within the irradiation chamber of a nanosecond electron accelerator.

WeR02-p20
10:00-13:30

Optically pumped Ar-He gas laser
A.A. Kalacheva, Yu.A. Adamenkov, M.A. Gorbunov, E.V. Kabak, V.A. Shaidulina, A.V. Yuriyev; RFNC-VNIIEF, Russia
We represent the results of experiments on studying an optically pumped Ar-He laser (OPRGL). Measurements of output power of generation with longitudinal and transverse circuits and the maximum value of generation power obtained to date are given.
Gradient method for piezoresonance laser calorimetry

Moscow Institute of Physics and Technology (National Research University),
Kotel'nikov Institute of Radio Engineering and Electronics RAS, Russia

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

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

M.V. Zavidullin, P.A. Mihiyev, A.D. Dvornikov, R.A. Kuramshin; Samara Branch of Lebedev Physical Institute, Samara State Korolev University, Russia

Numerical simulations of an active medium of an optically pumped rare gas laser driven by a nanosecond repetitively pulsed discharge in an Ar-H2 mixture at an atmospheric pressure, were performed. Calculations were carried out within the framework of a one-dimensional model of the transfer of plasma components and electron energy, with an account for spatially inhomogeneous optical pumping.

Thermal lens measurement in LNM with Gerchberg-Saxton algorithm

A.S. Burkov, N.V. Tereshchenko, N.A. Khohlov; Moscow Institute of Physics and Technology, NTU IRE-Polus, Russia

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

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

E.V. Borisova, A.A. Ponosova, I.I. Galagani, V.V. Koltashev; Moscow Institute of Physics and Technology, Moscow, Russia

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

Simulation of the process of laser radiation on steel

Dias Sultanuly, Juliia S. Ruzankina, St. Petersburg Electrotechnical University "LETI", Russia

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

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

A. Saramud, Iu. Ruzankina, St. Petersburg Electrotechnical University "LETI", Russia

Objects of cultural and historical heritage made of iron and steel have colored decorative finishes that become dull over time under the influence of adverse environmental conditions. The conducted research has shown that the application of laser treatment is a promising method for restoring patina on the surface of cultural heritage objects made of iron-containing metals.

WeR02-p30

Multichannel diode-pumped Nd:glass zig-zag slab amplifier for XCELS facility

D. Sizimzhanov, S. Koshevich, A. Dobikov, N. Mal'sev, G. Sannikov, E. Dmitrieva, M. Galvilenko, V. Derkach; All-Russian Scientific Research Institute of Experimental Physics, Sarov, Russia

A laser system for pumping OPCPA preamplifiers at the XCELS facility, with a pulse energy of 40 J per channel is being developed. The system is based on a multichannel Nd:glass zig-zag slab amplifier, water cooling and transverse diode pumping at 870 nm. The simulation results of the pumping, laser pulse amplification and thermally induced front face distortions are presented.

WeR02-p31

Automatic laser beam pointing and positioning system with 4 wale-aperture folding mirrors on motorized gimbal mounts

I. Galaktionov, V. Toporovsky, A. Nikitin, A. Rukozuev, J. Sheldakova, A. Kudryashov; Sadykov Institute of Geosphere Dynamics RAS, Moscow, Russia

The semi-automatic system for laser beam alignment was developed and researched. The alignment system was used to control the pointing and positioning of the beam as well as tip-tilt and overall curvature of the wavefront.

WeR02-p32

Study of migration of elements on the metal surfaces after laser shock peening in water medium

D.A. Bessonov, Yu.V. Chebotarevsky, T.N. Sokolova, E.L. Surmenko, P.N. Ustinov, Saratov State Technical Univ., Russia

The results of the laser shock peening in water medium are presented. The estimation of chemical composition of surface was studied by LIBS-method. The diffusion of paints and migration of elements of the substrate was observed layer-by-layer for aluminum and steel plates.
Radiation power distribution over the beam cross section in a nitrogen laser pumped by longitudinal discharge
Z.V. Shvets, B.A. Kozlov; Ryazan State Radio Engineering Univ, Russia
The influence of exciting pulses on the distribution of radiation in beam cross section nitrogen laser has been studied. The determining role in the formation of radiation with minimal power in the “halo” is played pulse repetition frequency and rise time of the voltage pulses.

Microwave pumped multi-frequency planar (CO2 -Xe)-laser
A.P. Mineev, S.M. Nefedov, P.A. Goncharov; General Physics Institute RAS, Russia
In a planar gas-discharge (CO2:Xe)-laser with microwave pumping and diffusion cooling of the working gas in discharge channel size 2x25x250 mm, lasing was obtained simultaneously on xenon atoms and on carbon dioxide molecules. A pulsed output power of 60 W at a wavelength of $\lambda=10.6$ μm and a total of 0.7 W at $\lambda=2.03$ and 3.43 μm was achieved.

WeR05-p01
Generation of long-lived strong magnetic fields in laser targets with cylindrical micro-channels
A.A. Andreev1,2, L.A. Litvinov3, K.Yu. Platonov3; `St. Petersburg State University; `Piter the Great St. Petersburg Polytechnical University; `Ioffe Institute, Russia
Superstrong magnetic field generation by a circularly polarized intense laser pulse in a target consisting of several touching cylindrical nano-channels is considered. The cylindrical shells collapse towards the cylinder axis leads to magnetic field increase and continues for a sub-picosecond time. As a result, a long-lived Giga-Gauss magnetic field is generated in the laser target volume.

WeR05-p02
Plasma-mirror -based laser pulse contrast enhancement system for multiterawatt laser facility
Laser pulse contrast enhancement system (CeS) for a 200 TW femtosecond laser was developed on the base of the double plasma mirror technology. We report optical schemes of the CeS, optical alignment system and results of the first experiments on the interaction of the high-contrast laser pulses with solid targets at intensities up to 1020 W/cm2.

WeR05-p03
Research of ultrashort laser processing Si and glass for microelectronics applications
D.M. Kataev1,2, L.N. Evthikhiev2, M.A. Murzakov2; 1IRE-POLUS LTD; 2National Research Nuclear University MEPhI, Russia
Research of the laser processing by femtosecond pulses of borosilicate glass and silicon substrate has been carried out. At pulse energies in the range up to 15 μJ, a weld is formed at the interface “glass-silicon substrate”. Experiments were carried out on laser cutting glass to form a base cut. The work of perforating holes in the Si was completed.

WeR05-p04
Research of the interaction ultrashort pulses in the processes of laser welding dissimilar metal and glass joints
M.A. Murzakov1, N.N. Evthikhiev2, D.M. Kataev1; 1IRE-POLUS LTD; 2National Research Nuclear University MEPhI, Russia
Results of experiments on the formation of metal-glass welded joints under influence of 1-3 ps pulses are presented. When laser radiation interacts with metal and glass, mechanical bond is formed at the interface between dissimilar materials. It is shown that the formation welds occurs at pulse energies of 30 μJ.

WeR05-p05
Experimental observation of Weibel instability in the astrophysical and Fast Ignition relevant plasmas induced by ultrashort 250 TW laser pulse
R.S. Zemskov, S.E. Perevalov, A.V. Kotov, A.A. Murzanov, A.N. Stepanov, A.A. Soloviev, M.V. Starodubtsev, A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia
Weibel instability was observed experimentally in the plasma generated after irradiation a solid target with a 250 TW ultrashort laser pulse at the PEARL petawatt laser facility. A small-scale current-structured Weibel instability has been studied using various optical diagnostics. The influence of laser radiation intensity and an external magnetic field on generation of the Weibel instability has been investigated.

WeR05-p06
Numerical simulation of broadband chirped pulses amplification in Yb3+-KGW using Maxwell-Bloch equations
I.V. Kuzmin, S.Yu. Mironov, E.R. Kocharovsky; Federal Research Center Institute of Applied Physics RAS, Russia
The features of broadband chirped infrared laser pulses amplification by using a numerical solution of the Maxwell-Bloch equations for a four-level medium are considered in this work.

WeR05-p07
Theoretical model of the self-trapping of a laser pulse in a relativistic plasma
I.I. Metelskii1,2, V.F. Kovalev1,2, V.Yu. Bychenkov1,2, I.A. Glushkov, I.B. Mukhin, E.A. Perevezents; Institute of Applied Physics RAS (IAP), Russia
Using a model approach the previously discovered in numerical simulation regime of stable propagation of relativistically intense laser pulses in a plasma over distances much greater than the Rayleigh length was studied. Conditions for matching the laser spot size with the plasma density and laser pulse intensity, which correspond to the self-trapping of radiation for relativistic plasma nonlinearity, are obtained.

WeR05-p08
Development of multicolor parametric amplifier based on sub-ps ytterbium laser
I.A. Glushkov, I.B. Mukhin, E.A. Perevezents; Institute of Applied Physics RAS (IAP), Russia
A universal multicolor converter of sub-ps pulses of ytterbium lasers in a few cycle femtosecond pulses with the ability to adjust the central wavelength in the range from 650 to 2500 nm has been created. The possibility of amplification of these pulses to the mJ energy level by OPCPA and FOPA methods has been studied.
Temporal transformation of noise-like pulse bunches in an Er-doped fiber laser
A.Yu. Fedorov, A.O. Prudnikov, I.O. Orekhov, D.A. Dvoretskii, S.G. Sazonkin, L.K. Denisov, V.E. Karasik; Bauman Moscow State Technical University, Russia
A fiber laser generating noise-like two-pulse bunches with duration of ~66 fs is presented. The transformation of these pulses into a multi-bound soliton regime with a duration of 142 fs is investigated.

Energy relaxation in a strongly excited electron subsystem of a Nickel film on a substrate
S.A. Romashevskiy, S.A. Evlashin, P.A. Tsygankov; 1 Joint Institute for High Temperatures RAS, 2 Center for Materials Technologies, Skolkovo Institute of Science and Technology, Russia; 3 Grekhov Institute of Applied Physics, 2 Lobachevsky State University of Nizhny Novgorod, 3 Voronezh State University, Russia
We introduce a flexible method utilizing femtosecond laser technology for the formation of a striped pattern of supercontinuum distribution. The periodic change of the short-wavelength cutoff of the supercontinuum. The group velocity dispersion moves the channel produced by ultrashort relativistically intense laser pulse with near-critical density plasmas has been studied numerically. We identify distinctive mechanisms of drift, diffusion, and acceleration of electrons in quasi-static fields generated in the laser plasma channel produced by ultrashort intense laser pulses.

High-order harmonics generation by solid slabs in two-color infrared and ultraviolet field
A.A. Romanov, A.A. Silaev, N.V. Vvedenskii, M.V. Frolov; 1 Institute of Applied Physics RAS, 2 Nizhny Novgorod State University, 3 Voronezh State University, Russia
The generation of second and third harmonics of XUV pulse by noble-gas atoms in the presence of intense infrared field
A.A. Romanov, A.A. Silaev, N.V. Vvedenskii, M.V. Frolov; 1 Institute of Applied Physics RAS, 2 Nizhny Novgorod State University, 3 Voronezh State University, Russia
We introduce a flexible method utilizing femtosecond laser technology for writing FBGs inside fiber core. Using a spatial light modulator enables precise positioning of the focal point within the core. This method allows to change the grating pitch dimension from a single point to more complex shapes, showcasing 3D structuring.
Interferometric reconstruction of the complex amplitude (IRCA) of femtosecond pulses
A. Mukhamedyanov1,2, K.A. Akmarov2, K.A. Emelyanov1,2, S.A. Babaev2, S.P. Nikitin2;
1 MIPT Univ., 2 FemtoVision LLC, Russia
A novel femtosecond diagnostic technique based on interferometric reconstruction of the complex amplitude (IRCA) is introduced. It employs same-scan acquisitions of the Michelson interferometer signal along with the fringe-resolved autocorrelation function. Fourier transform spectrometry is used to evaluate pulse spectrum. The pulse E-field is calculated based on acquired ACF and spectrum. Such approach simplifies hardware, reduces mechanical dimensions and costs.

Generation of tunable ultraviolet pulses using gas ionization by chirped two-color pulses
A.A. Romanov2,3, A.A. Silaev2,4, A.V. Budin2, N.V. Vvedenskii2,3, A.V. Gaponov-Grekhov Institute of Applied Physics RAS, 2 Lobachevsky State University of Nizhny Novgorod, Russia
We propose a method for generating pulses of ultraviolet radiation with stable phase and tunable frequency. The method is based on gas ionization by two-color laser pulses with frequency chirp of opposite sign and variable time delay. Changing the time delay allows simple tuning of the generation frequency near the fourth harmonic of the fundamental field.

Shape and temperature fiber sensors based on fs-laser written reflectors in 7-core fiber and machine learning
Z.E. Munkueva1,2, K.A. Bronnikov3, D. Salmo4, I.Y. Kokhanovsky3, A.V. Dostovalov5, S.A. Babin1,2; 1 Institute of Automation and Electrometry SB RAS, 2 Novosibirsk State University, 3 School of Physics and Engineering, ITMO University, Russia
We present the experimental results on development of 3D shape and temperature fiber sensors based on random and regular reflectors inscribed by femtosecond laser radiation in 7-core fiber. In the first case the 3D shape measurements accuracy of <5% was achieved, whereas in the second case temperature sensor utilizing a machine learning algorithm for a spectral analysis was demonstrated.

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

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

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

Measuring the parameters of relativistic electron beams accelerated from thin solid targets by femtosecond laser pulses of 100 TW power
A series of experiments on the generation of relativistic electron beams from thin solid targets was carried out using a femtosecond high-intensity laser system. Spectra, angular distributions and total charges of the relativistic electron bunches accelerated in the laser field and transmitted to the back side of the target were characterized.
Simulation of super-Gaussian laser beam propagation over 1 km turbulent atmospheric path with account for pre-generated Kolmogorov phase screens
I. Galaktionov, P. Kuzmitsky, V. Toporovsky, A. Kudryashov, Sadovsky Institute of Geosphere Dynamics RAS, Russia
The turbulence simulator software that generates the sequence of phase screens with Kolmogorov spectra is developed and tested. The numerical experiment of laser beam propagation over the 1 km atmospheric path is performed and results are investigated.

Development of models and methods for forecasting methane emissions
S.L. Verkhoshentseva, O.V. Nepomnuashy, A.S. Tsipotan; Siberian Federal University, Russia
The problem of identifying the dynamics of emissions of methane-containing gases is considered. The problem of constructing adequate mathematical models intended for intelligent automated forecasting of emissions of the gas under study has been determined and solved. Methane emission models, algorithmic and software for modeling gas clouds and studying them have been developed.

Increasing the sensitivity of spark discharge diagnostics during the transition to the long-wave region
K.T. Smaznova, E.V. Parkevich; Lebedev Physical Institute RAS, Russia
It was shown that in the laser sensing method, the resolution of the spark channel structure increases during the transition from 532 nm to 1064 nm, which makes it possible to obtain quantitative data on the plasma parameters of a single microchannel.

PECVD synthesis of the CdTe thin films for tandem solar cells application
L.A. Mochalov, M.A. Kudryashov, M.A. Vshivtsev, Yu.P. Kudryashova, S.S. Saltonova, E.I. Tetukov; Lobachevsky University; ‘Roche’ Institute, Russia
CdTe thin films were prepared by PECVD on silicon substrates at the substrate temperature 50 °C. The structural quality and morphology of the samples were studied by XRD and SEM, respectively. The optical band gap of the resulting CdTe films was also determined.

Optical solver for diffraction imaging of plasma microstructures in the field of a coherent laser radiation
E.V. Parkevich, A.I. Khiyanova, T.F. Khiyanov, D.V. Tolbukhin, K.V. Shpakov; Lebedev Physical Institute RAS, Russia
We demonstrate an optical solver designed for the in-depth imaging analysis of plasma microstructures with the possibility to reconstruct their optical properties by using the results of laser interferometry and shadowgraphy. The solver is based on modeling direct and inverse diffraction problems in various approximations, processing laser interferograms and shadowgrams taking into account the response function of a lens system.

Visible light communication system based on RGBW LEDs
D.S. Shiryaev, K.R. Razhivina, A.A. Kundius, I.S. Polukhin, E.S. Kolodeznyi; ITMO University, Russia
RGBW Li-Fi communication system with data transfer rate up to 42 Mbit/s was designed.
Correction for non-leveling ground-based Doppler wind lidar

Zhang Caishi 1,2 , Sheng Yicheng 1,2 , Cao Dingxiang 2 , Zhao Deping 2 , Chen Zhe 1,3 ; 1 Tomsk State University; 2 Institute of High-Current Electronics SB RAS; 3 VELMAN LLC; 3 JiHua Laboratory, Foshan, Guangdong, China

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

R10: NONLINEAR QUANTUM PHOTONICS - POSTERS

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

WeR10-p01 15:00-18:30
Crystal growth and optical properties of TbM3 (BO) (M = Al, Ga) crystals
A.E. Koch 1, A.Y. Jamous 1, M.I. Rakhmanova 1, K.A. Koch 1, A.B. Kuznetsov 1; Sobolev Institute of Geology and Mineralogy SB RAS; 2 Tomsk State University; 3 Nikolaev Institute of Inorganic Chemistry SB RAS, Russia
TbGa3(BO3)4 and TbAl3(BO3)4 crystals were grown using the flux method. The produced compounds crystallize in the R32 space group. A strong green emission of the luminescence is primarily dominated by the 5D4 to 7F5 transition in Tb3+. According to the data obtained, the SHG efficiency is higher for the TbGa3(BO3)4 compound due to its higher molar mass

WeR10-p02 15:00-18:30
Resonant scattering under two-photon excitation in a GaN crystal
L.E. Semenova 1, Y.Y. Maslova 1, M.A. Semenov 1, 2; Prokhorov General Physics Institute RAS, 2 Lebedev Physical Institute RAS, Russia
The resonant hyper-Raman scattering process in a wurtzite GaN crystal was theoretically studied, taking into account the possible dipole transitions to the deeper valence band.

WeR10-p03 15:00-18:30
Increasing BOTDA precision using correlation image processing methods
Yu.A. Konstantinov, F.L. Barkov, A.I. Krivosheev; Perm Federal Research Center UB RAS, Russia
We demonstrate improving the precision of correlation methods for Brillouin frequency shift extraction in distributed fiber optic sensors by applying the algorithms in 2D space. The use of several spectra at once to calculate correlation functions made it possible to increase the BOTDA precision. The developed approaches are effective when processing spectra with low frequency resolution.

WeR10-p04 15:00-18:30
H3 diamond color centers for quantum magnetometry
E.I. Lipatov 1, O.I. Lyga 1, V.V. Chashchin 1, M.A. Shulepov 1, 2, V.G. Vins 1, A.P. Yelisseyev 1, 3; Tomsk State University; 1 Institute of High-Current Electronics SB RAS; 2 VELMAN LLC; 3 Sobolev Institute of Geology and Mineralogy SB RAS, Russia
The sensitivity of diamond H3 color centers to magnetic field has been demonstrated for the first time. Diamond H3 color centers represent the neutral charge state of N-V-N centers with two donor electrons localized in the vacancy. This suggests the spin splitting of electronic states. Probably, H3 centers may be preferable to NV centers for quantum sensors and computing.

WeR10-p05 15:00-18:30
Achieving subwavelength cavity using an amplifying medium
I.V. Doronin 1, A.A. Zyablovsky 1; FSUE VNIIA; 1 ITEA RAS, Russia
We show that resonance condition can be achieved for an active dielectric layer of subwavelength size placed in free space. This effect occurs due to the fact that light, when reflected from the amplifying medium-vacuum interface, acquires a negative phase shift that compensates positive propagation phase shift. We show that at large gain rate lasing begins in the proposed subwavelength.

WeR10-p06 15:00-18:30
Center-of-mass tomography for multimode photon states
I.V. Dudinets 1, 2, V.I. Mar’ko 1, M.A. Mar’ko 1, 2; Russian Quantum Center, 1 Moscow Institute of Physics and Technology, 2 Lebedev Physical Institute RAS, Russia
There exists tomographic probability representations of quantum mechanics. In these representations the states of quantum systems are described by probability distributions. In our work we study the center-of-mass tomography of multimode electromagnetic field states. We present the concept of entangled probability distribution of random variables. Examples of entangled probability distribution are considered.
WeR10-p07 15:00-18:30

High effective LiB O2 laser
N.G. Zacharov, A.S. Safronov, A.V. Savkin, V.I. Lazarenko, E.V. Saltkyov, I.I. Karpov, A.A. Lobanova, L.A. Danilova; "Russian Federal Nuclear Center; Sarov branch of the Lomonosov Moscow State University, Russia

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

WeR10-p08 15:00-18:30

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

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

WeR10-p09 15:00-18:30

Optical system for gravimeter based on cold atoms
G.V. Ospanenko, M.S. Aleynikov; FSUE "VNIIFTRI", Russia

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

WeR10-p10 15:00-18:30

Two-polarisation distribution in task of laser cooling in fields with a polarisation gradient of atoms
A.A. Kirpichnikova, R.Va. Ifenkov, O.N. Prudnikov; Institute of Laser Physics SB RAS, Russia

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

WeR10-p11 15:00-18:30

Research on EIT in ground state of NV centers in diamond in transverse magnetic field
S.M. Drofa, V.V. Bolshevskii, V.V. Gushenko, E. Primak, P. Vilyuzhanina, A.N. Smolyaninov, V.N. Sorokin, A.V. Akimov, L. Fedin, Physical Institute; 1Spinor Technologies; 2Moscow Institute of Physics and Technology; 3Russian Quantum Center; 4National Research Nuclear University MEPhI, Russia

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

WeR10-p12 15:00-18:30

Thermo-optical effects impact on a compact high-Q Fabry-Perot cavity characteristics
K.Yu. Khabarova, D.S. Kryuchkov, N.O. Zhadnov, K.S. Kudelyarov, G.A. Vishnyakova, N.N. Kolachevsky; "Russian Quantum Center; "Lebedev Physical Institute RAS; "Moscow Institute of Physics and Technology, Russia

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

WeR10-p13 15:00-18:30

Broadband OTDR device for quantum key distribution systems
K.D. Bondar, I.S. Sushchev, D.S. Bulavin, K.E. Bugai, A.S. Sidel'nikova, D.A. Dvoryetskiy; 1Quantum Technology Centre and Faculty of Physics, Lomonosov Moscow State University, Russia; 2FBI Laboratory, Ltd.; 3Bauan Moscow State Technical University, Russia

We present a method for security analysis against Trojan-horse attacks on a practical fiber-based quantum key distribution (QKD) system across a wide spectral range. Our approach involves utilizing optical time-domain reflectometry (OTDR) for the analysis, specifically in the near and middle-infrared range with centimeter-level resolution for assessing peak reflections from the QKD setup.

WeR10-p14 15:00-18:30

Nonclassical phase-space dynamics of single-atom laser
S.V. Vlasenko, A.B. Mikhailichev, S.V. Kilin; B.I. Stepanov Institute of Physics NASB, Belarus

We investigate dynamics of a single-qubit single-mode laser with continuous incoherent pump of the qubit in terms of quasi-probability distributions. Analysis of partial differential equations for quasi-probability distributions helps us distinguish two stages of evolution: coherent and incoherent. The system can exhibit bistability-like behaviour and is capable of generating Schrödinger cat states.

WeR10-p15 15:00-18:30

Integrated phononic platform for hybrid computing
A.S. Baburin, Dukhov Automatics Research Institute (VNIIA), Russia

We present high confinement silicon nitride thermally-massively and E/O tuned integrated photonics platform, that shows propagation losses lower than 0.01 dB/cm for 1550 nm wavelength and lower than 0.30 dB/cm for 935 nm wavelength. Hybrid devices based on matrix multiplicator chips fabricated with proposed technology could be used for neuromorphic and quantum computing

WeR10-p16 15:00-18:30

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

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

WeR10-p17 15:00-18:30

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

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

WeR10-p18 15:00-18:30

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

Raman spectroscopy allows the detection of gas molecules, including diatomic molecules such as O2, N2 and H2. In a developed system, concentrations of gases in a mixture are determined by the intensity of the Raman spectra peaks. For H2, N2, O2 and CO2, the demonstrated detection limit was tens of ppm with 60 s exposure time.
On investigation dispersive readout technique for NV - center in diamond

D.A. Denisov1, D.Yu. Demushkin1, I.V. Grishchenko1, N.A. Khokhlov1, E.S. Barkanova1, A.P. Sadowsky1, A.V. Konyashkin1, O.A. Ryabushkin1, P.G. Vilyuzhina1, S.M. Drofa1, A. Chernyavskiy1, V.N. Sorokin1, A.N. Smolyaninov1, A.V. Akimov1, A.N. Dvorkin1

We present a protection method operating on the fiber fuse effect, which can be produced via fission of the two-soliton breather in the optical fiber with periodically varying along the fiber dispersion for quantum communications and quantum sensing. For the detection of the scattered field we propose to use the frequency resolved gating technique.

Second-harmonic generation in LiNa5Mo9O30 crystalline sample

D.A. Denisov1, D.Yu. Demushkin1, I.V. Grishchenko1, N.A. Khokhlov1, E.S. Barkanova1, A.P. Sadowsky1, A.V. Konyashkin1, O.A. Ryabushkin1, P.G. Vilyuzhina1, S.M. Drofa1, A. Chernyavskiy1, V.N. Sorokin1, A.N. Smolyaninov1, A.V. Akimov1, A.N. Dvorkin1

WeR10-p21
15:00-18:30
Second-harmonic generation in LiNa5Mo9O30 crystalline sample

D.A. Denisov1, D.Yu. Demushkin1, I.V. Grishchenko1, N.A. Khokhlov1, E.S. Barkanova1, A.P. Sadowsky1, A.V. Konyashkin1, O.A. Ryabushkin1, P.G. Vilyuzhina1, S.M. Drofa1, A. Chernyavskiy1, V.N. Sorokin1, A.N. Smolyaninov1, A.V. Akimov1, A.N. Dvorkin1

WeR10-p22
15:00-18:30
Correlation-based technique for the BFS extraction

F.L. Barkov1, A.I. Krivosheev1, Yu.A. Konstantinov1, Perm Federal Research Center UB RAS, Russia

The paper presents a method for extracting the Brillouin frequency shift from spectra obtained by Brillouin sensors. At low signal-to-noise ratios, the method, and especially its combination with Lorentz curve fitting, outperform existing approaches in accuracy.

Efficiency assessment for quantum repeater scheme based on multimode optical Schrödinger cat states

R. Goncharov1, A.D. Kiselev2, V. Egovor1, Quantum Information Laboratory, ITMO University, Saint Petersburg, Russia; 1Leading Research Center “National Center for Quantum Internet”, ITMO University, Saint Petersburg, Russia; 2SMARTS-Quantelecom LLC, Saint Petersburg, Russia; 3Laboratory of Quantum Processes and Measurements, ITMO University, Saint Petersburg, Russia

We study the quantum repeater architecture based on multimode optical cat states proposed in our recent paper [Phys. Rev. Appl. 20, 044030 (2023)]. It is shown that, for the scheme that employs the doubling strategy, approximate estimates of the mean waiting time are close to exact values. Our protocol is found to outperform the one using photon pair sources.

Protection method against bright light attacks based on fiber fuse effect

K.E. Bugai1, I.S. Sushchev1, D.S. Bulavkin1, R. Yu. Lokhmatov1, D.A. Dvoretsky1, SFB Laboratory Ltd., 1Bauman Moscow State Technical University, Russia

We present a protection method operating on the fiber fuse effect, which restricts the light of eavesdropping devices. Successful proof-of-principle testing was demonstrated, with the method applicable to other components of the power-limiting quantum key distribution system.

Influence of strong coupling of excitons and phonons of the active medium on laser dynamics.

E.A. Tereshchenkov1, E.A. Andrianov2, Dukhov Research Institute of Automatics (VNIIA); 2Moscow Institute of Physics and Technology; 1Institute for Theoretical and Applied Electromagnetics, Russia

We consider the influence of strong electron-phonon coupling on the amplification properties of conventional lasers. We find that there is a critical value for the Fröhlich coupling constant between excitons and phonons. Below this critical value, conventional laser dynamics are observed. Above this critical value, new operating regimes arise, namely, non-harmonic auto-oscillations, bistability and deterministic chaos.

Frequency and intensity noise measurement of single-frequency lasers

K.A. Zagarukko1, A.V. Kozlov2, N.P. Khayyev1; 1Russian Metrological Institute of Technical Physics and Radio Engineering; 2National Research Nuclear University MEPhI, Russia

We report the results of frequency and intensity noise measurements of single-frequency lasers. Different types of semiconductor and fiber lasers were investigated. RF phase noise analyzer was used to measure the frequency noise of beat notes of the lasers. The fiber lasers have the lowest frequency noise and at the same time high values of the relative intensity noise.

The implementation of the MS gate on an ion trap Ca40 quantum computer

N.V. Morozov1, A.V. Akopian1, E.A. Andrianov1, A.N. Matveev1, M.M. Borisov1, O.Y. Lakhnanskaia1, K.E. Lakhnansky1, Russian Quantum Center; 2National Research Nuclear University MEPhI; 3Moscow Institute of Physics and Technology, Russia

We demonstrate the implementation of a Molmer-Sorensen gate entangling two 40Ca+ ions in linear Paul trap. We obtain the fidelity of 91.7% for gate duration tgate = 69 μs. This result coincides with world outcome obtained for systems without magnetic field shielding.

The effect of turbulent disturbances in entanglement-based quantum key distribution systems

D.M. Melkonian1, K.S. Kravstov1, Quantum Technology Centre and Faculty of Physics, Lomonosov Moscow State University, 1SFB Laboratory, Ltd., Russia

In this paper, the possible negative effects of the influence of turbulent disturbances in atmospheric communication channels for entanglement-based quantum key distribution systems have been considered. In order to decrease these effects an active tracking system has been developed. We demonstrate the results of its evaluation in a quantum key distribution system.

Quantum correlation in twin pulses generated by soliton fission

A.A. Sysiadiin1, L.A. Melnikov1, Yu.G. Konyukhov1, A.I. Konyukhov2, Saratov State Technical University. 1Institute of Physics, Saratov State University; 2Prokhorov General Physics Institute RAS, Russia

We study the quantum fluctuations of a pulse pair parameters created by second-order soliton fission in a dispersion oscillating fiber. The correlation function and squeezing ratio depend on the modulation period and modulation phase of the fiber dispersion. The squeezing ratio depends on the pulse propagation distance and can be enhanced using optimized dispersion parameters.
Relaxation processes in optical systems with ultra-strong coupling regime
T.T. Sergeev, A.A. Zyblovsky, Dukhov Research Inst. of Automation (VNIIA); Moscow Inst. of Physics and Technology; Inst. for Theoretical and Applied Electromagnetics, Russia

Ultra-strong coupling regime occurs in systems where the coupling strength is about the eigenfrequency of the system. We present an analytical model for calculating relaxation rates in systems with ultra-strong coupling regime. The results show that increasing of coupling strength leads to significant decreasing of relaxation rates. It can be used to suppress losses in optical systems with strong coupling.

Study of light diffraction on chirped two-layer inhomogeneous holographic diffraction structures PPM-LC
D.S. Rastrygin, V.O. Dolgirev, S.N. Shanarovsky, Tomsk State University of Control Systems and Radioelectronics, Russia

In this paper, as a result of numerical modeling, an increase in the width of the selective response of a diffraacted beam is shown by changing the period of recorded chirped double-layer holographic diffraction structures formed in a photopolymer material with nematic liquid crystals.

Dark-state resonances in elliptically polarized field for alkali vapors in a buffer-gas cell

We investigate dark-state resonances for alkali-metal atoms in a cell with buffer gases excited by frequency modulated elliptically polarized laser field. It is shown that all the resonance parameters depend on the ellipticity and that for some parameters this dependence is crucial for designing high-performance chip-scale atomic clocks.
Mid IR fiber lasers based on rare earth ions doped chalcogenide glasses (Invited paper)

V.V. Koltashev, V.G. Plotnicenko, B.I. Denker, B.I. Galagan, S.E. Sverchkov, M.V. Sukhanov, A.P. Velmuzhov, M.P. Frolov, A.P. Velmuzhov; Prokhorov General Physics Institute RAS; Devyatkykh Institute of Chemistry of High-Purity Substances RAS; Lebedev Physical Institute RAS, Russia

We demonstrate chalcogenide glass fiber lasers emitting at 4.6-5.4 μm. The fibers had Ø20 μm selenide core with of Tb3+ or Ce3+ doping and undoped Ø240-250 μm sulfide cladding. The 200 and 7 mW output power with 8 and 17% slope efficiency was obtained for Tb3+- and Ce3+-doped fibers respectively.

Neodymium glass laser emitting at ~6 μm.

B.I. Denker, M.P. Frolov, B.I. Galagan, V.V. Koltashev, Yu.V. Korostelnik, V.G. Plotnicenko, M.V. Sukhanov, S.E. Sverchkov, A.P. Velmuzhov; Prokhorov General Physics Institute RAS; Lebedev Physical Institute RAS; Devyatkykh Institute of Chemistry of High-Purity Substances RAS, Russia

This investigation describes the energy transfer in Tb3+, Nd3+ co-doped selenide glass pumped by 2.93μm Er:YAG laser. At liquid nitrogen temperature it leads to efficient population of 4I11/2 Nd3+ level. Stimulated emission corresponding to a novel laser transition 4I11/2 – 4I9/2 of Nd3+ ions was demonstrated. 16 mJ output and spectral tuning from 5.56 to 6.01 μm were obtained.

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


In this report, the thermo-optical lensing and laser-induced damage were studied in some ternary and quaternary glasses based on sulfides and selenides of Ge, As, Sb, Ga and In, including doped with Tb3+ and Pr3+ ions. The thermal Z-scan technique with the quasi-CW Tm-doped fiber laser at 1908 nm was applied to study thermal lensing in ChG.

Pushing the limits of mid-IR iron-doped chalcogenide-based laser sources

A.V. Pushkin, F.V. Potemkin; Faculty of Physics, Lomonosov Moscow State University, Russia

We present the approaches for improving the properties of mid-IR ultrafast lasers based on iron-doped chalcogenide crystals, including energy scaling due to multipass chirped pulse amplification in Fe:ZnSe, spectral synthesis in combination of Fe:ZnSe and Fe:CuSe gain media, as well as spectral broadening in chalcogenide fibers and studying of nonlinear properties of carbon nanotubes.
This approach can be efficiently used for gain broadening and equalization in a heterogeneous bismuth-doped multi-layered fiber design is proposed. A concept of spatial separation of the different types of active centers in copper is octahedrally coordinated in all of these hosts and Jahr-Teller is expressed in the experiment. Therefore, the radial heat flow is blocked and thermally-induced lensing is reduced. The method was implemented with thick-disk Yb:YAG active element and composite Yb:YAG/sapphire. Zero thermal lens active element was demonstrated in the experiment.

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

Laser generation on NV-center in diamond: state of things and prospects
D.E. Gemin, E.I. Lipatov, V.G. Vins, A.D. Savvin, P.E. Komarova, V.F. Lebedev, T.S. Misnikova, Ya.A. Rykov; National Research Tomsk State University, Russia

In 2021 laser generation on NV-center in diamond was demonstrated for the first time. At the time being the parameters of such-like lasers are the following: pulse energy up to 0.2 mJ, pulse duration about units of ns, also we found some interesting features. Most of them are presented in this work. Such-like lasers is a promising for different applications.

Quantum yield of bismuth active centers luminescence in germanosilicate optical fibers
A.V. Elipov, M.V. Yashkov, A.N. Abramov, K.E. Riumkin, S.V. Firstov, M.A. Melkumov; Prokhorov General Physics Inst, Dianov Fiber Optics Research Center, Russia
The quantum yield (QY) of luminescence of bismuth active centers associated with silica (BAC-Si) at 830 nm and 1400 nm was measured in bismuth-doped optical fibers. The branching ratio (BR) of radiative transitions at 830 nm and 1400 nm excited at 800 nm was defined. The influence of co-doping with boron on QY and BR is examined.

Pulsed oscillation of diode-side-pumped Nd:YAP laser with intracavity etalon
P.G. Zverev, I.V. Smirnov, A.A. Sirotkin; Prokhorov General Physics Inst. RAS, Russia
Single and dual wavelength oscillation of Nd:YAG laser at 1318 - 1338 nm
P.G. Zverev, I.V. Smirnov; Institute of Applied Physics RAS, Russia

Pulsed oscillation of diode-side-pumped Nd:YAP laser with intracavity prism was studied. Single and dual-wavelength oscillations at 1318.8, 1338.2, 1356.4, 1414.0, 1444.0, 1318.8 + 1338.2, 1338.2 + 1356.4 nm with output energy up to 350 mJ and slope efficiency of 6% was demonstrated.

Pulse instability suppression in Q-switched thin-disk lasers
S. Radmard; Tarbiat Modares University, Iran

Quantum yield of bismuth active centers luminescence in germanosilicate optical fibers
A.V. Elipov, M.V. Yashkov, A.N. Abramov, K.E. Riumkin, S.V. Firstov, M.A. Melkumov; Prokhorov General Physics Inst, Dianov Fiber Optics Research Center, Russia

Pulsed oscillation of diode-side-pumped Nd:YAP laser with intracavity etalon
P.G. Zverev, I.V. Smirnov; Institute of Applied Physics RAS, Russia

Pulsed oscillation of diode-side-pumped Nd:YAP laser with intracavity prism was studied. Single and dual-wavelength oscillations at 1318.8, 1338.2, 1356.4, 1414.0, 1444.0, 1318.8 + 1338.2, 1338.2 + 1356.4 nm with output energy up to 350 mJ and slope efficiency of 6% was demonstrated.

Pulse instability suppression in Q-switched thin-disk lasers
S. Radmard; Tarbiat Modares University, Iran

Abstract is not available.

- Lunch Break -
**R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID**

**Location:** Stenberg 1 Room, Floor 3; **Date:** Thursday, July 04, 2024

**Session Chair:**

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**ThR02-18**  
**09:00-09:30**  
**Gas lasers on hollow-core fibers (Invited paper)**  
A.V. Gladyshev, Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia  
Progress in the development of gas lasers that are based on hollow-core fibers is reviewed. Gas fiber lasers based on both population inversion and stimulated Raman scattering are considered. Recent demonstration of the first gas-discharge fiber laser is discussed.

**ThR02-19**  
**09:30-09:45**  
**UV nitrogen laser pumped by a joint pulsed longitudinal electric and inductive discharge**  
A.M. Razhev, D.S. Churkin, R.A. Tkachenko, I.A. Trunov, Institute of Laser Physics SB RAS, Russia  
The joint method of nitrogen laser pumping by electric longitudinal and inductive discharges has been proposed and experimentally implemented. The generation energy reached 2 mJ at nitrogen pressure of 9...10 Torr. Enhancing pumping by inductive discharge made it possible to significantly increase the operating efficiency of an electric-discharge nitrogen laser, and in addition, improve the quality of the laser beam.

**ThR02-20**  
**09:45-10:00**  
**New approach of non-coherent power scaling of fiber sources for material processing**  
S. Larin, N. Brotyman, I. Obronor, R. Vilho, Industrial division, IRE-Polus, Russia  
A new method of a few fiber laser sources combining is proposed: using a single bulk termination with a multiple fiber inputs. A practical implementation of multi-channel pulsed fiber laser for surface cleaning application was demonstrated.

**ThR02-21**  
**10:00-10:15**  
**Design of fiber laser based technological equipment for direct laser deposition**  
G.A. Turichkin, E.V. Zemlyakov, K.D. Babkin, Inst. of Laser Welding Technology, St. Petersburg Marine Technical Univ., Russia  
Influence of laser beam parameters on DLD productivity and stability discussed in connection with design of laser focusing head and deposition nozzle shape. The process stability conditions on the base of linear stability analysis have been determined and proved experimentally. Practical realization of DLD technology and implementation of developed principles of equipment design will be presented also.

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**ThR02-22**  
**10:15-10:30**  
**Woofe-tweeter adaptive optical system for atmospheric turbulence mitigation**  
V.V. Toporovsky, I.V. Galaktionov, A.N. Nikitin, A.V. Kudryashov, V.V. Samarkin, A.L. Rukosuev, Sadovsky Institute of Geosphere Dynamics RAS, Russia  
A woofe-tweeter approach is presented for compensation of the atmospheric turbulence negative effects. As a wavefront corrector for mitigation of the low-order aberrations with large amplitude the 23-channel bimorph deformable mirror was used. To compensate for high-order aberrations with small amplitude the stacked-actuator deformable mirror with 55 control elements was exploited.

**ThR02-23**  
**10:30-10:45**  
**Methods of parallel mode decomposition for investigating real-time mode dynamics**  
M.D. Gervaziev, A.A. Revyakin, A.G. Kuznetsov, N.N. Smolyaninov, M. Ferraro, F. Mangini, D.S. Kharenko, S. Wabnitz, S.A. Babin, Inst. of Automation and Electrometry SB RAS, Russia; Novosibirsk State Univ., Russia; University of Calabria, Italy; Sapienza Univ. of Rome, Italy  
In this work we numerically compared digital hologram generation methods for the purpose of fiber mode decomposition. After that, the most accurate method was implemented in the experimental analysis of real-time intermodal dynamics in a Raman fiber laser.

**ThR02-24**  
**10:45-11:00**  
**The method for the investigation of wavefront distortion in laser amplifiers**  
G.V. Kuptsov, V.A. Petrov, V.V. Petrov, Institute of Laser Physics SB RAS; Novosibirsk State Technical University; Novosibirsk State University, Russia  
The method of laser scanning is proposed and developed for the investigation of radiation wavefront distortion in active elements of high-power laser amplifiers. Optical path difference profile is calculated from simultaneously investigated temperature and inverted population distributions in an active element. Optical path difference profiles introduced by pumped active elements of high-power laser amplifier are studied.

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**Location:** Stenberg 1 Room, Floor 3; **Date:** Thursday, July 04, 2024

**R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID 5**

**Session Chair:**

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**ThR02-25**  
**11:30-12:00**  
**Development of high power front-end laser system for a sub-exawatt XCELS facility (Invited paper)**  
The detailed design of the front-end system for XCELS laser facility has been proposed and frontend prototype is under development. The testing of the main components of the frontend laser on the PEARL laser demonstrates a significant increase of the pulse-to-pulse stability up to 3% RMS and femtosecond pulse shortening up to 36 fs.

**ThR02-26**  
**12:00-12:30**  
**Adaptive optical correction of powerful laser beams (Invited paper)**  
A. Kudryashov, M.A. Sadovskii Institute of Geosphere Dynamics RAS, Russia  
In this paper we present the latest results in investigation of the efficiency of the use of adaptive optics to correct for high-power laser beam radiation. A set of deformable mirrors were applied to obtain the highest peak-power of the laser radiation in the world.
New generation of broad-range femtosecond IR laser sources: the way to multispectral excitation of matter (Invited paper)

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

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

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

E.K. Mikhailov1, K.K. Bobkov2, A.E. Levchenko1, V.V. Velmiski1, D.V. Khudyakov2, S.S. Aleshkina1, T.S. Zaushitsyna1, M.M. Bubnov1, D.S. Lipatov1, M.E. Likhachev1; 1 Lebedev Physical Institute RAS; 2 National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia

We present results of computational and experimental studies of several schemes for accelerating electrons with a femtosecond laser pulse with a peak power of 1-2 TW, the possibility of scaling the developed schemes, and the corresponding spectral components. The experimental results of conditions study for formation of a highly directional white light in airborne laser plasma (Invited paper)

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

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

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

A. Savel'ev, Lomonosov Moscow State University, Russia

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

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

L. Selezniov1, G. Rizaev2, M. Levus1, D. Mokrousova1, D. Pushkarev2, D. Shipilo1, N. Panov2, I. Nikolaeva1, O. Kosareva1, A. Ionin2; 1 Lebedev Physical Institute RAS; 2 Faculty of Physics, Lomonosov Moscow State University, Russia

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

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

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

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

Hybrid fiber/solid-state power amplifier laser system with picosecond master oscillator

A.I. Lobanov1, A.A. Sirotnik1, Y.L. Kalachev1, S.A. Filatova1, V.A. Kamynin1, B.D. Ovcharenko1, V.B. Tsvetkov1; 1 Prokhorov General Physics Institute RAS; 2 National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia

A hybrid fiber master oscillator solid-state power amplifier system with a Holmium fiber laser-based reference oscillator and a YSGG:Cr3+:TM3+:Ho3+: crystal-based amplifier is demonstrated. The time dynamics of the amplification of the YSGG:Cr3+:TM3+:Ho3+: crystal as a function of pump power and the central wavelength of the master oscillator were characterized.

Frequency domain model for high power solid-state laser amplifiers

A.O. Kuptsova1, G.V. Kuptsov1, V.A. Petrov1, V.V. Petrov1, 1 Institute of Laser Physics SB RAS; 2 Novosibirsk State University; 3 Novosibirsk State Technical University, Russia

The numerical model of the laser amplification process based on the nonlinear Schrödinger equation for systems with simultaneously high peak power and pulse repetition rate has been developed. A model describes the interaction of the amplified radiation and the active element in the frequency domain without loss of phase relationships between the corresponding spectral components.

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

L. Selezniov1, G. Rizaev2, M. Levus1, D. Mokrousova1, D. Pushkarev2, D. Shipilo1, N. Panov2, I. Nikolaeva1, O. Kosareva1, A. Ionin2; 1 Lebedev Physical Institute RAS; 2 Faculty of Physics, Lomonosov Moscow State University, Russia

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

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

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

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

Frequency domain model for high power solid-state laser amplifiers

A.O. Kuptsova1, G.V. Kuptsov1, V.A. Petrov1, V.V. Petrov1, 1 Institute of Laser Physics SB RAS; 2 Novosibirsk State University; 3 Novosibirsk State Technical University, Russia

The numerical model of the laser amplification process based on the nonlinear Schrödinger equation for systems with simultaneously high peak power and pulse repetition rate has been developed. A model describes the interaction of the amplified radiation and the active element in the frequency domain without loss of phase relationships between the corresponding spectral components.

- Coffee Break -
Recent progress in research on few-cycle and unipolar electromagnetic pulses (Invited paper)

N.N. Rosanov1, M.V. Arkhipov1, R.M. Arkhipov1,2, A.V. Pakhomov1; 1Ioffe Institute; 2Phys. Dept., St. Petersburg State Univ., Russia

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

Optimization of noncollinear schemes of coherent beam combining

V.I. Trunov1,2, S.N. Bagaev1, S.A. Frolov1, A.V. Kirpichnikov1, S.V. Avtaeva1, V.V. Petrov1,2, 1Laboratory of Physics of Ultrashort Pulse Lasers, Institute of Laser Physics SB RAS, 2Novosibirsk State University, Russia

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

Spatio-temporal properties of an atomic medium interaction with vortex vector fields of femtosecond duration

A.V. Andreev, O.A. Shoutova; Lomonosov Moscow State University, Russia

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

Generation of CEP stable GigaWatt sub-cycle pulses and its application for spectroscopy of ultrafast electron dynamics in semiconductor (Invited paper)

A.B. Fedotov1,2, I.V. Savitsky1, A.A. Voronin1,2, E.A. Stepanov1,2, A.A. Lanin1,2, 1Lomonosov Moscow State University, 2Russian Quantum Center, Skolkovo, Russia

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

Control of plasma instabilities (Invited paper)

S. Kawata; Utsunomiya University, Japan; Laboratory for Laser Plasmas, Shanghai Jiao Tong University, China

Dynamic plasma control is discussed to mitigate actively plasma instabilities and non-uniformities. Generally plasma instabilities and non-uniformities emerge from perturbations. Normally perturbation phase in plasmas is unknown, and so instability growth rate is discussed. However, if the perturbation phase is known even in plasmas and fluids, the instability growth can be controlled by a superimposition of perturbations imposed actively.

Experimental setup to study the effect of radiation transfer on the development of hydrodynamic instabilities

S.I. Glazyrin1,2; FSUE VNIIA, 1Lebedev Physics Institute RAS

The paper discusses the possibility to study the effect of radiation on hydrodynamical instabilities development on an interface, accelerated in a laser experiment. A multilayer target dynamics is considered. By changing initial parameters different regimes of radiation transport can be switched in experiments. The impact of the regimes on interface instability growth is studied numerically.
Enhancement of nuclear reaction yield in nano-structure targets irradiated by circular polarized, ultrashort and intense laser pulses

A.A. Andreev1,2, K.Yu. Platonov1, I.A. Litvinov1, S.I. Petersburg State University; 2 Institute of Automation and Control Processes FEB RAS; 3 Far Eastern Federal University, Russia

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

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

S.G. Bochkarev1,2, D.A. Gozhev1, O.E. Vais1,2, M.G. Lobok1,2, A.V. Brantov1,2, V.Yu. Bychenkov1,2, I.M. Mordvintsev1,2, K.A. Ivanov1,4, T.A. Semenov1,2, S.A. Shulyapov1, A.V. Lazarev1, A.A. Rupasov1, A.A. Kologrivov1, E.A. Bolkhovitinov2, I.A. Zhitny1, I.N. Tsimbalov1, R.V. Volkov1, V.M. Gordanenko1, A.B. Savel’ev1,2, P.A. Babushkin1, Yu.E. Geints1, A.M. Kabanov1, A.A. Andreev1,2, K.Yu. Platonov1, I.A. Litvinov1, S.I. Petersburg State University; 2 Lebedev Physical Institute RAS; 3 Faculty of Chemistry, Lomonosov Moscow State University; 4 National Research Centre "Kurchatov Institute", Russia

Results of experimental investigation of charged particles generation and X-ray emission under relativistic interaction of laser pulse with (C2H6)N clusters are presented. Energy spectra of protons, ions and electrons are examined, revealing few hundreds of MeV particles.

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

M.S. Kuritskij, A.V. Tsibulnikova, I.I. Lyatun, I.G. Samusev, V.V. Bryukhanov; Immanuel Kant Baltic Federal University, Russia

The concept of maximizing the yield of DD neutrons and synchrotron X-rays from a large-volume laser-heated microdroplet target by matching the focal spot size and structural scale of the target to the laser pulse intensity is confirmed.

LIPSS on titanium plate prepared by nanosecond pulses

M.S. Kuritskij, A.V. Tsibulnikova, I.I. Lyatun, I.G. Samusev, V.V. Bryukhanov; Immanuel Kant Baltic Federal University, Russia

The method of nanosecond laser periodic restructuring of the titanium surface is presented for the aim of further studying optical and mechanical properties of the formed structures, such as reflection and refraction in the visible and infrared (IR) wavelength ranges, as well as the wettability of structured titanium.

Low-order harmonics generation by atoms and asymmetric molecules in static electric field and intense laser pulse

A.A. Silaev1,2, A.A. Romanov1,2, N.V. Vvedenski1,2; 1 IAP RAS, Russia; 2 Nizhny Novgorod State Univ., Russia

We study analytically and numerically low-order harmonics generation during the interaction of femtosecond laser pulse with atoms and asymmetric molecules in the presence of the static electric field. We find the ranges of parameters corresponding to the dominance of the ionization mechanism of even harmonics generation. These parameters can be used for high-resolved sampling detection of terahertz and mid-infrared pulses.

Laser-plasma accelerator for radiation hardness testing of microelectronic devices


The use of compact laser plasma accelerators may significantly reduce duration and cost of radiation hardness assurance testing of microelectronic devices. In support of this statement, we conducted a series of experiments at 200 TW femtosecond laser facility on generation of charged particles and irradiation of test devices.

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


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

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

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

Intense ultrashort laser pulses can drive the electrons and the lattice in a solid material far out of equilibrium and thus creating highly excited matter with extraordinary properties. We report on an experimental approach to study the relaxation of electrons in a bulk gold using time-resolved reflectivity measurements with phase-sensitive signal detection in a wide range of absorbed energy densities.

Laser-plasma accelerator for radiation hardness testing of microelectronic devices


The use of compact laser plasma accelerators may significantly reduce duration and cost of radiation hardness assurance testing of microelectronic devices. In support of this statement, we conducted a series of experiments at 200 TW femtosecond laser facility on generation of charged particles and irradiation of test devices.

Femtosecond laser-induced periodic surface structures formation on optical fibers

K. Bronnikov1, S. Gladkikh1, V. Terentiev1, V. Simonov1, S. Mikerin1, S. Babin1, A. Kuchminzhak1, A. Dostovalov1; 1 Institute of Automation and Electrometry SB RAS, 2 Institute of Automation and Control Processes FEB RAS, Pacific Quantum Center, Far Eastern Federal University, Russia

Here we study TLIPSS formation on the curved samples such as a side surface of optical fibers with deposited Ti thin film. Different morphologies depending on the polarization direction of the laser radiation were revealed. TLIPSS formation on fiber tip (normal and angle cleaved) and their perspective applications will be also presented.
R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

ThR08-38 16:30-16:45
Influence of fluid microstructure on dynamics of laser-induced post-effects
N.M. Asharchuk, E.I. Mareev
Kurchatov Complex Crystallography and Photonics, NRC «Kurchatov Institutes», Russia
The study investigates the dynamics of ultra-short laser pulse interactions with water and supercritical carbon dioxide. Following the laser impact, shock waves and a cavitation bubble are generated. Unlike the cavitation process in water, the cavitation bubble does not collapse in supercritical carbon dioxide; instead clusters ranging in size from 1 to 200 microns are formed.

ThR08-39 09:30-09:45
Dispersion of effective nonlinearity for frequency conversion in biaxial crystals
E. Shevelkina, S.G. Grechin; NTO IRE-Polyus, Prokhorov General Physics Institute RAS, Russia
The results of dispersion estimation for effective nonlinearity in biaxial crystals for different point groups are presented. Phenomenon of nonlinearity dispersion is caused by pronounced changing of the angle to the optical axis of the crystal, which is typical for many recently synthesized media.

ThR08-40 09:45-10:00
Gigawatt few-cycle mid-IR pulses generated from advanced non-oxide nonlinear crystals
E.A. Migal, D.Z. Suleimanova, D.V. Badikov, F.V. Potemkin; Lomonosov Moscow State University, Russia
Advanced nonlinear materials – LGS, HGS and BGGS – were studied for parametric down conversion of Cr:Forsterite laser pulses into 1.5 – 8 μm spectral region. Conversion efficiency as high as 18% resulting in 0.4 – 1.5 kW microsecond pulses was done using various energies, pulse numbers and scanning velocities. The effective second harmonic generation has been demonstrated in crystals with periodical domain structure created in the bulk.

ThR08-41 10:00-10:15
Dual-pumped integrated microring degenerate optical parametric oscillator
A.K. Vorobyev, N.A. Kaprtdov, T.R. Yunusov, A.E. Shitikov, D.A. Chemoshentsev, I.A. Bilenko; Russian Quantum Center, Moscow Institute of Physics and Technology, ITMO University, Russia
We study the nonlinear degenerate four-wave mixing in high-Q integrated silicon nitride ring microresonator dual-pumped by continuous wave lasers. We optimize a microresonator geometry as well as dual-pump powers and frequency detunings. Highly efficient degenerate optical parametric oscillator is demonstrated experimentally.
Interference of radiation at fundamental and triple frequencies with superbroadening of the few-cycle pulse spectrum in nonlinear media (Invited paper)
S.A. Kozlov, I.R. Artser, M.V. Melnik, A.N. Tsypkin; ITMO University, Russia
In media with cubic nonlinearity, broadening of the optical pulses' spectrum is observed due to their phase modulation and generation of radiation at triple frequencies. The report discusses the theory of these phenomena and presents the results of their experimental observations in the terahertz spectral range.

Nonlinear higher-order topological states and higher-order topological solitons (Invited paper)
Yiqi Zhang1, Yanoslav V. Kartashov2, Xin Jiaotong University, China; Institute of Spectroscopy, Russia
We show our achievements on the nonlinear manipulation about 0D topological states. Such power thresholdless nonlinear 0D topological states bifurcate from their linear counterparts. Since these nonlinear topological states are localized bound states of the system, they represent higher-order-topological solitons with the localization effectively affected by the beam power.

Light bullets in higher-order photonic topological insulators (Invited paper)
S.K. Ivanov1, Ya.V. Kartashov2; University of Valencia, Institute of Materials Science (ICMUV), Spain; Institute of Spectroscopy, Russia
We consider a new class of stable three-dimensional solitons (light bullets) in higher-order topological insulators based on a two-dimensional Su-Schrieffer-Heeger array of coupled waveguides. These solitons inherit topological protection from their linear corner counterparts and survive in the presence of disorder.

Nonlinear propagation of ultrashort pulses in nanophotonic halide perovskite waveguides
A.D. Mikhin1, N. Glebov1, M. Masharin1, S.V. Yulin1, S.V. Pakhmonov2, D.N. Krizhanovskii1, A.K. Samusev1, V. Kratsov1; ITMO University, Russia; EPFL, Switzerland; ITMO University, Russia
Perovskite-based nanophotonic structures are promising systems for studying strong light-matter coupling effects. In this work, we investigate the nonlinear propagation of fs laser pulses in halide perovskite waveguides in the strong exciton-phonon coupling regime. Our results demonstrate that self-phase modulation and group velocity dispersion lead to spectral broadening and generation of new frequency components.

Polarization state evolution of extremely compressed femtosecond laser wave packets in fused silica
I.Y. Geints, O.G. Kosareva; Lomonosov Moscow State University, Russia
The evolution of radiation polarization parameters during the filamentation and formation of extremely compressed femtosecond wave packets in fused silica is studied numerically on the basis of the carrier-resolved unidirectional pulse propagation equation (UPPE). It is revealed that the polarization state of radiation tends to linear one in the core of the formed extreme wave packet.

Beam self-cleaning and transition from nonlinear to geometric focusing during filamentation
D.V. Pushkarev1, G.E. Rizaev1, M.V. Levus1, L.V. Selezniev1; Lebedev Physical Institute RAS, Lomonosov Moscow State University, Russia
We propose an approach to distinguish filamentation regimes with nonlinear and geometric focusing predominance, basing on beam profiles after filamentation. At tight focusing, the beam self-cleaning is not observed. Transitional numerical aperture between the regimes scales as inverse square root of self-focusing critical power. When it is low enough, the nonlinear focusing dominates even at numerical apertures close to 1.

Few-fs half-cycle pulse train with an ultra-high pulse repetition rate from nested quantum wells
R.M. Arkhipov1, M.V. Arkhipov2, A.V. Pakhomov1, N.N. Rosanov2; St. Petersburg State University, Russia
We propose a simple and compact structure, consisting of a pair of nested quantum wells, as a source of a train of half-cycle pulses of few-fs duration when driven by an external electric field. We demonstrate the possibility of the generation of ultrafast half-cycle pulse trains with ultra-high pulse repetition rates of tens of THz.

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S.K. Ivanov1, Ya.V. Kartashov2; University of Valencia, Institute of Materials Science (ICMUV), Spain; Institute of Spectroscopy, Russia
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Spectral, spatial and energy stabilization of filament supercontinuum Stokes waves by amplitude modulation
D.V. Pushkarev1,2, N.A. Zhidovtsev1, D.S. Uryupina1, E.V. Mitina1, R.V. Volkov1, A.B. Savelev2,3; Faculty of Physics, Lomonosov Moscow State University, 1Lebedev Physical Institute RAS, Russia

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

Formation and dynamic parameters of light-induced microcavities in a resonant medium
O.O. Diachkova1,2, R.M. Arkhipov1,2, M.V. Arkhipov1,2, A.V. Pakhomov1, N.N. Rosanov1,2; 1St. Petersburg State University; 2Ioffe Institute, Russia

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

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Modeling the interfacial profiles in III-V VLS axial nanowire heterostructures based on group V interchange
V.G. Dubrovskii; Faculty of Physics, St. Petersburg State University, Russia
Interfacial abruptness in axial heterostructures within III-V nanowires (NWs) grown by the VLS method is affected by the reservoir effect in catalyst droplets. Here, we present a model which provides explicitly the interfacial profiles in double NW heterostructures based on group V interchange of any composition, and fit the data on Au-catalyzed InP/InAs/InP, self-catalyzed GaAs0.6P0.4/GaAsxP1-x/GaAs0.6P0.4 and GaP/GaAs-xP1-x/GaP NW heterostructures.
ThR09-16 09:15-09:30
Tuning the composition of III-V ternary nanomaterials by V/III flux ratio
E.D. Leschenko1, V.G. Dubrovskii1; Submicron Heterostructures for Microelectronics, Research and Engineering Center RAS; 1 St. Petersburg State University, Russia
We develop a growth model for ternary AsB1-xC nanomaterials and show that the vapor-solid distribution can be tuned from the equilibrium to kinetic shape by decreasing the total (A+B)/C flux ratio. We demonstrate the excellent fits of available data for AlSbAs epilayers, InSbAs, InAsP and GaAsP NWs grown under different total V/III flux ratios in vapor.
ThR09-17 09:30-09:45
Modeling the crystal phase switching in self-catalyzed GaAs nanowires
A.A. Koryakin1, N.V. Guruleva1; St. Petersburg State University; 1 St. Petersburg Academic University, Russia
A model is proposed to depict the crystal phase switching in the self-catalyzed GaAs nanowires considering different shapes of the nanowire growth facet.
ThR09-18 09:45-10:00
Semiconductor nanowires for resonant enhancement, light guiding and hybrid sources development
A.D. Bolshevakov; Moscow Institute of Physics and Technology; Alferov University, Russia
We present nanophotonic hybrid structure based on a monolayer of MoS2 and GaP nanowires (NW) as a novel system to achieve enhancement and directionality of the emission via employment of the NW modes. Furthermore, we investigate the resonant optical action of our GaP NW with a remarkable Q factor exceeding 350.
ThR09-19 10:00-10:15
Growth and properties of microstructures based on aluminum fluoride
A.M. Dautov1, K.P. Kotyar1, T.H. Berezovskaya1, A.M. Khaizurin2, T. Shugabaev3, E. Lendyashova1; Faculty of Physics, St. Petersburg State University, Alferov University, St. Petersburg State Electrotechnical University LETI, Russia
Aluminum fluoride (AlF3) is a promising material for a variety of industrial applications. Due to its electrophysical parameters, it can become a cheap analogue of silicon dioxide. It can be used in microwave waveguides and optical devices in the ultraviolet range. In this paper, we present a study of the synthesis process of morphologies based on AlF3.
ThR09-20 10:15-10:30
Formation of nanovoids grating in Zr/SiO2/Si at scanning of tightly focused cw laser beam
D.A. Belousov, R.I. Kuts, V.P. Korolkov; Institute of Automation and Electronics SB RAS, Russia
The formation of nanovoid grating at thermochemical laser writing on Zr/SiO2/Si multi-layer material has been demonstrated. Unlike other publications, continuous rather than pulsed laser radiation was used in this work. Possible mechanism of the effect is discussed.
ThR09-21 10:30-10:45
Large-scale chiral nanostructures with tunable optical activity in UV-visible range
D.R. Dadadzhanov1,2, N.S. Petrov1, I.A. Gladskikh1, T.A. Vartanyan2, G. Markovich1, I Raymond and Beverly Sackler Faculty of Exact Sciences, School of Chemistry, Tel Aviv University, Israel; 1 International Research and Education Center for Physics of Nanomaterials, ITMO University, Russia
Circular dichroism in silver nanostructures on dielectric substrate was induced by laser irradiation with circular polarization. The morphology changes of silver nanostructures upon various power density have been explored by scanning electron microscopy. The influence of aging of silver nanoparticles on optical activity in UV-Vis spectral range has been revealed and discussed.
ThR09-22 10:45-11:00
Pb-catalyzed GaAs nanowires grown by molecular beam epitaxy on Si substrate
I.V. Shtrum1,2, N.V. Sibirev1, I.V. Il'kiv1, I.P. Soshnikov1, R.R. Reznik2, G.E. Cirlin1,2,3; Institute for Analytical Instrumentation RAS, 1 Institute of Physics, 2 RAS, Russia
The Pb-assisted MBE growth of GaAs NWs was demonstrated for the first time. Here we discuss the growth of GaAs nanowire with lead catalyst. Lead could easily dissolve As as well as Ga, which allows to switch nanowire growth from Ga-rich to As-rich growth.

Location: Pudovkin 1+2 Room, Floor 3; Date: Thursday, July 04, 2024

R09: OPTICAL NANOMATERIALS 5
Session Chair:

Effect of topology on the optical properties of quantum confined semiconductor nanocrystals (Invited paper)
A.L. Simões Gamboa1, E.N. Bodunov1, A.V. Fedorov1; ITMO Univ., Russia; 1 Emperor Alexander I St. Petersburg State Transport Univ., Russia
We investigate theoretically the effect of topology on the optical properties of quantum confined semiconductor nanocrystals. In particular, we compare the wavefunctions, energy spectra, and intraband matrix elements of the momentum operator in a semiconductor hollow sphere with those in a spherical quantum dot.
ThR09-23 11:30-12:00
Nanoprobes for in vivo Imaging (Invited paper)
Mingyuan Gao; Center for Molecular Imaging and Nuclear Medicine, School of Life Sciences, Soochow University, China
Functional nanoparticles have shown great potentials in medical applications. Over past years, we have been developing versatile functional nanoparticles and nanoparticle-based probes for detecting tiny tumors and lymphatic micrometastasis, evaluating the vulnerability of atherosclerotic plaques, and visualizing tumor microenvironment abnormal signatures. In this presentation, we will present our recent studies on above subjects.
ThR09-24 12:00-12:30
Molecular detection using plasmonic nanostructures of particular geometry
G.V. Zmaga¹, A.A. Kuzmin¹, Y. Sun¹, Q. Pan¹, M. Su¹, Y. Song¹, D.A. Zuev¹, P.A. Belov¹; ¹ITMO Univ., Russia; ²Key Laboratory of Green Printing, Inst. of Chemistry CAS, China
Surface-enhanced Raman spectroscopy (SERS) is used to detect substances in low concentration. Neglecting the chemical enhancement phenomena, the model of polystyrene structures with silver nanoparticles was used to obtain Raman signals from molecules of rhodamine 6G. In the current work different geometries of these plasmonic structures are investigated and their ability to enhance the electromagnetic field is compared.

Optical nanoheaters with fluorescent thermometers on board
A.V. Povolotskiy¹, D.A. Soldatova¹, A.A. Tyshchenko¹, A.V. Shmakova¹, D.A. Lukyanov¹, A.S. Konev¹; ¹St. Petersburg State University; ²Peter the Great St. Petersburg Polytechnic University, Russia
The results of the synthesis and study of optical nanoheaters based on gold nanoparticles and fluorescent ratiometric thermometers based on porphyrins are presented. Plasmonic nanoparticles are combined with molecular thermometers into hybrid nanostructures, allowing controlled heating. These optical nanomaterials can be used in various fields of science, industry and medicine, in particular, for photothermal therapy.

Optical properties of epitaxial InAs/GaAs quantum dots overgrown under different V/III flux ratios
S.V. Balakirev¹, A.M. Nadtochiy², N.V. Kryzhanovskaya², D.V. Kuzin³, N.E. Chernykh¹, N.A. Shandyba¹, S.D. Komarov¹, A.S. Dragunova², A.E. Zhukov², M.S. Solodovnik¹; ¹Southern Federal University; ²HSE University, Russia
Using photoluminescence and excitation spectroscopy, we study optical properties of InAs/GaAs quantum dots overgrown under different V/III flux ratios. While multiple peaks around 1.37 eV are observed in the photoluminescence spectrum at low V/III ratio, it is red-shifted and becomes smoother with increasing ratios. We explain this behavior in terms of enhanced quantum dot decomposition depending on the V/III ratio.

Quantum dots. Hydrophilization techniques for analytical applications
O.A. Goryacheva, D.V. Tsyupka, E.A. Mordovina, T.S. Ponomaryova, D.D. Drozd, A.V. Markin, I.Yu. Goryacheva; Institute of Chemistry, Saratov State University, Russia
Quantum dots are semiconductor crystals with unique optical properties. Analytical applications are made possible due to the stability of the crystal, the ability to vary the fluorescence wavelength, and the capacity for non-radiative energy transfer. They are influenced by the composition and coating of QDs.
Terahertz subwavelength-resolution polarization-sensitive microscopy based on solid immersion effect

D.R. Il' enkova1, D.D. Rybnikov1, V.A. Zhelnov1, A.I. Alekseeva1, K.I. Zaytsev1, N.V. Chernomyrin1; ‘Prokhorov General Physics Institute RAS’, ‘Research Institute of Human Morphology, Russia

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

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

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

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

Active region overheating in quantum cascade lasers

I.I. Vrubel, E.D. Cherotchenko, D.A. Mikhailov, V.V. Dudelev, G.S. Sokolovskii; Ioffe Institute, Russia

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

Pulsed cathodoluminescence kinetics of Fe:ZnSe ceramic

A.V. Spirina1, A.S. Makarov1, V.I. Solomonov1, A.S. Korsakov2, F.M. Kucherenko2, V.S. Kostrov2; ‘Institute of Electrophysics UB RAS’, ‘Iuliu Hațieganu University of Science and Technology’, Romania

Pulsed cathodoluminescence kinetics (PCL) of Fe:ZnSe ceramic samples, which were manufactured at the IEP UB RAS, was studied. The luminescence of divalent iron ions has a wide radiation band in the range of 3.6-4.4 μm at the 5T2 to 5E transition. This material is promising as an active medium for mid-infrared lasers and scintillation sensors.
Optimization of the energy barrier layer position in 1550 nm high-power laser diodes

A.A. Podoskin, D.A. Veselov, T.A. Bagayev, V.N. Svetogorov, I.V. Yarotskiy, V.V. Zolotarev, V.I. Trukhov, I.V. Shushkanov, M.A. Ludginin, A.A. Marmalyuk, S.O. Slipchenko, A.Y. Egorov, 1, V.M. Ustinov; 1 Io

I.I. Novikov, A.G. Gladyshev, L.Ya. Karachinsky, A.Y. Egorov, G.S. Sokolovskii, 1 Stel'makh Research Institute Polys; 2 Ioffe Institute; 3 Stel'makh Research Institute Polys, Russia

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

THR03-p13
10:00-10:30

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


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

THR03-p14
10:00-10:30

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

P.Ya. Ilyushin, 2, D.E. Shipilo, 1, O.E. Nikolaeva, 1, N.A. Parov, 2, O.G. Kosareva, 1, 2; 1 Faculty of Physics, Lomonosov Moscow State University, 2 Lebedev Physical Institute, Russia

A model of a semiconductor optical amplifier has been developed. Using this model we simulated the distortions of a quadrature-modulated signal propagating through a fiber-optic line with semiconductor amplifiers and determined the range of baud rates and powers which guarantee a non-critical number of errors during transmission.

THR03-p15
10:00-10:30

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


The study of the spectral linewidth of the 1.55 μm-range MBE-grown wafer-fused VCSELs based on InGaAs/InAlAs strained quantum wells is presented. The linewidths as small as 18 MHz and linewidth-power product at 32.8 MHz for the VCSELs with low photon lifetime. The paper examines photoactivated current switches for pumping diode laser stacks with ns and sub-ns current pulses. Test pulse: 860 nm, 50 ps leading edge, adjustable up to 9.3 W. Samples tested at up to 50 V bias. Photoresponse reaches 17 V (340 mA) with linear dependence on pulse power. Photoresponse leading edge duration ~80 ps (20-80% level).

THR03-p16
10:00-10:30

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

B.A. Zhmud, 2, 1, B.H. Sobolev, 1, R.A. Khabibullin, 1; 2 V.G. Mokerov Inst., of UHF Semiconductor Electronics RAS; 1 MIPT, Russia

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

THR03-p17
10:00-10:30

Influence of anti-reflection and partial-high-reflection coatings on characteristics of quantum cascade lasers in 4-5 μm range


We analyze the influence of optical coatings on the electro-optical characteristics of quantum cascade lasers. We compare light-current characteristics of devices without and with different combinations of optical coatings. The highest output power is achieved with combination of anti- and high-reflection coatings, while the lowest threshold with partial-high- and high-reflection coatings.

THR03-p18
10:00-10:30

Simulation of laser sources based on heterogeneously integrated III-V/SOI structures

I.S. Shashkin, D.N. Nikolaev, V.A. Kryuchkov, M.G. Rastegaeva, S.O. Slipchenko, N.A. Pikhtin; Ioffe Institute, Russia

We have developed a numerical model and analyzed the waveguide properties of III-V/SOI structures for the creation of injection laser sources at wavelengths ranging from 1260 to 1600 nm. We studied the transmission coefficients of hybrid laser modes propagating from III-V/SOI to SOI waveguide in a three-dimensional waveguide with variable dimensions. The model enables the three-dimensional waveguide design optimization.

THR03-p19
10:00-10:30

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

I.V. Shushkanov, A.A. Podoskin, I.N. Arsentiev, N.A. Rudova, A.A. Klimov, A.E. Kazakova, S.O. Slipchenko, N.A. Pikhtin; Ioffe Institute, Russia

The paper examines photoactivated current switches for pumping diode laser stacks with ns and sub-ns current pulses. Test pulse: 860 nm, 50 ps leading edge, adjustable up to 9.3 W. Samples tested at up to 50 V bias. Photoresponse reaches 17 V (340 mA) with linear dependence on pulse power. Photoresponse leading edge duration ~80 ps (20-80% level).

THR03-p20
10:00-10:30

Wafer-fused 1550-nm VCSELS with the active region based on InGaAlAs and InGaAs QWs

P.E. Kopytov, 2, S.S. Rochas, 1, E.S. Kolodeznyi, 1, N.V. Kochetkov, 2, K.O. Voropaev, I.I. Novikov, S.A. Blokhin, ITMO University; 2 Ioffe Institute, Russia

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

THR03-p21
10:00-10:30

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

I.S. Shashkin, N.V. Shulavlova, P.S. Kopiev, S.O. Slipchenko, N.A. Pikhtin; Ioffe Institute, Russia

A computational study of high-contrast gratings (HCG) in a vertical-cavity surface-emitting laser (VCSEL) on silicon-on-insulator (SOI) for multispectral laser sources is performed. The simulation model analyzes reflectivity of the HCG grating, formed in the SOI device layer. HCG filters higher-order modes, optimizing VCSEL performance. An algorithm maximizes HCG reflectivity with fixed SOI thickness.

THR03-p22
10:00-10:30

Interrogation of FBG using standard telecom DFB diode as a transceiver

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

An low-cost fiber Bragg grating sensor interrogation system based on standard Telecom distributed-feedback laser utilized as a transceiver to detect the spectral response from an FBG, is presented in this paper. The proposed method allows to achieve a resolution of 0.01 nm. The results obtained can be used to miniaturize and simplify the optical design of sensor systems using FBGs.
ThR03-p23 10:00-13:30

Study of the capabilities of high-power UV and blue LEDs for pumping coumarin dye lasers
A.V. Aladov1, A.E. Chernyakov1, A.E. Ivanov1, A.L. Zakgeim1, 1Submicron Heterostructures for Microelectronics Research and Engineering Center RAS; 2St. Petersburg Electrotechnical University LETI, Russia
High-power AlGaiN LEDs are of interest for pumping of dye lasers. In this regard, comprehensive studies of the power and spectral characteristics of LEDs in short-pulse modes used to laser pump were carried out. The energy capabilities and spectral properties of LED excitation of coumarin dyes were revealed.

ThR03-p24 10:00-13:30

1550 nm few-mode laser diodes
Yu.K. Kirichenkov1, D.A. Veselov1, A.Yu. Lesniko1, A.E. Rizaev1, S.O. Slipchenko1, N.A. Pikhitin1, A.A. Marmalyuk2, Yu.L. Ryboshitan1, M.A. Ladugin1, 1Io Institute; 2Sigm Plus Company, Russia
The main characteristics of 1550 nm few-mode laser diodes with aperture width 20 µm were measured. There were two ranges of pump currents in which the characteristics of lasers behave differently: in the first range there is a scatter in the output characteristics of lasers due to few-mode operating mode; in the second range the laser operates predictably and stably.

ThR03-p25 10:00-13:30

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

ThR03-p26 10:00-13:30

Compact high-power laser pulse sources with nanosecond (ns) and sub-ns durations for time-of-flight LiDAR systems
S.O. Slipchenko1, A.A. Podoskin1, I.V. Shushkanov1, A.E. Rizaev1, M.I. Kondratov1, A.E. Grishin1, V.K. Bakhvalov1, Yu.K. Kirichenko1, A.I. Zhelnin1, T.A. Bagayev2, M.A. Ladugin1, A.A. Marmalyuk2, N.A. Pikhitin1, 1Io Institute; 2Sigm Plus Company, Russia
The report discusses the main experimental results related to the development and current pulse sources, enabling pulse durations in the ns and sub-ns ranges. A compact stack, comprising a semiconductor laser and current switch, is demonstrated, achieving a peak optical pulse power of 36 W with a pulse duration of 3 ns. Approaches for generating high-power sub-ns laser pulses are also studied.

ThR03-p27 10:00-13:30

Vortex Bessel beam generation from conically refracted laser diode radiation
S.H. Abdullazak1, V.Yu. Mylynikov1, S.N. Losev1, N.G. Deryagin1, V.V. Dudelev1, G.S. Sokolovskii1, Io Institute, Russia
We demonstrate generation of Bessel beam from conically refracted laser diode radiation. Conical refraction provides annular distribution of the diode radiation. Conical refraction provides annular distribution of the beam at the axison that is favorable for efficient Bessel beam generation.

ThR03-p28 10:00-13:30

Noise performance of 89X nm single-mode VCSELs
M.A. Bobrov1, S.A. Blokhin1, Ya.N. Kovach1, A.A. Blokhin1, N.A. Maleev1, A.G. Kuzmenko1, Yu.M. Zhadrian1, M.M. Kulagina1, Yu.A. Guseva1, A.P. Vasil’ev1, M.N. Marchii1, V.M. Ustirov1, 1Io Institute; 2SHM R&E Center, Russia
The study of the noise characteristics of the 89X nm single-mode polarization-stable VCSELs based on InGaAs quantum wells is presented. When VCSEL emission is in resonance with the Cs D1 line, the relative intensity noise (RIN) is ~ 110 dB/Hz at 10 Hz and ~ 140 dB/Hz at 10 kHz. The polarization-resolved RIN is slightly higher than RIN but exhibits similar frequency behavior.

ThR03-p29 10:00-13:30

Microscopic origins of the thermally stimulated wavelength chirp in quantum cascade lasers
E.D. Chernotenkov1, I.I. Vrubel1, A.V. Pavlov1, A.S. Konarykhina2, R.G. Polozkov1, V.V. Dudelev1, G.S. Sokolovskii1, 1Io Institute, Institute of Quantum Electronics and Equipment Engineering, Southern Federal University, Russia
We study the QCL active region overheating by the analysis of the refractive index-temperature variation. We apply ab-initio methods and interpret the numerical results by the normal dispersion theory. The outcomes of the work create the reliable theoretical basis for the thermal management of QCL devices via the wavelength chirp measurement.

ThR03-p30 10:00-13:30

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

ThR03-p31 10:00-13:30

Annealing temperature effect on the GaAs nanowire growth on the FIB-modified Si substrate
N.A. Shandyba, M.M. Eremenko, D.V. Kirichenko, N.E. Chenko, S.V. Balakirev, M.S. Solodovnik; Laboratory of Epitaxial Technologies, Institute of Nanotechnologies, Electronics and Equipment Engineering, Southern Federal University, Russia
It is shown that an increase of the annealing temperature from 600 to 750 leads, on the one hand, to an increase of the nanowire density up to ~ 40 µm-2 at the maximum dose value. On the other hand, this leads to an increase in the proportion of vertically oriented nanowires up to 100%.

ThR03-p32 10:00-13:30

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

ThR03-p33 10:00-13:30

Hybrid pulsed laser-thyristsors output optical power-time characteristics
T.A. Bagaev1, N.V. Gultikov1, A.I. Zhelnin1, M.A. Ladugin1, A.A. Marmalyuk1, Yu.V. Kurnyakov1, V.V. Kirichevsky1, A.M. Morozzyuk1, V.P. Konyayev1, V.A. Simakov1, S.O. Slipchenko2, A.A. Podoskin1, N.A. Pikhitin; 1Stelmatkhe Research Institute Polyus; 2Io Institute, Russia
High-power hybrid semiconductor laser-thyristsor consisting of thyristor crystals soldered with a semiconductor laser with three emitting sections are studied. Experimental dependences of laser-thyristsor output optical power on the charging capacity and pulse duration were obtained.

ThR03-p34 10:00-13:30

PbSe thin films for Mid-IR high-sensitive photodetectors
I.A. Mochalov1, M.A. Kudryashov1, I.O. Prokhrov1, E.A. Slapovskaya1, Yu.P. Kudryashov1, S.V. Telegin1, E.U. Rafailov1, A.N. Baranov1, L.P. Lobachevsky Institute, 1Nizhny Novgorod State Technical University, Russia; 2Ast University, United Kingdom; 3University of Montpellier, France
In order to obtain the highly sensitive lead selenide layers, the novel PECVD approach was developed. The production and sensitization of the resulting films with indium pentoxide was carried out in one vacuum cycle. The influence of annealing conditions on the surface morphology and photoelectric properties of the final films was studied.
UV emission of ZnO structures with whispering gallery modes synthesized by different methods

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

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

Cost-efficient fiber optic distributed acoustic sensor


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

In-well pumping of an InGaP/AlGaN/P-based semiconductor disk laser

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

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

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

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

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

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


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

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

N. Mgedle, O.S. Oluwafemi; Department of Chemical Sciences, University of Johannesburg; Centre for Nanomaterials Science Research, University of Johannesburg, South Africa

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

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

O.B. Vyskubenko, V.V. Chishchevsky, M.V. Lakhmatski, S.Ya. Kiliin; Institute of Physics NASB, Belarus

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

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

I.V. Oreshko, A.E. Kazakova, V.V. Zolotarev, V.V. Shushkanov, S.O. Slipchenko, N.A. Piktin; Institute of Russia

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

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


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

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


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

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


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

Optical parametric amplification of quantum cascade laser radiation in ZnGeP2 crystal

O.B. Vyskubenko, S.G. Garanin, N.G. Zakharov, V.V. Kusakina, V.I. Lazarenko, A.V. Mukhin, G.S. Sokolovskii, K.A. Tulyakov; RFNC-VNIIEF, Lobachevsky University, Institute of Electronics and Photonics, Lomonosov Moscow State University, Russia

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

G.O. Kornyshov1,2, A.S. Payusov1, A.A. Beckman1, Yu.M. Shemyakov1, S.A. Mintairov, N.A. Kalyuzhnyy1, N.Yu. Gordeev1, M.V. Maximov2, Ioffe Institute, A.Flerov University, Russia

We studied experimentally the wavelength dependence of transparency current of the novel type of quantum-sized heterostructures – InGaAs/GaAs quantum well-dots. Using the obtained results, we have studied the population level of the active region of superluminescent diodes based on chirped quantum well-dots and showed that at current density of 160 A/cm², the low-energy layer is filled with carriers.

Advanced thin films of gallium selenide

L.A. Mochalov1, M.A. Kudryashov1, E.A. Slapovskaya1, Yu.P. Kudryashova1, S.V. Telegin1, E.U. Rafailov1, A.N. Baranov1, Nizhny Novgorod State Technical University;

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

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

M.A. Ladugin1, A.A. Marmalyuk1, A.S. Payusov1, A.A. Beckman1, Yu.M. Shemyakov1, S.A. Mintairov1, Ioffe Institute, Russian Academy of Science, St.Petersburg, Russia

We investigated microlasers with InGaAs/GaAs quantum well-dots in the active region with broken rotational symmetry of the cavity. For the first time, lasing at elevated temperatures is demonstrated. Deviation of the cavity shape from the circular leads to the directionality of the emission in the lateral direction. The quality factor of structures is estimated to be at least 10⁴°.

R04: LASER BEAM CONTROL - POSTERS

Location: Nikolsky + Levinson Foyer; Floor 2; Date: Thursday, July 04, 2024

Optical radiation homogeniser of a power supply system with energy transfer via optical fibre

A.A. Garkushin1, V.V. Krishtop1, I.L. Volkhin2, D.A. Kustov1, E.V. Nifontova1, M.E. Belkin1, K. Voropaev2, D. Klyushnik1, M.G. Vasiliev3, MIREA - Russian Technological University, Russia

The paper proposes a power supply system with power transmission via optical fiber. Modelling is performed in the COMSOL Multiphysics software package using the finite element method. A digital model of a homogenizer for a photovoltaic converter is obtained. The homogeneity of the model and experiment was 71.7% and 76.5%, respectively.
Optical multi-pass cell for TDLAS analysis of human breath
V.V. Vasinovich, A.O. Pivovarov, M.S. Khadjiev, A.S. Grishkanich, S.A. Davydov; 1 Photonic Systems; 2 ITMO University, Russia; 3 Taskient University of Information Technologies, Uzbekistan; 4 LLC Kobaklab, Russia; 5 Halitus GmbH, Germany

We conducted optical modeling and constructed a multi-pass optical cell for TDLAS analysis. The cell comprises two cylindrical mirrors and achieves a 3.5 m optical path within a 5 x 5 x 5 cm³ volume, enabling its use in portable devices for examining human exhalation.

10:00-13:30

Metrological assurance of frequency-stabilized lasers
K.V. Chekirda, Z.V. Fomkina, N.A. Kononova, Yu.G. Zacharenko; Mendeleyev Institute for Metrology (VNIIM), Russia

The report is about the metrological assurance of frequency-stabilized lasers.

10:00-13:30

New method of controlling the axis of laser radiation in Anderson differential cuvette in mobile refractometer
D.S. Provodin, M.A. Yakusheva, N.A. Riabogina, A.A. Goldberg, I.D. Kochetkov, V.V. Davydov, Peter the Great St. Petersburg Polytechnic University, Russia

A design of mobile refractometer with Anderson’s differential cuvette and new methodology for controlling the axis of laser emission has been developed to ensure measurement of the refractive index n of liquid medium in the range of 1.230 to 2.830 with an accuracy of 0.0001 for an unambiguous express control of its condition. This result was obtained for the first time.

10:00-13:30

Beam profiles and radiation coherence at the output of solid-state and dye lasers with an intra-cavity immersion diffuser
O.A. Burdukova1,2, A.L. Koromyslov1, V.A. Petukhov1, Yu.V. Senatsky1; 1 Lebedev Physics Inst. RAS, Russia; 2 Moscow State University, Russia

A diffuser of radiation based on a cuvette with an immersion mixture of LiF crystal microparticles and isobutyl alcohol, transparent in the range of 0.4–1.1 µm (similar to a Christiansen filter), is proposed. Low-coherent solid-state and dye lasers using this immersion diffuser in the resonator are proposed.

10:00-13:30

Refractive phase masks for lensless laser beam shaping
D.A. Radnatarov1,2, A.Yu. Kokhanovskiy1, P.V. Kozmina1, S.M. Kobtsev1; 1 Novosibirsk State University; 2 ITMO University, Russia

This work describes a method of laser beam transformation in lensless optical systems by phase SLM. This method relies on an iterative algorithm of wavefront reconstruction that uses a physical model of a laser resonator with propagation of a conjugated wave front and smooth morphing of the target beam profile. This method allows formation of beams with a smooth phase and intensity profiles.

10:00-13:30

Application of piezoactuators to provide the required resolution of laser interferometers
E.A. Lavrov; Russian Research Institute of Physical, Technical and Radiotechnical Measurements (FSUE “VNIIFTI”), Russia

A drive unit for the reflector of the reference arm of a laser interferometer for measuring displacements has been developed. With its help, the displacement of the reference arm mirror is simulated to accumulate measurement results and provide a resolution of less than 1 micron. Experimental results of measurements of a laser interferometer are considered.

10:00-13:30

Peculiarities of laser beam parameters control a during goniometric measurements of biological liquids refractive index
B.K. Reznikov, G.V. Stepanenkov, V.V. Davydov, N.Yu. Kolyubelev, D.V. Oasserel, E.A. Logvinova; 1 The Bonch-Bruevich St. Petersburg State University of Telecommunications; 2 Peter the Great St. Petersburg Polytechnical University, Russia

The necessity of using laser radiation of several wavelengths to control the biological media state by measured values of refractive indices n is substantiated. The technique of measuring at several wavelengths using a goniometer is proposed. The requirements to laser radiation parameters are defined. Results of biological media studies with different proteins, solids, and other compositions are provided.

10:00-13:30

Using neural networks to reconstruct the wavefront of laser radiation based on the focal distribution of fluence near the waist
A.V. Kotov, A.A. Soloviev; Federal Research Center Institute of Applied Physics RAS, Russia

The paper proposes a method for reconstructing the wavefront of laser radiation based on the focal distribution of fluence near the waist. For the wavefront reconstruction task, we propose to use deep convolutional neural networks. The method has shown good efficiency and can significantly speed up and improve the quality of calibration of an adaptive optical system.

10:00-13:30

Laser switching of VO₂ attenuation in pulse-periodic mode
A.A. Antonov, I.M. Belousova, A.P. Zhevlakov, A.S. Narionchik, Vavilov State Optical Inst., Russia

VO₂ attenuator was developed capable of smoothly adjusting the intensity of laser radiation for ophthalmic and angiography. It has been experimentally established that the switching speed of VO₂ due to the semiconductor-metal phase transition and the reverse restoration of the initial state can be carried out in the GHz range repetition rate of the applied ns laser pulses.

10:00-13:30

Constructing confocal Fabry-Perot cavity to stabilize multiple lasers for 40Ca⁺ optical qubit
S. Zarutskiy1,2, A.O. Kadykov1, L.A. Apokin1, A. Matveev1, N.V. Morozov1, K. Lakhmanskiy1; 1 Russian Quantum Center; 2 Moscow State Univ., Russia

We present the design and its characterization for the laser stabilization system for ion-based quantum computer. The design is based on the custom-constructed Fabry-Perot cavity locked to the stable Nd:YAG 532 nm laser. The target 866 nm laser used for 40Ca⁺ cooling is then locked to the stabilized cavity.

10:00-13:30

Coherent beam combining of a multichannel fiber laser with an automatic alignment system
N.M. Rakichev, S.V. Tyutin, V.S. Tyyski, M.I. Konovlatsiy; Russian Federal Nuclear Center All-Russian Research Institute of Experimental Physics, Russia

In this work, the coherent beam combining of a seven-channel fiber laser is demonstrated. Channel phase alignment is achieved using a two-stage stochastic parallel gradient algorithm. The system of automatic channel reduction on one optical axis is demonstrated.

10:00-13:30

Laser noise reduction with additional filtering resonator
A.P. Gordeev1,2, Naveed Kour1, I.B. Bobrov1,2, S.S. Straupe1,2, S.P. Kulik1,2; 1 Faculty of Physics, Lomonosov Moscow State University; 2 Quantum Technology Center, Moscow State University, Moscow Institute of Physics and Technology, Russia

Rydberg states in quantum computer based on neutral atoms are obtained by shining on the array of cold atoms with two lasers. Stability of the driving lasers and noise reduction are required to be high fidelity of quantum gates. Theoretical analysis and experimental setup of PDH-locking scheme with additional filtering resonator will be presented.
We show that the chirp brings about additional control over the fast-slow propagation of chirped femtosecond laser pulses in epsilon-near-zero nanorods based metamaterials. The uniqueness of this method lies in the simultaneous laser-injection and far-IR using antireflection microstructures (ARMs) fabricated with femtosecond laser ablation assisted with wet chemical etching. The results of the research may be applied in design of luminescent sensors and screen matrices.

**Experimental and theoretical study of a flow photoreactor operating in the strong light-matter coupling regime**

E.A. Granizo¹, I.S. Kriukova², P.S. Samokhvalov¹, I.R. Nabiiev¹,², Laboratory of Nano-Bioengineering, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia; Life Improvement by Future Technologies (LIFT) Center, Skolkovo, Russia; Laboratoire de Recherche en Nanosciences (LRN-4682), Université de Reims Champagne-Ardenne, France

Fluidics in optical systems attract attention due to advantages from employing strong light–matter coupling that allow the development of novel photoreactors. Experiments with an aqueous solution of methylene blue in a microfluidic cavity at room temperature have shown strong light–matter coupling in this system, demonstrating potential for explorations in photocorrosions and overcoming challenges in organic chemistry.

**Estimation of the electro-optical response of lithium niobate modulators from the high-frequency transmission of traveling wave electrodes**

M.V. Parfenov, A.V. Varlamov, A.V. Tronev, P.M. Agruzov, I.V. Ilichev, A.V. Shmarai; Ioffe Institute, Russia

The technique for estimation of an integrated-optical modulator electro-optical response without optical measurements was developed and tested for a lithium niobate modulator. The electro-optic response prediction was based on experimentally measured propagation characteristics of high-frequency electrodes using numerical simulation of optical waveguides. The presented technique can be used to perform rapid tests on a wafer in production of integrated-optical modulators.

**Production of hybrid materials in the MF₂ (M=Ba,Ca):LiQ system by co-precipitation**

M.Yu. Andreeva, P.V. Strekalov, K.I. Runina, O.B. Petrova; The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, Russia

Hybrid materials were obtained in the MF₂ matrices (M=Ba, Ca) using an organic phosphor lithium (8-hydroxyquinolate). Hybrid materials were obtained by direct and reverse co-precipitation from aqueous-alcoholic solutions with ammonium fluoride under various synthesis conditions. The resulting luminescent materials have effective broadband photoluminescence in the region of 390-650 nm.

**Formation of linear carbon chains in aqueous chloroauric acid (HAuCl) solutions by laser irradiation**

I.Yu. Nikitin, L.N. Borodina, A.V. Boltenko, M.A. Baranov, I.A. Gladskikh, T.A. Vertanyan; International Research and Educational Center for Physics of Nanostructures, ITMO University, Russia

In this work the optical properties of porous hybrid alumina-silver matrix nanostructures were investigated. The Förster resonant energy transfer and Purcell effect were observed and studied for anodic alumina F-centers and for dye molecules of rhodamine 6G and pseudocyanine. The results of the research may be applied in design of luminescent sensors and screen matrices.

**Glasses with I-VII and II-VI semiconductor nanocrystals for nonlinear optical limiting**

A. Babkina, E. Kolobkova, K. Zyryanova, N. Nikonorov; ITMO Univ., Russia

The spectral properties of inorganic glasses with I-VII and II-VI nanocrystals and quantum dots are investigated. Nanosized copper halide and cadmium chalcogenide crystals stabilized fin glass matrix are shown to be a perspective material for nonlinear optical limiting.
Direct aqueous synthesis of Mn-doped ZnInS/ZnS: the effect of the impurity on singlet oxygen generation and photo-thermal profiling

R. Maluleke1, S.O. Olouwafemi2,3; 1Department of Chemical Sciences, University of Johannesburg; 2Centre for Nanomaterials Science Research, University of Johannesburg, South Africa

This study presents a direct aqueous synthesis of manganese (Mn)-doped ZnInS/ZnS quantum dots and investigates the influence of the dopant on singlet oxygen generation and photo-thermal profiling. Quantum dots play a pivotal role in various applications, and the introduction of dopants can tailor their properties for specific applications.

Upconversion responsivity of 4F9/2-4I15/2 transition of erbium in NaYF4 matrix at high power pump

I. Asharchuk1, N. Voiov1, Yu. Bondarev1, I. Filippov1, A. Kravchenkov1, M. Babaev1,2, Y. Anufriev1,2, M. Tarkhov1,2; 1Institute of NanoTechnology of Microelectronics RAS, 2National Research University "Moscow Power Engineering Institute", 3Skolkovo Institute of Science and Technology, Russia

In this work is shown investigations the luminescence behavior of the erbium 4f9/2-4i15/2 transition in a NaYF4 crystalline matrix doped with Yb and Er ions, over a wide range of pump power with a wavelength of 980 nm.

Multiple optical switching of GST thin films for reflective display applications

V.B. Glukhenkaya, E.P. Kitsyuk, N.M. Tolkach, G.N. Pestov; 1National Research University of Electronic Technology, 2Scientific-Manufacturing Complex "Technological Centre", Russia

The crystallization/amorphization processes of GST thin films under pulsed laser exposure were investigated. It was found that the optimal laser mode for GST crystallization and re-amorphization is 50 mW/10 μs and 106 mW/50 ns respectively. We demonstrate the 11-multiple write/ rewrite/ uniform-area of GST on the surface of large-size GST/ITO/Al and 106 mW/50 ns respectively. We demonstrate the 11-multiple write/rewrite/ uniform-area of GST on the surface of large-size GST/ITO/Al/ and 106 mW/50 ns respectively. We demonstrate the 11-multiple write/rewrite/ uniform-area of GST on the surface of large-size GST/ITO/Al/ and 106 mW/50 ns respectively. We demonstrate the 11-multiple write/rewrite/ uniform-area of GST on the surface of large-size GST/ITO/Al/

Study of the effective optical characteristics of metal surfaces using terahertz surface plasmon interferometry

V.S. Vanda1,2, V.V. Gerasimov1,2, A.K. Nikitin3; 1Budker Institute of Nuclear Physics SB RAS, 2Novosibirsk State University, 3Scientific and Technological Center of Unique Instrumentation RAS, Russia

The theoretical and experimental studies of the effective optical constants of metal surfaces in the THz frequency range using dynamic plasmon interferometry will be presented. It was shown that the length of propagation of surface plasmon polaritons over conductors, as well as their optical constants, significantly depend on the surface metal roughness.

Lasing of polymer microspheres doped with AgInS2 quantum dots and plasmonic nanoparticles

E.O. Solov'eva1, K. Kurasova1, K.V. Bogdanov1, A.A. Starovoytov1, N.A. Toropov2, N.N. Shevchenko1, T.A. Varatyany1; 1ITMO University, Russia; 2Univ. of Southampton, United Kingdom; 3Inst. of Macromolecular Compounds, Russia

Whispering-gallery mode (WGM) microlasers were made of polystyrene microspheres in an aqueous solution of plasmonic nanoparticles and AgInS2 quantum dots. The emission spectra of doped microspheres exhibited narrow peaks corresponding to WGM. The presence of silver and gold nanoparticles reduces the emission intensity and, in the case of gold, simultaneously increases the microlaser quality factor.

Coalescence of III-V and III-nitride nanowires

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

We study theoretically the nanowire coalescence process and present the structural diagrams separating the domains of partial or full coalescence depending on the presence or absence of a catalyst droplet at the NW tip and the epitaxy technique (either directional MBE method or vapor phase epitaxy).

Magnetic control of coherent tunneling in hybrid magnetic-dielectric integrated waveguides

O.V. Borovkova1,2, A.A. Kolosova1,3, V.I. Belotelov2; 1Russian Quantum Center; 2Lomonosov Moscow State University; 3Moscow Institute of Physics and Technology, Russia

Magnetic control of the light routing and transfer in the integrated planar waveguide structure that combined both magnetic (iron garnet) and nonmagnetic (quartz) waveguides on the silicon dioxide chip based on the coherent tunneling by adiabatic passage (CTAP) is addressed. The effect is studied for two different directions of the external magnetic field.

Modeling approaches for the compositional control in ternary nanowires and heterostructures

E.D. Leschenko1, V.G. Dubrovski2; 1Submicron Heterostructures for Microelectronics, Research and Engineering Center RAS; 2Faculty of Physics, St. Petersburg State University, Russia

The critical step in nanowire-based device design is the ability to control the nanowire composition. The shift of the research focus toward the investigation of more complex materials was accompanied by the development of a variety of models. Here we present recent progress in modeling strategies for the stationary compositions of ternary nanowires and the interfacial abruptness of the heterointerface.

Vibrational spectroscopy of Yb2O3, Nd2O3, and Er2O3 material

D.A. Artemonov, A.V. Tsibulnikova, I.G. Samusev, V.V. Bryukhanov, B.F. Ospanov; Faculty of Fundamental and Applied Photonics, Nanophotonics, Immanuel Kant Baltic Federal University, Russia

In this work, the synthesis of Yb2O3, Nd2O3 and Er2O3 was carried out and the vibrational spectroscopy of the obtained complex of different concentrations was investigated. Based on the results of vibrational spectroscopy, it was found that the Raman spectrum of the Nd2O3/Yb2O3 oxide mixture shows an increase in the intensity of vibrational bands after sintering at T = 750°C.
**Red- emissive carbon dots: machine learning for prediction and optimization of properties**

V.S. Tuchin, E.A. Stepanidenko, A.A. Vedemikova, S.A. Cherevko, E.V. Usakho1,2; International Research and Education Centre for Physics of Nanostructures, ITMO University, Russia; Department of Materials Science and Engineering, and Centre for Functional Photonics (CFP), City University of Hong Kong, China

Development of nanotechnology opens a way to control the properties and performance of nanostructured materials at atomic scale. However, existing trial-and-error approach for synthesis of such materials is time-consuming, not effective considering cost of materials and manpower. Machine learning approaches may help to overcome this limitation. Here, we investigated the property-synthesis parameters relation via machine learning for red-emissive carbon dots.

**ThR09-p20** 15:00-18:30

**High thermal tunability of optical transmission of Epsilon-Near-Zero metamaterials based on nanorods in liquid crystals**

V.B. Novikov, A.K. Zagravski, S.V. Sotnichuk, N.K. Davidenko, A.Yu. Bobrovsky, K.S. Napoltski, T.V. Muzrina; Lomonosov Moscow State University, Russia

We revealed a salient thermal effect in the transmission of the epsilon-near-zero metamaterial consisting of an array of plasmonic nanorods in a dielectric template. The flavor of the structure is free-standing nanorod segments surrounded by liquid crystals possessing a strong thermal dependence of the permittivity. The observed resonant enhancement of the thermal sensitivity harnesses nonlocal optical response of the structure.

**ThR09-p21** 15:00-18:30

**Study of light-emitting properties in a GaNPAs heterostructure on silicon**

L.N. Dvoretskaia, A.M. Mozharov1,2, A.S. Funtikova2, V.V. Fedorov1, I.S. Mukhin1,2; 1Alferov University; 2Peter the Great St. Petersburg Polytechnic University, Russia

The work demonstrates the results of a study on the creation of a matrix structure based on a p-i-n Ga/P/gP/NAs/GaP diode on Si.

**ThR09-p22** 15:00-18:30

**2.5 μm photodetectors based on MBE grown InAlAs/InGaAs/InP metamorphic heterostructures**

E.I. Vasilkova, E.V. Pirogov1, K.Yu. Shubina, O.V. Barantsev, K.O. Voropaev, A.A. Vasil'ev, L.Ya. Karachinsky, I.I. Novikov1, M.S. Sobolev, A.V. Dvoletsy1; 1Alferov University, Russia; 2“OKB-Planeta”, ITMO University, Russia

This work reports on In0.83Ga0.17As/InP photodiodes based on heterostructures with InAlAs metamorphic buffer layers grown by molecular beam epitaxy. The fabricated photodiodes are sensitive to 2.5 μm light source as shown by the current-voltage characteristics. The measured photodiode dark current is ~300 nA under 10 mV reverse bias voltage.

**ThR09-p23** 15:00-18:30

**Fabrication of nanostructures by femtosecond laser exposure of thin Au films with zero-order vortex beam retarder**

V.A. Gulinyan, E.I. Ageev, D.A. Zuev; ITMO University, Russia

This study demonstrates nanostructures formation using single-shot femtosecond laser exposure on a thin gold film with zero-order vortex beam retarders. The research investigates the influence of the focused laser beam on the produced nanostructures and explores the dependencies of sizes and types on laser fluence. The proposed method simplifies fabrication and allows scaling up the production of arrays of nanostructures.

**ThR09-p24** 15:00-18:30

**Optical properties of self assembled aligned single walled carbon nanotubes**

A. Ismael1,2, I.O. Orekhov, N.R. Artyukhan, S.G. Sazonkin, D.A. Dvoretsy1, K.L. Denisov1, V.E. Karasik, E.D. Obraztsova1,2; 1Bauman Moscow State Technical University; 2Moscow Institute of Physics and Technology; 3Prokhorov General Physics Institute, Russia

The self-assembly method was used to prepare aligned single-walled carbon nanotubes for application as a saturable absorber in ultrashort pulses lasers. The nonlinear characteristics of the prepared aligned nanotubes film were compared to typical film with random nanotubes. The saturable absorber modulation depth was increased by 6% due to the alignment features.

**ThR09-p26** 15:00-18:30

**New materials for optical fibres based on oxochloride lead-tellurite glasses**

A.M. Vasilenkova1, D.A. Butenkova1, K.I. Runina1, A.A. Pyenikov2, M.A. Uslamina1, M.B. Grishechkin1, O.B. Petrova1,2; 1The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, ITMO University; 2Institute of Natural Science, Westlake University, Hangzhou, China

Heavy lead-gallate glasses were synthesized in a wide range of compositions. The glasses have record low absorption of hydroxyl groups, wide range of transparency and good crystallization stability. The materials are promising for drawing optical fibers.

**ThR09-p28** 15:00-18:30

**Aluminum metasurface as a booster for chemiluminescence sensors**

K.A. Bromlikov, A.P. Chetverikova, N.S. Solodovchenko; ITMO University, Russia

Chemiluminescence, notwithstanding its relatively low yield, is an important transduction mechanism for chemical and biological sensors. To extend the applicability of chemiluminescence sensors in more demanding situations we explore the opportunity to enhance the chemiluminescence intensity via acceleration of radiation transitions which is known to be possible in the vicinity of a periodic array of nanoparticles possessing plasmon resonances.

**ThR09-p29** 15:00-18:30

**Heavy glasses based on lead-gallate system for IR applications**

O.B. Petrova, A.B. Terekhova, D.A. Butenkova, K.I. Runina; The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, Russia

Heavy lead-gallate glasses were synthesized in a wide range of compositions. Spectroscopic studies have shown that the system is promising for applications in the infrared spectral region. The glasses have good transmittance, low absorption of hydroxyl groups and are stable to crystallization.
**Fe²⁺ doped transparent lithium aluminosilicate glass-ceramics with broadband absorption in the spectral range of 2 μm**

K.S. Trukhanova, O.S. Dymshits, S.S. Zapalova, I.P. Alekseeva, K.V. Bogdanov, M.Ya. Tsenter, M.I. Tenevitch, V.I. Popkov, A.A. Zhiilin; Center of Nanotherostructure Physics, Ioffe Institute, \*Glass Department, S.I. Vavilov State Optical Institute, \*International Research and Education Center for Physics of Nanosstructures, ITMO University, \*D.V. Eternov Institute of Electrophysical Apparatus, Russia

Transparent thermal-shock resistant glass-ceramics of the lithium aluminosilicate system nucleated by titania and doped with ferrous ions have been developed. These structure, thermal-mechanical and optical properties were studied. Their broadband absorption in the spectral region of 1.5–2.5 μm is due to Fe²⁺ ions in tetrahedral positions in γ-Al₂O₃ crystals.

### ThR09-p32 15:00-18:30

**Reversible SERS platform based on Na⁺ - Ag⁺ ion-exchanged glass**

Y.M. Sgibnev, A.V. Sheleev, A.V. Banytshev; \*Dukhov Automatics Research Institute Na⁺ – Ag⁺ ion exchange of sodium-aluminoisilicate glass and subsequent heat treatment in air is shown to result in growth of silver nanoisland films only on the glass surface. Properties of silver films are determined by heat treatment parameters. The proposed method allows to grow and remove silver nanoisland film repeatedly several times, paving the way for developing reversible SERS-active substrates.

### ThR09-p34 15:00-18:30

**Spectroscopy of thulium ions in novel oxychloride lead-tellurite glasses**

D.A. Butenkov, A.M. Vasilenkova, K. Veselky, P. Loiko, A. Braud, P. Camy, O.B. Petrova; \*Department of Chemistry and Technology of Crystals, Mendeleev University of Chemical Technology, Russia; \*Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, France; \*Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Czech Republic

Thulium-doped oxychloride lead-tellurite glasses were synthesized, and their spectroscopic properties were studied focusing on Tm³⁺ emissions of both Nd³⁺ and Nd³⁺/Yb³⁺ is also considered. The intensity of Er⁺ emissions increases by 3.5 times after fluorination. After the formation of two-phase Nd³⁺/Yb³⁺:CeO₂/CeF₃ samples, emissions of both Nd³⁺ and Yb³⁺ are observed.

### ThR09-p39 15:00-18:30

**Photoluminescence enhancement of nanowires in IR-range induced by surface plasmon**

T.M. Shugabaev, V.O. Gridchin, P. Bulkin, I.A. Melnichenko, A.A. Maksimova, K.P. Koltyar, V.V. Lendyasheva, K.V. Lichkachev, N.V. Kryzhovskaya, R.R. Reznik, G.E. Cirlin; \*St. Petersburg State Univ; \*Allerov Univ; \*Inst. for Analytical Instrumentation RAS; \*UPICM CNRS, Ecole Polytechnique, IP Paris, France; \*HSE Univ; \*St. Petersburg Electrotechnical Univ. \*LEIT; \*Ioffe Inst, Russia

Nanowires are promising solids for creating efficient optoelectronic and nanophotonic devices. Here, we study the optical properties of single InP/InAsP/InP nanowire transferred to Ag/SiOₓ plasmonic substrate. For the first time, photoluminescence enhancement for these nanowires due to exciton-plasmon interaction was demonstrated.
Vertical subwavelength grating coupler inspired by the moth’s eye metasurface
I. Kazakov, A.V. Shipulin; ScolTech, Russia
We propose a new design principle for vertical grating couplers for integrated photonics. The principle is based on breaking the symmetry of the waveguide stripe using a moth’s eye-inspired metamaterial. Our simulations of the grating coupler on a 220 nm SOI material platform show a coupling efficiency of 28% and unidirectionality of over 31 dB.

Polarization coupling in a bent optical waveguide based on thin film lithium niobate
D.N. Moskalev1,2, E.D. Voblikov, V.V. Krishtop1,2,3; 1 Perm State University; 2 Perm National Research Polytechnic University, Russia
In the present paper the simulation of modes in waveguides based on thin film lithium niobate was performed. Further, the coupling coefficients depending on the waveguide angle were obtained. The results showed the maximal absolute value of the coupling coefficient was 0.013, which corresponds to direction of the waveguide at an angle of 50°.

Preparation and optical properties of transparent spinel-based glass-ceramics containing Fe(II) ions
O. Dymshits1,2, V. Bukina1, K. Eremeev3, S. Zapalova1, I. Alekseeva2, L. Basyrov1, K. Bogdanov1, A. Volokitin1, M. Tsenter1, P. Loiko1, V. Popkov1, A. Zhihir1; 1 Center of Nanoheterostructure Physics, Ioffe Institute, 2Glass Department, 3Glass Department, St. Petersburg State University, Russia
Transparent glass-ceramics of magnesium, lithium-gallium, lithium, and zinc aluminosilicate systems based on Fe2+-doped nanocrystals with spinel structure are developed by secondary heat-treatments of glasses melted in reducing conditions using TiO2 or a mixture of TiO2 and ZrO2 as nucleating agents. Their structure and optical properties are studied. The glass-ceramics are promising as saturable absorbers for lasers operating at ~2 μm.

Plasmon effect on energy transformation of electronic excitation in molecular systems
N.Kh. Ibrayev1, E.V. Selievstova1, M.G. Kucherenko; 1Buketov Karaganda University, Kazakhstan; 2Orenburg State University, Russia
The influence of plasmon metal nanoparticles on intra- and intermolecular electronic processes in condensed matters has been studied. The transient absorption of plasmon nanoparticles as well as the competitive effect of plasmonic enhancement of fluorescence and Förster energy transfer in the “chromophores/plasmon nanoparticles” system, and plasmonic effect on singlet-singlet and triplet-singlet energy transfer in the same donor-acceptor pair was considered.

Luminescence temperature sensing based on spectral characteristic of CeF₃ - TbF₃ - YF₃ nanoparticles
S.I. Kalinichenko, A.S. Nizamutdinov, M.S. Pudovkin; Kazan Federal University, Kazakhsthan; 2Orenburg State University, Russia
Luminescence intensity of Ce³⁺ and Tb³⁺ peaks was used as a temperature-dependent parameter (303-523K range). The LIR functions decay with the increase of temperature and depends on Tb³⁺ concentration. We suggest, that this is due to the competition of two processes: multiphonon non-radiate transition of Tb³⁺ from SD3 to SD4 and cross-relaxation between Tb³⁺ ions, which was considered less temperature-dependent.

Ultrafine precursor for laser sintering of Er:YAG-20Bi₂O₃-60B₂O₃-20BaO glass ceramics
A.D. Pidkowych, A.M. Kuz’kin, E.E. Rostokina, M.E. Komshina, V.Y. Balueva, K.F. Shumovskaya; Devyatikh Institute of Chemistry of High Purity Substances RAS, Russia
A method has been developed for producing an amorphous ultrafine precursor with different ratios of Er:YAG and 20Bi₂O₃-60B₂O₃-20BaO. The method of selective laser sintering has been used to demonstrate the possibility of forming functional glass ceramics with a crystalline phase represented by yttrium aluminium garnet and yttrium/erbium borate.

Thin film GeTe and Ge,Sb,Te₃ for photonic applications
A.A. Burtsev, A.V. Kiselev, V.V. Ionin, A.A. Nevzorov, V.A. Mikhailovsky, N.N. Eliseev, A.A. Lobin; NRC «Kurchatov Institute», Russia
Thin film phase-change materials (PCM) such as germanium telluride are commonly utilized in photonic and optoelectronic devices. This study presents a reversible alteration in the optical properties of thin-film samples due to phase transitions under the influence of pulsed laser radiation using the pump-probe scheme.

A model of the process of forming the optimal fractional composition of powders during compaction
A.V. Kharkova, K.A. Frolov, D.A. Kochuev, R.V. Chkalov, D.G. Chkalova; Vladimir State University named after A. G. and N. G. Stoletov, Russia
A mathematical model for estimating the optimal fractional composition of the powder for compaction has been developing. The model has been tested on the data of fractional compositions of three mixtures. The layering of the powder mixture is modeling using the finite element method.

Photoluminescence enhancement of InGaN core-shell nanowires via wet chemical treatment
V.O. Gridchin1,2,3, A.S. Kulagina1, T. Shugabaev1, A.I. Khrebtov1, V.V. Lenshavshova1, I.S. Makhov1, Yu.B. Samsonenko1,2,3, R.R. Reznik1,2,3, G.E. Cirillo1,2,3; 1St. Petersburg State University; 2Allertonov Institute; 3IIT RAS, *HSE University, Russia
It has been revealed that removing the shell of spontaneously formed InGaN nanowires increases the amplitude and narrows their emission spectrum. It has been established that radiative recombination dominates in the nanowires. And the dependence of the integrated photoluminescence intensity on the pump power for nanowires after etching is super-linear in comparison with the initial ones.

Ultrathin GaN epitaxial layers for UV sensing
V.O. Gridchin, A.S. Kulagina, T. Shugabaev, A.I. Khrebtov, V.V. Lenshavshova, I.S. Makhov, Yu.B. Samsonenko, R.R. Reznik, G.E. Cirillo; 1St. Petersburg State University; 2Allertonov Institute; 3IIT RAS, *HSE University, Russia
Ultrathin GaN epitaxial layers are grown on Si(111) substrates by plasma assisted molecular beam epitaxy (PA MBE) and investigated. The UV photodetectors based on epilayers obtained are formed and their I-V and transient photoresponse off-on characteristics are studied. It is shown that GaN epitaxial layers with labyrinth-like morphology are prospective for fast-response UV detectors development.
Femtosecond laser-induced optical anisotropy in thin chalcogenide vitreous semiconductor films

D.V. Shuleiko, E.V. Kuzmin, P.P. Pakholchuk, D.V. Pepelyaev, T.S. Kunkel, S.V. Zabotnov, P.K. Khashkarov; Faculty of Physics, Lomonosov Moscow State University; Institute of Advanced Materials and Technologies, National Research University of Electronic Technology; Moscow Institute of Physics and Technology, Russia

Femtosecond (515 nm, 300 fs) laser-induced periodic surface structures of various types were formed on As2Se3 vitreous semiconductor film. These structures have subwavelength (160±10 nm) or wavelength (480±10 nm) periods and form within the irradiated area independently or simultaneously, as a hierarchical structure. The formed structures demonstrate birefringence with the difference between the refractive indices up to 0.1.

Composite nanostructures for biomedical applications formed by femtosecond laser irradiation

D.T. Murashko, E.P. Otusko, A.Yu. Gerasimenko; National Research Univ. of Electronic Technology; M. Sechenov First Moscow State Medical Univ., Russia

Composite nanostructures were fabricated using carbon nanotubes, that were incorporated in bovine serum albumin matrix. Hardness and Young’s modulus of the nanostructures with carbon nanotubes were 0.3 GPa and 5.9 GPa, respectively. The conductivity of the composite nanostructure were 33 μS. The possibility of transferring composite nanostructures to the skin surface has also been verified.

Dyakonov surface modes in an interfacing ring resonator

D.A. Chermoshentsev, I.I. Stepanov, O.V. Borokova, A.V. Masalov, I.A. Blenko, N.A. Giputz, S.A. Dyakoa, Russian Quantum Center, Skolkovo Institute of Science and Technology, Moscow Institute of Physics and Technology, Russia

We predict the occurrence of Dyakonov surface modes in an anisotropic ring-shaped interface resonator. Our results indicate that for larger rings, the resonant conditions for these surface modes can be effectively described using the propagation constant of the Dyakonov surface waveguide mode in a straight interface waveguide. We examine the field structure of these modes.

Structural laser diagnostic for ordered substances, optical materials, and nanosystems

Ya.A. Fofanov, V.V. Manoilo, Institute for Analytical Instrumentation RAS, Russia

New prospects for laser polarization-optical diagnostics of structural features and fluctuations of ordered substances and functional materials are considered. Investigations of the polarization responses of optical materials and elements with a high degree of optical and structural homogeneity, magnetically ordered materials, perfect optical crystals, magnetic nanosystems (nanofluids) and other topical objects are described.

Void-free uniform gap filling between thick PECVD silicon nitride waveguides

A.M. Mumlyakov, N.Yu. Dmitriev, M.V. Shibalov, I.V. Trofimov, I.A. Filipov, A.A. Anikanov, I.A. Blenko, M.A. Tarkhov; Institute of Nanotechnology of S.V. Zabotnov, P.K. Kashkarov; Faculty of Physics, Lomonosov Moscow State University of Electronics Technology; Moscow Institute of Physics and Technology, Russia

In this research, we present a novel manufacturing technology for silicon nitride waveguides, which is designed to address the issue of defects (voids) in areas where waveguides are closely situated. The technique is based on the use of a void-free uniform gap filling method between thick PECVD silicon nitride waveguides.

Annealing of lead thin films on silicon

N.V. Sibirev, I.P. Soshnikov, I.V. Shtrim, I.V. Ilkiv; St. Petersburg State University; loffe Institute; IAS RAS, Alferov University, Russia

III - arsenide nanowires are often grown via the vapor-liquid-crystal mechanism with foreign catalyst. Here we discuss the initial stage of nanowire growth with lead catalyst – annealing of thin film. The influence of thin film thickness, temperature, and time of annealing, was discussed.

Study of the oxygen defects influence on optoelectronic properties of single-walled carbon nanotubes


In this research we quantitatively study defect-induced changes of optoelectronic properties of single-walled carbon nanotubes. Based on the measurements, we suggest empirical laws of the parameters depending on the concentration of dopant. These results might be applicable for many potential applications, including sensors.
Photoluminescence properties of YPO₄:Pr³⁺ nanoparticles in polystyrene nanocomposite films
B. Kahoangi, M. Lamine, O. Salim; Laboratory of Physical-Chemistry, University of Bejaia, Algeria
Inorganic-polymeric nanocomposites (NCs) have recently attracted tremendous attention from the scientific community. Owing to their reasonably low manufacturing costs, as well as the known physical and chemical properties of polymeric materials, they can be manipulated in different geometrical forms and with sufficiently large sizes.

Sodium modification effect on the Ti³⁺-doped Bi₂O₃ - GeO₂ glasses NIR luminescence
K.S. Serkina, A.V. Koro, D.V. Volkova, K.I. Runina, I.V. Stepanova; The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, Russia
Sodium-modified and thulium-doped bismuth-germanate oxide glasses were synthesized and their spectral-luminescent characteristics have been investigated. It was revealed that sodium modification and thulium doping improved the optical quality and luminescent characteristics of Bi₂O₃-GeO₂ glasses.

Study of Terahertz transmission of metal halide optical materials
D.D. Salingareev, A.E. Livov, A.A. Yuzhakova, P.V. Pestereva, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia
A study was carried out of the AgCl₀.₂₅Br₀.₇₅ – TlCl₀.₇₄Br₀.₂₆ and Ag-CI₀.₂₅Br₀.₇₅ – TlBr₀.₄₆I₀.₅₄ systems optical materials' transmission in the infrared and terahertz regions. The data obtained will make it possible to produce a variety of optical products, including terahertz fiber optics for the creation of new generation equipment.

Optical free-standing waveguides with broadband prism couplers made by two-photon lithography
I.O. Batuev, A.N. Androsov, A.I. Maydkovskiy, D.O. Apostolov, T.V. Muzrina; Lomonosov Moscow State University, Russia
We present a free-standing optical waveguide with prism adapters printed from polymer with two-photon laser lithography method. The diameter of the printed waveguides ranges from 0.5 to 2 micrometers and the length is 20 micrometers. We demonstrate experimentally obtained optical loss values ranging from 50% at wavelength 450 nm to 89% at 1300 nm, which are confirmed by numerical modeling.

Optical properties of silver halide single crystals and ceramics - promising materials for fiber optics
D.D. Salingareev, A.E. Livov, D.V. Shatunova, E.Y. Kabykina, P.V. Pestereva, L.V. Zhukova; Ural Federal University, Russia
A study of functional properties of single crystals and optical ceramics of the AgCl – AgBr₀.₇₁ system was carried out. The range of materials spectral transmission, the refractive index dispersion in a wide range of wavelengths, and the refractive index imaginary part have been determined. The results are the basis for modeling and manufacturing infrared fibers.

Laser formation of photocatalytically active TiO₂ coating
E.Y. Popkatova, A.S. Shturn¹, A.M. Kuzmichev, D.A. Rud', E.I. Ageev, D.A. Sinev; Institute of Laser Technologies, ITMO University, Russia
This work proposes the laser creation of TiO₂ coatings with different anatase-rutile phase ratios on the surface of a titanium plate. Pulse repetition rate and scanning speed are used as variable laser parameters. It is shown that the structures are capable of accelerating the decomposition of the MB dye up to 6.3 times and can be used as efficient photocatalysts.
The photoluminescence of nanostructures as InP/InAsP/InP nanowires, passivated by layers of colloidal quantum dots at increasing pump power, has been studied. A feature of the system is the existence of several luminescent centers connected through mechanisms of multi-stage non-radiative exciton transfer. It has been shown that the kinetics of decay of excited states depends on the nature of excitation.

**Site-controlled Ga(Al)As nanostructure arrays emitting at 740 nm**

N.E. Chernenko, I.S. Makhov, I.A. Melnichenko, S.V. Balakirev, D.V. Kirichenko, N.A. Shandyba, N.V. Kryzhanovskaya, M.S. Solodovnik; National Research University Higher School of Economics, Russia

In this work, we present the method of creating arranged-microvoid volumetric reflective gratings using femtosecond laser writing. These volumetric modifications are prospective to be used instead of reflective coatings in miniaturized lasers. The calculation results revealed the effectiveness of proposed modifications compared to conventional multi-layer reflective coatings that are applied directly on the faces of an active medium crystal.

**ThR09-p77**

**Site-controlled Ga(Al)As nanostructure arrays emitting at 740 nm**

N.E. Chernenko, I.S. Makhov, I.A. Melnichenko, S.V. Balakirev, D.V. Kirichenko, N.A. Shandyba, N.V. Kryzhanovskaya, M.S. Solodovnik; National Research University Higher School of Economics, Russia

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**Site-controlled Ga(Al)As nanostructure arrays emitting at 740 nm**

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**ThR09-p78**

**On investigation femtosecond laser writing of defects in hexagonal boron nitride**

P.G. Vilyuzhina, E.A. Primak, E.A. Stepanov, I.V. Savitsky, A.B. Fedotov, S.V. Bolshedevorskii, V.V. Soshenko, I.S. Copicari, A.M. Kozodaev, S.M. Drofa, A. Chernyavskiy, V.N. Sorokin, A. Smolyaninov, A.V. Akimov; National Research Nuclear University 'MEPhI'; Russian Quantum Center; Lebedev Physical Institute, Russia

We present the results of our ongoing investigations on h-BN defects, including femtosecond laser writing for defect creation.

**ThR09-p79**

**Optical properties of functionalized carbon dots and its application**

N.Kh. Ibrayev, G.S. Amanzholova, T.N. Khamza, E.V. Seliverstova; Buketov Karaganda University, Kazakhstan; Istanbul Technical University, Turkey

The influence of the composition of carbon dots (CDs) on the features of generation and deactivation of their electron-exciton states. The influence of the addition of activators. The influence of CDs on absorption and luminescence of CDs, the influence of Ag nanoparticles (NPs) on absorption and luminescence of CDs, the influence of CDs on the photovoltaic properties of solar cells was studied.

**ThR09-p80**

**Study of the evanescent field of terahertz surface plasmon polaritons on metal-dielectric layers**

V.D. Kulagina, I.V. Gerasimov, V.S. Vanda; Budker Institute of Nuclear Physics, Novosibirsk State University, Russia

The results of a study of the influence of the technology of deposition of gold films with a dielectric coating of zinc sulfide, as well as the roughness of the substrate on the penetration depth of the field of surface plasmon polaritons, are presented. Which was measured using the "shielding" method at the Novosibirsk free electron laser.

**ThR09-p81**

**Method of creating arranged-microvoid volumetric reflective gratings in ZnSe**

A.S. Gerasimenko, A.A. Bushunov, M.K. Tarabin; Bauman Moscow State Technical University, Russia

In this work, we present the method of creating arranged-microvoid volumetric reflective gratings using femtosecond laser writing. These volumetric modifications are prospective to be used instead of reflective coatings in miniaturized lasers. The calculation results revealed the effectiveness of proposed modifications compared to conventional multi-layer reflective coatings that are applied directly on the faces of an active medium crystal.

**ThR09-p82**

**Site-controlled Ga(Al)As nanostructure arrays emitting at 740 nm**

N.E. Chernenko, I.S. Makhov, I.A. Melnichenko, S.V. Balakirev, D.V. Kirichenko, N.A. Shandyba, N.V. Kryzhanovskaya, M.S. Solodovnik; National Research University Higher School of Economics, Russia

In this work, we present the method of creating arranged-microvoid volumetric reflective gratings using femtosecond laser writing. These volumetric modifications are prospective to be used instead of reflective coatings in miniaturized lasers. The calculation results revealed the effectiveness of proposed modifications compared to conventional multi-layer reflective coatings that are applied directly on the faces of an active medium crystal.

**ThR09-p83**

**Topological laser concept with tunable wavelength depending on cavity curvature**

M.E. Bochkarev, N.S. Solodovechenko, K.B. Samusev, M.F. Limonov; ITMO University, Russia

We propose the concept of a laser with switchable resonant wavelength, which is based on the effect of CW-CCW modes splitting upon topological and curvature transformation from dielectric ring resonator to split resonator with narrow gap. By modulation of the gap size one can achieve any resonant wavelength in the range of one half-wavelength.

**ThR09-p84**

**The effect of annealing and co-activation by Nd3+ ions on the temperature dependence of the spectral and kinetic characteristics of YF3:Eu3+ nanoparticles**

E.I. Oleynikova, M.S. Pudovkin, S.L. Korablieva, O.A. Morozov; Institute of Physics, Kazan Federal University, Russia

The YF3:Eu3+ nanoparticles demonstrated, that annealing in air at 400 °C for 4 hours increases the rise times by about 2 times and the luminescence decay times by about 1.2 times. Stronger temperature dependence of decay time was observed for samples without annealing. The addition of Nd leads to the increase of temperature sensitivity of spectral characteristics of YF3:Eu3+ nanoparticles.

**ThR09-p85**

**Novel oxochloride lead silicate glass doped with neodimium ions for NIR applications**

A.M. Slastuhina, E.A. Bogoyavlenskaya, O.A. Butenko, K.I. Runina, V.M. Korshunov, D.A. Butenko; St. Petersburg State University, Russia

Nd-doped lead oxochloride silicate glasses were synthesized and their spectral characteristics were studied. The new synthesis technique made it possible to reduce losses due to lead chloride volatilization to two mass percent. Based on the combination of physical and chemical characteristics, these materials are promising for photonic and fiber optics applications.

**ThR09-p86**

**Indirect evidence of the high antimony concentration during the growth in the shape of GaSb nanowires**

N.V. Silin, I.V. Shrom; St. Petersburg University, Russia

GaSb nanowires are grown two-dimensional layer-by-layer mechanism, where a droplet plays a key role. In-situ observation of droplet composition during the growth is often difficult. This paper discusses the possibility of determining the composition of the drop on the basis of studying the shape of nanowire.
8TH INTERNATIONAL A. M. PROKHOOROV SYMPOSIUM ON BIOPHOTONICS
MoSYP-01 14:30-15:15
Advancing 7TM-protein structural studies: from XFELs to light-enabled cell control (Plenary)
V.I. Borslchevskiy; Moscow Institute of Physics and Technology, Russia
The talk will focus on modern methods of studying the structure of 7-alpha-helical transmembrane proteins and their practical applications. The speaker will discuss the use of synchrotrons and XFELs, along with advancements in single-molecule FRET spectroscopy.

MoSYP-02 15:15-16:00
Laser radiation, ultrasound and nanostructured particles work together to realise the theranostic approach (Plenary)
D. Gorin; Skolkovo Institute of Science and Technology, Russia
The application of photonic and acoustic tools can be used for visualization, navigation of multifunctional carriers and remote-controlled release of bioactive substances. These particles will combine the ability to deploy drugs in a controllable manner with physical triggering, multimodal detection, and visualization as well as sensing of important biological markers.

MoSYP-03 16:00-16:45
Multimodal spectro-imaging for human skin carcinoma in vivo optical biopsy (Plenary)
W. Blondel1, V. Kupriyanov1, S. Zyatsev1, G. Khairallah1, C. Perrin-Mozet2, C. Fauvel1, C. Daul1, Y. Kistenev1, M. Amouroux1, Université de Lorraine, CNRS, CRAN UMR7039, France; 1Tomsk State University, Russia; 2Metz-Thionville Regional Hospital, Department of plastic, aesthetic and reconstructive surgery, France
Abstract is not available.

TuSYA-01 09:00-09:30
High-power erbium-doped pulsed fiber laser for non-ablative fractional photo-rejuvenation (Invited paper)
M.Yu. Koptev1, A.N. Morozov2, K.V. Shatilova2, S.V. Muravyev3, A.E. Zapryalov4, M.E. Likhachev5, A.V. Kim; 1Institute of Applied Physics RAS; 2Melsytech LLC; 3Fiber Optics Research Center RAS, Russia
A high-power erbium laser system for fractional photorejuvenation was presented. The system generated rectangular pulses with a duration varying from 200 μs to 5 ms and pulse energy up to 130 mJ. The novelty of the system was the use of a powerful seed source in combination with a synchronously pumped amplifier made on a single-mode erbium-doped LMA fiber.

TuSYA-02 09:30-10:00
Infrared fibers based on AgCl - AgBr0.7I0.3 for medical and laser technologies
A.A. Yuzhakova, A.E. Lvov, D.D. Salimgareev, P.V. Pestereva, I.V. Yuzhakov, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia
For medical laser technologies, IR fibers based on single crystals of the AgCl – AgBr0.7I0.3 system have been developed. Using computer simulation, extrusion modes were determined and fibers with a diameter of 465 μm and a length of 1.4 m were obtained. They have a transmission range of 3.4–24.0 μm without absorption windows and low optical losses.

TuSYA-03 10:00-10:30
Infrared fibers based on AgCl - AgBr0.7I0.3 for medical and laser technologies
A.A. Yuzhakova, A.E. Lvov, D.D. Salimgareev, P.V. Pestereva, I.V. Yuzhakov, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia
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Perspectives on a 3050 nm fiber laser mediated ablative fractional laser treatments in dermatology (Invited paper)
V. Arkhipova1, A. Mimov2, V. Smolyannikova1, I. Larionov1, D. Pathankar4, I. Yaroslavsky1, V. Andreeva1, G. Althsuler2, IRE Polus; 1DORI Clinic; 2Sechenov University, Russia; 3IPG Medical, USA
We have evaluated a novel laser emitting at a wavelength of 3050 nm. We analysed its effect on skin ablation and regeneration. Our data show that this system has a strong tissue regenerative effect and a great potential for use in dermatology.
TuSYA-06 11:30-12:00
Study of the possibility of using dielectric nanoparticles doped with rare earth ions for the treatment of tumors under non-contact exposure to near-IR laser radiation (Invited paper)
S.A. Khrushchalina,1 P.A. Ryabochkina,1 O.A. Kulikov,1 V.I. Shlyapina,1 V.P. Ageev,1 N.Yu. Tabachkova,1 S.E. Kukarkina,1 E.E. Zimin,1 1National Research Ogarev Mordovia State University; 2National University of Science and Technology “MISIS”, Russia
In this work, we investigated the possibilities of using Yb-containing particles (ZrO2-30 mol.% Yb2O3) when excited by laser radiation with a wavelength of 980 nm for the treatment of subcutaneous tumors. Cytotoxicity studies of these particles and in-vivo experiments (on mice) were conducted.
TuSYA-07 12:00-12:30
Endovenous laser coagulation of large diameter varicose veins (Invited paper)
V.Yu. Bogachev,2 V.P. Minaev,2 1The First Phlebological Center; 2Pirogov Russian National Research Medical University; 3IRE-Polus Ltd., Russia
The purpose of this report is to justify the selection of the optimal method of endovenous laser coagulation (EVLC) of varicose veins of large (more than 2 cm) diameter.
TuSYA-08 12:30-13:00
Laser perforation of bones. Photothermal effects and clinical applications (Invited paper)
I.A. Abushkin,2 A.E. Anchugova,2 A.V. Lappa,2 V.P. Minaev,2 V.M. Chudnovsky,2 1Center for Medical Laser Technologies; 2South Ural State Medical University; 3Chelyabinsk State Univ.; 4NTO IRE-Polus; 5Pacific Oceanological Inst., Russia
The study investigates the mechanism and clinical effectiveness of laser osteoperforation using radiation with wavelengths of 0.97 and 1.9 μm. The key points of the technology implementation were intermittent contact of the optical fiber with the bone at adequate radiation power. The clinical effectiveness of laser osteoperforation has been confirmed in the treatment of various bone pathologies.

Location: Petrov-Vodkin 3 Room, Floor 2; Date: Tuesday, July 02, 2024
SYA: ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES 2
Session Chair:

TuSYA-09 13:00-13:15
Laser technologies in the osteomyelitis treatment
A.V. Lychagin,1 N.A. Nabatchikov,12 O.D. Podkosov,1 1Sechenov First Moscow State Medical Univ.; 2Botkin Hospital, Russia
Currently, the treatment of distal tibia osteomyelitis remains a hot topic for discussion. Traditional method involves radical segmental bone resection to the level of healthy tissue, which in turn leads to bone defect, which significantly increases treatment and rehabilitation time. But nowadays we have a new treatment method – laser osteoperforation.
TuSYA-10 13:15-13:30
Laser formation of biointegrated electronic components based on carbon nanotubes and graphene
A.Yu. Gerasimenko,1,2 A.V. Kuksi1, E.A. Gerasimenko,1 A.S. Morozova,1,2 M.S. Savel’ev,1,2 1Institute of Biomedical Systems, National Research University of Electronic Technology; 2Institute for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical University, Russia
Based on the revealed features of the interaction of laser radiation with carbon nanotubes and graphene, a new approach is proposed for the fabrication of silicon electronic devices and flexible wearable/implantable bioelectronics. Laser radiation stimulates the formation of graphene-nanotube contacts. That lead to the development of novel flexible electrically conductive constructs for tissue recovery and electrostimulation of cell growth.
- Lunch Break -

TuSYA-11 15:00-15:30
Thulium fiber laser: experimental study on biological tissue (Invited paper)
M.A. Ryabova,1 M.Y Ulupov1, G.Y. Yukina1, E.G. Sukhorukova,2 J.O. Rakhmonov2, 1Department of Otorhinolaryngology with Clinic of Pavlov First St. Petersburg State Medical University; 2Research Institute of Experimental Oncology and Biomedical Technologies; 3Chelyabinsk State Univ., Russia
One of the important issues, to develop an optimal mode for minimally invasive outpatient turbinoplasty surgery. In this paper, we select the optimal mode at a wavelength of 1.94 μm on calf kidney tissue to achieve maximum coagulation without ablation of the superficial and interstitial layer. The optimal mode of exposure is concluded.
TuSYA-12 15:30-16:00
Surgery guidance with optical spectroscopy: advances in clinical translation (Invited paper)
E.A. Shirshin; Lomonosov Moscow State University, Russia
Optical spectroscopy has been multiply shown to be capable of assisting surgery guidance based on differences in the detected signal from tissue. However, the progress in clinical translation of optical intraoperative diagnostics is not that obvious. In this talk, we will discuss the state-of-art results in optical surgery guidance in urology with a focus on recently developed clinical systems.

TuSYA-13 16:00-16:30
Dual channel video platform for fluorescence diagnostics in augmented reality (Invited paper)
M.V. Loshchenov,1 A.M. Udeeneev,1 N.A. Kalyagin1,2 1Department of Laser Micro-nano and Biotechnology, National Research Nuclear University MPhil, 2Federal State Budgetary «Federal Scientific and Clinical Center for Medical Rehabilitation and Balneology of the Federal Medical and Biological Agency», 3Prokhorov General Physics Institute RAS, Russia
The topic of the presentation is a wide overview of the diagnostic video system combining excitation white light in the red region of visible spectrum and usual white light to give the physician ability observing the area of interest in full or semi-full colors so the diagnostic data appears right on top of the picture in natural colors.
TuSYA-14 16:30-16:45
Optical methods for new medical application: identification of disorders in blood circulation and structure of urethral tissues
E.B. Kisileva,1 A.S. Kuyarov1, L.A. Matyeev,1 V.V. Dudenkova,1 V.V. Elagin,1 O.S. Streltsova1, 1Research Institute of Experimental Oncology and Biomedical Technologies; 2I.V. Shakhov Department of Urology; 3Nonlinear Geophysical Processes Department, Institute of Applied Physics RAS, Russia
This study presents for the first time the combined use of several optical methods for in vivo examination of women with primary urethral pain syndrome (PUPS). Laser Doppler flowmetry (LDF) and transvaginal Doppler ultrasound (TVDUS) allow identifying disorders of blood circulation. Collagen fibrosis were revealed by cross-polarization optical coherence tomography (CP OCT) and then confirmed by nonlinear confocal microscopy.
Erbium laser for modification of dentin surface of the tooth
Y.S. Kozlova, S.N. Razumova, A.S. Brago; Russia

Indications for usage of Erbium family lasers in dentistry are increasing. The success of root canal treatment depends on removing bacteria and smear layer for better adhesion of sealer. Usage lasers in endodontical treatment enhancing success for the treatment in long-term follow up.

Promising approaches to optimize the efficiency of laser hydroacoustic processing of biological tissues
A.V. Belikov1,2, R. Nasser1, S.N. Smirnov1; 1ITMO University; 2Pavlov First St. Petersburg State Medical University, Russia

The results of experimental study of the fiber tip end shape influence on the size of the Yb,Er:Glass-laser-induced cavitation bubble and the value of the bubble collapse pressure, as well as theoretical study of the possibility of using 1.45 \( \mu \)m and 1.54 \( \mu \)m laser radiation to pre-heat the liquid before high-intensity laser pulse action, are presented.

Wide-band diffuse reflectance spectroscopy with a self-calibrating fiber-optic probe (Invited paper)

A wide-band diffuse reflectance spectroscopy system with a fiber-optic contact probe with two source and two detection fibers has been created. Self-calibration approach made it possible to significantly reduce the influence of surface optical inhomogeneities of tissues and fluctuations of transient characteristics of the device on the obtained result, thus providing reliable data on tissue physiological characteristics.

Tissue exposure to laser pulses delivered by sapphire medical instruments: advantages for laser coagulation and ablation (Invited paper)
I.N. Dolganova1, P.V. Aleksandrova1, A.K. Zotov1, A.A. Platonova1, K.I. Zaytsev1, V.N. Kurlov1, D.G. Kochiev1; Osipyan Institute of Solid State Physics RAS, Russia

We describe the advantages of sapphire shaped crystals for manufacturing of medical instruments, in particular, capillary needles for interstitial laser therapy. The application of them for tissue ablation and coagulation is discussed. The particular attention is paid to tissue exposure to short laser pulses delivered by these needles.

Theoretical and experimental study of the effect of laser heating on the optical characteristics of human skin (Invited paper)
A.V. Belikov1,2, V.Yu. Chuchin1,2, A.A. Masharskaya1, ITMO University; Pavlov First St. Petersburg State Medical University; NPP VOLO LLC, Russia

For the first time in an in vivo experiment, the dependence of the reflectance spectrum of human skin when heated by laser radiation was measured. Theoretical interpretation of the experimental results is given, and it is shown that the change in reflectance observed in the experiment may be associated with the conversion of skin blood hemoglobin into methemoglobin.

Studies of the effects of hydrogen fluoride laser radiation on biological tissues
V.M. Fomin; JSC “NIIEFA”, Russia

The effects were studied of HF-laser radiation on the eye cornea of primates, human skin - in vivo and on a human myocardial wall - in vitro. The obtained data the results of our previous works and the results of studies by other authors demonstrate the effectiveness and safety of the use of the HF lasers in surgery.
Determination of the spectral dispersion for the heart muscle

- A Kramers-Kronig approach (Invited paper)

Luis M. Oliveira, Maria R. Pinheiro, Hélder P. Oliveira, Maria I. Carvalho, Valery V. Tuchin, Polytechnic of Porto, School of Engineering, Portugal; Institute for Systems and Computer Engineering, Technology and Science (INESC TEC), Portugal; Porto University, Faculty of Science, Portugal; Porto University, Faculty of Engineering, Portugal; Institute of Physics and Science Medical Center, Saratov State University, Russia; Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University, Russia; A. N. Bach Institute of Biophotonics, RC "Biotecnology of the Russian Academy of Sciences", Russia

The refractive index of the pigs heart was measured at wavelengths between 255 and 850 nm to calculate the dispersion. The total transmittance and total reflectance spectra of the pig heart were measured between 200 and 1000 nm to calculate the spectral absorption coefficient. Using Kramers-Kronig relations, the dispersion of the heart was matched to experimental refractive index values.

Optical monitoring of intradermal delivery of drug-loaded vaterite carriers (Invited paper)

Yu.I. Sveranskaya, M.S. Saveleva, P.A. Demina, R.A. Verkhovskii, Yu.I. Surkov, R.A. Anisimov, I.A. Serebryakova, V.V. Tuchin, Saratov State University, Russia

Drug administration via skin appendages has gained great scientific interest, especially concerning delivery to specific targeted regions and the reduction of systemic toxicity. We propose a novel particulate system for the delivery of glucocorticoids into hair follicles aiming to treat inflammatory skin diseases. The system has been shown to be biodegradable and provide high intradermal concentration of the delivered drug.

Surgery guidance in orthopedics and dentistry (Invited paper)

G.S. Budyl'ina, N.R. Rovnyaagina, E.E. Nikonova, P.V. Dyakonov, V.A. Petrov, D.A. Davydov, A.Yu. Turkina, M.M. Lipina, A.V. Lychagin, P.S. Timashev, E.A. Shirshin, Laboratory of Clinical Biophotonics, Sechenov First Moscow State Medical University; 2Therapeutic dentistry department, Sechenov First Moscow State Medical University; 3Department of Trauma, Orthopedics and Disaster Surgery, Sechenov First Moscow State Medical University; 4Institute for Regenerative Medicine, Sechenov First Moscow State Medical University; 5Faculty of Physics, Lomonosov Moscow State University, Russia

The assessment of knee joint tissue condition during arthroscopy and the measurement of distance to the dental pulp when removing caries-infected dentin using a fiber-optic implementation of the diffuse reflectance spectroscopy method are investigated.

Optical monitoring of intradermal delivery of drug-loaded vaterite carriers (Invited paper)

E.A. Shirshin, Lomonosov Moscow State University, Russia; 2The National Medical Research Center for Endocrinology, Russia

In this talk applications of biophotonics in endocrinology will be discussed, namely (1) parathyroid detection and viability assessment for surgery guidance, (2) tumor cells identification with spectrally-resolved confocal microscopy and fluorescence saturation microscopy, (3) body composition analysis with NIR spectroscopy.

Discovery of novel fluorophores in the human organism with quantitative structure-property relationship approach (Invited paper)

B.P. Yakimov, A.A. Rubekina, L.S. Urusova, E.A. Shirshin, Laboratory of Clinical Biophotonics, Sechenov First Moscow State Medical University; Faculty of Physics, Lomonosov Moscow State University, Moscow, Russia

This study explores the application of AI-approach to identify new fluorophores in the human organism. Trained on the multiple representations of the chemical structure of molecules, the approach accurately restored optical properties for known fluorophores and identified new sources in the human body using available databases. The predictions of the presented approach were experimentally validated for fluorophores identified in tissues.
Time-resolved fluorescence spectroscopy in differential diagnosis of liver cancer in vivo *(Invited paper)*

E.V. Potapova, V.V. Shupletsov, V.V. Dremin; Research & Development Center of Biomedical Photonics, Orel State University, Russia; College of Engineering and Physical Sciences, Aston University, UK; Orel Regional Clinical Hospital, Russia

This work reports a machine-learning-based approach to interpret time-resolved fluorescence spectroscopy data acquired during optical biopsy of the liver. The approach allowed to differentiate between liver parenchyma and tumor with sensitivity and specificity above 0.91 and 0.79, respectively, providing differential diagnosis of liver cancer (primary malignant tumor, metastases, or benign) with sensitivity and specificity of at least 0.80 and 0.95.

Development of dual-mode hyperspectral/fluorescence lifetime imaging system

V.V. Shupletsov, I.A. Goryunov, E.V. Potapova, V.V. Dremin; Research & Development Center of Biomedical Photonics, Orel State University, Russia

This paper presents a microscopic diagnostic system that combines hyperspectral and frequency domain fluorescence lifetime imaging to record the content of chromophores and high-speed changes in cell and tissue metabolism. The efficiency of the system was tested on liver tumor slices of a laboratory mouse.

Determination of gold concentration in colloids by UV-vis spectroscopy: universality for various nanoparticles and clusters *(Invited paper)*

N.G. Khlebtsov, Institute of Biochemistry and Physiology of Plants and Microorganisms, Saratov Scientific Centre RAS (IBPPM RAS), Saratov State University, Russia

The UV-vis extinction method universality is demonstrated with six experimental and theoretical Au models: nanospheres, nanosphere clusters, nanorods, 2D nanotriangles and nanoplates, and 3D nanostars. In total, 34 samples with different nanoparticle sizes, shapes, morphology, and Au concentrations were fabricated and the content of chromophores and high-speed changes in cell and tissue metabolism was recorded. The sensitivity of the method and resolution limit were found to be comparable to the sensitivity and resolution of the frustrated total internal reflection method.

Plasmon-enhanced chemiluminescence of lucigenin due to interaction with colloidal gold nanoparticles

D.V. Kononov, A.V. Palehova, A.V. Kochakov, A.V. Afanasieva, T.A. Vartanyan, D.R. Dadadzhanov; ITMO University, Russia

Chemiluminescence enhancement of lucigenin in the vicinity of colloidal gold nanoparticles was studied. The chemiluminescence intensity was found to increase twice independent of the nanoparticle's concentration in the range of 10-4 to 10-8 M.

TuSYC-04 10:15-10:30

Optical express biopsy of lymph nodes with time-resolved fluorescence macroimaging

A.M. Mozherov, A.A. Plekhanov, P.A. Kochetkova, D.S. Myalk, A.Yu. Vorontsov, B.P. Yakimov, A. Gayer, E.A. Shirshin, S.V. Gamayunov, V.I. Shcheslavsky; Privolzhsky Research Medical Univ.; Nizhny Novgorod Regional Oncologic Hospital; Lobachevsky State Univ.; Lomonosov Moscow State Univ., Russia

We present a simple and fast approach to perform lymph nodes biopsy in a clinical setting using fluorescence time-resolved macroimaging. Histologic analysis is used as the reference standard. We demonstrate that the obtained data allow us to differentiate healthy and metastatic lymph nodes.

- Coffee Break -
Targeted PLGA nanoparticles as versatile platform for the delivery of oncotherapeutic compounds (Invited paper)
V.O. Shipunova1,2, E.N. Komedchikova2, A.V. Pushkarov1, M.A. Yurchenko1, D.A. Maedi1, A.M. Skirda1, M.P. Nikitin1,2, M.V. Efremova4, P.I. Makarevich5, V.A. Sarkisova6, P.I. Nikitin1,2, Prokhorov General Physics Institute RAS, Russia

In this study, we present the creation of targeted polymer nanoparticles, targasomes, which are loaded with paclitaxel for imaging and treatment of HER2-positive cancer. These synthesized nanoparticles were employed for targeted delivery to tumors and tumor growth reduction in vivo.

TuSYC-08
12:00-12:30

Genetically engineered nanocapsules with fluorescent and magnetic markers for cell tracking and targeted drug delivery (Invited paper)
A.N. Gabashvili, D.D. Namestrikova, I.L. Gubsky, S.S. Vodopyanov, M.V. Efremova, P.I. Makarevich, V.A. Sarkisova, P.I. Nikitin, Prokhorov General Physics Inst. RAS, Department of Neurology, Neurosurgery and Medical Genetics, Education, Eindhoven Univ. of Technology, Netherlands; Prokhorov General Physics Institute RAS, Russia

Currently, various functionalized nanocarrier systems are extensively studied for biomedical diagnostics and targeted drug delivery. Extending the approaches of genetic and chemical engineering novel carriers have been produced based on encapsulins, which are capsid-like protein structures, consisting of a shell and various payload inside. A range of potential applications of encapsulins have been developed.

TuSYC-09
12:30-12:45

Glutathione-loaded magnetic nanoparticles as a protective theranostic carrier in oncology
V.V. Barinova1,2, D.A. Tarasova1,2, V.S. Fedorov1,2, L.Y. Yakovleva1,2, N.M. Yudintseva1,2, D.E. Bobkov1,2, B.P. Nikolaev1,2, M.A. Shevtsov1,2, Institute of Cytology RAS, Almazov National Medical Research Centre, St. Petersburg State Institute of Technology (Technical University); Department of Inorganic Chemistry and Biophysics, St. Petersburg State University of Veterinary Medicine, Russia

Glutathione-conjugated magnetic nanoparticles were proposed as a protective drug carrier in theranostics. During the course of work, a stable conjugate was synthesized and had its physico-chemical and antioxidant properties investigated.

TuSYC-10
12:45-13:00

Low-dimensional magnetic structures as sensing nanoprobes for advanced bioapplications (Invited paper)
A.V. Orlov, Prokhorov General Physics Institute RAS, Russia

This research explores the potential of one- and two-dimensional magnetic nanomaterials in biobased applications. Here, innovative methods are presented for advanced sensing, including ultrafast biomarker detection, electronic and optical quantification of anisotropic magnetic nanostructures, and simultaneous determination of various materials in a single sample. These methods hold the promise of faster targeting, advanced diagnostics, and new optical and magnetic bioimaging.
TuSYC-14 16:00-16:15

Ensemble methods for analyzing Raman spectra of macromolecular complexes with a small amount of additives
O.A. Mayorova, M.S. Saveleva, D.N. Bratashov, E.S. Prikhozhdenko; Science Medical Center, Saratov State University, Russia

Combining Raman spectroscopy and machine learning is a great way to study the chemical structure of macromolecules and their complexes. Random forest and gradient boosting approaches were implemented in solving regression and classification problems in analysis of WPI:HA Raman spectra with low HA amount. Feature importance obtained could highlight the Raman bands that differ the most among the samples.

TuSYC-15 16:15-16:30

Strategies for miRNA delivery to stimulate liver regeneration: nanocarriers and metabolic imaging
S. Rodimova¹, D. Kozlov¹, D. Krylov¹,², A. Mozherov¹, V. Elagin¹, L. Mikhailova¹, M. Zyuzin¹, D. Kuznetsova¹; ¹Privolzhsky Research Medical University; ²National Research Lobachevsky State University; ³ITMO University, Russia

We present a new strategy to develop a controlled method to stimulate liver regeneration. The method is based on the use of nanocarriers with microRNAs. Nanoparticle-based complexes represent a tool not only for therapy, but also for visualizing the distribution of the therapeutic agent.
TuSYA-p01 15:00-18:30
IR spectroscopy for hematology
L.V. Plotnikova1, A.D. Garfullin1,2, A.Y. Kuvshinov3, S.V. Veloshin1,4, R.V. Butyaev4, A.D. Kartashova1, A.M. Polyanchiko1,2, 1 St. Petersburg State University, 2 Russian Research Institute of Hematology and Transfusiology, 3 Russian Academy, 4 Mechnikov Northwestern State Medical University, Russia
Currently, there is an increase in the number of oncohematological diseases. Simple and reliable screening methods are required for their effective diagnosis. One of the promising and rapidly developing approaches is IR spectroscopy of various samples of biomaterials.

TuSYA-p02 15:00-18:30
Fiber pyrometer based on AgCl.25Br.75-Agl fiber for measuring temperature in hard-to-reach places
A.E. Urov, A.A. Yuzhakova, D.D. Salimgareev, P.V. Pestereva, A.S. Konsakov, L.V. Zhukova; Ural Federal University, Russia
The work is devoted to the manufacture of a fiber pyrometer based on AgCl0.25Br0.75 – AgI fibers and using it to measure the temperature of objects in the range of 36-50 °C.

TuSYA-p03 15:00-18:30
Studying thermal effects of infrared femtosecond laser pulses applied for laser assisted harvesting procedure on mouse embryos
D.S. Sitnikov, M.A. Filatov, M.V. Kubekina, Y.Y. Sileva; JIHT RAS; Core Facility Centre; IGB RAS, Russia
Infrared femtosecond laser pulses are used for microsurgery of zona pelucida of mouse embryos at late stages of preimplantation development. Safety of the procedure is studied through embryo viability and heat shock proteins (HSP) gene expression assessment methods. Expression levels of the genes encoding HSPs were shown to increase slightly compared to the negative control group.

TuSYB-p01 15:00-18:30
The effect of optical clearing agents on the results obtained with the digital nailfold capillaroscopy
P.A. Moldon, A.E. Lugovtsov, P.B. Ermolinskii, Y.I. Gurfinkel, A.V. Priezhev; Lomonosov Moscow State University, Russia
In this work the influence of optical clearing agents (OCA) on the blood flow in nailfold capillaries was studied. It was shown that parameters obtained by nailfold capillaroscopy technique depend on OCAs used for visualization of capillaries.

TuSYB-p02 15:00-18:30
Two approaches to estimate the depth of light penetration into biotissues
A.P. Tarasov1,2, D.A. Rogatkin1,2; Moscow Regional Research and Clinical Institute (MORNI), 1National Research Centre ’Kurchatov Institute’, Russia
The work compares two approaches to evaluate the depth, based, respectively, on the exponential decay, and on the estimation of a volume, where 95% of absorbed light is accumulated. It is shown that the approach, which uses the conventional exponential decay, underestimates the penetration depth in more than 2 times.
TuSYB-p04 15:00-18:30
Validation and comparative analysis of off-axis digital holographic microscopy and SLIM for biological applications
I.V. Semenova1, A.V. Belashov1, A.A. Zhikhoreva1, M.V. Belashov2, P.S. Butorin1; "Ioffe Inst., "ITMO Univ., Russia
The paper presents analysis of the performance of two quantitative phase imaging methods implemented on the model object of polystyrene beads dissolved in water. Phase images obtained using two realizations of SLIM technique and off-axis digital holographic microscopy were compared with the expected phase shift image from spherical transparent phase objects.

TuSYB-p05 15:00-18:30
Fast Spectroscopic Technique of Optical Biopsy of Intracranial Tumors
I.D. Romanishkin1, T.A. Savelieva1, A. Ospanov1, S.V. Shugai1, S.A. Goryaynov1, G.V. Pavlova2,3, I.N. Pronin1, V.B. Loschenov1,2; "Prokhorov General Physics Institute RAS, "National Research Nuclear University MEPhI, "N.N. Burdenko National Medical Research Center of Neurosurgery, "Institute of Higher Nervous Activity and Neurophysiology RAS, Russia
The possibility of differentiation of glial and meningeal tumors on the basis of the proposed method of optical-spectral analysis was shown. For non-fluorescing tumors, the most significant indicators were the intensity of elastic light scattering, carotenoid content, and the change in lipid/protein ratio.

TuSYB-p06 15:00-18:30
Advanced optoacoustic imaging capabilities using piezopolymer detectors: increased sensitivity, wide reception bandwidth, high numerical aperture
A.A. Kurnikov1, A.G. Sanin1, G.P. Volkov1, A.V. Orlova1, A.V. Kovalchuk1, D. Razansky2, P.V. Subochev2; "Inst. of Applied Physics RAS, Russia, "ETH Zurich, Switzerland
Optoacoustic (OA) angiography is a non-invasive imaging technique that involves probing tissue with laser pulses and recording ultrasound signals. This study focuses on analyzing the sensitivity, reception bandwidth, and numerical aperture of piezoelectric transducers used for ultrasound detection. Through numerical simulations and experiments, the effectiveness of piezopolymer detectors in providing detailed OA visualization of complex vascular networks has been demonstrated.

TuSYB-p07 15:00-18:30
Monte Carlo modeling of the red blood cell aggregation in photoplethysmography
D.G. Lapitan, A.P. Tarasov; Moscow Regional Research and Clinical Institute ("MONIKI"), Russia
The effect of red blood cell (RBC) aggregation on the photoplethysmography (PPG) signal at a wavelength of 810 nm was investigated using the Monte Carlo method. It was found that the main contribution to the formation of the PPG signal is made by scattering variations due to changes in the rouleaux size (84% versus 16% absorption, respectively).

TuSYB-p08 15:00-18:30
OCT monitoring of scattering kinetics in tissue phantoms at optical clearing with depth resolution
I.A. Serebryakova1,2, Y.I. Surkov1,2, E.A. Genina1,2, V.V. Tuchin1,2,3,4; "Optics and Biophotonics Department, Saratov State University, "Laboratory of Laser Diagnostics of Technical and Living Systems, Institute of Precision Mechanics and Control RAS, Russia
A method for reconstructing and monitoring the scattering coefficient with a depth resolution of homogeneous samples with optical clearing of the sample has been developed and tested on a gelatin phantom. The proposed method makes it possible to track changes in the scattering coefficient at different depths.

TuSYB-p09 15:00-18:30
Channel shape inside sapphire capillary needles and its impact on transmitted laser beam
I.A. Shikunova, D.O. Strukov, Yu.N. Zubareva, I.N. Dolganova, V.N. Kurov, Osipyan Institute of Solid State Physics RAS, Russia
In sapphire needle capillaries, we analyze the form of the internal channel and the needle tip and their influence on the shape of the outgoing beam. We propose some methods of alteration of the capillary shape via growth conditions that contribute to obtaining the required geometry.

TuSYB-p10 15:00-18:30
Development of optical modules to existing laboratory devices for biomarker detection in vivo
M.A. Makhortov1, O.V. Grishin1, S.A. Perkov1, O.I. Gusliakova2,3, D.N. Bratashov1, E.S. Prikozhdenko1; "Science Medical Center, Saratov State University, "Photonics Center, Skolkovo Institute of Science and Technology, "Vladimir Zelman Center for Neurobiology and Brain Rehabilitation, Skolkovo Institute of Science and Technology, Russia
Usually, existing laboratory devices for conducting in vitro studies require modification to carry out in vivo measurements. We have developed the fiber probe connected to Raman spectrometer Renishaw inVia and the external optical circuit for in vivo photoacoustics cytometer which allows measuring photoacoustics signal of biological fluids either in laboratory tubes, or in vivo in laboratory animals.

TuSYB-p11 15:00-18:30
129Xe nuclear spin laser hyperpolarizer
V.M. Vodovozov, R.F. Kurnov, A.V. Pavlenko, V.M. Baev, M.V. Kuleshov, V.A. Chemichev, V.V. Eremkin, A.A. Baturina; JSC "NIEFA", Russia
The experimental model of the 129Xe laser hyperpolarizer for MRI diagnostics of human organs inaccessible for examination by classical proton tomography is presented. Spin Exchange Optical Pumping (SEOP) is used to develop the hyperpolarized state of 129Xe. A polarization level of 40% has been achieved with a gas capacity of ~1.2 l/hour.

TuSYB-p12 15:00-18:30
Mathematical simulation of uniform heating of biological tissues by laser radiation
K.V. Sovin1, N.V. Kovalenko1, V.S. Anpilov1, V.P. Surovtseva1, O.A. Rabyushkin1,2; "Moscow Inst. of Physics and Technology (National Research University), "Frazino branch of Kotel'nikov Inst. of Radio-Engineering and Electronics, Russia
The description of thermal damage to biological tissues is based on the Arrhenius formalism. Measurements of Arrenius parameters are conducted under the assumption of homogeneously degraded samples. We simulated the degradation processes under conditions of heating with air, water and optical radiation. Optical heating demonstrated high accuracy in the retrieving degradation kinetics parameters at different sample thicknesses and degradation times.
Microcirculatory-tissue systems of the human body as an object of study in space research (Invited paper)
A.V. Dunaev, Orel State University, Russia
This paper presents the results of the study of changes in microcirculatory-tissue systems under spaceflight and isolation experiment conditions. For the first time, a technique has been developed for measuring microcirculatory-tissue systems in the limbs of cosmonauts during the period of acute adaptation to microgravity conditions and readaptation after the completion of a spaceflight.

The problem of data reproducibility in laser diffractionometry of erythrocytes (Invited paper)
S.Yu. Nikitin; Physics Faculty of Lomonosov Moscow State University, Russia
Two algorithms for measuring the red blood cell mean radius and red blood cell distribution width (RDW) are proposed, based on the analysis of the diffraction pattern that occurs when a laser beam is scattered on a blood smear.

Experimental comparison of imaging photoplethysmography and laser speckle contrast imaging for blood flow assessment (Invited paper)
A.A. Kamshilin; Institute of Automation and Control Processes FEB RAS, Russia
In this work, responses of cortical vessels to administration of a metabolic agent were measured in rats using contactless imaging photoplethysmography and laser speckle contrast imaging systems providing full-field of view visualization of blood flow. It was found that blood-flow changes detected by two systems are significantly different due to different nature of light interaction with tissues underlying these methods.

Optically measured blood microcirculation parameters and their correlation with endothelium function in healthy volunteers and patients suffering from cardiovascular diseases
A.V. Priezzhev, P.B. Ermolinskiy, Yu.I. Gurfinkev, E. Sovetnikov, A.E. Lugovtsov, Lomonosov Moscow State University, Russia
The objective of this work was to examine and compare the microcirculation in healthy volunteers and two groups of patients suffering from cardiovascular diseases, specifically coronary heart disease (CHD) and atrial fibrillation (AF).

Imaging of microcirculation enhanced with optical clearing agents and evaluation of their effect on blood micro rheology
A.E. Lugovtsov,1 P.B. Ermolinskiy,1 P.A. Maldon1, D.A. Umerenkov1, Yu.I. Gurfinkev1, P.A. Timoshina1, Pengcheng Li1, A.V. Priezzhev1, Lomonosov Moscow State University, Russia; 1 Saratov State University, Russia; 2 Huazhong University of Science and Technology, China
The efficiency of 15 optical clearing agents (OCAs) that are widely used for enhancement of imaging of tissues was investigated. We show a significant impact on elevating the transparency and improving the visualization of the nail bed capillaries. A significant effect of OCAs on micro rheological parameters of blood was shown.

Optical measurements in vitro and in vivo of erythrocyte aggregation parameters in patients with different pathologies (Invited paper)
P.B. Ermolinskiy1, M.K. Maksimov1, D.A. Umerenkov1, Yu.I. Gurfinkev1, L.I. Dychuk2, A.E. Lugovtsov1, A.V. Priezzhev1, Department of Physics, Lomonosov Moscow State University, Russia; 1 Medical Research and Education Center, Lomonosov Moscow State University, Russia; 2 Saratov State University, Russia
Blood micro rheological parameters are essential for understanding blood microcirculation. In this study, we applied different laser-optical techniques to measure aggregation parameters in blood samples from healthy donors and patients suffering from cardiovascular diseases. We identified significant differences in aggregation parameters between groups, demonstrating the effectiveness of these methods for assessing erythrocyte aggregation both in vivo and in vitro.

Intraoperative assessment of blood flow during esophageal resection using fluorescence diagnostics and diffuse scattering spectroscopy
A.A. Kivetskaya, D.M. Kustov1, V.V. Levkin1, S.V. Osminin1, S.S. Kharna1, E.V. Eventeva1, F.P. Vetsev1, N.N. Komarov1, A.S. Gorbunov1, K.G. Linkov1, T.A. Savelieva1, V.B. Loschenov1, 2 Prokhorov General Physics Institute RAS; 1 Institute of Engineering Physics for Biomedicine, National Research Nuclear University MEPhI, 2 Department of Surgery No.1, I.M. Sechenov First Moscow State Medical University, Russia
The assessment of tissue blood supply during surgery can reduce the risk of postoperative complications. This work proposes the use of fluorescence diagnostics and diffuse scattering spectroscopy for the accomplishment of the desired aim.

Cerebral blood flow dynamics in rats with blood loss
N.V. Golubova1, I.A. Ryzhkov1, K.N. Lapin1, V.N. Prizemin1, A.V. Dunaev1, V.V. Dremin1, E.V. Potapova1, Research & Development Center of Biomedical Photonics, Orel State University, Russia; 1 Federal Research and Clinical Center of Intensive Care Medicine and Reabilitology, Russia
This paper presents the results of investigating the blood flow dynamics using the laser speckle contrast imaging method in rats with blood loss and without it. The results indicate that under such conditions, there was no significant decrease in speckle perfusion values.
Wearable multimodal analyzers in the microcirculatory-tissue systems monitoring during different sleep stages
Y.I. Loktionova1, E.V. Zharkikh1, D.F. Kleeva2, V.S. Yanushin3, V.V. Sidorov4, A.I. Krupatkin5, A.V. Dunaev1; 1 Research & Development Center of Biomedical Photonics, Orel State University; 2 National Research University Higher School of Economics; 3 SPE “LAZMA” Ltd.; 4 Priorov Central Research Institute of Traumatology and Orthopedics, Russia
This paper presents the first results of the study of changes in microcirculatory-tissue systems functioning during different sleep stages. Wearable multimodal devices were used to monitor the microcirculatory-tissue systems during night sleep simultaneously with electroencephalography to separate the sleep stages.

Revolutionizing vascular diagnostics: the role of wideband ultrasound detectors in optoacoustic visualization technologies (Invited paper)
P.V. Subochev; Institute of Applied Physics RAS, Russia
This presentation explores the transformative impact of wideband ultrasound detectors in optoacoustic angiography, combining optical imaging’s molecular specificity with ultrasound’s depth. We’ll discuss advancements in piezopolymer detector design and the potential of these detectors in enhancing image quality, resolution, and real-time diagnostic capabilities in biomedical optoacoustic imaging.

Photoacoustic technologies for visualizing tumors and searching for foreign objects in the blood stream (Invited paper)
D.N. Bratashov, N.A. Shushunova, M.A. Makhortov, E.S. Prikhozhdenko; Saratov State University, Russia
Development of tumors at different stages in an animal model with engrafted tumors and study the number of circulating tumor cells produced by the tumors was investigated. The in vivo photoacoustic flow cytometry setup was developed for second task. It can work with the blood flow in a large vessel of an animal or the human body.

In vivo applications of raster-scan optoacoustic angiography (Invited paper)
A.G. Orlova1, K.G. Akhmedzhanova2, A.A. Kurnikov1, A.M. Glyavina2; D.A. Khochenkov3, Yu.A. Khochenkova3, A.V. Maslennikova2, S.V. Nemirova2, I.V. Turchin1, P.V. Subochev1; A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia; N.I. Lobachevsky State University of Nizhny Novgorod; N.N. Blokhin National Medical Research Center of Oncology; Privolzhsky Research Medical University, Russia
Vascular network of human and animal tissues was studied using raster-scan system with 532 nm laser source and wideband PVDF detector. Experimental tumors of different origin were compared. Changes in vascularity of tumors after radiation therapy were demonstrated. For patients with post-thrombotic syndrome changes in blood volume, vessel diameter and tortuosity were revealed.

Multispectral fluorescence lifetime imaging microscopy of endogenous fluorophores at a single excitation wavelength (Invited paper)
B. Yakimov2, A. Komarova1, E. Nikonova1, A. Mozherov1, L. Shimolina1, M. Shirmanova1, W. Becker1, E. Shirshin1, V. Shcheslavska1, 2; Sechenov First Moscow State Medical University, Russia; Lomonosov Moscow State University, Russia; Privolzhsky Research Medical University, Russia; Becker&Hickl GmbH, Germany
We present experiments on multi-wavelength fluorescence lifetime imaging microscopy of NAD(P)H and flavins at a single wavelength of 750 nm. We show the advantages and limitations of using single photon counting spectral detectors for metabolic imaging of cells and tumor spheroids.

Time-resolved fluorescence microscopy of QDs in investigations of endolysosome acidification (Invited paper)
E.S. Kornilova1,2, I.K. Litvinov1, A.V. Salova1, T.N. Belyaeva1; Institute of Cytology RAS, Russia; Peter the Great St. Petersburg Polytechnic Univ., St. Petersburg State Univ., Russia
Endolysosome acidification was assessed by time-resolved fluorescence microscopy (FLIM) using quantum dots targeted by EGF (EGF-QDs). It has been shown that the interpretation of the results of changes in the QD lifetime using the proton pump inhibitor BafA1 depends on the method of its administration. Also, some additional factors in endolysosomes can affect lifetime of QDs besides pH.
Targeted magnetic nanoparticles for cancer diagnosis and treatment

O.A. Kolesnikova1, E.N. Komedchikova1, O.A. Goryacheva2, A.M. Yurchenko1, D.A. Maedi1, A.M. Skirda1,2, O.V. Shipunova1,2, V.O. Shipunova1,2, V.I. Shcheslavskiy1; 1Privolzhsky Research Institute of Organic Synthesis and Technology, Saratov State University, Saratov, Russia

Multifunctional hybrid nanoparticles as vectors for regulating the expression of target genes

P.I. Nikitin1, A.M. Skirda2,3; 1Prokhorov General Physics Institute RAS, Moscow, Russia; 2Moscow Institute of Physics and Technology, Moscow, Russia; 3Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry RAS, Moscow, Russia

Chiral carbon dots (CDs) are promising nanoparticles for sensing and biosensing. In this study, we compared the biodistribution of PLGA nanoparticles after intravenous or intraperitoneal injections – two commonly used administration routes.

In this work, two new Ir(III) complexes were synthesized. All complexes exhibit efficient phosphorescence with pronounced sensitivity to the presence of oxygen. For the most promising complex the phosphorescence lifetime imaging experiments were conducted, revealing that this sensor markedly changes the phosphorescence lifetime values in cells from 1.8 to 4.1 μs upon transition from normoxia to simulated hypoxia.

Luminescent nanoparticles and nanoclusters represent a promising tool for imaging and bioanalysis. The sophisticated design of nanoparticles allows them to be used as active and passive labels to detect the presence of various compounds. The potential of nanoparticles to alter the optical signal in response to the presence of analytes and their analytical applications are discussed.

In this study, we compared the biodistribution of PLGA nanoparticles 4h after intravenous or intraperitoneal injections – two commonly used administration routes.

Over the past few years, nanomaterials have garnered considerable attention, in particular, targeted nanofluidic processes due to their high specificity of delivery to molecular targets and reduced systemic toxicity for the organism. Here we report the study of the cellular delivery of targeted fluorescent magnetic nanoparticles to human epidermal growth factor receptor 2, clinically significant oncogene.

The potential for controlled intracellular applications.

Green and red emissive N, O-doped chiral carbon dots functionalized with L-cysteine

A.A. Vedomikov1, S.A. Shipilovskikh2, E.V. Ushakova3, I.T. International Research and Education Center for Physics of Nanostructures, ITMO University,้าง, School of Physics and Engineering, ITMO University, Russia

Chiral carbon dots (CDs) are promising nanoparticles for sensing and biosensing. In this study, we compared the biodistribution of PLGA nanoparticles 4h after intravenous or intraperitoneal injections – two commonly used administration routes.

Multifunctional hybrid nanoparticles have been developed for gene therapy and addresses the need for carriers of minimal cytotoxicity. The obtained nanoparticles exhibit optical and superparamagnetic properties, biomolecule binding, form stable complexes with therapeutic nucleic acids, and can serve as carriers for gene regulation. They demonstrate high efficiency in targeted siRNA delivery and offer biocompatibility and potential for controlled intracellular applications.

- Coffee Break -
Rigidochromic porphyrazine dyes: smart molecules for sensing and cancer treatment (Invited paper)
I.V. Balalaeva1, N.N. Peskova1, L.N. Shestakova1, N.Yu. Shilyagina2, V.I. Plekhanov2, S.A. Lermontova1, L.G. Klapshina1; 1 Lobachevsky State Univ. of Nizhny Novgorod, Russia; 2 Gaponov-Grekhov Inst. of Applied Physics RAS, Russia

WeSYC-28 15:00-15:30

Polymer optic fiber photoluminescent probe for cortisol continuous monitoring with metal-enhanced displacement fluoroiimmunoassay (Invited paper)
P.A. Kusov, Yu.V. Kotelevtsev, V.P. Drachev, Skolkovo Institute of Science and Technology, Russia

WeSYC-29 15:30-16:00

Detection and analysis of protein compounds based on Raman scattering and machine learning
E.Y. Pronkrova1, A.S. Shtumpf1, I.I. Fatkhutdinova1, G.I. Bikbaeva1, A.Y. Kokhanovskiy1, A.A. Bogdanov1, A.A. Marshina1, D.A. Zuev1; ‘Institute of Chemistry, St. Petersburg State Univ., Russia

WeSYD-01 09:00-09:40

Targeted photodynamic therapy treatment on colorectal tumour spheroids (Keynote presentation)
H. Abrahamse, N.W.N. Simelane; Laser Research Centre, Faculty of Health Sciences, University of Johannesburg, South Africa

WeSYD-02 09:40-10:00

Photosensitization of singlet molecular oxygen by bacterial C40 carotenoids
A.A. Krasovsky Jr., A.S. Bendiktin, A.A. Ashikhmin, A.A. Moskalenko, I.A.N. Bach Institute of Biochemistry, Federal Research Center of Biotechnology RAS; Pushchino Scientific Center for Biological Research RAS, Institute of Basic Biological Problems RAS, Russia

WeSYD-03 10:00-10:15

Sub-nanosecond excited state relaxation in FAD bound with bacterial diaphorase
I.A. Gorbunova, D.A. Volkov, D.Y. Yashkov, M.E. Sasin, O.S. Vasyutinskii; Ioffe Institute, Russia

WeSYD-04 10:15-10:30

ALPcS Cl is effective against Squamous cell carcinomas
A. Crous; Laser Research Centre, University of Johannesburg, South Africa

WeSYD-05 10:30-10:45

Logic-gate-controlled density of antibody binding sites on sensing surface for immunoassays with improved analytical performance
N.A. Belyakov1, D.O. Novichikhin1, B.G. Gorshkov1; ‘Prokhorov General Physics Institute RAS, ‘National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia

WeSYD-06 10:45-11:00

Proteins are integral to cellular function within the human body. However, conventional techniques such as immunoassay and chromatography may not always provide accurate results in detecting biological compounds. This study proposes the utilization of Raman spectroscopy for the identification of individual amino acids and protein compounds, followed by machine learning-based quantitative and qualitative analysis of the acquired data.

WeSYC-32 16:15-16:30

Targeted photodynamic therapy treatment on colorectal cancer. Our findings highlight the synthesis and characterization properties of molecular rotors and photodynamic agents. The fluorescence lifetime and quantum yield of these compounds are highly dependent on local viscosity, so they can be used as sensors of intracellular viscosity. The rigidochromic behaviour of the compounds provides a tool to quantify cell damage in real time during photodynamic cancer treatment.

WeSYC-30 16:00-16:15

A time-resolved measurement of photosensitized luminescence of singlet oxygen (SO) has been applied to studies of SO generation and quenching by C40 carotenoids (phyttoene, zeta-carotene, neurosporene, lycopene, rhodopin and spirilloxanthin) having (5-13) conjugated double bonds (CBD) in their molecules. It was found that these carotenoids combine the property of strong SO quenching with an ability of SO generation upon photoexcitation.

WeSYC-31 16:00-16:15

Logic-gate-controlled density of antibody binding sites on sensing surface for immunoassays with improved analytical performance
N.A. Belyakov1, D.O. Novichikhin1, B.G. Gorshkov1; ‘Prokhorov General Physics Institute RAS, ‘National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia

Session Chair:

WeSYC-30 16:00-16:15

Sub-nanosecond excited state relaxation in FAD bound with bacterial diaphorase
I.A. Gorbunova, D.A. Volkov, D.Y. Yashkov, M.E. Sasin, O.S. Vasyutinskii; Ioffe Institute, Russia

WeSYD-03 10:00-10:15

WeSYD-04 10:15-10:30

A time-resolved measurement of photosensitized luminescence of singlet oxygen (SO) has been applied to studies of SO generation and quenching by C40 carotenoids (phyttoene, zeta-carotene, neurosporene, lycopene, rhodopin and spirilloxanthin) having (5-13) conjugated double bonds (CBD) in their molecules. It was found that these carotenoids combine the property of strong SO quenching with an ability of SO generation upon photoexcitation.

WeSYC-31 16:00-16:15

Logic-gate-controlled density of antibody binding sites on sensing surface for immunoassays with improved analytical performance
N.A. Belyakov1, D.O. Novichikhin1, B.G. Gorshkov1; ‘Prokhorov General Physics Institute RAS, ‘National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia

WeSYC-32 16:15-16:30
Spectroscopic intraoperative diagnostics of tumors during photodynamic therapy (Invited paper)

K.T. Efendiev1,2, P.M. Alekseeva1, A.A. Shiryaev1, T.N. Pisareva1, V.B. Loschenov1,2; 1 Prokhorov General Physics Institute RAS; 2 National Research Nuclear University "MEPhI"; 3 Sechenov First Moscow State Medical University, Russia

Methods of intraoperative diagnostics of tumors in the process of photodynamic therapy have been developed, which include the use of a single light source for fluorescence diagnostics and photodynamic therapy. The obtained results demonstrate the possibility of tumor phototheranostics with simultaneous monitoring of photosensitizer photobleaching, blood oxygen level and the state of the vascular system of irradiated tumor tissues.

- Coffee Break -

Synthesis of core-shell ternary quantum dots - porphyrin conjugates and its photodynamic therapy application

O.S. Oluwafemi; Department of Chemical Sciences (formerly Applied Chemistry), University of Johannesburg; Centre for Nanomaterials Science Research, University of Johannesburg, South Africa

In this presentation, a large-scale aqueous synthesis of ternary quantum dots (QDs) and its conjugation to porphyrin as an efficient way to overcome photosensitizer shortcomings will be discussed. The singlet oxygen generation of this highly aqueous soluble novel conjugate and its cell viability against different cancer cell lines, which shows its potential for PDT applications, will be discussed.

Impacts of quantum dots in photodynamic processes (Invited paper)

A.O. Orlova; ITMO University, Russia

Luminescent quantum dots (QDs) and their composites are currently being widely studied as generators of reactive oxygen species (ROS). Binary and ternary QDs with different chemical compositions have been shown to be efficient energy or charge donors in QD-based composites. A method to enhance the energy or charge transfer efficiency because of photoinduced modification of the QD surface is proposed.

Cannabidiol enhances photodynamic therapy effects on breast cancer cells (Invited paper)

B.P. George, D.R. Mokoena, H. Abrahamse; Laser Research Centre, Faculty of Health Sciences, University of Johannesburg, South Africa

Cannabidiol (CBD) is a derivative of Cannabis sativa with several therapeutic applications. In this study, hypericin photosensitizer was adsorbed on gold nanoparticles. CBD was utilized to treat MCF-7 breast cancer cells, followed by in vitro photodynamic combination therapy. This study proposes that the CBD and PDT combination is effective in killing breast cancer cells in vitro by inducing apoptosis.

Mechanisms of the photodynamic effect with polycationic photosensitizers on the foci of bacterial and oncological diseases (Invited paper)

G.A. Meerovich1,2, E.V. Akhlyustina1, E.A. Makarova1, E.A. Kogan1, S.Sh. Karshieva4, I.D. Romanishkin1, I.G. Tiganova1, Yu.M. Romanova1, Zhi-Long Chen8, V.B. Loschenov1,2, I.V. Reshetov1, Prokhorov General Physics Institute RAS; 2 National Research Nuclear University MEPhI; 3 Organic Intermediates and Dyes Institute; 4 T.E. Sechenov First Moscow State Medical University; 5 National University of Science and Technology MISIS; 6 N.N. Blokhin National Medical Research Center of Oncology; 7 Gamaleya National Research Centre for Epidemiology and Microbiology, Russia; 8 Huadong Hospital, Fudan University, China

This work presents the results of studies of the features, mechanisms and effectiveness of the photodynamic effect of PS based on polycationic derivatives of long-wave phthalocyanines and synthetic bacteriochlorin on bacteria, bacterial biofilms, tumor cells and experimental animal tumor model.
Intraoperative fluorescent imaging of peripheral pulmonary nodules *(Invited paper)*
A. Akopov, G. Papayan, D. Fedotova, A. Gerasin; Pavlov First St. Petersburg State Medical Univ., Russia

This presentation is devoted to the discussion of various aspects of the intraoperative fluorescent imaging of lung cancer. The current situation based on the use of indocyanine green, the issues of using new targeted drugs are examined, as well as the possibility of increasing the depth of probing and combining with related treatment methods.

Robot-assisted photodynamic therapy *(Invited paper)*
T.G. Grishacheva¹, A.S. Vasiliev², A.V. Grabovskiy³, S.A. Nikitin³, V.V. Kharlamov³, N.N. Potrashov⁴, A.D. Obornev⁴, N.N. Petrishchev⁵; *Laser Medicine Center, Pavlov First St. Petersburg State Medical University;* *LLC Renomed;* °LLC Medical Robotics; °Department of Electronic Instruments and Devices, St. Petersburg Electrotechnical University «LETI»; °Department of Thoracic Surgery, St. Petersburg State Research Institute of Phthisiopulmonology, Russia

Medical robot assisted fluorescence diagnostics (FD) and photodynamic therapy (PDT) of malignant lesions of external localizations, as well as intraoperative PDT is presented. This technique provides accuracy and uniformity of laser radiation distribution on the object and safety of treatment protocol.

Clinical and immunologic results of photodynamic therapy for HPV-associated cervical diseases
M.S. Afanasiev¹, A.D. Ruskin², T.G. Grishacheva¹, O. Svitich³, P. Kukina³, A. Avagyan⁴, E. Biryukova¹, A. Khangeldie⁵, A. Karaulov¹; °Sechenov University, Clinical Immunology and Allergology; °Moscow City Oncology Hospital No62; °Pavlov First State Medical University; °Mechnikov Research Institute of Vaccines and Sera, Russia; °NJSF “Astana Medical University”, Kazakhstan

Chlorine E6 photodynamic therapy (PDT) was used to treat 183 patients with HPV-related cervical diseases. The main of this study was to characterize the local immune response during treatment with PDT in patients with persistent HPV infection, LSI, HSIL and cervical cancer. PDT is able to stimulate antiviral innate immune response, being important to treatment effectiveness.

- Coffee Break -
On-chip multisensor array based on phosphorylated graphene for the alcohol selective detection

V.S. Gabrielli1, N.S. Struchkov2, M.A. Solomatin3, S.D. Saveliev4, S.A. Ryzhkov-5, P.D. Chevriakov1, A.S. Varezhnikov1, S.I. Pavlov1, D.A. Kirilenko1, V.V. Sysoev6, M.K. Rabchinski4, 1Ioffe Institute, National Research University of Electronic Technology, 2Yuri Gagarin State Technical University of Saratov, Russia

Herein, we consider the fabrication and gas-sensing properties of On-chip multisensor arrays based on a phosphorylated graphene (Gr-P) film with a gradually changed thickness. Selective detection of the alcohols, from methanol to butanol, mixed with air to match permissible exposure OSHA limits is demonstrated for the chip operating at room temperature.

Dynamic of the absorption spectra of biological active substances of Tagetes flowers extract in visible wavelength region

E.S. Zemlyakova1, A.V. Tsibulnikova1, I.G. Samusev1, V.V. Burykanov1, D.A. Skorov2, 1Institute of Optics and Quantum Technologies, 2Kant Baltic Federal University, Kaliningrad, Russia

In this work, spectral studies of marigold flower extract have been carried out. The extraction was prepared by maceration method. The triglycerides of fatty acids were used as an extractant. The resulting extract was diluted and the absorption spectra were measured. Absorption spectra show bands in the blue wavelength range, what is caused by the presence of the carotenoids.

Enhancement of magnetic dipole emission in the presence of a spherical particle

A.D. Utyushev1, R. Gaponenko1, S. Sun1, A.A. Shcherbakov1, A. Moroz1, I. L. Rasskazov1, 1School of Physics and Engineering, ITMO University, Russia

We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.

Study of the temperature stability of the parameters of a fiber-optic resonator with preservation of polarization

K.A. Ovchinnikov1, D.G. Gilev1, V.V. Krishtop1, 1Perm Scientific-Industrial Instrument Making Company, Perm National Research Polytechnic University, Russia

The temperature dependences of FSR, FWHM, Finesse, Q-factor and sensitivity of emission quantum yield and lifetime to the variations in media acidity. The obtained hydrophilic emitters display sensitivity of emission quantum yield and lifetime to the variations in media acidity.

Laser-pumping attack on QKD sources

M. Fadeev1, A.A. Ponomova1, R. Shakirov1, V. Makarov1, 1Russian Quantum Center, Skolkovo, 2ITMO University, 3NTI Center for Quantum Communications, National University of Science and Technology MISiS, Moscow Technical University of Communications and Informatics, Russia, 4University of Science and Technology of China, China

We demonstrate a new type of attack on QKD systems based on laser pumping of a photon source. It includes injection of cw laser emission into a source at a wavelength that shorter than the system operating one. Particularly, we show that laser emission at 1310 nm induces increase in power at 1550 nm, changes in pulse energy and width.

Compact biosensor devices have been developed based on low-coherence interferometry. These devices are characterized by high energy efficiency and offer ultrasensitive real-time registration of changes in the thickness of biomolecular complexes on widely available disposable sensor chips.

Biocompatible pH sensors based on the Re(I) luminophores containing oligo(ethylene glycol) groups

K.S. Kise1, N.A. Zharkaia1, S.A. Silonov1, 1ST Petersburg State University, 2Institute of Cytology RAS, Russia

Herein we present the synthesis of the rhenium(I) systems containing the diimine ligands with pH-sensitive carboxyl functions, as well as the auxiliary phosphine ligands containing oligo(ethylene glycol) (OEG) groups which impart biocompatibility and solubility in the physiological media to the target compounds. The obtained hydrophilic emitters display sensitivity of emission quantum yield and lifetime to the variations in media acidity.

Investigation of NV center ensemble in dense carbon-13 diamond for quantum sensing

V.V. Soshenko1, O.R. Rubins1, I.S. Cojocaru1, S.V. Bolshevskii1, P.G. Vilyuzhanina1, E.A. Primak1, S.M. Drofa1, A.M. Kozodaev2, V.G. Ver6, V.N. Sorokin1, A.M. Smolyaninov1, A.A. Akimov2, 1Sensor Spin Technologies, 2Lebedev Physical Institute RAS, Russia, 3IMOMEC, Belgium, 4IMO, Hasselt University, Belgium, 5Russian Quantum Center, 6NRNU "MPEI", Moscow Institute of Physics and Technology, LLC Velman, Russia

Current work is devoted to investigation of Nitrogen-vacancy centers in diamond, doped by carbon-13 isotope (~30%). ODMR spectrum of such a diamond was analyzed with possible determination of magnetic field concentration in diamond was developed.
**Temperature stabilized microfluidic chip for plasmonic fiber biosensor**

L.I. Fakhtudinova, D.O. Gagarinova, A.F. Cherединкова, A. Kokhanovskiy, M.V. Zyzulin; School of Physics and Engineering, ITMO University, Russia

We developed a plasmonic fiber biosensor with microfluidic chip with thermostabilization. The biosensor includes a tilted fiber Bragg grating covered in gold to generate surface plasmon resonance. Temperature stability is ensured using a Peltier cell with an active PID-controller. Specific proteins are immobilized to the fiber’s surface to selectively detect biomarkers in biofluids, based on changes in refractive index.

**Laser synthesis of cobalt-based nanoparticles in gaseous media and magnetic field**

M.A. Duz, A.S. Chernikov, A.V. Kharkova, D.A. Kochuev, E.S. Oparin, D.V. Abramov, A.F. Galkin, K.S. Khorkov; Vladimir State University, Russia

This paper presents the results of laser ablation of cobalt targets in a magnetic field in argon and air. The experimental setup, processing parameters are described and the results of scanning electron microscopy are presented, which allow us to estimate the size and shape of particles.

**Laser formation of a carbon conductive network for a gesture recognition system**


The study introduces a method to create conductive network of multi-walled carbon nanotubes in a silicone elastomer for strain-sensitive sensors. Laser radiation improves sensor characteristics, reducing initial resistance by 6 times than non-irradiated sensors. This enhancement enables a touch gesture recognition system with 94% accuracy. Data is processed through a developed electronic unit.

**Interferometric studies of nanoparticle conjugates for ultrasensitive detection of zearalenone in food**

J.A. Malkerov, A.S. Rakitina, G.M. Sorokin, A.I. Nikitin, A.G. Burenin, A.M. Skirda, S.L. Zholkov, M. Prokhorov; General Physics Institute RAS, Russia

The research explores various magnetic nanoparticle types, employing low coherence interferometry to study antibody kinetics. Monoclonal antibodies against ZEA are characterized, selected and immobilized on magnetic nanoparticles. A rapid, ultrasensitive lateral flow assay for on-site ZEA detection in food is developed, showcasing determination in real contaminated samples.

**Modeling of the quantum dynamics of nitrogen-vacancy centers in the spectrum for quantum sensors**

V.V. Soshenko, L.S. Cofio, A.M. Kozodaiev, S.V. Bolshedvorski, V.N. Sorokin, A.N. Smolyaninov, A.V. Akimov, l.I. Ledeev; Physical Institute RAS, Russia

The system on the basis of which a quantum sensor can be built, must have a long coherence time, be technologically advanced in manufacturing, and have the ability to prepare and read states efficiently. The nitrogen-vacancy coloring center (NV center) in diamond possesses all these properties. In addition, NV center-based sensors can operate at room temperature.
WeSYC-p23 15:00-18:30

Fluorescently controlled investigation of super-enhancers with CRISPR interference and CRISPR prime editing systems

N.N. Orlova1, M.G. Gladkova1, G.A. Ashniev1, A.V. Orlov1

1 Prokhorov General Physics Institute RAS; 1 Faculty of Bioengineering and Bioinformatics, Lomonosov Moscow State University, Russia

In the evolving landscape of genomic research, our study delves into the intricate exploration of super-enhancers, pivotal and controversial elements exerting profound influence over gene expression. Utilizing CRISPR interference and CRISPR prime editing systems, our work yields promising results and opens avenues for future research to refine and expand these approaches across diverse cell types.

WeSYC-p24 15:00-18:30

Method for measuring pairwise affinity of substantially non-complementary oligonucleotides

V.I. Arkhipova1, E.S. Korenkov1, M.Sh. Makhmuryan1, M.A. Gubaidullina1, Y.P. Chebotareva1, E.N. Mochalova1,2, D.O. Novichikhin1, M.P. Nikitin1,2

1 Nanobiomedicine Division, Sirius University of Science and Technology; 2 Moscow Institute of Physics and Technology; 3 Prokhorov General Physics Institute RAS, Russia

Strand commutation based on low-affinity interactions of non-complementary nucleic acids is a unique tool for data processing through DNA. Here we demonstrate a method for measuring pairwise oligonucleotide affinity, which allows us to create accurate predictive resources. We used a range of optical techniques, including UV- and fluorescence spectroscopy, to determine the binding constant in DNA duplex of non-complementary strands.

WeSYC-p25 15:00-18:30

Biocompatible composite material for the regeneration of large tissue defects

U.E. Kurilova1,2, E.A. Gerasimenko1, I.A. Suetina1, M.V. Mezentseva1, L.I. Russu1, G.Yu. Galechyan1, A.Yu. Gerasimenko1,2; 1 World-Class Research Center “Digital Biodesign and Personalized Healthcare”, I.M. Sechenov First Moscow State Medical University, 2 Inst. of Biomedical Systems, National Research Univ. of Electronic Technology, 3 Inst. of Virology, National Research Center for Epidemiology and Microbiology Named after the Honorary Academician N.F. Gamaleya, 4 Inst. for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical Univ., Russia

This paper presents a technology for formation of biocompatible material for bone defect regeneration based on carbon nanotubes and biopolymers. Studies of the structure of the formed samples indicate the presence of the necessary characteristics. Biocompatibility studies have shown the applicability of the developed material for the regeneration of large tissue defects.
Terahertz-wave scattering in turbid biological tissues (Invited paper)

K.I. Zaytsev1, A.S. Kucheryavenko1, N.V. Chernomyrdin2, D.R. Il’enkova1,  
I.N. Dolganova1, V.V. Tuchin3,4,5, I. Prokhvorov General Physics Institute RAS;  
Institute of Solid State Physics RAS;  
Institute of Physics and Science Medical Center, Saratov State University;  
Institute of Laser Molecular Imaging and Machine Learning, Tomsk State University;  
Institute of Precision Mechanics and Control, FRC “Saratov Scientific Centre RAS”, Russia

In our research, we combine the terahertz (THz) pulsed spectroscopy, superresolution THz solid immersion microscopy with methods of the Lorentz–Mie scattering theory and radiation transfer theory to shine the light on the THz-wave – turbid tissue interactions.

ThSYB-31 09:30-10:00

Terahertz spectroscopy of blood plasma for cancer diagnosis (Invited paper)

Q. Cherkasova1, N. Nikolaev1;  
Laboratory of Terahertz Photonics, Institute of Automation and Electrometry SB RAS;  
Department of Data Acquisition and Processing Systems, Novosibirsk State Technical University;  
Laboratory of Laser Biophysics, Institute of Laser Physics SB RAS, Russia

Cancer is one of the major diseases that seriously affect human health. The early cancer diagnosis has of great significance and can be achieved by analyzing blood plasma. In the report, we will consider ways to increase the sensitivity of THz pulsed spectroscopy to cancer diagnosis.

ThSYB-32 10:00-10:30

Terahertz spectroscopy and machine learning for medical and ecological applications (Invited paper)

Yu. Kistenev, V.V. Prishepa, V. Skiba, V. Nikolaev, G. Rasponin, D. Makashev, A.K. Tretyakov, A. Borisov, LMML Laboratory, Tomsk State University, Russia

The aim of the report is to demonstrate the usefulness of machine learning methods applications in qualitative and quantitative analysis of spectral data on examples of medical diagnostics and the atmosphere state monitoring. The work was conducted with the financial support of the Ministry of Science and Higher Education of Russia (Agreement No. 075-15-2024-557 dated 04/25/2024)

ThSYB-33 10:30-10:45

Terahertz-wave scattering in tissues: tissue-mimicking scattering phantom

A.S. Kucheryavenko1, I.N. Dolganova1, N.V. Chernomyrdin2, A.A. Gavdush2, V.M. Masalov1, V.S. Nozdrin1, V.V. Tuchin3,4,5, K.I. Zaytsev1, Institute of Solid State Physics RAS;  
Prokhorov General Physics Institute RAS;  
Institute of Physics and Science Medical Center, Saratov State University;  
Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University;  
Institute of Precision Mechanics and Control, FRC “Saratov Scientific Centre RAS”, Russia

Heterogeneity of biological tissues at the terahertz-wavelength scale can result in the non-Rayleigh scattering and doubts the applicability of effective medium theory for such tissues. For this reason, a tissue mimicking scattering phantom is developed, and the effective optical properties of the proposed phantom are still determined by EMT over wide ranges of scatterers’ diameters and volume fractions.

ThSYB-34 11:30-12:00

Antibacterial photodynamic therapy. Role of endogenous Zn-coproporphyrin in the sterilization of M. tuberculosis (Invited paper)

A. Savitsky1, M.O. Shleva1, I.A. Lingle1, A.S. Apit1, A.S. Kaprelyants1;  
Federal Research Centre of Biotechnology RAS;  
Central Tuberculosis Research Institute, Russia

In the live and dormant forms of M. tuberculosis, the synthesis Zn-porphyrines significantly increased in the presence of 5-aminovaleric acid and viability of dormant Mtb reduced by more than 99.99% under illumination with 565 nm as well accumulation of active Mtb cells in lung macrophages cells give the same results. These findings create a perspective for the treatment multidrug-resistant tuberculosis.

ThSYB-35 12:00-12:30

Combined photodynamic/photothermal cancer therapy accompanied by optical clearing (Invited paper)

E.A. Genina1, A.B. Bucharskaya1, V.D. Genin2, N.A. Navolokin1, D.A. Mudrak1, G.N. Maslyakova1, B.N. Khlebtsov2, N.G. Khlebtsov1, V.V. Tuchin1,4,5;  
Institute of Solid State Physics RAS;  
Institute of Physics and Science Medical Center, Saratov State University;  
Institute of Laser Molecular Imaging and Machine Learning, Tomsk State University;  
Institute of Precision Mechanics and Control RAS, Russia

Combined technology of photodynamic therapy and laser plasmon photothermal therapy accompanied by optical clearing was developed for rats with tumor. Temperature monitoring and spectral measurements were made. Morphological studies were performed with standard and immunohistochemical methods. We observed pronounced necrotic changes in the tumor tissue. 21 days after the therapy, the tumor growth inhibition index by tumor mass was 77.4%.

ThSYB-36 12:30-13:00

Controlled photosensitizer-free singlet oxygen release for biomedical applications (Invited paper)

I.N. Makovik1, A.V. Dunae2, E.U. Rafailov1, V.V. Dremin1,2;  
Orel State University, Russia;  
Aston University, UK

Although various studies reporting the initiation of apoptosis or optimization of mitochondrial respiration by laser illumination and generation of singlet oxygen in various types of cells and tissues have been published, there is still a huge gap in knowledge and an essential need to identify the exact mechanism by which laser irradiation leads to these effects.

ThSYB-37 13:00-13:15

Laser-induced singlet oxygen stimulates bioenergetics of insulin-producing cells

L.V. Eratova, I.N. Makovik, A.Y. Vinokurov, V.V. Dremin; Research & Development Center of Biomedical Photonics, Orel State University, Russia

The paper presents the results of the study of the effect of singlet oxygen induced by 1267 nm laser exposure without the use of photosensitizers on the bioenergetics of rat insulinoma RINm5F. Differences in changes of analysed parameters of the investigated cells after laser treatment were revealed in comparison with the control group that were not exposed to laser.
ThUSB-38 13:15-13:30
Plasmonic agents for bioimaging and photothermal therapy with red and NIR lasers
E.V. Solovyeva, V.O. Svinko, A.I. Demenshin, A.N. Smimov; St. Petersburg State University, Russia
This work is addressed to the development of hybrid systems which are considered as new means of imaging and therapy of malignant neoplasms. We represent here the study of a wide range of combinations of morphologically different gold nanoparticles and various molecular probes (fluorophores or Raman reporters).

- Lunch Break -

ThUSB-39 15:00-15:30
Optical coherence elastography with osmotically-induced strains for assessing degradation of cartilage samples (Invited paper)
Y.M. Alexandrovskaya1,2, A.A. Svetovskaya, E.M. Kasianenko1,2, A.L. Matveev1, D.A. Atyakshin4, O.I. Patsap4, M.A. Ignatiuk4, A.V. Volodkin2, V.Y. Zaitsev2, A.V. Zamanov1,3, V. Shcheslavskiy1; 1 Institute of Biomedical Technologies, 1 A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia; 2 Terra Quantum AG, Switzerland; 3 National Research Center Kurchatov Institute, Russia; 4 Scienti Privolzhskiy Medical Research University; 2 Lopukhin FRCC PCM; 3 Nizhny Novgorod Regional Clinical Oncological Dispensary, Russia
A new variant of Optical Coherence Elastography is presented, in which osmotically-induced strains are used instead of such auxiliary stimuli as compression or elastic-wave excitation. The method efficiency is demonstrated to differentiate cartilage samples with various stages of proteoglycan-component degradation. The method also looks promising for utilization with other tissue types, e.g., for express assessment of biopsy-needle samples.

ThUSB-40 15:30-16:00
New mechanisms in stem cells differentiation and tissue regeneration discovered by optical imaging (Invited paper)
E. Zaganova1,2, A. Meleshina1, D. Kuznetsova1, S. Rodimova1, A. Kashirina1, P. Ermakova1, V. Zagamov1, V. Shchelanskii1; 1 Institute of Biomedical Technologies, Privolzhsky Medical Research University; 2 Terra Quantum AG, Switzerland
Using FLIM and multiphoton fluorescence microscopy we have made investigation of metabolic status in mesenchymal stem cell during adipogenic, osteogenic and chondrogenic differentiation, metabolic activity and intracellular pH in iPSC differentiating in dermal, epidermal, neuronal directions, in 3D neurospheres from iPSCs, in neural spheroids with Down syndrome, metabolic changes in living islets of Langerhans, and during liver regeneration.

SYC: PHOTONICS AND NANOBIOTECHNOLOGY

ThSYC-34 09:15-09:45
Laser engineering of microbial systems: a new tool for microbiology (Invited paper)
N.V. Minayev1, V.S. Zhigarkov, V.S. Cheptsov1,2, V.I. Yusupov1; 1 Institute of Photon Technologies of Kurchatov Complex Crystallography and Photonics, NRC "Kurchatov Institute"; 2 Soil Science Faculty, Lomonosov Moscow State University, Russia
We present laser engineering of microbial systems (LIMS) technology - a new promising tool which allows significant progress towards solving the ambitious task of microbiology associated with expanding the base of cultivable microorganisms. The technology is based on laser-induced forward transfer (LIFT) of microscale gel droplets with living microorganisms from various natural environments while preserving their natural microenvironment.

ThSYC-36 09:45-10:00
Wettability control on glass surface by laser-induced nanostructures for nanoparticles self-assembly
Chunyu Li, M.A. Gremilov, E.I. Ageev, D.A. Zuev; ITMO Univ., Russia
To control the self-organized assembly of nanoparticles on substrate, which are distributed in solution, the LIPSS technology is used for the wettability controllable template fabrication. The template with adjustable period and morphology of nanostructures will help organize the alignment of nanoparticles. And these will provide an important step for development of metasurfaces.
Water transportation across membrane aquaporin channels by monomer H$_2$O
S.M. Pershin$^1$, E.V. Stepanov$^1$, D.G. Artemova$^2$, B.G. Katsnelson$^3$, Prokhorov General Physics Institute RAS, Russia; University of Haifa, Israel
P. Agre (Nobel Prize, 2003) said that water transportation across membrane aquaporin channel by monomer H$_2$O occurs with intensity around 3E9 monomer/s. It’s still unknown till now where this monomer amount may storage? We have observed that water-air interface layer consists of a two water fraction: it has high/low meniscus height when capillary touch the surface/bulk water.

ThSYC-38
10:15-10:30
Sapphire THz waveguides for sensing and endoscopy applications
G.A. Katsyn$^1$, S.P. Lebedev$^2$, A.S. Kucheryavenko$^3$, I.N. Dolganova$^4$, A.V. Kaledin$^1$, A.K. Zolotov$^5$, M.G. Burdanova$^6$, K.I. Zaytsev$^7$, V.N. Kurlov$^8$, Institute of Solid State Physics RAS; Prokhorov General Physics Institute RAS; Moscow Institute of Physics and Technology, Russia

THz technologies developments into practice are limited by the absence of commercially available THz endoscopic systems. Previously, the transmission properties of waveguides, fibers and even fiber bundles based on shaped sapphire were studied. Sapphire hollow-core waveguides are suitable for efficient radiation transmission with minimal losses and for applications in endoscopy of hard-to-access objects and high-resolution imaging.

Fluorescence polarization immunoassay for detection of pesticides in food products (Invited paper)
S.A. Eremin$^1$, M.K. Kolokolova$^2$, A.N. Bach Institute of Biochemistry, Research Centre of Biotechnology RAS, Faculty of Chemistry, Lomonosov Moscow State University, Russia
Fluorescence polarization immunoassay (FPIA) is an immunochemical method based on the application of antibodies as recognition element and fluorophore as label for detection by measurement of fluorescence polarization. FPIA is simple method for organic compounds monitoring. Developments of FPIA for detection of pesticides 2,4-Dichlorophenoxyacetic acid and Glyphosate in food stuffs will be presented. The study was supported by RSF grant №24-43-00196.

ThSYC-42
12:00-12:15
Optical-magnetic characterization of IgG and nanoparticles for rapid biosensor development: detection of cardiac markers and mycotoxins
J.A. Malikova$^1$, S.L. Znoyko$^2$, V.A. Bragina$^3$, B.G. Gorshkov$^4$, Prokhorov General Physics Institute RAS, National Research Nuclear University MEPhI, Russia
This study introduces a novel method for characterizing IgG and nanoparticles in biosensor development. Using label-free low-coherence interferometry and magnetic lateral flow immunoassay, it enables kinetic studies, IgG sorption density quantification, and functional nanoparticle characterization. Demonstrating efficacy in sensitive assays for mycotoxins and cardiovascular biomarkers underscores its potential. Promising results in analytical characteristics highlight versatility for rapid biosensor advancement.

Chlorophyll fluorescence parameters of maize plants grown under linearly polarized light
Chlorophyll fluorescence parameters are presented for three varieties of maize plants grown under linearly polarized light. It is shown that there was no stress in groups grown under polarized radiation. The maize plants of Ra’nya lakomka and Zo’lotoy Batam varieties grown under polarized treatment demonstrated greater values of photosynthesis parameters than plants grown under non-polarized treatment.

Estimation of the contribution of all-trans and cis-isomers to carotenoid absorption
V.A. Kurkov$^1$, D.D. Chesalin$^2$, U.A. Shkirina$^3$, I.M. Sechenov First Moscow State Medical University, Russia
We propose an original approach to determine the concentration of cis-isomers of carotenoids in solvents by performing the fitting of experimental data with the help of differential evolution. The total contribution of cis-isomers to the resulting optical response was modelled by a Gaussian curve, whereas the spectrum of the all-trans isomer was calculated within the framework of semi-classical theory.

Photophoresis-assisted transport administration of a micron-sized capsule: theoretical simulation
Yu.E. Geints, E.K. Panina, V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia
We present the numerical model of photophoresis of a microcapsule illuminated by an intense laser pulse.
Limiting factors affecting the precision and stability of a quantum gyroscope based on NV centers in diamond and strategies to overcome them

I. Cojocaru1,2,3, V.V. Soshenko1,2, A.M. Kozodaev2, S.V. Bolshedvorskii3, O.R. Rubinas1,2, V.N. Sorokin1,2, A.N. Smolyaninov4, A.V. Akimov1,2,3; 1 Lebedev Institute RAS; 2 LLC Sensor Spin Technologies; 3 Russian Quantum Center, Skolkovo Innovation Center, Russia (The work was supported by Rosatom in the framework of the Russian Roadmap for Quantum computing (Contract No. 868 1.3-15/15-2021 dated October, 2021))

Nitrogen-vacancy (NV) centers nuclear spins show great potential as candidates for an innovative gyroscope. The precision and stability of this system depend on various parameters at each stage of the measurement protocol, including temperature fluctuations and the magnetic field of the environment. We characterize the influence of some of these parameters and propose protocols that could surpass these limitations.

- Lunch Break -
ThSYD-21 11:30-11:45

Methylene blue-mediated photodynamic therapy and tissue oxygen saturation control of postoperative mammary gland scars
D.M. Kustov1, P.M. Alekseeva1, A.S. Moskaletov1, L.Yu. Loschenova2, A.V. Voitova2, P.V. Pimpanchev3, A.A. Shiryaev3, V.B. Loschenov4; 1Prokhorov General Physics Institute RAS, 2Biospec LTD, 3IM. Sechenov First Moscow State Medical University; 4National Research Nuclear University MEPhI, Russia

Wounds are major health care problem. Photodynamic therapy (PDT) is a non-invasive procedure, can be applied to stimulate healing of skin wounds resulting from mammary gland surgery. The development of approaches to treatment of postoperative scars with PDT and simultaneous tissue oxygen saturation control will reduce the time of tissue healing and decrease the incidence of postoperative scars inflammation.

ThSYD-22 11:45-12:15

Method for rapid intraoperative analysis of the optical properties of multilayered walls of hollow organs (Invited paper)
T.A. Savelieva1,2, A.A. Krivetskaya1,2, V.V. Levin1, D.M. Kustov1, A.S. Gorbunov1, A.A. Shiryaev1, S.S. Hamasi1, K.G. Linkov1, V.B. Loschenov1; 1Prokhorov General Physics Institute RAS, 2Institute of Engineering Physics for Biomedicine, National Research Nuclear University MEPhI, Russia

The optical properties of tissues are important information that allows planning various types of laser-induced effects on biological tissues. In this work, we propose an approach to simultaneous intraoperative measurements of the spectra of diffuse reflectance and transmittance of light through intestinal wall tissue to restore the optical properties of these tissues with customized variant of Kubelka-Munk model.

ThSYD-23 12:15-12:45

Experimental models of photodynamically-induced thrombi in blood vessels (Invited paper)
I.A. Mikhailova, N.N. Petrishchev, T.G. Grishacheva, S.G. Meloyan, S.G. Chefu, G.Yu. Yukina; Pavlov First State Medical University, Russia

The review of commonly experimental in vivo models of phototherapy thrombosis of vascular bed is presented. Herein we discuss some of their advantages and disadvantages of these models being applied to different areas of vascular bed.

ThSYD-24 12:45-13:15

The use of mid-infrared lasers in ophthalmology: prospects and advantages, a look at future development (Invited paper)
Yu.N. Yusefi1, D.V. Petrachkov1, E.N. Korobov2, I.M. Belousova2, A.P. Zhevlakov2, A.S. Narivonchik3; 1Dept. Innovation Vitreoretinal Technology, Krasnov Research Institute of Eye Diseases; 2Nanophotonics Department, Pavlov Optical Institute, Russia

We are evaluate the effect of laser radiation with a wavelength of 3 μm on the tissues of cadaver eyes and compare it under similar parameters with the 532-nm laser. The impact of laser radiation on eye tissues was assessed using a scanning electron microscope.

ThSYD-25 13:15-13:45

Singlet and triplet oxygen detection by time-correlated single photon counting (Invited paper)
P. Morozov1, V.S. Andreev1, M.V. Shirmanova1, V.I. Shcheslavskiy2, G.N. Goltzman1,1Scontel; 2Pivolzhskiy Research Medical University, Russia; 3Becker&Hickl GmbH, Germany

We present the technique for molecular oxygen measurements both in ground and excited states. It is based on time-correlated single photon counting technique and use of a superconducting nanowire single-photon detector that has a high quantum efficiency and an extremely low dark count rate.
Spectroscopic verification of contrast enhancement methods in fluorescence diagnostics of basal cell carcinoma with scar tissue
National Research Nuclear University MEPhI, Federal State Budgetary «Federal Scientific and Clinical Center for Medical Rehabilitation and Balneology of the Federal Medical and Biological Agency», Prokhorov General Physics Institute RAS, Russia

Fluorescent diagnosis of skin malignancies requires contrast enhancement of fluorescent images. The contrast enhancement methods of dividing the chlorine e6 fluorescence by the auto fluorescence and subtracting the auto fluorescence from the drug fluorescence were tested spectrometrically. Both methods have shown the possibility of enhancing tumor-healthy tissue contrast, with localization more easily determined by subtraction and accumulation assessed by division.

Photodynamic therapy for cancer of external and visceral localizations in Russia
E.Ph. Stranadko, A.V. Baranov, T.I. Malova, M.V. Riabov, M.A. Andreeva
Skobelkin Scientific and Practical Center for Laser Medicine FMBA, "VETA-GRAND" LLC, Russia

Photodynamic Therapy (PDT) for cancer at various stages and locations has been practiced in Russia for 32 years. PDT is utilized in the majority of oncology clinics. The effectiveness of PDT reached 95-96%. PDT fundamentally changes the status of a significant group of inoperable patients with various cancer localizations.

Endoscopic photodynamic recanalization for inoperable obstructive esophageal cancer
E.Ph. Stranadko, V.A. Duvansky, V.L. Shabarov, M.V. Riabov, T.I. Malova, M.A. Andreeva
Skobelkin Scientific and Practical Center for Laser Medicine FMBA, RUDN University, Moscow Regional Research and Clinical Institute ("MONIKI"), "VETA-GRAND" LLC, Russia

PDT is effective in advanced obstructive esophageal cancer, improving the outcomes for this challenging group of patients and enhancing their quality and duration of life. The recanalization effect lasts for 6-7 months. In cases of dysphagia recurrence after stenting, PDT is the only possible method for eliminating the tumor stricture.

- Coffee Break -
Comparison of Ce6 photobleaching rate on the surface and in the depth of basalioma during photodynamic therapy at a wavelength of 660 nm using registration of fluorescence excited in the red and violet ranges

Excited in the red and violet ranges

The photobleaching measuring at different tissue depths is important for photodynamic therapy monitoring. Photodynamic therapy of basaliomas was conducted with a 660 nm LED source. Photobleaching was measured with camera and with violet and red LEDs. Dependencies of a photosensitizer bleaching rate at the depth and surface of the basalioma tissue were obtained and analysed.

Singlet oxygen generation by Radachlorin photosensitizer in albumin-containing solutions

We present experimental analysis of singlet oxygen (SO) generation by Radachlorin photosensitizer (PS) in solutions with human serum albumin (HSA) at different relative concentrations of PS and HSA molecules. The gradual decrease of the SO phosphorescence signal with rising amount of albumin molecules has been observed and interpreted.

Study of photo-oxidation of tetrahydrobiopterin with the addition of Pt - Pd nanoparticles

In the work, it was shown that the addition of platinum and palladium nanoparticle suspension promotes the formation of dihydropterin dimers when irradiated with ultraviolet light (325 nm) in the presence of oxygen.

Picosecond to millisecond transient absorption spectroscopy of carboxy- and oxyhemoglobin in the visible and mid-infrared spectral region

Picosecond to millisecond transient absorption spectroscopy in the visible and mid-infrared spectral region was used to study carbon monoxide and molecular oxygen re-binding as well as conformational relaxation following ligand photodissociation in human hemoglobin. Significant functional non-equivalence of the alpha and beta subunits of hemoglobin in both the gmineate ligand rebinding and concomitant structural relaxation was revealed.

Optimization of energy parameters for laser-induced photodynamic therapy of cervical tissues using numerical simulation and fluorescent monitoring

Optimization of energy parameters for laser-induced photodynamic therapy of cervical tissues using numerical simulation and fluorescent monitoring

Absorption spectra of molecular oxygen at 800 - 1300 nm in aerated organic solvents and water

Comparison of SERS spectra of intact and inactivated viruses via machine learning algorithms for the viral disease's diagnosis application

This study explores using inactivated influenza A viruses instead of intact ones for creating a spectral database in a diagnostic method with SERS and machine learning. Spectral differences between the forms reveal illuminating in using inactivated viruses for database creation and ML training for virus detection, but the data obtained can be utilized for vaccine quality monitoring technology.

Effect of folic acid on photophysical properties and photosensitized singlet oxygen formation by cationic tetrapyridyl porphyrins

The effect of folic acid on photophysical properties and photosensitized singlet oxygen formation by cationic tetrapyridyl porphyrins was investigated. It was found a strong quenching of the porphyrin fluorescence and the efficiency of singlet oxygen formation in the presence of folic acid. The reasons for the observed changes are discussed.

Extracorporeal treatment of carbon monoxide poisoning stimulated by laser radiation. Model of physical and chemical processes

The main problem in the photodynamic therapy of tumors is insufficient light exposure to tissue depth or the appearance of undesirable surface effects. It is required to investigate the influence of energy density and radiation spot diameter on the photosensitizer photobleaching efficiency by depth.

Fiber and diode lasers (800 - 1300 nm) were applied to investigation of the quantum efficiency of singlet oxygen trapping in aerated organic and aqueous media. Two main absorption bands at 1070 and 1273 nm corresponding to the 0-1 and 0-0 transitions in oxygen molecules were revealed with the relative intensities of 1:100.

Extracorporeal treatment of carbon monoxide poisoning stimulated by laser radiation. Model of physical and chemical processes

The reasons for the observed changes are discussed.

Comparison of SERS spectra of intact and inactivated viruses via machine learning algorithms for the viral disease’s diagnosis application

Comparison of SERS spectra of intact and inactivated viruses via machine learning algorithms for the viral disease’s diagnosis application

Effect of folic acid on photophysical properties and photosensitized singlet oxygen formation by cationic tetrapyridyl porphyrins

Extracorporeal treatment of carbon monoxide poisoning stimulated by laser radiation. Model of physical and chemical processes

Extracorporeal treatment of carbon monoxide poisoning stimulated by laser radiation. Model of physical and chemical processes
Wireless chronic electrical stimulation of peripheral nerves via organic optoelectronic device.

E.A. Iusupovskaia¹, G.A. Piavchenko², A.N. Konovalov¹,³, D.V. Telyshev¹, A.G. Markov¹;
¹Institute for Bionic Technologies and Engineering, I. M. Sechenov First Moscow State Medical University, Russia; ²Department of Histology, Cytology and Embryology, I.M. Sechenov First Moscow State Medical University (Sechenov University), Russia; ³National Medical Research Center of Neurosurgery named after N.N. Burdenko, Russia; ⁴Institute of Biomedical Systems, National Research University of Electronic Technology, Russia

Here we report chronic wireless electrical stimulation of the sciatic nerve in rats by an implanted multilayered organic semiconductor optoelectronic device that transduces deep-red light (625 nm) into electrical signals. In freely moving rats, fixation of the cuff around the sciatic nerve, 10 mm below the surface of the skin, allowed stimulation of the nerve for over 90 days.
SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY

Location: Stenberg 2 Room, Floor 3; Date: Friday, July 05, 2024

Session Chair:

FrSYB-43  09:00-09:30
Made-to-order organ: the common future of biophotonics and biofabrication (Invited paper)

Peter Timashev, Science and Technology Park for Biomedicine of the Sechenov Medical University; Faculty of Chemistry, Lomonosov Moscow State University, Russia

Various strategies have been developed to produce biocompatible tissue-engineered constructs, including the use of natural biomaterials like collagen or functionalization of synthetic biomaterials. There is a trend towards bioactive constructs that stimulate tissue remodeling and integration. Challenges include quality control and imaging without destruction. Biophotonics offers instant tissue visualization. These approaches hold promise for revolutionizing regenerative medicine.

FrSYB-44  09:30-09:45
Plasmonic sensors for detection of protein aging in solution

A.A. Rubekina¹, V.I. Kukushkin¹, E.A. Shirshin¹; ¹Physics department, Lomonosov Moscow State University; Institute of Solid State Physics RAS, Russia

The aging process of proteins is accompanied by their oxidation and the formation of post-translational modifications. Their optical properties changes due to its oxidation: they acquire a fluorescent response in the near-infrared regions of the spectrum. This work examines the possibility of using plasmonic sensors to monitor the fluorescence of proteins during their aging process.

FrSYB-45  09:45-10:00
Singlet oxygen prevents the mitochondrial NADH depletion in β-amyloid induced neurotoxicity

O.A. Stelmashchuk¹, V.V. Dremin¹, A.Y. Abramov¹; ¹Research & Development Center of Biomedical Photonics, Orel State University, Russia; ²Department of Clinical and Movement Neurosciences, UCL Queen Square Institute of Neurology, UK

This paper demonstrates the results of the application of singlet oxygen in β-amyloid induced neurotoxicity. The experimental results of the use of 1267 nm laser for generating singlet oxygen in primary co-culture of cortical cells addition β-amyloid peptide fragment 25-35 (5 μM) are described.

FrSYB-46  10:00-10:30
Advanced Monte Carlo simulations in spectral and fluorescence optical diagnostics (Invited paper)

M.Yu. Kirillin¹, D.A. Kurakina¹, A.A. Getmanskaya¹, A.V. Khilov¹, V.V. Perekatova¹, V.V. Shishkova¹, I.V. Turchin¹, E.A. Sergeeva¹; ¹A.V. Gaponov-Grekhov Institute of Applied Physics RAS, ²NI. Lobachevsky State University of Nizhny Novgorod, Russia

We report on the development of Monte Carlo based models of signal formation in systems of spectral and fluorescence imaging. Numerical simulations allow tracking photon trajectories providing imaging volume analysis, while parallel processor architecture allows to significantly speed up calculations.

FrSYB-47  10:30-10:45
Simulation of infrared radiation backscattering in multilayer tissue models

V.L. Kuzmin¹, Yu.A. Zhavoronkov¹, S.V. Ul'yanov¹; ¹Peter the Great St. Petersburg Polytechnic University; ²St. Petersburg State University, Russia

Calculating and studying the characteristics of infrared radiation scattered by multilayer systems expands the possibilities of noninvasive diagnostics. We present Monte Carlo simulation results of backscattering from a four-layer bio-tissue model based on the solution of the Bethe-Salpeter equation. The calculations reveal that backscatter intensity are extremely sensitive to the penetration of blood into the cerebrospinal fluid layer.

FrSYB-48  11:30-12:00
Human serum SERS analysis for non-infectional diseases detection: avoiding overestimation of classification models (Invited paper)

I.A. Bratchenko¹, Yu.A. Khrissoforova¹, P.A. Lebedev¹, M.A. Skuratova¹, L.A. Bratchenko¹; ¹Laser and Biobtech Dept., Samara National Research University; ¹Therapy Dept. Samara State Medical University; ¹Samara Regional Clinical Hospital named after VD Seredavin, Russia

The in vitro analysis of human serum was performed for more than 500 subjects for the detection of chronic heart failure, chronic kidney failure and other non-communicable diseases. Analyzed groups separation was performed based on deep learning was implemented using a separate one-dimensional convolutional neural network, projection on latent structures combined with discriminant analysis and other machine learning approaches.

FrSYB-49  12:00-12:30
Development of SERS-active substrates for Raman investigations of microorganisms (Invited paper)

V.V. Tregulov¹, E.V. Perevedentseva¹, A.I. Ivanov¹, D.S. Kostsov¹, N.N. Melnik¹; ¹Ryazan State University named after S. Yesenin; ²Lebedev Physical Institute RAS, Russia

The developing of active substrates for surface enhancement Raman scattering (SERS) based on porous silicon with Fano resonance is presented. Such structures provide both high amplification of the Raman signal and obtaining reproducible and clearly interpretable results for using SERS like a tool for detection, identification and research of pathogenic and non-pathogenic microorganisms.
FrSYB-50  
12:30-12:45  
Assignment of low-frequency bands in micro-Raman spectra of hair keratins  
E.I. Travkina, N.N. Brandt; Faculty of Physics, Lomonosov Moscow State University, Russia  
We identify conformation-sensitive bands in the low-frequency micro-Raman spectra of human hair keratins. A comparison of hair spectra measured at different orientations of the sample relative to the exciting radiation reveals changes in an interval of 110-190 cm\(^{-1}\), corresponding to vibrations of polarization sensitive \(\alpha\)-helical structures. It was also shown that spectral interval of 235-353 cm\(^{-1}\) characterizes vibrations of \(\beta\)-structures.

FrSYB-51  
12:45-13:00  
Plasmon based tags for Raman bioimaging in silent region  
A.I. Demenshin, V.N. Sorokoumov, E.V. Solovyeva; St. Petersburg State University, Russia  
Surface-enhanced Raman scattering is characterized by high specificity, spatial resolution and signal-to-noise ratio which make it attractive for bioimaging purposes. The use of alkynes in combination with plasmonic materials opens up the possibility of multifunctional diagnostic agents. In this work, the tags based on gold nanorods functionalized with 4-amino-tolane via covalent conjugation are developed for alkyne-targeted bioimaging and photothermal therapy.

- Lunch Break -
A1. EXHIBITION WORKSHOP

Зал Пьемонт, 3 этаж
3 Июля 2024, 15:00–17:00
Язык мероприятия: Русский
Модератор: Андрея Е. Чупров,
ООО «Специальные Системы. Фотоника», Россия

Piedmonte Room, 3rd floor
July 3, 2024, 15:00–17:00
Language of the event is Russian
Moderator: A.E. Chuprov,
Special Systems. Photonics, LLC, Russia

15:00–15:15
Обзор современных лазерных решений для научных и промышленных задач
A. Е. Чупров, ООО «Специальные Системы. Фотоника», Россия

Overview of modern laser solutions for scientific and industrial tasks
A. E. Chuprov, Special Systems. Photonics, LLC, Russia

15:15–15:30
Актуальные разработки лазерных источников и компонентов фотоники в ЛАССАРД
A. С. Щекин, ООО «Лассард», Россия

Latest innovations in laser sources and photonics components at LASSARD
A. S. Schekin, LASSARD, LLC, Russia

15:30–15:45
Лазеры для решения специальных задач
D. А. Вельтберг, ООО «Лазерные компоненты», Россия

Lasers for specialized purposes
D. A. Weltberg, Laser Components Ltd., Russia

15:45–16:00
Современные тенденции в области конфокальной микроскопии и доступные технологии в области фотоники
A. М. Козьмин, ООО «Криотрейд Инжиниринг», Россия

Current trends in confocal microscopy and available technologies in photonics
A. M. Kozmin, Cryotrade Engineering, LLC, Russia

16:00–16:15
Лазерные оптоакустические томографы медицинского назначения на основе высокочувствительных ультразвуковых гидрофонов
П. В. Субочев, ООО «БАРИ - НН», Россия

Laser optoacoustic tomography systems for biomedical applications based on highly sensitive ultrasound hydrophones
P. V. Subochev, BARI-NN Ltd., Russia

16:15–16:30
Новые разработки в семействе лазеров УКИ компании «АВЕСТА», в том числе титан-спирт движущиеся осцилляторы со средней выходной мощностью более 1 Вт с прямой диодной накачкой
И. И. Курицын, К.Е. Резников, ООО «Авеста-Проект», Россия

Recent developments in Avesta's ultrafast laser family including direct diode-pumped Ti:Al2O3 oscillators with >1 W output average power
I. I. Kuritsyn, K.E. Reznikov, Avesta Project Ltd., Russia

16:30–16:45
Современные нанометровые и оптические методы измерений с помощью зондовых, спектральных и лазерных технологий
Н. М. Толкач, ООО «Активная фотоника», Россия

Modern nanometer and optical measurement methods using probe, spectral and laser technologies
N. M. Tolkach, ActivePhotonics, LLC, Russia
LASSARD, LLC is a Russian vertically integrated company which independently conducts all production cycles. Since 2015 it has been developing, manufacturing and selling optomechanical products, lasers, laser systems and lasery machinery.

LASSARD is part of the Varton Group, which has been in the industrial production market since 2008.

The company designs and manufactures equipment, systems and components for various industries and activities: microelectronics, medicine, energy industry, automotive and aircraft manufacturing, oil and gas industry, communication systems and telecommunications.

Avesta Project Ltd. produces femtosecond lasers and relevant measurement equipment and accessories. We offer Ti:S, Yb and Cr:F solid-state fs and CW lasers, Ti:S, Yb and Cr:F fs mJ-level amplifiers up to multi-TW level, fiber lasers (Er-, Yb-doped and frequency-doubled, frequency combs and supercontinuum systems), as well as optical parametric oscillators and amplifiers.

The diagnostics include autocorrelators, VIS and IR spectrometers, cross-correlators, SPIDER. Additional components like pulse pickers, pulse compressors, Faraday isolators and rotators, THz generators, attenuators and harmonic generators are also available.

We also develop customized systems based on requirements. Our optomechanics division produces a broad range of optomechanical products like adjustable mirror mounts, translation stages, rotation stages, motorized components.
Laser Components LLC is a big Russian supplier of optics, laser, navigation, thermal imaging, measuring, vacuum and semiconductor equipment, as well as a wide range of highly reliable electronic components and ready-made solutions for building complex security systems from leading manufacturers in China.

The company is constantly increasing the range and volume of supplies, providing organizations and enterprises in critical sectors of the economy, incl. carrying out state defense orders, with modern and reliable instruments and components, analogues that successfully replace Western products. All products are characterized by high reliability, impeccable quality, safety and ease of operation and are provided with warranty and service. Laser Components LLC has a quality management system certificate according to GOST ISO 9001-2001 (ISO 9001:2008), as well as GOST RV 0015-002-2012.

Among our clients are more than 50 organizations that are part of the Rosatom and Rostec state corporations, more than 10 organizations of the rocket and space industry, as well as about 30 research institutes.

Hangzhou Yong Hee Photonics Co., Ltd. was established in 2001, the company is located in the beautiful city of Hangzhou. We have been committed to the development and manufacture of laser crystals, laser cavity parts, laser modules, optical lenses, infrared crystals, nonlinear crystals and Q-switches parts, electro/acoustic-optical crystals; meantime actively provide users with value-added services such as product design, customization, maintenance, coating services etc.

We have gone through 22 years and have an excellent entrepreneurial team and advanced production lines. We are widely involved in industrial laser systems, medical and cosmetic laser systems, optical communications, scientific research and military industry. Efficiency comes from diligence, tirelessness, continuous pursuit of science and technology, for domestic and foreign high-tech manufacturing enterprises and R&D colleges to provide first-class products and services.
PHOTONIC TECHNOLOGY SYSTEMS LLC, RUSSIA
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The research and production company PhotonTechSystem LLC was founded by a group of scientists in 2017. We manufacture educational photonics kits, laser beam visualizers, optical table, laminar flow box, laser safety systems and other high-tech products. Our goal is to integrate the results of scientific and educational activities in the field of photonics and business. PhotonTechSystem are based on the spirit of partnership, continuous development and high quality.

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AZIMUTH PHOTONICS specializes in the distribution and promotion of leading international manufacturers optoelectronic components on the Russian market. Our company is actively involved in the development new projects with OEMs and research organizations. Our aim is introduction of state-of-the-art technologies and innovative solutions in the field of optoelectronics into production to encourage development and support projects of Russian OEM companies.

We supply optoelectronic components such as X-ray modules, photodiodes, photomultiplier tubes, detectors, CCD/CMOS, IR arrays, IR emitters, scintillation materials, laser diodes and laser modules, DPSS lasers.
SLS Prime Technology is a manufacturer of lasers & laser systems for solving scientific and industrial tasks of any complexity. The company’s main specialization is development and production of pulsed solid-state lasers that generate laser radiation with specified characteristics in various spectral ranges from UV to IR.

We offer solutions in the following product lines:
- DPSS Lasers
- Flash Lamp Lasers
- OPOs & Tunable Laser Systems
- Custom Laser Systems

Special Systems. Photonics, LLC, specializes in the distribution of photonics solutions for various applications. Our team consists of professionals and rests primarily on engineering support in the implementation of products from leading world manufacturers.

We are dedicated to develop long-term and mutually beneficial partnerships with Russian and CIS customers. We have own test lab and service center with various equipment and components, so we are ready to provide technical support in the following areas:
- Pulsed lasers: nanosecond, picosecond, femtosecond;
- Laser diode stacks and pumping modules;
- Single-frequency fiber lasers, DPSS and diode lasers;
- Laser components and polarization optics;
- Spatial light modulators SLM (LCOS, DMD);
- RF and optical measurement equipment;
- Quantum technology;
- Technology station for fiber optic;
- Integrated photonics;
- High-precision positioners and stages;
- Optomechanics and optical tables;
- Educational kits.
State Scientific and Production Association of Optics, Optoelectronics and Laser Technology has been created by National Academy of Sciences of Belarus in 2011. SSPA “Optics, Optoelectronics and Laser Technology” includes such well-known organizations as B.I. Stepanov Institute of Physics of National Academy of Sciences of Belarus, Center of LED and Optoelectronic Technologies of National Academy of Sciences of Belarus, Centre of Geophysical Monitoring of National Academy of Sciences of Belarus etc. Main research and development activity of the SSPA “Optics, Optoelectronics and Laser Technology” belongs to the fields of laser physics, nonlinear optics and laser spectroscopy, microwave photonics, photoelectronics, robotic systems and sensors. Own mechanical and optical departments enable manufacturing of lasers and optics with required characteristics in the shortest time periods. One of the main directions is development and manufacturing of compact eye-safe pulsed erbium glass lasers, powerful diode-pumped Nd:YAG lasers, and optical parametric oscillators for wide temperature range.

ACTIVE PHOTONICS LLC is a resident of Skolkovo. The company is a leading developer and manufacturer of equipment for microscopy and spectroscopy, high-end scientific instruments for experimental research in the field of nanotechnology. The company’s developments include:

- Raman and photoluminescent confocal microspectrometer
- Solid-state thermally stabilized visible and near-infrared lasers for Raman and photoluminescence spectroscopy
- Cooled low-noise detectors (CCD cameras) in visible range for spectral technology
- The company’s products are ideally compatible with solutions for Scanning Probe Microscopy with various options and settings for research in STM and AFM modes in air, liquid and gas environments, with sample heating, using in-plane and out-plane magnetic fields. Combining the capabilities of AFM and Raman spectroscopy; MFM with Magneto-Optical Microscope and dual beam balanced polarimeter, etc.
SOLAR LS, BELARUS
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Phone: +375 17 347 95 90
E-mail: info@solarls.eu
www.solar-laser.com

SOLAR LS CJSC is one of the major companies in Belarus in the field of development and production of laser systems and spectral instruments for scientific, industrial and medical applications. SOLAR LS product line includes:
- nanosecond and sub nanosecond lamp and diode pumped lasers with harmonic generators;
- lasers with a kHz repetition rate with harmonic generators in visible, UV and IR spectral regions;
- diode pumped picosecond and femtosecond lasers with harmonic generators;
- tunable nanosecond laser systems with a tuning range 200nm - 20μm;
- modular spectrofluorometers for measuring stationary fluorescence;
- high-precision wavelength meters in the range of 190 nm-1.7 μm;
- spectrometers, monochromators, spectrographs, including customized products;
- powerful Xe light sources, tunable in the range of 250 nm-2.5 μm;
- medical aesthetic devices based on Nd:YAG, Alexandrite and CO2 lasers.

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Femtovision, LLC is a manufacturer of innovative femtosecond laser equipment, unique pumping system and educational equipment for universities. Our solid-state titanium doped sapphire laser “TiS-Quantum” can generate pulses shorter than 30 femtoseconds at 100 MHz repetition rate. We have developed and patented multi-diode laser modules and used them to build the first Russian Ti:sapphire femtosecond laser employing multi-diode pump. Pumping femtosecond laser with our diode modules greatly reduces costs and power consumption of the system and makes it easier to run. The products we design are going to be more mobile, smaller in size and several times cheaper than similar lasers available today.
Cryotrade Engineering was founded in 2008 in Moscow. The company has two different directions of the business – production of cryogenic equipment and sales of photonics and cryogenics equipment from foreign manufacturers.
The company has been operating in the Russian market for more than 10 years. During this time, we delivered hundreds of items of imported equipment and several more than a hundred systems of our own production. Production is based in Moscow on an area of more than 700 m².
We offer comprehensive confocal microscopes for different applications, any possible optics and optomechanics, analytical equipment, optical tables, DPSS and fiber lasers, Raman spectrometers, photon counting systems, etc.

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SC «LLS» the largest Optics and Photonics distributor in Russia. Resident of ITMO University Technopark, member of the Laser Association.
Headquarter is located in St. Petersburg. Branch offices are located in Moscow, Novosibirsk and Vladivostok.
LLS offers a wide range of fiber-optic and laser components, including:
Options and optomechanics;
Test and measurement equipment;
Laser systems and jets;
Fiber-optic components;
Optical fibers;
RF photonics;
Quantum technologies;
Telecommunication systems;
High-power lasers for material processing.
The company has its own research and engineering laboratory and production site, which covers the following areas:
Laser repair and service;
Demonstration and testing of equipment;
Equipment and components for fiber laser systems assembly and testing;
Measurement of fiber-optic components characteristics and laser radiation parameters
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ETM Photonics, LLC supplies equipment for scientific research in the fields of photonics, laser physics and quantum optics. Founded in 2021 in St. Petersburg, with a branch in Moscow. All company employees have higher technical education or specialized education related to direct job responsibilities.

Since 2021, the company has been a member of the Lomonosov Moscow State University Quantum Technology Center.

We directly work with manufacturers and independently carry out customs clearance of imported products, which ensures fulfillment of warranty obligations and high-speed delivery at reasonable prices. At the same time, the company is constantly working to find new manufacturers of high-quality products, create new logistics chains and additional hubs in the most important regions for supplies, and establish financial and business relationships that allow us to maintain stability and uninterrupted supply of complex scientific equipment.

LASERS AND OPTICAL SYSTEMS, RUSSIA
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«Lasers & Optical Systems» Co. Ltd. is an industrial company producing solid state lasers and systems. We combine science and industrial experience to meet consumer demand and to innovate cutting-edge technologies into commercial products. We produce diode pumped solid state lasers, eye-safe lasers, environmental lidars and laser systems for various applications. We have been in the market for over 25 years and our brand is well-recognized both in Russia and abroad. LOS participates in the ITER Project in the European Fusion Programme.
BUREAU OF ACOUSTIC DEVELOPMENTS AND INNOVATIONS OF NIZHNY NOVGOROD LTD., RUSSIA
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www.photoacoustics.ru

BARI-NN Ltd. offers custom-made piezo-polymer ultrasonic detectors for optoacoustic imaging. Our antennas have a record reception bandwidth from 100 kHz to 100 MHz and a receiving sensitivity of about 1 μV/Pa, making them ideal for biomedical applications. The acoustic impedance of PVDF antennas is close to the acoustic impedance of water and biological tissue, making them practically sound-transparent and not introducing impedance distortions into the measured acoustic fields.

We offer complete freedom in terms of geometric characteristics of your ultrasonic detector, with options including flat, cylindrical, conical, spherical, with frequencies from 100 kHz to 100 MHz, with the number of elements from 1 to 512, and with apertures from 0.5 mm to 10 cm. For ordering single element antennas, we recommend using the product code PVDF-Thickness-Focal distance-Aperture-Diameter-Length.

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https://Fedal.com

FEDAL develops and produces laser electronics and accessories. FEDAL was founded in 2002. Working hard these years our specialists have got unique experience, that allows us to solve a wide range of technical tasks. Our product line includes:
Laser diode drivers (power supplies) – CW, QCW or CW/QCW modes for lamp-, diode-pumping lasers;
Charging modules;
Multichannel systems;
Accessories (low-power electronics for laser systems).

We are developers, manufacturers, integrators. We supply our products all over the world. And we are always open to cooperation.
T8, RUSSIA
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T8 is the leading Russian vendor of wavelength-division Multiplexing telecommunication equipment (DWDM).
Headquartered in Moscow, the company is one of a few companies in the world, designing and manufacturing a line equipment with channel rate up to 800 Gbit/s. T8 also specializes in the development:
- 10 mW sub-kHz linewidth single frequency laser in butterfly-type package
- Narrowband external cavity laser. Russian laser with an instantaneous linewidth of less than 2 kHz.

T8 offers integrated solutions for building DWDM systems for metro or long-haul core networks, data-center interconnections and other carrier-grade high capacity bandwidth networks including the infrastructure of 5G networks.
For many years T8 is listed among Russian high-tech innovative leaders, provides expertise to clients in network optimization and analytics for most efficient use or scalability of network resources.

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Polarus LLC is the developer and manufacturer of picosecond fiber lasers. We offer picosecond lasers with an average power of 5 to 50 W at a wavelength of 1030/1064 nm. The key feature of lasers manufactured by Polarus is a narrow optical spectrum of the output radiation. Our lasers can be used for cold ablation micromachining of various materials. We can design a laboratory micromachining laser system based on our lasers for your unique needs.
The product line of Polarus also includes a picosecond master laser and a set of electronic control units named “Laser Control System”, which can be used for high-power pulsed lasers and research purposes.
Laser Control System is designed to control a laser and power electronic components of medium and low output power pulsed lasers, in particular to control pump laser diodes and a master laser diode source (SEED), as well as to synchronize and stabilize temperatures of laser component.
AUTHOR INDEX
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### MONDAY, JULY 1

1. ICLO 2024 PLENARY SESSION

### TUESDAY, JULY 2

**TECHNICAL SESSION**

1. R02: HIGH POWER LASERS: SOLID STATE, GAS AND HYBRID
2. R04: LASER BEAM CONTROL
3. R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES
4. R06: LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY
5. R07: FREE ELECTRON LASERS
6. R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS
7. R10: NONLINEAR QUANTUM PHOTONICS
8. R11: LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION AND GLOBAL NAVIGATION

**POSTER SESSION**

14. R07: FREE ELECTRON LASERS
14. R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

### WEDNESDAY, JULY 3

**TECHNICAL SESSION**

21. R01: SOLID-STATE LASERS
22. R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS
24. R04: LASER BEAM CONTROL
26. R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS
28. R09: OPTICAL NANOMATERIALS
30. R10: NONLINEAR QUANTUM PHOTONICS
30. POSTDEADLINE SESSION

**POSTER SESSION**

32. R01: SOLID-STATE LASERS
36. R02: HIGH POWER LASERS: SOLID STATE, GAS AND HYBRID
39. R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES
41. R06: LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY
43. R10: NONLINEAR QUANTUM PHOTONICS
46. R11: LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION

### THURSDAY, JULY 4

**TECHNICAL SESSION**

47. R01: SOLID-STATE LASERS
49. R02: HIGH POWER LASERS: SOLID STATE, GAS AND HYBRID
51. R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES
53. R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS
56. R09: OPTICAL NANOMATERIALS

**POSTER SESSION**

58. R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS
62. R04: LASER BEAM CONTROL
64. R09: OPTICAL NANOMATERIALS
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