19th International Conference
Laser Optics ICLO 2020

Technical Program

St. Petersburg, Russia
2—6 Novermber, 2020

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«RITM» Magazine

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Topical Committees

Solid State Lasers

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High Power Lasers: Fiber, Solid State, Gas and Hybrid

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Semiconductor Lasers, Materials and Applications

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Laser Beam Control

A. Forbes, Univ. of the Witwatersrand, South Africa

J. Sheridan, Univ. College Dublin, Ireland

G. Vdovin, Delft Univ. of Technology, Netherlands

V.Yu. Venediktov, St.-Petersburg State Electrotechnical Univ., St.-Petersburg State Univ., Russia

Super-Intense Light Fields and Ultra-Fast Processes

A.A. Andreev, St. Petersburg State Univ., Russia; ELI-ALPS Inst., Hungary

P. McKenna, Univ. of Strathclyde, UK

A.M. Sergeev, Inst. of Applied Physics of RAS, Russia

Lasers and Systems for Imaging, Green Photonics and Sustainability

P. Loza-Alvarez, ICFO, Spain

V. Pasiskevicius, KTH, Sweden

Free Electron Lasers

M. Kiskinova, FERMI Elettra-SincrotroneTrieste, Italy

S.L. Molodtsov, European XFEL, Germany

V.L. Nosik, Shubnikov Inst. of Crystallography, Russia

N.A. Vinokurov, Budker Inst. of Nuclear Physics, Russia

Nonlinear Photonics: Fundamentals and Applications

Ya.V. Kartashov, Inst. of Spectroscopy RAS, Russia

Yu.S. Kivshar, Australian National Univ., Australia; ITMO Univ., Russia

N.N. Rosanov, Vavilov State Optical Inst., Russia

S.K. Turitsyn, Aston Univ., UK

Optical Nanomaterials

V.G. Dubrovskii, Ioffe Inst., ITMO Univ., Russia

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

Nonlinear and quantum integrated optics

R. Morandotti, Institut National de la Recherche Scientifique-Énergie Matériaux Télécommunications, Canada

M. Kues, Leibniz Univ. Hannover, Germany

B. Wetzel, XLIM Research Inst., France

6th International Symposium on Lasers in Medicine and Biophotonics

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V.V. Tuchin, Saratov State Univ., Russia

Topics

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

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 fiber lasers including multichannel systems • Fusion lasers and terawatt science • CO2/CO lasers • Iodine lasers • Chemical lasers • Excimer lasers • Alkali vapor lasers

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

Laser Beam Control

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

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

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

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

Nonlinear Photonics: Fundamentals and Applications

Self-focusing, collapse, and applications • Conservative and dissipative optical spatial solitons • Nonlinear optics with structured light, optical vortices • Self-modulation and nonlinear temporal effects • Supercontinuum and frequency comb generation • Fiber optics and telecommunications • Nonlinear nanophotonics and plasmonics • Nonlinear meta-optics and metamaterials • Nonlinear

optical devices, including microresonators, waveguides, and PT-symmetric systems • Nonlinear topological photonics • Nonlinear photonics with surfaces and interfaces • Nonlinear THz optics

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

Nonlinear and Quantum Integrated Optics

Chip-based nonlinear optics, frequency mixing processes, nonlinear dynamics, supercontinuum generation •Novel materials for optical gain and frequency conversion • Optical storage and quantum memories • Quantum optics in cavities • Generation and control of entanglement, squeezed states and other non-classical states of light • Quantum imaging and quantum metrology • Ultrafast phenomena, ultrafast measurements • Frequency combs and optical clock • Slow and fast light • Single-photon nonlinear optics • Optical data processing • Quantum computing and communication • Integrated optical resonators & applications • Raman and Brillouin Scattering & applications

6th International Symposium on Lasers in Medicine and Biophotonics

Section A. Advanced laser medical systems and technologies

New medical applications and advanced laser medical systems for ophthalmology, dermatology, urology, endoscopic and microsurgery, dentistry and other specialties

Section B. 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

Section C. Photonics and nanobiotechnology

Analytical biophotonics, chemical and biosensing principles and instrumentation, nanomaterials, methods and systems for diagnostics and therapy

Section D. 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 theranostics • Photodynamic action on pathogenic microflora

Section E. Nanophototheranostics

Laser radiation interaction with nanophotosensitizers • Spectral and luminescent properties of nanophotosensitizers • Pharmacokinetics and pharmacodynamics of nanophotosensitizers • Influence of the microenvironment on the nanophotosensitizers optical properties • Fluorescence diagnostics in vivo using nanophotosensitizers • Photodynamic therapy and hyperthermia with nanophotosensitizers, crystalline organic nanophotosensitizers, rare-earth-doped nanophotosensitizers • Bioimaging using nanophotosensitizers

19th International Conference Laser Optics - ICLO 2020

Section		Tuesday, November 3	Wednesday, November 4	Thursday, November 5
Opening and Plenary Session - Monday, November 2, Hall 1 14:30-17:15				
R1	Solid-State Lasers	Hall 1 11:30-19:00	Hall 1 14:30-19:00	Hall 1 14:30-19:00
R2	High Power Lasers: Fiber, Solid State, Gas and Hybrid	Hall 2 09:00-13:30		Hall 2 09:00-16:30
R3	Semiconductor Lasers, Materials and Applications	Hall 2 14:30-19:00	Hall 2 09:00-13:30	Hall 2 14:30-19:00
R4	Laser Beam Control	Hall 3 09:30-19:00		
R5	Super-Intense Light Fields and Ultra-Fast Processes	Hall 4 11:30-19:00	Hall 4 11:30-18:45	
R6	Lasers and Systems for Imaging, Green Photonics and Sustainability		Hall 2 14:30-19:00	Hall 4 15:00-18:30
R7	Free Electron Lasers		Hall 6 14:15-16:30	
R8	Nonlinear Photonics: Fundamentals and Applications	Hall 5 11:30-19:00	Hall 5 11:30-19:00	Hall 5 09:00-19:00
R9	Optical Nanomaterials	Hall 6 11:30-19:00		
R10	Nonlinear and Quantum Integrated Optics		Hall 3 09:00-11:00 14:30-19:30	
PD	Postdeadline		Hall 3 11:30-13:30	
SW	Side-Event Workshop: Laser systems: turnkey solutions and an overview of commercially available components and measurement systems for their creation			Hall 1 09:00-11:00

6th International A.M. Prokhorov Symposium on Lasers in Medicine and Biophotonics

Section		Tuesday, November 3	Wednesday, November 4	Thursday, November 5
Opening and Plenary Session - Monday, November 2, Hall 2 10:20-14:00				
SYA	Advanced laser medical systems and technologies	Hall 7 09:00-18:45		
SYB	Laser interaction with cells and tissues: clinical imaging and spectroscopy	Hall 8 14:30-19:00		Hall 8 09:00-19:00
SYC	Photonics and nanobiotechnology	Hall 9 09:00-19:00		Hall 9 09:00-19:00
SYD	Photodynamic processes in biology and medicine		Hall 6 17:00-19:00	Hall 7 09:00-19:00
SYE	Nanophototheranostics	Hall 8 09:00-13:30		

Poster Session is avaliable from Tuesday, November 3 till Friday, November 6 at https://online.laseroptics.ru

MoPL-01
Monday, November 02, 2020; 15:00-15:45;
Lasers and Zhores Alferov's heterostructures: past, current, and future
Plenary
S.V. Ivanov; Ioffe Inst., Russia

Short Bio
Sergey Ivanov received his Master Degree in electrical engineering, with honor, in 1983 from St. Petersburg State Electrotechnical University, at the basic Chair of optoelectronics of Ioffe Institute, established and led by Zhores Alferov. Since 1983 he has been working at Ioffe Institute, St. Petersburg, where he received PhD in 1989 on molecular beam epitaxy (MBE) of ultralow threshold AlGaAs/GaAs QW laser diodes (LDs) and made his habilitation in 2000 on MBE and basic research of wide gap II-VI QW and QD nanoheterostructures. His current position is a Director of Ioffe Institute, Head of the quantum-size heterostructures lab. He with his collaborators published about 600 articles in peer-reviewed journals and 10 book chapters. He gave about 40 invited and plenary talks at the International conferences. For many years, he served as the IAC and IPC member of regular International conferences in his research areas, in particular, ICPS, II-VI Compounds, ICMBE, IWN, ISGN, EuroMBE. He also organized and co-chaired several of them in St. Petersburg: PLMCN4 (2004), II-VI-2009, ISGN4 (2012), EuroMBE 2017, IWUMD4 (2019).
His research interests lay in the field of MBE growth and properties of low-dimensional heterostructures based on III-V, III-Nitride and II-VI semiconductor compounds for photonic applications. He has developed an original self-consistent thermodynamic approach to description of different phenomena in MBE of III-V and II-VI compounds, which helped him and his collaborators to perform pioneer research on MBE of advanced low-dimensional heterostructures for wide spectral range photonics - from mid-IR to deep-UV. Among them are the world lowest threshold (40A/cm^2) AlGaAs/GaAs SCH QW LDs with graded index superlattice waveguide, various Sb-based QD nanostructures, the world first green II-VI LDs with a CdSe QD active region, novel multi-functional photonic and spintronic III-V/II-VI hybrid heterostructures with a coherent heterovalent interface in the active region, and III-Nitride structures from bulk InN to low-threshold AlGaN QW lasers.

MoPL-02
Monday, November 02, 2020; 15:45-16:30;
Real time measurements, extreme events, and rogue waves in optics
Plenary
J.M. Dudley; Institut FEMTO-ST CNRS-University of Franche-Comté, France

Short Bio
John Dudley is currently Distinguished Professor of Physics at the Université de Franche-Comté and the CNRS Research Institute FEMTO-ST in Besancon, France. He received his PhD in New Zealand in 1992, and worked in Scotland and New Zealand before his appointment as Professor in France in 2000. His research spans a period of more than 25 years in which he has contributed to optical source development, ultrafast and nonlinear fibre optics, and the interdisciplinary physics of nonlinear waves. He served as the President of the European Physical Society from 2013-2015 and initiated and chaired the UN International Year of Light & Light-based Technologies 2015 and the follow-up annual UNESCO International Day of Light. He has won numerous national and international awards, including the Médaille d'Argent of the national French research agency CNRS, and the Harold E. Edgerton Award for High-Speed Optics of SPIE. He has also received awards and recognitions from the learned societies APS, IEEE, IOP, and OSA. In 2019 he was elected an Honorary Fellow of the Royal Society of New Zealand Te Aparangi.

MoPL-03
Monday, November 02, 2020; 16:30-17:15;
Widely tunable compact THz molecular laser pumped by a quantum cascade laser Plenary
F. Capasso; Harvard University Center for the Environment; School of Engineering and Applied Sciences; Center for Nanoscale Systems, United States

Short Bio
Federico Capasso received the doctor of Physics degree, summa cum laude, from the University of Rome, Italy, in 1973, and after doing research in fiber optics at Fondazione Bordoni in Rome, joined Bell Labs in 1976. In 1984, he was made a Distinguished Member of Technical Staff, and in 1997 a Bell Labs Fellow. In addition to his research activity Capasso has held several management positions at Bell Labs including Head of the Quantum Phenomena and Device Research Department and the Semiconductor Physics Research Department (1987–2000), and Vice President of Physical Research (2000–2002). He joined Harvard University on January 1, 2003.
He and his collaborators made many wide-ranging contributions to semiconductor devices, pioneering the design technique known as band-structure engineering. He applied it to novel low noise quantum well avalanche photodiodes, heterojunction transistors, memory devices and lasers. He and his collaborators invented and demonstrated the quantum cascade laser (QCL). Unlike conventional semiconductor lasers, known as diode lasers, which rely on the band gap of the semiconductor to emit light, the wavelength of QCLs is determined by the energy separation between conduction band quantized states in quantum wells. They have revolutionized mid-infrared photonics, as they represent the first high performance and reliable semiconductor lasers for this technologically and scientifically important spectral region. QCLs are finding widespread use in scientific and industrial applications: high-resolution spectroscopy, chemical sensing and trace gas analysis, atmospheric chemistry, combustion and medical diagnostics. He also pioneered flat optics based on metasurfaces, including the generalized laws of refraction, and reflection and high performance metalens.

R1: Solid-State Lasers

11:30 - 13:30 **Ultrafast lasers**
Session Chair: Uwe Morgner,
Ultrafast Laser Optics Inst. für Quantenoptik Leibnitz Univ., Germany

TuR1-01 11:30-12:00
"Vilnius OPCPA scheme" and progress on the way to 15 TW, CEP-stable sub-6.5fs SYLOS-2 system *(Invited paper)*
A.Michailovas; Ekspla UAB; Center for Physical Sciences and Technology, Lithuania
In 2019 in Szeged (Hungary) at ELI ALPS facilities Nobel Prize laureate Gerard Mourou started official operation of SYLOS-2 beamline. This was created by consortium of Lithuanian companies Ekspla and Light Conversion using knowledges accumulated by scientists from Vilnius University. In our presentation we will overlook history of OPCPA systems development and technologies used to implement SYLOS-2 laser system.

TuR1-02 12:00-12:15
Amplification of low energy chirped picosecond pulses to multi-mJ level with ytterbium disk laser heads
M.R.Volkov, I.I.Kuznetsov, I.B.Mukhin, O.V.Palashov; Inst. of Applied Physics RAS, Russia
We demonstrate regenerative amplification of chirped pulses from sub-nJ to multi-mJ level with CW pumped Yb:YAG thin-disk laser head. Multipass amplifier with quasi-CW pumping is developed to provide further amplification to 200 mJ range and ~70 mJ is demonstrated in first experiments at reduced repetition rate.

TuR1-03 12:15-12:30
Coherence of Fourier domain mode-locked (FDML) lasers in the ultra-stable regime
M. Schmidt[1], C. Grill[2], R. Huber[2], C. Jirauschek[1]; [1]Technical Univ. of Munich (TUM); [2]Univ. of Lübeck, Germany
We report on a coherent relationship of consecutive roundtrips in FDML lasers in the ultra-stable regime. The results are obtained by numerical simulations and agree well with recent beat signal measurements. An understanding of the inter-sweep stability is of particular importance in finding the maximum possible coherence length of FDML lasers which greatly affects imaging and sensing applications.

TuR1-04 12:30-12:45
Direct generation of clean femtosecond vortex pulses at millijoule level from a 1 kHz-800 nm Ti: sapphire regenerative amplifier
Shixiang Xu, Shuiqing Zheng, Hongyu Wang, Zhenkuan Chen, Qinggang Lin, Yi Cai, Dianyuan Fan;
This paper reports experimentally to generate femtosecond vortex pulses directly from a reformed 1 kHz-800 nm Ti: sapphire regenerative amplifier. The output pulses are the first-order Laguerre-Gaussian mode with a ring-to-center spatial intensity contrast up to 300:1. The time duration is about 51 fs while the pulse energy is up to 1.8 mJ.

TuR1-05 12:45-13:00
Picosecond high power Yb:LuAP laser system
A.S. Rudenkov[1], V.E. Kisel[1], A.S. Yasukevich[1], K.L. Hovhannesyan[2], A.G. Petrosyan[2], N.N. Rubtsova[3], A.A. Kovalyov[3], V.V. Preobrazhenskii[3], N.V. Kondratyuk[4], D.A. Homan[4], N.V. Kuleshov[1]; [1]Belarusian National Technical Univ., Belarus; [2]Inst. for Physical Research NAS, Armenia; [3]Rzhanov Inst. of Semiconductor Physics, SB RAS, Russia; [4]SolarLS JSC, Belarus
12W-picosecond SESAM mode-locked Yb:LuAP laser was developed. 2ps-laser pulses were obtained at the central wavelength around 999nm and optical-to-optical efficiency of 38% at 70MHz PRF. 4.8W of second harmonic radiation was obtained using 20mm LBO crystal with critical angular phase matching. Tunability from 668nm to 783nm was obtained in preliminary experimental study of LBO based synchronously pumped OPO.

TuR1-06 13:00-13:15
High rep-rate cryogenic Yb:YAG and Yb:YLF chirped pulse amplifiers
M. Pergament[1], L. Zapata[1] , U. Demirbas[1,2] , M. Kellert[1], S. Reuter[1], J. Thesinga1, Yi Hua[1,3], Yizhou Liu.1,3, H. Cankaya[1,3], A.-L. Calendron[1], F.X. Kärtner[1,3,4]; [1]Deutsches Elektronen-Synchrotron DESY, Germany; [2]Antalya Bilim Univ., Turkey; [3]Univ. of Hamburg, [4]The Hamburg Centre for Ultrafast Imaging, Germany
We present cryogenically cooled chirped pulse amplifiers with Yb doped gain media. The different amplifier concepts are demonstrated, providing energies up to 1.2 J at 500 Hz for composite-thin-disk (CTD) Yb:YAG amplifier. In case of slab Yb:YLF we have achieved sub-ps pulses with 70 W average power from the regenerative amplifier system working at up to 10 kHz repetition rate.

TuR1-07 13:15-13:30
All-fiber nonlinear polarization evolution mode-locked laser at 980 nm
S.S. Aleshkina, M.E. Likhachev; Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center
We present the first all-fiber NPE laser operated near 0.98 μm. The laser is based on a specialty developed Yb-doped fiber with increased absorption from the cladding. Realized pulses had 4.8 ps pulse duration and 25 nm spectral bandwidth that is significantly broader than Yb-gain bandwidth. External compression using bulk grating shortened the pulse duration down to 230 fs.

R1: Solid-State Lasers

14:30 - 16:30 **Mid-IR lasers**
Session Chair: Maximilian Lederer,
European XFEL GmbH, Germany

TuR1-08 14:30-15:00
High-efficiency repetitively-pulsed 2.3-3.2 μm lasers based on Cr2+-doped single-crystalline or polycrystalline chalcogenides with low-quantum-defect pumping *(Invited paper)*
O.L. Antipov; Inst. of Applied Physics RAS; Nizhny Novgorod State Univ., Russia
An overview of polycrystalline and single-crystalline Cr2+:ZnSe and Cr2+:CdSe lasers at 2.3-3.2 μm pumped by repetitively-pulsed Ho3+:YAG lasers at 2.1 μm will be presented. The laser system architectures and the methods of wavelength tuning of the broadband laser operation will be discussed.
This research was supported by RFBR Grant(s) # 18-32-00105

TuR1-09 15:00-15:15
50 mW tellurite glass fiber laser at 2.3 microns
B.I. Denker[1], V.V. Dorofeev[2], B.I. Galagan[1], V.V. Koltashev[3], S.E. Motorin[2], S.E. Sverchkov[1], V.G. Plotnichenko[3]; [1]Prokhorov General Physics Inst. RAS, [2]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, [3]Fiber Optics Research Center RAS, Russia
We demonstrate 45-55 mW average output power at 2.3 microns in Tm3+-doped tellurite glass fiber laser pumped by a 794 nm multimode laser diode. To the best of our knowledge it is the highest 2.3 micron output from a fiber laser, and it is already a practically significant power that can be used in various applications.
This research was supported by RFBR Grant(s) # 20-02-00425

TuR1-10 15:15-15:30
A narrow linewidth singly resonant PPLN OPO seeded by HeNe at 3390 nm for CH4 photoacoustic detection
E.Y.Erushin[1,2], A.A.Boyko[1,3], N.Yu. Kostyukova[1,3], I.V.Sherstov[1,3], D.B.Kolker[1,3]; [1] Inst. of Laser Physics SB RAS,[2] Novosibirsk State Technical Univ.,[3] Novosibirsk State Univ., Russia
The system of optical parametric oscillator based on fan-out PPLN crystal – seed He-Ne laser at 3.39 μm for photoacoustic detector is presented

TuR1-11 15:30-15:45
Cr2+-Fe2+ ions energy transfer analysis in Zn1-xMnxSe crystals
M.E. Doroshenko[1], H. Jelinkova[2], A. Riha[2], M. Jelinek[2], N.O. Kovalenko[3], I.S. Terzin[3]; [1]Czech Technical Univ., Prague, Czech Republic; [2]Inst. for Single Crystals NAN Ukraine, Ukraine
Energy transfer mechanism as well as macro- and microparameters of Cr2+-Fe2+ ions interaction in Zn1-xMnxSe crystals with different Mn content x were determined. Cr2+-Fe2+ ions energy transfer efficiency was shown to increase with Mn content x up to 55% for x=0.3

TuR1-12 15:45-16:00
Emission properties of rare earth doped chalcogenideglasses and their chance to become active media for~5 micron lasers
S.E. Sverchkov[1] , M.F. Churbanov[2] , B.I. Denker[1] , B.I. Galagan[1] , V.V. Koltashev[3] , V.G. Plotnichenko[3] , G.E. Snopatin[2], M.V. Sukhanov[2] , A.P. Velmushov[2]; [1]Prokhorov General Physics Inst. RAS, [2]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, [3]Fiber Optics Research Center RAS, Russia
Ultrapure rare-earth doped chalcogenide glasses were analyzed for their mid-infrared emission properties. The parameters of selenide glasses activated by Tb, Pr and Ce were found promising for ~5 microns laser action.
This research was supported by RFBR Grant(s) # 18-29-20079

TuR1-13 16:00-16:15
Inband pumped efficient Ho:LuLiF MOPA laser transmitter for spaceborne coherent wind lidar
Jirong Yu[1], Jane Lee[2], Teh-Hwa Wong[2], Larry B. Petway[1], Michael J. Kavaya[1]; [1] NASA Langley Research Center,[2] Science Systems & Applications, Inc., USA
A single frequency Ho:LuLiF MOPA laser with 75 mJ energy and 200 ns pulse width at 200 Hz PRF was developed for spaceborne coherent wind lidar instrument, fulfilling the spaceborne wind lidar measurement sensitivity and accuracy requirements.

TuR1-14 16:15-16:30
Spectroscopy and CW laser performance of Er3+,Yb3+: YMgB5O10 crystal
K.N. Gorbachenya[1], V.E. Kisel[1], A.S. Yasukevich[1], R.V. Deineka[1], E.V. Vilejshikova[1], V.V. Maltsev[2], D.D. Mitina[2], E.A. Volkova[2], N.I. Leonyuk[2], and N.V. Kuleshov[1];[1] Belarusian National Technical Univ., Belarus,[2] Moscow State Univ., Russia
We present spectroscopy and continuous-wave (CW) diode-pumped laser operation of Er,Yb:YMgB5O10 crystal. Absorption and emission spectra as well as kinetics of luminescence decay were studied. A maximal output power of 0.2 Wwas obtained at the wavelength of 1570 nm.

R1: Solid-State Lasers

17:00 - 19:00 **Pulsed, CW and mid-IR lasers**
Session Chair: Maximilian Lederer,
European XFEL GmbH, Germany

TuR1-15 17:00-17:30
A high-average-power, 1.5/3.2-μm OPCPA driver for a high-flux soft X-ray beamline and attosecond strong-field spectroscopy *(Invited paper)*
M. Mero[1], Z. Heiner[2], V. Petrov[1], H. Rottke[1], F. Branchi[1], J. Mikosch[1], G.M. Thomas[1], M.J.J. Vrakking[1]; [1]Max Born Institute, Germany; [2]Humboldt-Universität zu Berlin, Germany
We present a 100 kHz, dual-beam OPCPA system designed for simultaneous delivery of a 0.43 mJ, 50 fs, carrier-envelope phase-stable beam at 1.5 μm and a 0.13 mJ, 70 fs beam at 3.2 μm.

TuR1-16 17:30-17:45
2 Joule flashlamp-pumped 1047 nm Nd:YLF laser with near-diffraction-limited beam quality
A.F. Kornev[1], A.M. Makarov[1,2], Yu.V.Katsev[1], V.K.Stupnikov[1]; [1]«Lasers & Optical Systems» Co. Ltd., [2]ITMO Univ., Russia
We report on a flashlamp-pumped 1047 nm Nd:YLF laser with near-diffraction-limited beam quality. The laser was based on master oscillator power amplifier design. The output pulse energy was 2 J with 3 ns pulse duration at 10 Hz. High beam quality of the laser output was provided by using SBS mirror in the amplifier. The output beam divergence was 1.1xDL.

TuR1-17 17:45-18:00
Advantages of composite disk active elements made by thermal diffusion bonding of dissimilar materials Yb:YAG and sapphire
I.B. Mukhin, M.R. Volkov, I.I. Kuznetsov; Inst. of Applied Physics RAS, Russia
The technology of thermal diffusion bonding of Yb:YAG/Sapphire composite disk active elements (AE) has been developed. The first experiments demonstrate a good optical quality of composite AE, suppressing of ASE and imrooving of thermal effects.

TuR1-18 18:00-18:15
Boosting room temperature Yb:YAG laser with a multipass cryogenic Yb:Y2O3 ceramic disk amplifier
E.A. Perevezentsev, I.I. Kuznetsov, I.B. Mukhin, M.R. Volkov, O.L. Vadimova and O.V. Palashov; Inst. of Applied Physics RAS, Russia
Boosting of a room temperature Yb:YAG laser with a multipass cryogenic Yb:Y2O3 ceramic disk amplifier was investigated for the first time. 15.8W at 11.5kHz, with 0.5ns pulse duration, and 1.2nm spectrum width was achieved. Given an appropriate source, broader-band radiation may be amplified with a further compression to the subpicosecond range of pulse durations.
This research was supported by RFBR Grant(s) # 18-32-00117

TuR1-19 18:15-18:30
Cancellation of side lobes in “droplet” Bessel beams generated with semiconductor laser
S.H. Abdulrazak, D.V. Chistyakov, S.N. Losev, V.Yu. Myl’nikov, Yu.M. Zadiranov, N.G. Deryagin, V.V. Dudelev, V.I. Kuchinskii, and G.S. Sokolovskii; Ioffe Inst., Russia
We demonstrate the generation of “droplet” Bessel beams using a semiconductor laser and an axicon with a rounded tip. Interference of Bessel and Gaussian wave fronts leads to cancellation of side lobes of Bessel beam

TuR1-20 18:30-18:45
Comparison of thin-tapered-rod and thin-rod Yb:YAG laser amplifiers at high average power operation
S. Chizhov , I. Kuznetsov , O. Palashov , I. Mukhin; Inst. of Applied Physics RAS, Russia
We present a comparative study of amplifier modules for femtosecond laser system based on fiber seed laser and double stage single crystal fiber or thin-rod amplifiers.

TuR1-21 18:45-19:00
High-energy and high average power thin-rod and thin-tapered-rod Yb:YAG laser amplifiers
I.I. Kuznetsov, S.A. Chizhov, I.B. Mukhin, O.V. Palashov; Inst. of Applied Physics RAS, Russia
8mJ pulse energy is achieved at the output of the thin-rod Yb:YAG laser amplifier at 1.5kHz repetition rate that is 3 times surpasses the previous record for this geometry due to the higher quality of the crystal coatings. It is proposed to use thin-tapered-rod active elements for further energy scaling simultaneously with average power increasing and beam quality preserving.
This research was supported by RFBR Grant(s) # 18-32-20124

R2: High Power Lasers - Fiber, Solid State, Gas and Hybrid

09:00 - 11:00
Session Chair: *A.A. Ionin,*
Lebedev Physical Inst. of RAS, Russia

TuR2-01 09:00-09:30
Experimental and theoretical studies of diode pumped alkali lasers *(Invited paper)*
B.D. Barmashenko, I. Auslender, E. Yacoby, K. Waichman, S. Rosenwaks; Ben-Gurion Univ. of the Negev, Israel
Experimental and theoretical studies of Cs and K DPALs are presented. In static Cs DPAL improving beam quality by inducing refractive index gradients is studied. For static K DPAL dependence of laser performance on addition of methane to He buffer gas is investigated and calculated laser powers are compared with experimental results.

TuR2-02 09:30-10:00
New kinetic data for processes with excited oxygen and iodine molecules *(Invited paper)*
V.N. Azyazov[1,2], A.P. Torbin[1], A.A. Pershin[1,2], M.V. Zagidullin[1], I.A. Medvedkov[1], M.C. Heaven[1,3]; [1]Lebedev Physical Inst., Samara Branch, [2]Samara National Research Univ., Russia; [3]Emory Univ., USA
Recently measured kinetic constants for processes with excited O2 and I2 molecules are presented. It has been found that O2(b) is quenched to O2(a) with a branching fraction close to unity for all tested molecules except I2. The rate constants for O2(b) deactivation by a variety of collisional partners were measured at elevated temperatures.
This research was supported by RFBR Grant(s) # The work was supported at Samara University by the RFBR grant # 19-33-90265.

TuR2-03 10:00-10:15
Composite optical elements for high-power lasers made by Surface Activated Direct Bonding
I.I. Kuznetsov[1], A.E. Pestov[2], I.B. Mukhin[1], M.R. Volkov[1], M.V. Zorina[2], N.I. Chkhalo[2], O.V. Palashov[1]; [1]Inst. of Applied Physics RAS; [2]Inst. for Physics of Microstructures RAS, Russia
Surface Activated Direct Bonding method is realized for manufacturing composites from dissimilar materials for high power lasers. Yb:YAG/Sapphire active element for thin-disk laser and TGG/Sapphire for high-power Faraday isolator is made for the first time. The advantages of new composites are demonstrated. Continuous-wave laser based on Yb:YAG/Sapphire active element with 49% slope efficiency and 320W average power is developed.
This research was supported by RFBR Grant(s) # 19-02-00631

TuR2-04 10:15-10:30
An investigation of dual-pump schemes optically pumped rare gas lasers
P. Sun[1], D. Zuo[1], X. Wang[1], J. Han[2], M. C. Heaven[2]; [1]Huazhong Univ. of Science and Technology, China; [2]Emory Univ., USA
Modeling of 1s4-2p10, 1s4-2p8 and 1s4-2p7 dual-pump schemes for optically pumped rare gas lasers was conducted. Simulations showed significant enhancement for the laser performance, which was verified by preliminary experimental results.

TuR2-05 10:30-10:45
Lasing on the D' - A' transition of BrF molecules (355 nm) excited by TEA discharge
A.M. Razhev[1], D.N. Kapusta[1,2], E.S. Kargapol'tsev[1]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State Univ., Russia
High-power lasing was obtained on the electronic D' - A' transition of the BrF molecule using a transverse electric discharge as a method of pumping a high-pressure He-Br2-NF3 active medium (5 atm). The maximum laser energy was 13 mJ. With the laser pulse duration of 10 ± 2 ns (FWHM), the peak power was more than 1 MW.

TuR2-06 10:45-11:00
IR Ar I laser pumped by a pulsed inductive discharge
A.M. Razhev[1], D.S. Churkin[1,2], R.A. Tkachenko[1]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State Univ., Russia
For the first time, laser radiation at transitions of neutral argon atoms pumped by a pulsed inductive discharge was obtained. The radiation consisted of spectral lines with wavelengths of 1.213 μm, 1.240 μm, 1.270 μm, 1.694 μm, 1.791 μm. Studies of the temporal characteristics of the radiation showed the duration of the optical pulse was 4 ± 1 ns (FWHM).
This research was supported by RFBR Grant(s) # 16-02-00316 A

R2: High Power Lasers - Fiber, Solid State, Gas and Hybrid

11:30 - 13:30
Session Chair: *A.A. Ionin, Lebedev Physical Inst. of RAS, Russia*

TuR2-07 11:30-12:00
High-power ultrafast thin-disk lasers for Terahertz science *(Invited paper)*
C. Saraceno; Ruhr Univ. Bochum, Germany
Not available

TuR2-08 12:00-12:30
Laser technologies for interferometric gravitational wave detectors developed by IAP RAS *(Invited paper)*
A. Starobor; Inst. of Applied Physics RAS, Russia
The paper is dedicated to the work of IAP RAS in collaboration with LIGO and VIRGO. A number of scientific studies have been carried out for gravitational interferometers: the creation of interferometers for incoming inspection of the surface and contamination of mirrors, the active control of the thermal lens of mirrors, the development of unique Faraday isolators, etc.

TuR2-09 12:30-12:45
Single longitudinal mode Cr:forsterite master-oscillator power-amplifier laser system with 50 mJ output radiation and 0.5 pm linewidth
L.I. Stoychev[1,2], M. Baruzzo[1,3], J.J. Suárez-Vargas[1,3], H. Cabrera[1,4], I.P. Nikolov[5], P. Sigalotti[5], A.A. Demidovich[5], M.B. Danailov[5], A. Vacchi.1,3; [1]Ist. Nazionale di Fisica Nucleare, Italy; [2]Inst. of Solid State Physics, Bulgarian Academy of Sciences, Bulgaria; [3]Udine Univ., Italy; [4]The abdus Salam International Centre for Theoretical Physics, Italy; [5]Elettra-Sincotrone, S.C.P.A, Italy
We present the design of a Cr:forsterite based single-frequency master-oscillator power-amplifier laser system delivering output energy of 50mJ in the spectral region around 1252-1272 nm, with a good beam quality M2 ~ 1.8 and narrow spectral linewidth of 0.5 pm. The system has three amplifying stages with total of 14-passes configuration.

TuR2-10 12:45-13:00
Methods for suppressing of transverse parasitic oscillation in Fe:ZnSe and Fe:ZnS lasers with disk geometry
S.S. Balabanov[1], K.N. Firsov[2], E.M. Gavrishchuk[1,3], V.B. Ikonnikov[1], I.G. Kononov[2], S.V. Kurashkin[1], S.V. Podlesnykh[2], D.V. Savin[1], A.E. Dormidonov[2]; [1]Inst. of Chemistry of High-Purity Substances RAS; [2]General Physics Inst. RAS; [3]Nizhny Novgorod State Univ., Russia.
In this work, we study the conditions for the appearance of transverse parasitic oscillation in Fe:ZnSe and Fe:ZnS polycrystalline active elements under high-intensity longitudinal laser pumping. The possibility of using solid-state diffusion bonding in combination with hot isostatic pressing technology to suppress transverse parasitic oscillation is discussed.
This research was supported by RFBR Grant(s) # 18-03-01009, 18-08-00793

TuR2-11 13:00-13:15
Spectral-domain approach for temporal envelope distortions control in saturated amplifiers
A. Soloviev, I. Mukhin; Inst. of Applied Physics RAS, Russia
The application of chirped pulses in high-power nanosecond laser systems allows controlling the time envelope using a number of passive spectral methods. We propose an approach for suppressing distortions of the time envelope during amplification in the saturation mode at the expense of spectral inhomogeneity of gain cross-section. The analytical consideration of the proposed approach is confirmed by numerical modeling.

TuR2-12 13:15-13:30
Dual-color mode locking at 1.5 and 2 μm by nonlinear multimode interference
Kangjun Zhao[1], Yan Li[2], Xiaosheng Xiao[1], Changxi Yang[1]; [1]Tsinghua Univ.; [2]Guangdong Polytechnic Normal Univ., China
We demonstrate two-color mode locking at 1.5 and 2 μm by a single saturable absorber based on nonlinear multimode interference in a graded-index multimode fiber, which may lead to significant applications in nonlinear spectroscopy.

R3: Semiconductor Lasers, Materials and Applications

14:30 - 16:30
Session Chair: *G.S. Sokolovskii*, *Ioffe Inst., Russia*

TuR3-01 14:30-15:00
Highly nonlinear metasurfaces based on intersubband polaritons *(Invited paper)*
N. Nookala[1], S. Mann[2], S. Johnson[3], J. Krakofsky[4], A. Mekkawy[2], J. Xu[1],Y. Liu[1] J. Lee[1], M. Tymchenko[1], J.S. Gomez-Diaz[1], G. Boehm[4], J.F. Klem[5], I. Brener[5], M. Raschke[3], A. Alu[2], M.A. Belkin[1,4]; [1]The University of Texas at Austin, USA; [2]City Univ. of New York, USA; [3]Univ. of Colorado at Boulder, USA; [4]Walter Schottky Inst., Technische Universität München, Germany; [5]Sandia National Laboratories, USA
I will review progress in nonlinear metasurfaces based on coupling of optical modes in nanoresonators with intersubband transitions in semiconductor heterostructures. Plasmonic and dielectric metasurface designs for second- and third-order nonlinear response will be discussed.

TuR3-02 15:00-15:30
Auger recombination in QW mid-infrared lasers: III-V vs group IV materials *(Invited paper)*
A. Andreev, E. O'Reilly; Tyndall National Inst., Ireland
Recently emerged GeSn-based structures are promising for the creation of mid-infrared lasers in group IV materials. We present here the first theoretical investigation of the Auger recombination in SiGeSn QW structures. To understand the relative potential of the studied group IV based QW we compare the calculated Auger rates with similar structures based on III-V materials.

TuR3-03 15:30-15:45
Stimulated emission from InAs(Sb)-based LED heterostructures
A.A. Semakova[1], K.D. Mynbaev[1], N.L. Bazhenov[2], A.V. Chernyaev[3], S.S. Kizhaev[3], N.D. Stoyanov[3]; [1]ITMO Univ., Russia; [2]Ioffe Inst., Russia; [3]Microsensor Technology, Russia
The electroluminescence of light-emitting diodes (LED) heterostructures based on InAsSb epitaxial films and structures with quantum wells was studied. At low temperatures (4.2-100 K), stimulated emission was observed. It was found that an optical cavity was formed normal to the growth plane, which makes such structures promising for the development of mid-infrared vertical-emitting lasers.
This research was supported by RFBR Grant(s) # 19-32-90091

TuR3-04 15:45-16:00
Conical refraction with Gaussian Schell-model sources
V.Yu. Mylnikov[1], E.U. Rafailov[2], G.S. Sokolovskii[1]; [1]Ioffe Inst., Russia, [2]School of Engineering and Applied Science, Aston Univ., UK
We derive the theory of the conical refraction for partially spatially coherent light using the Gaussian Schell-model. The effect of narrowing of the CR ring width due to reducing the coherence degree is predicted.

TuR3-05 16:00-16:30
Purcell effect in plasmonic metamaterial structrues *(Invited paper)*
K.M. Morozov[1], K.A. Ivanov[2], A.P. Monkman[3], M.A. Kaliteevski[1,2]; [1]Alferov Univ., Russia; [2]ITMO Univ., Russia; [3]Durham Univ., UK
We report the results of theoretical and experimental studies Purcell effect in metamaterial structures based on silver and organic light – emitting materials. In metal-dielectric metamaterials absorption in metals limits the maximal value of Purcell factor. However, in the structures of more complicated design features Purcell coefficient, can be shifted away from plasma frequency, increasing the Purcell coefficient.

R3: Semiconductor Lasers, Materials and Applications

17:00 - 19:00
Session Chair: *E.U. Rafailov*, *Aston Univ., UK*

TuR3-06 17:00-17:30
Noise properties of gigahertz frequency combs *(Invited paper)*
Th. Südmeyer, Université de Neuchâtel, Switzerland
Optical frequency combs operating at multi-GHz spacing enable a high power per comb mode and easier access to individual optical lines. There are advantageous for many applications, including low-noise RF generation by optical-to-microwave frequency division. We discuss and compare different GHz comb technologies, including diode-pumped solid-state lasers, quantum cascade lasers and semiconductor disk lasers, and present application areas.

TuR3-07 17:30-18:00
Self-injected mode-locked lasers for frequency comb generation and application to multi-Terabit/s data transmission *(Invited paper)*
K. Merghem[1], Q Gaimard[2], G Aubin[2], A Ramdane[2], F Lelarge[3], V Vujicic[4], A Anthur[4], R Zhou[4], L P Barry[4], P Marin[5], J N Kemal[5], J Pfeifle[5], C Koos[5]; [1]SAMOVAR, TELECOM SudParis, CNRS, Institut Polytechnique de Paris, [2]Centre de Nanosciences et de Nanotechnologies (C2N), CNRS, Université Paris Sud, Université Paris-Saclay, [3]Almae Technologies, France; [4]Dublin City Univ., Ireland; [5]Inst. of Photonics and Quantum Electronics (IPQ), Karlsruhe Inst. of Technology (KIT), Germany
This paper reviews our recent work on Optical Frequency Combs generated by self-injected quantum-dash mode locked laser. Their broadband optical spectrum and low phase noise performances allow multi-Tbps data transmission.

TuR3-08 18:00-18:15
Phase analysis and full phase control of chip-scale infrared frequency combs
F. Cappelli[1], L. Consolino[1], M. Nafa[1], R. Eramo[1], I. Galli[1,2], D. Mazzotti[1,2], P. Cancio Pastor[1,2], S. Bartalini[1,2], P. De Natale[1]; [1]CNR-INO Istituto Nazionale di Ottica, & LENS European Laboratory for Non-Linear Spectroscopy, [2]ppqSense Srl, Italy
For high-resolution molecular spectroscopy and metrology applications, infrared frequency combs need full frequency stabilization of all the emitted modes. Here we demonstrate full phase stabilization and independent control of the two comb degrees of freedom, offset and mode spacing, of quantum cascade lasers frequency combs. A technique enabling to monitor the obtained degree of coherence is also presented.

TuR3-09 18:15-18:30
Optical frequency comb generation for broadband microwave photonics receiver
S. Kontorov[1], V. Cherepenin[2], F. Kueppers[1], V. Kulagin[2,3], D. Prokhorov[4], A. Shipulin[1], V. Valuev[4]; [1]Skolkovo Inst. of Science and Technology, [2]Kotel'nikov Inst. of Radio-Engineering and Electronics RAS, [3]Sternberg Astronomical Inst. of Lomonosov Moscow State Univ., [4]National Research Nuclear Univ. MEPhI, Russia
Microwave photonics approach for ultrabroadband signals processing has been investigated. In this case, optical filters select reference signals from optical frequency comb, which are used then for down-converting regions of the incoming RF spectrum using optical heterodyning technique. Then, low-rate electronic ADCs process photodetector's outputs enabling full mathematical recovery of the incoming signal.
This research was supported by RFBR Grant(s) # 19-29-06108, 20-07-00768

TuR3-10 18:30-19:00
1D and 2D carbon nanostructures for solid-state laser mode-locking in the 2-μm spectral range and beyond *(Invited paper)*
U. Griebner[1], W. Chen[1,2], Y. Zhao[1,3], F. Rotermund[4], X. Mateos[5], P. Loiko[6], and V. Petrov; [1]Max Born Inst., Germany; [2]Fujian Inst. of Research on the Structure of Matter, China; [3]Jiangsu Normal Univ., China; [4]KAIST, Republic of Korea; [5]Tarragona Univ., Spain; [6]ITMO Univ., Russia
The nonlinear properties of saturable absorbers based on single-walled carbon nanotubes and graphene are compared with semiconductor based devices (SESAMs) and their performance in mode-locked lasers in the 2-μm spectral range and beyond is presented.

R4: Laser Beam Control

09:30 - 10:45
Session Chair: *V.Yu. Venediktov, St.-Petersburg State Electrotechnical Univ., St.-Petersburg State Univ., Russia*

TuR4-01 09:30-10:00
Polymer-based 1D photonic crystals for optical switching *(Invited paper)*
I.M. Kislyakov; Shanghai Inst. of Optics and Fine Mechanics CAS, China
Nonlinear optical properties of materials can be enhanced by designing them as thin polymer composite films alternating with other polymers and forming dielectric mirrors and microresonators wherein the input light intensity is increased. Such structures are proposed, produced and studied as compact and efficient all-optical switches for optical telecommunication systems.

TuR4-02 10:00-10:15
Laser-induced nonlinear optical processes in fluid systems with nanocarbon
P.V. Ivanov[1], A.V. Venediktova[1,2], I.M. Kislyakov[2], J. Wang[2], A.L. Nikolaeva[3], A.Yu. Vlasov[1]; [1]St.Petersburg State Univ., [2]Shanghai Inst. of Optics and Fine Mechanics, CAS, China; [3]Inst. of Macromolecular Compounds RAS, Russia
We report on nonlinear optical transmission in aqueous polymer suspensions of 1D, 2D and 3D carbon nanoparticles of quasi-continuous, fs- and ns-pulse laser irradiation in visible and NIR ranges. Fast processes leading to the optical limiting behavior are studied with regard to nanoparticles' individuality, degree of aggregation and sizes.

TuR4-03 10:15-10:30
Spatial mode multiplexing for THz laser beam mode control
Yu.Yu. Choporova[1,2], B.A. Knyazev[1,2], N.D. Osintseva[1,2], V.S. Pavelyev[3,4]; [1]Budker Inst. of Nuclear Physics SB RAS, [2]Novosibirsk State Univ., [3]Samara Univ., [4]Samara branch of the FSRC "Crystallography and and Photonics" RAS, Russia
Spatial mode multiplexing has been demonstrated for THz Hermite-Gaussian and vortex Bessel beams. The input Gaussian beam from the Novosibirsk Free Electron Laser was transformed by silicon phase binary elements. Specific mixed modes were generated in a two-channel interferometric optical scheme. A correlation filter was implemented as the mode analyzer.

TuR4-04 10:30-10:45
On laser frequency stabilization to sub-Hz level with cryogenic and large-base Fabry-Perot cavities
D.S. Kryuchkov[1,2], N.O. Zhadnov[1,2], G. A. Vishnyakova[2], K.S. Kudeyarov[1,2], K.Yu. Khabarova[1,2], N.N. Kolachevsky[1,2]; [1]Russian Quantum Center, [2]Lebedev Physical Inst. RAS, Russia
Sub-Hz laser systems are vital for the most of precision spectroscopy experiments. Basic technique for laser stabilization is locking it to the eigen mode of Fabry-Perot cavity and the point is to create an ultra-stable cavity and frequency locking system with active compensation of noises. Major features and troubles one meets on the way to sub-Hz level will be discussed.

R4: Laser Beam Control

11:30 - 13:30
Session Chair: *V.Yu. Venediktov, St.-Petersburg State Electrotechnical Univ., St.-Petersburg State Univ., Russia*

TuR4-05 11:30-12:00
Controlling light with DMDs *(Invited paper)*
V. Rodriguez-Fajardo[1], S. Scholes[1], R. Kara[1], J. Pinnell[1], C. Rosales-Guzman[2], N. Mashaba[1], I, Nape[1], A. Forbes[1]; [1]Univ. of the Witwatersrand, South Africa; [2]Harbin Univ. of Science and Technology, China
Digital micro-mirror devices (DMDs) have emerged as a cost-effective and flexible alternative to traditional approaches for light control, such as spatial light modulators, diffractive optics and metamaterials. We will outline key aspects of their operation, recent progress in how to effectively use them to create and detect exotic states of light (particularly arbitrary vector beams) and to mimic turbulence.

TuR4-06 12:00-12:15
Rapid parallelization of tailored laser beams with acousto-optofluidics
S. Surdo[1], A. Zunino[1,2], A.Diaspro[1,2], M. Duocastella[1,3]; [1]Istituto Italiano di Tecnologia, Italy; [2]Univ. of Genoa, Italy; [3]Universitat de Barcelona, Spain
A novel tool for the simultaneous shaping and parallelization of a laser beam is presented. Our method exploits the interaction of light and ultrasound in a fluid to form tunable arrays of Gaussian, Bessel, or annular beams and selecting them at high speed. Integration of the acousto-optofluidic system into a laser workstation enables material processing at high-throughput and fast microscopy.

TuR4-07 12:15-12:30
Generation of vortex light fields using a sectorial spiral plate based on ferroelectric liquid crystals
S.P. Kotova[1], E.P. Pozhidaev[2], S.A. Samagin[1], A.M. Mayorova[1], A.A Pichkasova[1]; [1]Lebedev Physical Inst., Samara Branch, Russia; [2]Lebedev Physical Inst., Russia
The quality of axially symmetric vortex fields formation using a novel modulator is studied. The modulator is a 12-sectorial spiral plate operating due to the orientational Kerr effect in ferroelectric liquid crystals with a switching frequency of up to 2 kHz. The structure of the inhomogeneous state of light field polarization in the near and far diffraction zones is analyzed.
This research was supported by RFBR Grant(s) # 20-02-00671, 19-52-06005 MNTI_a

TuR4-08 12:30-13:00
Photonic hook – a new sub-wavelength-scale self-bending light beam *(Invited paper)*
I.V. Minin[1,2], O.V. Minin[1,2]; [1]Tomsk Politechnical Univ., [2]Tomsk State Univ., Russia
During the last couples of years, it was shown that an electromagnetic beam configuration can be bent after propagation through a Janus dielectric particle, which adds a new degree of simplicity for the generation of a wavelength-scaled curved light beam. This effect is termed as the ‘photonic hook’.
This research was supported by RFBR Grant(s) # 20-57-S52001

TuR4-09 13:00-13:15
Comparison of four methods of optical vortex registration
V.P. Aksenov, F.Yu. Kanev; Zuev Inst. of Atmospheric Optics SB RAS, Russia
Intensity zeros and wavefront singular points associated with zeros are characteristic features of laser beams distorted in a turbulent atmosphere. In the report we consider four methods of vortex registration, compare precision, and asses possibility of their application in experimental studies. We demonstrate movements of optical vortices in a beam propagating under conditions of free diffraction
This research was supported by RFBR Grant(s) # 18-29-20115\18

TuR4-10 13:15-13:30
Manipulation of microparticles using optical vortex fields and convective heat fluxes
S.P. Kotova[1], A.V. Korobtsov[1], N.N. Losevsky[1], A.M. Mayorova[1], D.V. Prokopova[1,2]; [1]Lebedev Physical Inst., Samara Branch; [2]Samara National Research Univ., Russia
New types of vortex optical traps are realized, as well as traps on the base of joint use of optical pressure forces and convective heat of a liquid. The capabilities of organizing areas of increased concentration of microparticles and clean areas, alignment in a predetermined spatial configuration of both transparent and absorbing microobjects were demonstrated.
This research was supported by RFBR Grant(s) # 20-02-00671, 19-32-90078

R4: Laser Beam Control

15:00 - 16:30
Session Chair: *V.Yu. Venediktov, St.-Petersburg State Electrotechnical Univ., St.-Petersburg State Univ., Russia*

TuR4-11 15:00-15:15
Hybrid adapitve nonlinear system correcting turbulent distortions on the atmpospheric path
F.Yu. Kanev[1], P.A. Konyaev[1], V.P. Lukin[1], I.A. Gorbunov[2], O.V. Kulagin[2]; [1]Inst. of Anmospeheric Optics SB RAS, [2]Inst. of Apllied Physics RAS, Russia
An adaptive system was elaborated to ensure laser radiation focusing on extended atmospheric paths, which implements a combination of nonlinear-optical detection and adaptive correction methods. A coherent detection and phase conjugation of weak optical signals were demonstrated for the distance more than 1 km. The numerical simulation of coherent signal detection and phase conjugation by adaptive optics was analyzed.

TuR4-12 15:15-15:30
Frequency stabilization of phase-conjugate state pulse laser by intracavity reflecting Bragg grating
I.S. Khakhalin[1], E.E. Popov[1,2], A.P. Pogoda[1], A.S. Boreysho[1], V.M. Petrov[2]; [1]Baltic State Technical Univ. «VOENMEH», [2]ITMO Univ., Russia
This paper presented a comparison of spectral properties between the phase conjugate laser with and without intracavity reflecting Bragg grating. It is shown that the Bragg grating narrows the lasing spectrum from 20.7 pm to 5.3 pm.

TuR4-13 15:30-15:45
Effect of waviness parameters of a wavefront on the laser beam quality
D.A. Yagnyatinskiy, V.N. Fedoseyev; LUCH FSUE, Russia
The research analyses the effect of parameters of the wavefront having form of waviness on laser beam quality. The revealed effect of sharp increase of divergence is detected and its conditions are determined. These conditions may serve as a criterion of divergence for the considered kind of the wavefront.

TuR4-14 15:45-16:00
Tailoring structured OAM beams for the detection of rotating objects
Shiyao Fu, Chunqing Gao; Beijing Inst. of Technology, China
In this report we will introduce our recent work on the detection of rotating objects through rotational Doppler shift from tailoring structured orbital angular momentum beams.

TuR4-15 16:00-16:15
Fluctuations of the orbital angular momentum at a partial interception of a laser beam in the turbulent atmosphere
V.P. Aksenov[1], V.V. Kolosov[1,2], G.A. Filimonov[1]; [1]Zuev Inst. of Atmospheric Optics SB RAS; [2]Tomsk Scientific Center SB RAS, Russia
Numerical simulation of the laser beam propagation in the turbulent atmosphere has been used to study the average and fluctuation characteristics of the orbital angular momentum (OAM) of a beam measured within a limited aperture. The statistical characteristics of OAM in a turbulent medium have been calculated.
This research was supported by RFBR Grant(s) # 18-29-20115\18

TuR4-16 16:15-16:30
1500 Hz phase correction of dynamic turbulent distortions of the laser beam
A.L.Rukosuev[1], F.A. Starikov[2], M.V. Volkov[2], V.A. Bogachev[2], A.A. Khlebnikov[2], A.N.Nikitin[1]; [1]Inst. of Geosphere Dynamics RAS, [2]Inst. of Laser Physics (ILFI RFNC-VNIIEF), [3]Moscow Polytechnic Univ., Russia
Experiments and numerical simulations of the phase correction of laser beam turbulent distortions have been carried out by using the adaptive optical system with the bandwidth of 1500 Hz. It has been shown that the bandwidth of adaptive optical system should be an order of magnitude greater than the bandwidth of the turbulent distortions for the effective correction.

R4: Laser Beam Control

17:00 - 19:00
Session Chair: *V.Yu. Venediktov, St.-Petersburg State Electrotechnical Univ., St.-Petersburg State Univ., Russia*

TuR4-17 17:00-17:30
A broadband lithium niobate integrated optical modulators: advances and perspectives *(Invited paper)*
V.M. Petrov[1], A.V. Shamrai[2]; [1]ITMO Univ., [2]Ioffe Inst., Russia
A comprehensive overview of lithium niobate integrated optical modulators are presented. The basic principles of operation, achieved parameters, fundamental limitations and requirements of modern applications are considered.

TuR4-18 17:30-17:45
Optical films based angular filters for microlasers
L. Grineviciute[1], C. Babayigit[2], D. Gailevičius[3,4], M. Turduev[5], V. Purlys[3,4], T. Tolenis[1], H. Kurt[2], K. Staliunas[6,7]; [1]Center for Physical Sciences and Technology, Lithuania; [2]TOBB Univ. of Economics and Technology, Turkey; [3]Vilnius Univ., Lithuania; [4]Femtika LTD, Lithuania; [5]TED Univ., Turkey; [6]ICREA, Spain; [7]UPC, Terrassa (Barcelona), Spain
We propose a novel method of fabrication of Photonic Crystal Spatial Filters using a Vapor Deposition method on microstructured surfaces. Such spatial filters –layers of around 10 micron thickness, are very useful for intracavity filtering in microlasers.

TuR4-19 17:45-18:00
Nonlinear transmission of V2O3 films under the influence of IR laser irradiation
I.M. Belousova[1], O.B. Danilov[1], S.I. Klement'ev[1], V.A. Klimov[2], I.I. Shaganov[1], E.B. Shadrin[2], A.P. Zhevlakov[1]; [1]Vavilov State Optical Inst., [2]Ioffe Inst., Russia
Nonlinear optical structures based on V2O3 films on Al2O3 substrate were synthesized by laser ablation. Sample placed in the nitrogen filling cryostat with optical windows have operated in temperature T=70-300 K. It was irradiated by nanosecond laser pulses at wavelength of 4.8 mkm. Reduction pulse energy of 350 mkJ obtained experimentally at T=140 K have exceeded 22 times.

TuR4-20 18:00-18:15
Matrix acousto-optic devices for spatial controlling of laser beams
V.Ya. Molchanov, K.B. Yushkov; National Univ. of Science and Technology MISIS, Russia
New dispersive matrix acousto-optic method for phase control of the laser wavefront of pulsed laser radiation is proposed. The matrix rows are formed by independent acoustic beams generated by a multichannel transducer. Each matrix element within the rows is formed by one-dimensional spatial ultrasonic beam structure having amplitude and frequency modulation.
This research was supported by RFBR Grant(s) # 18-07-00670

TuR4-21 18:15-18:30
Tapered-core silver halide MOFs
E.A. Korsakova, N.A. Muftahitdinova, L.V. Zhukova, A.S. Korsakov; Ural Federal Univ., Russia
We fabricated IR silver halide tapered-core microstructured optical fibers. One of the advantages of obtained fiber is its constant outer diameter, which makes the fiber more robust. We investigated some properties of this fiber. It was revealed that it allows delivering signals in both directions with a quite high percentage. We propose such MOFs for scanning near-field infrared microscopy.

TuR4-22 18:30-18:45
Coherent acoustic phonons in optical limiting
V. V. Danilov[1], A. S. Kulagina[2,3] A. I. Khrebtov[2]; [1]St. Petersburg State Transport Univ., Russia; [2]St. Petersburg Academic Univ. Russia; [3]Ioffe Inst., Russia
The results of measurements of the nonlinear kinetics of QDs when excited by 20 ps laser pulses of various intensities are presented. It was found that the front of the obtained kinetics is modulated by vibrations of the order of the excitation pulse duration. Determined, that the frequency and amplitude of these oscillations depend on the laser intensity.
This research was supported by RFBR Grant(s) # not supported

TuR4-23 18:45-19:00
Optical technologies for laser mirrors production developed at R&DI "Polyus"named M.F.Stelmack
V.V. Azarova, Yu.D. Golyaev, E.V. Kuznetsov; JSC RDI "Polyus ", Russia
Technologies for obtaining precision optical surfaces of substrates with sub nanometer roughness and methods for their control are discussed. IBS method, are considered. Metrological features of absorption measurement in multilayer thin-film interference mirrors and technological methods for reducing it are discussed.

R5: Super-Intense Light Fields and Ultra-Fast Processes

11:30 - 13:30
Session Chair: *A.A. Andreev, St. Petersburg State Univ., Russia; ELI-ALPS Inst., Hungary*

TuR5-01 11:30-12:00
Towards single-cycle relativistic optics at high repetition rate *(Invited paper)*
M. Ouillé[1,2], A. Vernier[1], D. Gustas[1], Z. Cheng[1], M. Lozano[1], J.P. Rousseau[1], A. Blumenstein[3], P. Simon[3], S. Haessler[3], J. Faure[3], T. Nagy[4], R. Lopez-Martens[1]; [1]Laboratoire d'Optique Appliquée, CNRS, Ecole Polytechnique, ENSTA Paris, Institut Polytechnique de Paris, France; [2]Ardop Engineering, Cité de la Photonique, France; [3]Laser-Laboratorium Göttingen e.V., Germany; [4]Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany
We report on a near-single-cycle near-infrared light source that can be focused to relativistic intensity at 1kHz. Thanks to this unique source capability, we observe first experimental indications of light waveform effects in laser-wakefield acceleration of relativistic energy electrons

TuR5-02 12:00-12:15
Electric field area and short pulses interaction with electrons
N.N. Rosanov[1,2], I.A. Aleksandrov[3], D.A, Tumakov[3], A. Kudlis[2]; [1]Ioffe Inst., Russia; [2]ITMO Univ., Russia;[3] – St. Petersburg State Univ., Russia
We present a solution to the problem of determining the electric area of a field created in a vacuum by an accelerated charge motion. We reveal the decisive role of the electric area value in the efficiency of the effect of extremely short laser pulses on electrons at the classical and quantum levels.

TuR5-03 12:15-12:30
Raman compression of laser pulses without frequency modulation
A.A. Balakin, G.M. Fraiman, D.S. Levin, S.A. Skobelev; Inst. of Applied Physics RAS, Russia
The possibility of suppressing parasitic Raman amplification of plasma noises has been studied by creating plasma with an ionizing laser pulse injected co-directionally with seed one and slightly ahead of it. The critical delay between the ionization front and the seed laser pulse was estimated and confirmed by three-dimensional numerical simulations.

TuR5-04 12:30-12:45
Experimental studies on plasma physics and particle acceleration with ultra-intense lasers
M.V. Starodubtsev[1], A.A. Soloviev[1], K.F. Burdonov[1,2], V.N. Ginzburg[1], E.A. Khazanov[1], A.A. Kochetkov[1], A.A. Kuzmin[1], I.A. Shaykin[1], A.A. Shaykin[1], I.V. Yakovlev[1], A.D. Sladkov[1], A.V. Korzhimanov[1], G. Revet[1,2], S.N. Chen[2], S.A. Pikuz[3], I.Yu. Skobelev[3], S.N. Ryazantsev[3], M.A. Alkhimova[3], E.D. Filippov[3], T.A. Pikuz[3], A. Ciardi[4], B. Khiar[4], J. Fuchs[2]; [1]Inst. of Applied Physics RAS, Russia; [2]Ecole Polytechnique, Palaiseau, France; [3]JIHT RAS, Russia; [4]LERMA, Observatoire de Paris, France
Recent experimental results on laser-plasma interaction processes conducted at PEARL laser-plasma facility (IAP RAS) are reported. Main research fields described are related to the laser-driven proton and electron acceleration and to the laboratory astrophysics, namely to the interaction of high-velocity plasma flows with an ambient magnetic field.

TuR5-05 12:45-13:00
X-ray spectroscopy validation of ionization potential depression models in dense plasma created by petawatt laser pulses
A.S. Martynenko[1,2], S.A. Pikuz[1,2], S.N. Ryazantsev[1,2], I.Yu. Skobelev[1,2], I.E. Golovkin[3], C. Baird[4], N. Booth[5], L. Doehl[4], P. Durey[4], A.Ya. Faenov[1,6], D. Farley[4], R. Kodama[6,7], K. Lancaster[4], P. McKenna[8], C.D. Murphy[4], C. Spindloe[5], T.A. Pikuz[1,6], N. Woolsey[4]; [1]Joint Inst. for High Temperatures RAS, Russia, [2]National Research Nuclear Univ. «MEPhI», Russia, [3]Prism Computational Sciences, USA, [4]Univ. of York, UK, [5]Rutherford Appleton Lab., UK, [6]Osaka Univ., Japan, [7]Inst. of Laser Engineering, Osaka University, Japan, [8]Univ. of Strathclyde, UK
Density effects have great importance for studying the state of matter at high energies. The ionization potential depression effect for silicon ions generated with an ultrarelativistic optical laser was described and quantified for the first time. The "disappearance" of electronic states up to the state with a principal quantum number of n = 4 (inclusively) was demonstrated.

TuR5-06 13:00-13:15
High order mode structure of intense light fields generated in intense laser-foil interactions
P. McKenna[1], M. J. Duff[1], S. D. R. Williamson[1], R. Wilson[1], M. King[1], R. J. Gray[1], B. Gonzalez-Izquierdo[1], A. Higginson[1], Z. E. Davidson[1], R. Capdessus[1], N. Booth[2], S. J. Hawkes[2], D. Neely[2,1]; [1]Univ. of Strathclyde, [2]STFC Rutherford Appleton Laboratory, UK
Experimental results reported that demonstrate modifications to the polarisation and temporal properties of intense light measured at the rear of an ultrathin target foil irradiated by a relativistically intense laser pulse. The changes result from a superposition of coherent radiation, generated by a directly accelerated bipolar electron distribution, and the light transmitted due to the onset of relativistic self-induced transparency.

R5: Super-Intense Light Fields and Ultra-Fast Processes

14:30 - 16:30
Session Chair: *R.Lopez-Martens, LOA, France*

TuR5-08 14:30-15:00
Relativistic laser solid interaction with tailored preplasma: electron acceleration & gamma emission *(Invited paper)*
A. Savel'ev, Moscow State Univ., Russia
We present our recent experimental and numerical results on electron acceleration and gamma emission from the interaction of relativistic femtosecond laser pulse with solid target. Additional artificial nanosecond laser pulse created preplasma with the tailored density profile by adjusting its advancing time and intensity. We found out optimal condition for the generation of relativistic electron bunches and gamma flushes.
This research was supported by RFBR Grant(s) # 19-02-00104 A

TuR5-09 15:00-15:15
Increased flux of high energy particles and X-rays from relativistic nanostructured plasmas
K.A. Ivanov[1], N.S. Sukhanov[1], I.M. Mordvintsev[1], Yu.V. Kargina[1], I.M. Gavrilin[2], Yu.V. Nazarkina[2], D.A. Gozhev[1], R.V. Volkov1, S.A. Gavrilov[2], A.B. Savel'ev[1]; [1]Lomonosov Moscow State Univ., [2]National Research Univ. of Electronic Technology, Russia
In this work it was shown that the flux of charged particles may be significantly enhanced at relativistic high contrast femtosecond laser interaction with nanostructured targets. The effect of nanostructures shape and size onto the particles energy and angular distribution was studied. Manifold increase of hard X-ray flux was detected for high-Z targets opening the opportunity for fast X-ray imaging.

TuR5-10 15:15-15:30
Collimated MeV electron beam generation in the interaction of intense ultrashort laser pulse with a dense plasma and its applications
D.A .Gorlova[1,2], I.N.Tsymbalov[1,2], A.Yu.Zavorotniy[1], A.B.Savel'ev[1], V.G.Nedorezov[2]; [1]Lomonosov Moscow State Univ., [2]Inst. for Nuclear Research RAS, Russia
Generation of electron beam with 0.05 rad divergence and 2 MeV temperature in laser-solid interaction was experimentally demonstrated. Applications for nuclear photonics studies are also discussed.
This research was supported by RFBR Grant(s) # 19-020-00104, 20-32-70194

TuR5-11 15:30-15:45
Stochastic electron heating in micro-structured targets irradiated with intense laser radiation and applications
S.G. Bochkarev[1,2], D.A. Gozhev[1,3], N.I. Busleev[1], A.V. Brantov[1,2], S.I. Kudryashov[1], A.B. Savelev[3], and V. Yu. Bychenkov[1,2]; [1]Lebedev Physics Inst. RAS, [2]All-Russian Research Inst. of Automatics, [3]Lomonosov Moscow State Univ., Russia
The interaction of an ultrashort laser pulse of sub-relativistic intensity with an innovative high-average-density targets consisting of numerous sub-microwires and sheets was examined. The research demonstrates the stochastic nature of high-energy electron production in such targets. The considered laser-target design has a potential for use in compact laser-based neutron sources and warm dense matter research.
This research was supported by RFBR Grant(s) # 18-02-00452

TuR5-12 15:45-16:00
Acceleration of highly stripped ions by relativistic femtosecond laser pulse from nanoscale targets with contrast control
I.M. Mordvintsev[1,2], K.A. Ivanov[1,2], S.A. Shulyapov[1], A.B. Savel'ev[1,2], Yu.V. Kargina[1], I.M. Gavrilin[3]; [1]Lomonosov Moscow State Univ., [2]Lebedev Physical Inst. RAS, [3]National Research Univ. of Electronic Technology, Russia
The experimental results on the relativistic laser-plasma interactions of femtosecond laser pulse with bulk targets and contrast control and with nanoscale structured targets are presented. In experiments highly charged ions up to Si12+ and even fully stripped Si14+ were registered. A significant increase of ion energy and ion flux compared to experiment with clear Si were demonstrated.
This research was supported by RFBR Grant(s) # 18-32-00416, 19-020-00104

TuR5-13 16:00-16:15
X-ray generation from flat water jet irradiated by up to 120 mJ femtosecond laser pulse
M.O. Zhukova[1], E.A. Ponomareva[1], P.A. Sheglov[2], M.V. Chashin[2], A.N. Tcypkin[1], M.M. Nazarov[2]; [1]ITMO Univ., Russia; [2]Kurchatov Inst., National Research Center, Russia
X-ray measurements from 100 um flat water jet were done under the intense single-pulse pump of femtosecond laser with central wavelength 800nm, pulse repetition rate 10 Hz with varying energy up to 120 mJ, pulse duration together with chirp type and angle of incidence of IR radiation on the water surface.
This research was supported by RFBR Grant(s) # 18-02-40032

TuR5-14 16:15-16:30
Ultra-strong magnetic field generation in cluster gas irradiated by circularly polarized laser pulse
A.A. Andreev[1,2], Zs. Lecz[2]; [1]St. Petersburg State Univ., Russia; [2]ELI-ALPS, Hungary
The new mechanism to generate nanometer-scale magnetic dipoles is presented where strong axial magnetic field is sustained by electrons orbiting around spherical droplets after the interaction with intense circularly polarized laser pulse

R5: Super-Intense Light Fields and Ultra-Fast Processes

17:00 - 19:00
Session Chair: *M.V. Starodubtsev, Inst. of Applied Physics RAS, Russia*

TuR5-15 17:00-17:30
Laser-triggered generation of charge wave and related phenomena (invited) *(Invited paper)*
A.V. Brantov[1,2], V.Yu. Bychenkov[1,2]; [1]Lebedev Phisical Inst. RAS, [2]Dukhov Research Inst. of Automatics (VNIIA), Russia
Theoretical model which exploits idea that electron bunch crossing the boundary target-vacuum generates fast lateral skin current in the form of polarization wave has been developed. We also complement our theory with two simulation models, FDTD (Finite-Difference Time-Domain) and PIC (Particle-in-Cell) methods, in both of which distinctive features of the proposed theory are clearly manifested.

TuR5-16 17:30-17:45
Direct electron acceleration in the plasma channel with injection through the breaking of plasma waves of parametric instabilities
I.N. Tsymbalov[1], D.A. Gorlova[1], K.A. Ivanov[1,2], A.B. Savel'ev[1,2], V.Yu. Bychenkov[2]; [1]Lomonosov Moscow State Univ. [2]Lebedev Physical Inst. RAS, Russia
Efficient direct electron acceleration in the plasma channel with injection through the breaking of plasma waves generated by parametric instabilities was demonstrated experimentally and reproduced in the 2D3V PIC simulations.
This research was supported by RFBR Grant(s) # 19-32-60069, 20-32-70194

TuR5-17 17:45-18:00
Synchrotron gamma-rays radiation of high brightness from optimized laser-plasma acceleration
M.G. Lobok[1,2], I.A. Andriyash[3], O.E. Vais[1,2], V. Malka[3,4], V.Yu. Bychenkov[1,2]; [1]Lebedev Physics Inst. RAS, Russia; [2]Dukhov Research Inst. of Automatics (VNIIA), Russia; [3]Weizmann Inst. of Science, Israel; [4]Laboratoire d'Optique Appliquee, ENSTA-CNRS-Ecole Polytechnique, UMR7639, France
Synchrotron gamma-rays radiation is calculated for the electron bunch accelerated in non-linear self-trapping laser propagation regime in near critical density plasma. This regime shows high efficiency of laser energy conversion to gamma-rays and extremely hight brightness.

TuR5-18 18:00-18:30
QED effects in ultrafast laser-matter interactions near the PetaWatt power level *(Invited paper)*
Zs. Lecz[1], A.A. Andreev[1,2]; [1]ELI-ALPS, ELI-HU Nonprofit Ltd., Hungary; [2]Max-Born Inst. for Nonlinear Optics, Germany
We have investigated the generation of energetic particles (gamma photons or electron-positron pairs) near the lower threshold laser intensity of quantum electrodynamics processes. We concentrate on processes derived from the local constant field approximation, in particular on the Breit-Wheeler process, in laser mater interactions below 10^23 W/cm2 intensity.

TuR5-19 18:30-18:45
Resonant laser-assisted process of the electron-positron pairs annihilation and production
D.V. Doroshenko, V.V. Dubov, S.P. Roshchupkin; Peter the Great St. Petersburg Polytechnic Univ., Russia
We study resonant laser-assisted process of the electron-positron pairs annihilation and production. It is shown that resonant differential cross section can exceed the corresponding cross section without an external field (Bhabha cross section) by more than four orders of magnitude.

TuR5-20 18:45-19:00
Generation of unipolar pulses and their interaction with quantum systems
R.M. Arkhipov[1,2], M.V. Arkhipov[1], A.V. Pakhomov[3], I. Babushkin[4,5], N.N. Rosanov[2]; [1]St. Petersburg State Univ., Russia; [2]Ioffe Inst., Russia; [3]ITMO Univ., Russia; [4]Leibniz Univ. Hannover, Germany; [5]Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering-Innovation across Disciplines), Germany
In this talk, existence of unipolar pulses, methods of their generation and interaction with quantum objects are revised. The effective influence of unipolar pulses in comparison with bipolar pulses on quantum systems is shown. The question of mutual attraction and repulsion of unipolar impulses is also considered.
This research was supported by RFBR Grant(s) # 20-32-70049

R8: Nonlinear Photonics: Fundamentals and Applications

11:30 - 13:30
Session Chair: *V.I Makarov, Lomonosov Moscow State Univ., Russia*

TuR8-01 11:30-12:00
Nonlinear stage of modulational instability: towards a global understanding *(Invited paper)*
S. Trillo[1], G. Vanderhaegen[2], C. Naveau[2], P. Szriftgiser[2], M. Conforti[2], A. Kudlinski[2], A. Mussot[2]; [1]Univ. of Ferrara, Italy; [2]Univ. Lille, CNRS, UMR[8]523 - PhLAM - Physique des Lasers Atomes et Molecules, France
Modulational instability in its depleted stage of evolution is shown to exhibit rich and complex behaviors that range from symmetry breaking of recurrent evolutions, which is experimentally observed, to breakdown of recurrence mediated by coexistence of breather pairs with an expanding auto-modulation region.

TuR8-02 12:00-12:30
Light beams and soliton dynamics in quadratically nonlinear waveguides with gain and loss *(Invited paper)*
F.Kh. Abdullaev; Physical-Technical Inst., Uzbekistan Academy of Sciences, Uzbekistan
The dynamics of the light beams and solitons in active waveguides with quadratic nonlinearity is studied. Exact solutions for beams and solitons are obtained. Stationary, periodic and chaotic regimes for beams are identified for a single waveguide and a coupler in a presence of gain/losses.

TuR8-03 12:30-12:45
Three - waves self-trapping in a medium with quadratic nonlinear response
V.A. Trofimov[1], D.M. Kharitonov[2], M.V. Fedotov[2]; [1]South China Univ. of Technology, China; [2]Lomonosov Moscow State Univ., Russia
We found out new scenario of self-trapping of three pulses at fundamental, doubled and triple frequencies in a medium with a quadratic nonlinear response. Under the special condition, the propagation of waves at fundamental and at triple frequencies occurs without frequency conversion between all pulses and may occur without changing of the pulse shape.

TuR8-04 12:45-13:00
Spectra modification of first and second harmonic in the two-color filament of terawatt laser radiation
M.V. Chaschin, M.M. Nazarov; NRC "Kurchatov Inst.", Russia
The process of two-color filamentation is of great interest, especially for TW power. The dependence of 30-fs, 60 mJ pulse fundamental spectra at 800 nm and of its second harmonic on radiation properties and on gas pressure were studied. Spectra broadening and central frequency shift is observed for both 800 and 400 nm but in a different manner
This research was supported by RFBR Grant(s) # 18-52-16024, 18-02-00952

TuR8-05 13:00-13:15
Robust multifilament arrays using Dammann phase grating
D.V. Pushkarev[1], A.S. Lar'kin[1,2], E.V. Mitina[1], D.S. Uryupina[1], R.V. Volkov[1,2], S.V. Karpeev[3,4], S.N. Khonina[3,4], A.A. Karabutov[1,2], O.G. Kosareva[1,2] and A.B. Savel'ev[1,2]; [1]Lomonosov Moscow State Univ.; [2]International Laser Center of Lomonosov Moscow State Univ.; [3]Image Processing Systems Inst. RAS; [4]Samara State Aerospace Univ., Russia
We demonstrate a novel approach to create regular multifilament arrays under additional focusing by use of a Dammann grating. The employment of Dammann grating offers an advantage over the Hermite-Gaussian phase plates in terms of multifilament array robustness and resistance to beam imperfections and fluctuations.
This research was supported by RFBR Grant(s) # 18-52-16020, 18-32-00949

TuR8-06 13:15-13:30
The formation of optical vortices beyond phase plate and their breakdown during filamentation
A.A. Dergachev, F.I. Soyfer, S.A. Shlenov; Lomonosov Moscow State Univ., Russia
We numerically studied the transformation of Gaussian beam passed through phase plate with singularity into vortex beam. The modulation instability development in the vortex beam was studied for different noise parameters.
This research was supported by RFBR Grant(s) # 18-02-00624

R8: Nonlinear Photonics: Fundamentals and Applications

14:30 - 16:30
Session Chair: *S.A. Kozlov, ITMO Univ., Russia*

TuR8-07 14:30-15:00
Giant Kerr nonlinearity, slow-light bullets & vortices, and their active manipulation in Rydberg atomic gases *(Invited paper)*
Guoxiang Huang; East China Normal Univ. and New York Univ. Shanghai, China
Due to the strong atom-atom interaction, a cold Rydberg gas has giant Kerr nonlinearity; Rydberg-EIT has faster response; allows to realize stable (3+1)D optical bullets with slow velocity and low power; may be stored with high efficiency and fidelity.

TuR8-08 15:00-15:15
Ultrafast manipulation of a strongly-coupled light-matter system by a giant ac Stark effect
D. Panna[1], N. Landau[1], L. Gantz[1], L. Rybak[1], S. Tsesses[1], G. Adler[1], S. Brodbeck[2], C. Schneider[2], S. Hoefling[2], A. Hayat[1]; [1]Technion - Israel Inst. of Technology, Israel; [2]Universität Würzburg, Germany
We demonstrate experimentally non-perturbative modulation of a strongly coupled light-matter system – stronger than the Rabi energy, allowing for a wide range of applications, such as ultrafast all-optical polaritonic switches and phase imprinting on polariton condensates.

TuR8-09 15:15-15:30
High-efficiency low-coherent second-harmonic generation
Xiaohui Zhao, Lailin Ji, Dong Liu, Yanqi Gao; Shanghai Inst. of Laser Plasma, China
Considering the instantaneous broadband characteristics, we establish a model of second-harmonic generation (SHG) of a low-temporal-coherent pulse and reveal its differences from the coherent conditions. We propose a method for realizing low-coherent SHG with high efficiency and broad bandwidth, and experimentally demonstrate a conversion efficiency up to 70% with a bandwidth of 3.1 THz.

TuR8-10 15:30-16:00
Transformation of the orbital and spin parts of the angular momentum of laser beams in the course of their interaction in nonlinear gyrotropic media in the framework of classical electrodynamics *(Invited paper)*
V.A. Makarov[1,2], V.A. Dukov[1], K.S. Grigoriev[1,2], V.M. Petnikova1; [1]Lomonosov Moscow State Univ.; [2]International Laser Center, Lomonosov Moscow State Univ., Russia
Nonlinear optical mixing of light waves, carrying both orbital and spin angular momentum, can lead to conversion between spin and orbital angular momenta of the fundamental and signal photons. From this point of view, a number of classical problems of nonlinear optics of media with local and nonlocal nonlinear response were studied analytically and numerically.
This research was supported by RFBR Grant(s) # 19-02-00069

TuR8-11 16:00-16:15
Nonlinear effects in synthetic frequency dimension created by electro-optical modulation of a ring resonator
A. Tusnin, A. Tikan, T.J. Kippenberg; École Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Considering a chi^3 optical resonator with synthetic frequency dimension created by electro-optical modulation, we investigate dynamics of Turing patterns, chaotic MI, chimera states, and solitons. We discovered that modulation breaks the translation symmetry and leads to formation of solitons in predictable position. Also, there exists a critical value of coupling for which new stable states appear instead of chaotic MI.

TuR8-12 16:15-16:30
Double-resonant SFG of blue light with near-unity quantum conversion efficiency
H. Kerdoncuff[1], J.B. Christensen[1], T.B. Brasil[2,3], V.A. Novikov[2], E. Polzik[2], J. Hald[1], M. Lassen[1]; [1]Danish Fundamental Metrology, Denmark; [2]Niels Bohr Inst., Univ. of Copenhagen, Denmark; [3]Instituto de Física, Universidade de São Paulo, Brazil
Near-unity quantum conversion efficiency using sum frequency generation. The SFG system shows great potential for quantum frequency conversion for hybrid quantum system and networks.

R8: Nonlinear Photonics: Fundamentals and Applications

17:00 - 18:45
Session Chair: *S.A. Kozlov, ITMO Univ., Russia*

TuR8-13 17:00-17:30
A journey from the Kerr to Chi_2 frequency combs in microresonators *(Invited paper)*
D. Skryabin, Univ. Bath, UK
To be added

TuR8-14 17:30-17:45
Measurement of frequency tuning curves of soliton self-injection locking to a nonlinear microresonator
A.S. Voloshin[1], Junqiu Liu[2], N.M. Kondratiev[1], G.V. Likhachev[2], S.E. Agafonova[1], T.J. Kippenberg[2], I.A. Bilenko[1,3]; [1]Russian Quantum Center, Russia; [2]Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland; [3]Lomonosov Moscow State Univ., Russia
Self-injection locking effect eliminates the need for bulky narrow-linewidth, tunable, continuous-wave laser for pumping of high-Q optical microresonators, utilizing bare laser diodes. Here we propose an experimental technique, which allows measuring the main characteristic of self-injection locking, a frequency tuning curve. We measure tuning curves of locking to linear and nonlinear microresonators and compare them to the theoretical model.

TuR8-15 17:45-18:00
Precision optical spectroscopy using the compact source of optical frequency combs
S.E. Agafonova[1,2], G.V. Lihachev[3], S.N. Koptyaev[4], A.S. Gorodnitskiy[1,2], A.S. Voloshin[1]; [1]Russian Quantum Center (RQC), [2]Moscow Inst. of Physics and Technology, Russia; [3]Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland; [4]Samsung R&D Inst., Russia, SAIT-Russia Laboratory, Russia
We design microcomb sources and implement them to the spectroscopy of liquids. A combination of crystalline or on-chip microresonators with compact laser diodes provides a significant reduction in the size of the generator, broad spectra, and accuracy of determining glucose concentration in aqueous solution better than 5%. Our result is promising for the creation of wearable devices such as glucometers.

TuR8-16 18:00-18:15
Two-color platicons in χ(2) optical microresonators
V.E. Lobanov[1], N.M. Kondratiev[1], A.E. Shitikov[1,2], K.N. Min'kov[1], I.A. Bilenko[1,2]; [1]Russian Quantum Center; [2]Lomonosov Moscow State Univ., Russia
We demonstrated numerically generation of two-color flat-top solitonic pulses, platicons, in quadratically-nonlinear optical microresonators for both second harmonic generation and downconversion processes. It was shown that platicon excitation can be realized using pump amplitude modulation or controllable mode interaction approach. Excitation conditions and platicon generation domains were found. Properties of generated platicons were studied for different combinations of medium parameters.

TuR8-17 18:15-18:30
Numerical study of self-injection-locked Kerr frequency comb generation in WGM microresonator
N.M. Kondratiev[1], V.E. Lobanov[1], A.S. Voloshin[1], I.A. Bilenko[1,2]; [1]Russian Quantum Center; [2]Lomonosov Moscow State Univ., Russia
We propose that the problem of tuning to soliton comb state and frequency comb generation in normal dispersion regime can be efficiently solved by the self-injection locking of the pump laser to the nonlinear microresonator. We developed original model describing the process of frequency comb generation in the self-injection locking regime and performed numerical modelling of this process.

TuR8-18 18:30-18:45
Opposite direction pulse train propagation modelling in ring nonlinear microcavity
V.A. Razukov, L.A. Melnikov; Yuri Gagarin State Technical Univ. of Saratov, Russia
"Cabaret" scheme allows fast and precise simulating of long temporal dynamics of the microcavities with GVD, cross- and self-phase modulation taken into consideration. Proposed scheme and model allow investigating cavity dynamics with two counter-propagating pulse trains with second-order dispersion and modulation instability, Rayleigh scattering and other effects such as Raman and SB Scattering and linear wave coupling as required.

R9: Optical Nanomaterials

11:30 - 13:00
Session Chair: *V.G. Dubrovskii, Ioffe Inst., ITMO Univ., Russia*

TuR9-01 11:30-12:00
Composition dependence of the wurtzite-zinc blende crystal phases in InGaAs nanowires *(Invited paper)*
J. Johansson, E.D. Leshchenko; Lund Univ., Sweden
Not available

TuR9-03 12:00-12:15
Si doping of GaAs nanowires: MBE versus HVPE
H. Hijazi[1,2], I. V. Shtrom[3], G. Monier[1], E. Gil[1], A. Trassoudaine[1], C. Bougerol[4], C. Leroux[5], D. Castellucci[1], C. Robert-Goumet[1], Philip E. Hoggan[1], Yamina André[1], N. I. Goktas[6], R. R. LaPierre[6], V. G. Dubrovskii[2]; [1]Université Clermont Auvergne, CNRS, SIGMA Clermont, Institut Pascal, France; [2]ITMO Univ., Russia; [3]St. Petersburg State Univ., Russia; [4]Université Grenoble Alpes, CNRS, Institut Néel, France; [5]Université de Toulon, AMU, CNRS, IM2NP, CS[6]0584, France; [6]McMaster Univ., Canada
We study theoretically and experimentally Si doping of GaAs nanowires conditions and show that p-type doping is explained by low As concentrations in the droplet, which favors Si incorporation into As sites. We find that increasing Si concentration up to ~ 5% in hydride vapor phase epitaxy enables n-type Si doping of GaAs nanowires in this technique.
This research was supported by RFBR Grant(s) # 18-02-40006, 19-52-53031, 20-02-00351

TuR9-04 12:15-12:30
Stopping effect in growth kinetics of III-V nanowires
D.P. Wilson[1,2], F. Glas[3], R.R. LaPierre[2], V.G. Dubrovskii[1]; [1]ITMO Univ., Russia; [2]McMaster Univ., Canada; [3]Centre for Nanoscience and Nanotechnology, CNRS, Univ. Paris-Sud, France
We present a model for the growth kinetics of III-V nanowires which describes the time evolution of the monolayer coverage and the group V concentration in the droplet. We emphasize the stopping effect at low group V concentrations, where a 2D island initially forms rapidly and then the monolayer is completed at the droplet rate of refill from vapor.
This research was supported by RFBR Grant(s) # 18-02-40006, 19-52-53031, 20-02-00351.

TuR9-05 12:30-12:45
Stress field in core-shell nanowires with 3D dilatational eigenstrain prism core
S.A. Krasnitskii[1,2,3], A.M. Smirnov[1], M.Yu. Gutkin[1,2,3], A.E. Romanov[1]; [1]ITMO Univ.; [2]Inst. of Problems of Mechanical Engineering RAS; [3]Peter the Great St. Petersburg Polytechnic Univ., Russia.
We report on the misfit stress filed in nanowire heterostructures with an eccentric prism core of an arbitrary rectangular cross section subjected to 3D dilatational eigenstrain; such structures can be considered as key components of nano LEDs and LDs. The stress filed is found in closed form, which is convenient for the development of theoretical models describing relaxation processes.

TuR9-06 12:45-13:00
N-based nanostructures on silicon for optoelectronic applications
R.R. Reznik[1,2,3,4], K.P. Kotlyar[1], A.I. Khrebtov[2], N.V. Kryzhanovskaya[1], G.E. Cirlin[1,3]; [1]St. Petersburg Academic Univ., – Nanotechnology Research and Education Centre RAS, [2]ITMO Univ., [3]Inst. for Analytical Instrumentation RAS, [4]St. Petersburg State Univ., Russia
A possibility of InGaN nanostructures of a branched morphology MBE growth on Si substrate has been demonstrated. The results of morphological studies have shown that InGaN synthesis occurs in several stages. InGaN nanostructures turned out to be optically active at room temperature and have a wide radiation visible range. In addition, other N-based NWs were synthesized and studied
This research was supported by RFBR Grant(s) # 18-32-00768 mol_a

R9: Optical Nanomaterials

14:30 - 16:30
Session Chair: *V.G. Dubrovskii, Ioffe Inst., ITMO Univ., Russia*

TuR9-07 14:30-14:45
GaAs nanowires: advanced material for non-linearphotonics
I.V. Shtrom[1], I. Ilkiv[1,2] , R.R. Reznik[3] G.E. Cirlin[2,4], L. Lang[5], C. Renaut[5], F. Timpu[5], R. Grange[5]. M. Timofeeva[5]; [1]St. Petersburg State Univ., [2]St. Petersburg Academic Univ., [3]ITMO Univ., [4]Inst. for Analytical Instrumentation RAS, Russia; [5]ETH Zurich, Switzerland
We present GaAs nanowires grown by molecular beam epitaxy as advanced material for non-linear photonics applications.

TuR9-08 14:45-15:00
Analysis of filtering features based on simple geometry metasurfaces
E.A. Efremova[1], I.R. Krylov[2], U.V. Prokhorova[2], E.V. Shalymov[3], V.I. Shoev[1], S.S. Vergeles[4], A.A. Zinchik[1]; [1]ITMO Univ., [2]St. Petersburg State Univ., [3]St. Petresburg Electrotechnical Univ., [4]Landau Inst. for Theoretical Physics, Russia
Our work considers the optimal ways to construct both ultranarrow as comb-spectrum filter based on resonance metasurfaces with simple geometries.

TuR9-09 15:00-15:15
Axial heterostructure formation in GaInP nanowires
A.A. Koryakin, V.G. Dubrovskii; ITMO Univ., Russia
In this paper we present the results of modeling of InP/GaInP axial heterostructure formation in self-catalyzed GaInP nanowires. The elastic stresses produced due to the lattice mismatch between monolayers are considered in the model. The composition profiles of the InP/GaInP heterostructure are calculated for different growth conditions of GaInP nanowire growth.

TuR9-10 15:15-15:30
Excitons in polyyne carbon chains
S. Kutrovskaya1,2,3, A. Osipov3,4, A. Povolotskiy5, V. Samyshkin3,5, P. Lagoudakis6,7, A. Kavokin1,2,7, A. Kucherik3 [1]School of Science, Westlake University,[1]8 Shilongshan Road, Hangzhou[3]10024, China [2]Institute of Natural Sciences, Westlake Institute for Advanced Study,[1]8 Shilongshan Road, Hangzhou[3]10024, China [3]Department of Physics and Applied Mathematics, Stoletov Vladimir State University,[6]00000 Gorkii street, Vladimir, Russia [4]ILIT RAS — Branch of FSRC "Crystallography and Photonics" RAS,[1] Svyatoozerskaya, Shatura,[1]40700, Moscow region, Russia [5]Institute of Chemistry, St. Petersburg State University,198504, Ulianovskaya str.[5], St. Petersburg, Russia [6]Skolkovo Institute of Science and Technology,[3]0 Bolshoy Boulevard, bld.[1,] [1]21205 Moscow, Russia [7]Physics and Astronomy, University of Southampton, Highfield, Southampton, SO171BJ, United Kingdom
We synthesis long carbon chains stabilized by gold nanoparticles by laser fragmentation in liquid media. Resulting nano-objects are identified as polyynes. The observation of strong and narrow exciton resonances in PL spectra of monoatomic carbon chains paves the way to their applications in nano-lasers and single photon emitters.
This research was supported by RFBR Grant(s) # 17-32-50171, 18-32-20006, 19-32-50095

TuR9-11 15:30-15:45
Femtosecond-laser lithography on halide perovskite thin films for advanced nanophotonic applications.
A.A. Kuchmizhak[1,2], A.Yu. Zhizhchenko[1,2], S.V. Makarov[3]; [1]Far Eastern Federal Univ.; [2]Inst. of Automation and Control Processes FEB RAS; [3]ITMO Univ., Russia
We demonstrate novel approach for 3D micropatterning of perovskite films via direct femtosecond-laser projection lithography. Whereas the majority of previous works used laser processing only for rough cutting of perovskite materials at microscale, here by using advanced laser beam engineering and multi-pulse processing we showed capability of flexible non-destructive processing of perovskites at sub-diffraction resolution down to 250 nm.

TuR9-12 15:45-16:00

Flexible suspended membranes of GaP nanowires

Y. Berdnikov[1], V. Neplokh[2,3], V. Fedorov[2,3], A. D. Bolshakov[2], V. Yu. Mikhailovskii[4], D. Mitin[2,3], A. G. Nasibulin[5], R. M. Islamova[4], G.E. Cirlin[1,2], I. S. Mukhin[1,2] and V. G. Dubrovskii[1]; [1]ITMO Univ., [2]St. Petersburg Academic Univ., [3]Peter the Great St. Petersburg Polytechnic Univ., [4]St. Petersburg State Univ., [5]Skolkovo Inst. of Science and Technology, Russia

We report the fabrication of flexible membranes with semiconductor nanostructures which consist of three major steps: (i) self-catalyzed growth of GaP nanowires (NW) by molecular beam epitaxy, (ii) NW encapsulation in specifically designed polymer (iii) preparation of flexible contacts made of single-wall carbon nanotubes. The obtained nanostructures have potential applications in high quality flexible inorganic optoelectronic devices.

TuR9-13 16:00-16:15

GeTe thin film – material for optic devices of mid and far-infrared ranges

V.V. Ionin, N.N. Eliseev, A.A. Burtsev, A.V. Kiselev, M.A. Pankov, V.A. Mikhalevsky, A.A. Lotin; Inst. on Laser and Information Technologies RAS - Branch of Federal Scientific Research Center "Crystallography and Photonics" RAS, Russia

Thin film phase-change materials (PCM) based on germanium telluride (GeTe, GeSbTe, GeSbSeTe) are widely used in photonic devices. In this work, we studied thin films GeTe grown on substrates with different temperatures; the obtained spectral and electrophysical characteristics of such films demonstrate a strong dependence on the growth conditions.

This research was supported by RFBR Grant(s) # 19-29-12024

TuR9-14 16:15-16:30

Influence of thermal effects onto the process of self-assembly of quantum dots by quasi-resonant laser radiation

V.A.Tkachenko[1], A.S. Tsipotan[2], A.S. Aleksandrovsky[2,3], V.V. Slabko[2]; [1]Polytechnic Inst., Siberian Federal Univ., [2]Inst. of Engineering Physics and Radio Electronics, Siberian Federal Univ., [3]Kirensky Inst. of Physics Federal Research Center SB RAS, Russia

The process of aggregation of two colloidal quantum dots in the field of quasiresonant laser radiation is investigated via computer simulation. The cases of either completely deterministic movement of particles or the movement with the account for random forces are considered.

R9: Optical Nanomaterials

17:15 - 18:30
Session Chair: *V.G. Dubrovskii, Ioffe Inst., ITMO Univ., Russia*

TuR9-16 17:15-17:30
Luminescent sensors based on porphyrin fluorophores in hybrid nanostructures
A.V. Povolotskiy, D.A. Lukianov, O.S. Smirnova, A.A. Kireev, A.A. Kalinichev, A.V. Povolotckaia, O.A. Kopytko, A.S. Konev; St. Petersburg State Univ., Russia
We report on the temperature dependence of the photoemission properties of porphyrins and porphyrin dyads. Along temperature-sensitive emission band, temperature independent band is observed, enabling the development of ratiometric luminescent thermometer with accuracy of 0.2 °C. The experiments performed in the presence of triplet oxygen and in deoxygenated solutions suggest redox processes to underlie the observed thermosensitive emission response.

TuR9-17 17:30-17:45
Nanostructured elements for holographic solar concentrators and laser beams splitters
P.P. Sokolov, N.D. Vorzobova; ITMO Univ., Russia
The fabrication conditions and the properties of nanostructured elements for holographic solar concentrators are given, which determine the possibility of using solar energy in a wide range of incidence angles without tracking and increasing the efficiency at great incidence angles. The conditions for obtaining multichannel controlled laser beam splitters in new polymer material are determined.

TuR9-18 17:45-18:00
Nitrogen-vacancy nanodiamond for detection of vacuum ultraviolet, extreme ultraviolet and X-Ray
H.-C. Luo[1], J.-I. Lo[1], Y.-C. Peng[1], B.-M. Cheng[1], H.-C. Chang[2]; [1]Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, and Tzu-Chi Univ. of Science and Technology; [2]Inst. of Atomic and Molecular Sciences, Academia Sinica, Taiwan
Nitrogen-vacancy nanodiamonds emit light in wavelength region 550-750 nm upon excitation by VUV/EUV/X-radiations. The superb photostability and broad applicability of nitrogen-vacancy nanodiamonds offer a promising solution for the long-standing problem of lacking a robust and reliable detector for VUV, EUV, and X- radiations.

TuR9-19 18:00-18:15
Plasmonic nanostructures: sensitive detectors based on resonant plasmon-exciton interactions
V.F. Askirka, I.G. Motevich, S.A. Maskevich, N.D. Strekal; Belarusian Univ., Belarus
Dealing with metal plasmonic particles of several nanometers and the distances between them of the same value compared with quantum dot size gives the opportunity of "dressed photon" theory implementation. Particle of nanoscale size being exposed by ordinary propagating light generates near its surface optical non-propagating near-field and scatter energy after that into the far-field achieving significant emission enhancement.

TuR9-20 18:15-18:30
THz lasing by hyperbolic graphene-multilayer metamaterials: gain saturation effect
O.N. Kozina[1], L.A. Melnikov[2], I.S. Nefedov[3]; [1]Kotel'nikov Inst. of Radio-Engineering and Electronics RAS, Saratov Branch, Russia; [2]Yuri Gagarin State Technical Univ. of Saratov, Russia; [3]Aalto Univ., Finland
Theoretical investigation of THz wave lasing in the cavity with hyperbolic active media is present. The effect of enhancement of the THz radiation is proved. The intensity of THz radiation, the frequency of oscillations and intensity of the gain saturation are calculated.

R1: Solid-State Lasers

14:30 - 16:30 **Fiber lasers**
Session Chair: Uwe Morgner,
Ultrafast Laser Optics Inst. für Quantenoptik Leibnitz Univ., Germany

WeR1-22 14:30-15:00
Multi-GHz burst-mode fiber lasers *(Invited paper)*
F.Ö. Ilday; Bilkent Univ., Turkey
Ultrafast lasers with GHz repetition rates is necessary to access the highly efficient ablation-cooled lasermaterial processing regime. Burst-mode operation allows access to such high repetition rates at microjoule-level pulse energies without needing kW-level average powers. This talk will review the development of the first femtosecond burst-mode fiber lasers to date.

WeR1-23 15:00-15:15
All-fiber 1.9 um ultrafast amplifier based on normal dispersion thulium-doped fiber and large mode area silica fiber compressor
V.S. Voropaev[1], D.T. Batov[1], A.I. Voronets[1], D.S. Vlasov[1], A.I. Donodin[2], M.K. Tarabrin[1,3], V.A. Lazarev[1], A.M. Khegai[4], M.E. Likhachev[4], M.V. Yashkov[5] , V.E. Karasik[1]; [1]Bauman Moscow State Technical Univ., Russia; [2]Aston Univ., UK; [3]Lebedev Physical Inst. RAS, [4]Fiber Optics Research Center RAS, [5]Inst. of Chemistry of High-Purity Substances RAS, Russia
All-fiber ultrafast amplifier at the wavelength of 1.9 um based on normal dispersion thulium-doped germanosilicate fiber and large mode area silica fiber compressor is developed. Pulses at the repetition rate of 23.9 MHz with the duration of 63 fs and the pulse energy of 25 nJ are obtained. We assume that the pulse peak power is 250 kW.
This research was supported by RFBR Grant(s) # 18-38-00927

WeR1-24 15:15-15:30
Multiregime pulse fiber laser based on electrochemically gated carbon nanotube saturable absorber
A. A. Mkrtchyan[1], Yu. Gladush[1], D. Kopylova[1], A. Ivanenko[2], B. Nyushkov[2], S. Kobtsev[2], A. Kokhanovskiy[2], A. Khegai[3], M. Melkumov[3], M. Burdanova[4], M. Staniforth[4], J. Lloyd-Hughes[4], A. G. Nasibulin[1,5]; [1]Skolkovo Inst. of Science and Technology, [2]Novosibirsk State Univ., [3]Fiber Optic Research Center, Russia; [4]Univ. of Warwick, United Kingdom; [5]Aalto Univ., Finland
Pulse lasing based on saturable absorber (SA) in a fiber lasers depends on modulation characteristics of nonlinear material and implementation geometry of SA. These parameters can be controlled during the SA fabrication. We demonstrate electrical control of pulse lasing regimes in an all-PM fibre laser by controlling of the saturable absorption of original electrochemically gated in-line carbon nanotube SA.
This research was supported by RFBR Grant(s) # 20-03-00804

WeR1-25 15:30-15:45
Spatiotemporal solitons in multimode fiber mode-locked lasers
Yihang Ding, Kewei Liu, Xiaosheng Xiao, and Changxi Yang; Tsinghua Univ., Beijing, China
We will report on the observations of multimode soliton molecules and multiple solitons in graded-index multimode fiber lasers and spatiotemporal mode-locking in step-index multimode fiber lasers with large modal dispersion.

WeR1-26 15:45-16:00
Wavelength-tunable DBR fiber laser based on multicore fiber
A.V. Dostovalov[1,2], A.A. Wolf[1,2], M.I. Skvortsov[1,2], K. Proskurina[1], S.A. Babin[1,2] ; [1]Inst. of Automation and Electrometry SB RAS, [2]Novosibirsk State Univ., Russia
We present various configurations of erbium DBR lasers based on seven-core fiber. By using femtosecond writing technique, it is possible to fabricate fiber Bragg gratings in selective cores of multicore fibers at a certain location in a fiber, thus allowing for fabrication of advanced reflecting elements. Different schemes of laser wavelength tuning are presented based on uniform and chirped FBG
This research was supported by RFBR Grant(s) # 20-32-70132

WeR1-27 16:00-16:15
45 micron outer diameter Yb-doped fiber for efficient 976 nm lasers
L. Kotov[1], V. Temyanko[1], M. Bubnov[2], S. Aleshkina[2], D. Lipatov[3], N. Peyghambarian[1], and M. Likhachev[2];[1] Univ. of Arizona, USA;[2] Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center;[3] Inst. of High Purity Substances RAS, Russia
We present a new design of single-mode Yb-doped fiber for efficient 976 nm lasers. The fiber has 14/45 micron core/cladding diameters. Exploiting of this fiber with a specially designed pump/signal combiner allowed us to realize an all-fiber amplifier with the pump-conversion slope efficiency of 31 % and the output power of 10 W limited only by the available pump power.

WeR1-28 16:15-16:30
Sweeping regimes in a Tm-doped self-sweeping fiber laser
A.E. Budarnykh[1], I.A. Lobach[1,2], S.I. Kablukov[1,2]; [1]Inst. of Automation and Electrometry SB RAS, Russia; [2]Novosibirsk State Univ., Russia
We report on investigation of sweeping regimes in a Tm-doped self-sweeping fiber laser. Influence of the active fiber length and pump wavelength on the wavelength self-sweeping regimes and it's characteristics in the laser is demonstrated. It is expected that the research will help in optimization of output sweeping characteristics as well as in spectral dynamics management with pump power control.
This research was supported by RFBR Grant(s) # 20-32-70058

R1: Solid-State Lasers

17:00 - 18:45 **Guided wave and fiber lasers**
Session Chair: Uwe Griebner,
Max-Born-Inst., Germany

WeR1-29 17:00-17:30
Near-infrared femtosecond direct laser written waveguide lasers *(Invited paper)*
P. Loiko[1], E. Kifle[2], C. Romero[3], J. Rodríguez Vázquez de Aldana[3], Tae Gwan Park[4], Ji Eun Bae[4], F. Rotermund[4], P. Camy[1], U. Griebner[5], V. Petrov[5], M. Aguiló[2], F. Díaz[2], X. Mateos[2]; [1]CIMAP, CNRS, Université de Caen Normandie, France; [2]FiCMA-FiCNA-EMaS, Universitat Rovira i Virgili (URV), Spain; [3]Aplicaciones del Láser y Fotónica, University of Salamanca, Spain; [4]Department of Physics, KAIST, South Korea; [5]Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany
We present an overview of our recent achievements on fabrication, characterization and CW and passively Q-switched laser operation of Thulium and Holmium depressed-cladding waveguide lasers operating at ~2 μm and inscribed in anisotropic crystals by femtosecond direct laser writing. Variable waveguide geometries (buried and surface guides; circular, rectangular and hexagonal channels; Y-splitters) are described.

WeR1-30 17:30-17:45
Switching between single- and dual-wavelength mode-locking in waveguide Nd:YAG laser with graphene saturable absorber
M.V. Ponarina[1], A.G. Okhrimchuk[2,3], M.G. Rybin[1], T.V. Dolmatov[1], V.V. Bukin[1], P.A. Obraztsov[1]; [1]Prokhorov General Physics Inst., Russia, [2]Fiber Optics Research Center RAS, [3]D. Mendeleyev Univ. of Chemical Technology, Russia
This paper presents single-mode waveguide Nd:YAG laser passively mode-locked with graphene saturable absorber. The tubular waveguide structure ensures the generation of the main transverse mode. The developed compact laser provides the generation of picosecond pulses with GHz repetition rate. The possibility of switching between single- and dual-wavelength generation in the passive mode-locking using one saturable graphene-based absorber has been demonstrated.
This research was supported by RFBR Grant(s) # 19-32-90215

WeR1-31 17:45-18:00
Amplification properties of Raman fiber amplifiers for narrowband single frequency sources
V.I. Karpov, W.R.L. Clements; MPB Communications Inc., Canada
We study the intensity and phase noise as well as the spectral broadening of narrowband single-frequency fiber laser emission after amplification in a polarization-maintaining Raman fiber amplifier. The optical properties of a 10-W 1266-nm single-frequency source, based on a single-frequency low-noise fiber laser amplified in a Raman fiber amplifier, will be presented.

WeR1-32 18:00-18:15
Silver halide fiber fusion splicing
E.A. Korsakova, A.I. Bogdanov, A.M. Turabi, L.V. Zhukova, A.S. Korsakov; Ural Federal Univ., Russia
In this study, we demonstrated a robust splicing technique to join single-layer silver halide fibers using a custom-made splicer. Utilizing CO2 laser (λ = 10.6 μm), splice loss was measured to be less than 20% per splice point, which is 10% better than just butt-coupling. The tensile strength of the splice was assessed to be more than 50 MPa.

WeR1-33 18:15-18:30
Signal-to-noise ratio of Φ-OTDR assisted by distributed Raman amplifier
D.R. Kharasov[1,2], E.A. Fomiryakov[1,3], S.P. Nikitin1, O.E. Nanii[1,2,3], V.N. Treshchikov[1]; [1]T8 Sensor LLC, [2]Moscow Inst. of Physics and Technology (National Research University), [3]Lomonosov Moscow State Univ., Russia
We investigated signal-to-noise ratio (SNR) of Phase-sensitive OTDR (Φ-OTDR) assisted by bidirectional Raman amplifier (RA) in different pumping modes. It was demonstrated that use of RA increases SNR in the middle and far sides of 120-km-long optical fiber. We present theoretical model for calculation of SNR longitudinal dependencies for different optical fiber configuration.

WeR1-34 18:30-18:45
Numerical simulation of highly-efficient fiber laser cavity protective coating for environmental noise desensitization
A.A.Vlasov[1], E.A. Motorin[1], A.N. Ashirov[1], A.V. Varlamov[2], A.S. Aleinik[1]; [1]ITMO Univ., [2]Ioffe Inst., Russia
The influence of environmental acoustic vibrations on cavities of fiber lasers may significantly decrease their parameters. It is shown that protective coatings for desensitization of fiber laser cavities with efficiency up to -85 dB compared to the level of acoustic sensitivity of standard acrylate coated fiber can be produced by application of composite multi-layer structures of different-type materials.

R3: Semiconductor Lasers, Materials and Applications

09:00 - 11:00
Session Chair: *N. Pikhtin, Ioffe Inst., Russia*

WeR3-11 09:00-09:30
Frequency conversions and coherent light controlling by means of periodically poled crystals *(Invited paper)*
V.Ya. Shur[1], A.R. Akhmatkhanov[1], M.A. Chuvakova[1], A.A. Esin[1], B.N. Slautin[1], O.L. Antipov[2], A.A. Boyko[3], D.B. Kolker[3], V.S. Pavelyev[4], G.S. Sokolovskii[5]; [1]Ural Federal Univ.; [2]Inst. of Applied Physics RAS; [3]Novosibirsk State Univ.; [4]Image Processing Systems Inst. RAS; [5]Ioffe Inst., Russia
The periodically poled crystals have been used for effective second harmonic generation and optical parametric oscillation. The generation of the second harmonic of semiconductor laser radiation in ridge waveguides formed in PPLN crystals is demonstrated.
This research was supported by RFBR Grant(s) # 18-29-20077-MK

WeR3-12 09:30-09:45
Pulsed operation in a swept laser with feedback
A.V. Kovalev[1], K.M. Grigorenko[1], S. Slepneva[2,3,4], N. Rebrova[3,4], A.G. Vladimirov[5], G. Huyet[2], E.A. Viktorov[1]; [1]ITMO Univ., Russia; [2]Univ. Côte d'Azur, CNRS, INPHYNI, France; [3]Cork Inst. of Technology, Ireland; [4]Tyndall National Inst., Univ. College Cork, Ireland; [5]Weierstrass Inst., Germany
We demonstrate pulsed operation in an akinetic semiconductor frequency swept laser with optical feedback. In dependence on carrier density decay rate, the laser exhibits either mode-locked operation or high-intensity Q-switched pulses.

WeR3-13 09:45-10:00
Gain switching of the broad-stripe InAs/GaAs quantum dot lasers
E.D. Cherotchenko[1], V.V. Dudelev[1], A.S. Shkol'nik[2], D.A. Livshits[2], G.S. Sokolovskii[1]; [1]Ioffe Inst., Russia; [2]Innolume GmbH, Germany
We study gain switching of the broad-stripe InAs/GaAs quantum dot lasers and show that the ratio of ground and excited states emission varies with the lateral position at the laser facet.

WeR3-14 10:00-10:15
High-power narrow-stripe semiconductor lasers (1060 nm) at ultrahigh pump levels
S.O. Slipchenko, I.S. Shashkin, A.Y. Leshko, A.A. Klimov, L.S. Efremov, V.A. Kryuchkov, D.N. Nikolaev, V.V. Shamakhov, N.A. Pikhtin, P.S. Kop'ev; Ioffe Inst., Russia
Analysis of narrow-stripe laser diodes on the base of two types of heterostructures with (1) ultrathin waveguide and (2) ultra-wide waveguide. In the case of heterostructure (2) the maximum CW optical power reached is 2W, while the maximum efficiency reached is 54%. Under the pulsed pump for both types of heterostructures, there is a time domain of unstable lasing

WeR3-15 10:15-10:30
20-Gbps Directly Modulated Semiconductor Lasers Based on Surface High-order Grating Fabricated by I-line Photolithography
Pijie Ma[1], Jing Li[1], Fengxin Dong[1], Mingjin Wang[1], Wanhua Zheng[1,2,3];[1,2]- Inst. of Semiconductors CAS; [3]Univ. of Chinese Academy of Sciences, China
Directly modulated semiconductor lasers based on surface high-order grating have been designed, fabricated and measured. -3 dB bandwidth of small signal response is 17 GHz. Eye diagram of 20 Gbps was demonstrated.

WeR3-16 10:30-10:45
Energy barrier layers and internal optical loss in 1400-1600 nm semiconductor lasers
D.A. Veselov[1], Yu.K. Bobretsova[1], M.G. Rastegaeva[1], N.V.Voronkova[1], M.A. Ladugin[2], Yu.L. Ryaboshtan[2], A.A. Marmalyuk[2], S.O. Slipchenko[1], N.A. Pikhtin[1]; [1]Ioffe Inst., [2]POLYUS Research Inst., Russia
We investigated the effect of AlInAs energy barrier layers on the edge-emitting lasers of 1400–1600 nm spectral range. The barrier layer at the waveguide-cladding heterojunction provides charge carrier accumulation in the waveguide and prevents the internal quantum efficiency from drop. The use of barrier layer enables increasing the pulse optical power from 9 to 13 W from 100 µm aperture.

WeR3-17 10:45-11:00
All-optical majority gate based on an injection-locked laser
T. von Lerber, M. Lassas, V.S. Lyubopytov, L. Ylinen, A. Chipouline, K. Hofmann, F. Küppers
An all-optical computer has remained an elusive concept. To construct a practical equivalent to an electronic Boolean logic, one should utilize nonlinearity that overcomes weaknesses that plague many optical processing schemes. Here we demonstrate an all-optical majority gate based on a vertical-cavity surface-emitting laser (VCSEL). The arrangement provides Bit Error Ratio of 10-9 at the rate of 1 GHz.

R3: Semiconductor Lasers, Materials and Applications

11:30 - 13:00
Session Chair: *E.U. Rafailov*, *Aston Univ., UK*

WeR3-18 11:30-12:00
Revival of laser materials with new pump diodes *(Invited paper)*
B. Resan[1, 2], A. Rohrbacher[3], O. E. Olarte[4], P. Loza-Alvarez[4], I. Kuznetsov,[5]; [1]Univ. of Applied Sciences and Arts Northwestern Switzerland, Switzerland, [2]Univ. of Osijek, Croatia, [3]Lumentum, Switzerland, [4]ICFO, Inst. of Photonic Sciences, Spain, [5]Inst. of Applied Physics RAS, Russia
Recent advances in high power blue and red diodes are enabling direct diode pumping of the mature laser materials with superb output performance, but not yet implemented in industry, including Ti.sapphire and alexandrite.

WeR3-19 12:00-12:30
VCSEL packaging in flexible carriers for interconnects, sensing and imaging *(Invited paper)*
G. Van Steenberge, J. Missinne, T. Sterken; Ghent Univ., Belgium
We present a novel integration technology where VCSELs and electronic interface circuitry are embedded into a flexible substrate, allowing for systems with novel form factors, thereby enabling further penetration of VCSELs in consumerlike devices with optical interconnect, sensing and imaging capabilities.

WeR3-20 12:30-12:45
Outcoupling of microdisk laser emission by strip-loaded slot waveguide
N.V. Kryzhanovskaya[1,2], M.V. Fetisova[1,3], I.V. Reduto[3,4], V.V. Zhurikhina[1,4], O.A. Morozova[4], A.V. Raskhodchikov[1,4], M. Roussey[3], S. Pélisset[3], M.M. Kulagina[5], Yu.A. Guseva[5], A.A. Lipovskii[1,4], M.V. Maximov[1,5], A.E. Zhukov[2]; [1]Alferov St. Petersburg Academic Univ., [2]National Research Univ. Higher School of Economics, Russia; [3]Univ. of Eastern Finland, Finland; [4]Peter the Great St. Petersburg Polytechnic Univ., [5]Ioffe Inst., Russia
A strip-loaded slot waveguide is used for guiding the emission of a microdisk laser with InAs/InGaAs/GaAs quantum dot (QD) active region operating in continuous wave mode under optical pumping. The scanning near-field optical microscope measurements performed on the 10-micron microdisk covered by a TiO2/SiO2/TiO2 waveguide confirmed the mode coupling into and guiding along the loading strip
This research was supported by RFBR Grant(s) # 18-29-20063, 20-02-00334

WeR3-21 12:45-13:00
Enhanced laser self - mixing interferometry based on fiber Bragg grating
H. Lin, JB. Chen, W Xia, H. Hao, DM Guo; Nanjing Normal Univ., China
A new enhanced laser self-mixing interferometry (ESMI) based on edge-filter enhancement is presented. The frequency-modulated (FM) laser self-mixing signal is analyzed by a Fiber Bragg Grating, which transforms laser frequency variations into intensity variations when the laser wavelength is set to the edge of the FBG steep transmission profile.

R5: Super-Intense Light Fields and Ultra-Fast Processes

11:30 - 13:00
Session Chair: *P. McKenna, Univ. of Strathclyde, UK*

WeR5-21 11:30-12:00
Collective absorption of laser radiation in plasma at sub-relativistic intensities *(Invited paper)*
V. Tikhonchuk[1,2], J. J. Gu[2,3], O. Klimo[2,4], S. Weber[2]; [1]Univ. of Bordeaux, France; [2]ELI-Beamlines, Inst. of Physics of Czech Academy of Sciences, [3]Inst. of Plasma Physics of Czech Academy of Sciences, [4]Czech Technical Univ. in Prague, Czech Republic
We present results of investigations of the dynamics of laser absorption and electron acceleration and heating is obtained with full 3D numerical simulations with particle-in-cell code. The parametric instabilities responsible for coupling of laser and plasma are identified and the asymmetric features with respect to the laser polarization direction are explained thus establishing relation between 2D and 3D kinetic simulations.

WeR5-24 12:15-12:30
Characteristics of few-cycle pulses generated by phase compensated spectral broadening in media with alternating cubic nonlinearity sign
S. A. Frolov[1], V. I. Trunov[1,2]; [1]Inst. of Laser Physics SB RAS, Russia, [2]Novosibirsk State Univ., Russia
We present a scheme for pulse compression which consists of stage with negative cascading quadratic nonlinearity, which is effectively negative cubic, followed by stage with normal cubic nonlinearity. Compression of 20 fs pulses down to 6 fs is demonstrated by numerical simulation. Study of focusing and coherent combining of such pulses is presented.

WeR5-25 12:30-12:45
Development of a two-channel laser system with a peak power of up to 100 TW per channel with coherent field combining
V.I. Trunov[1,2,3], S.N. Bagayev[1], S.A. Frolov[1], E.V. Pestryakov[1], D.O. Shvydkoy1,3; [1]Inst. of Laser Physics SB RAS, [2]Novosibirsk State Technical Univ., [3]Novosibirsk State National Research Univ., Russia
The results of development of two-channel femtosecond laser system based on OPCPA in BBO and LBO crystals with peak power up to 100 TW per channel with 20fs pulse duration and a repetition rate of 10Hz are presented. It is shown that using active stabilization methods for coherent beam combining mode, intensities exceeding 1021W/cm2 can be achieved in the system

WeR5-26 12:45-13:00
High-definition laser pulse shaping for phase-only pulse synthesis and replication
K.B. Yushkov, V.Ya. Molchanov; National Univ. of Science and Technology MISIS, Russia
We report a new femtosecond laser pulse shaping technique based on high-definition acousto-optic diffraction. Phase-only generation of pulse replicas free of satellite pulses is demonstrated experimentally using multiple independent comb shaping with randomized widths of the comb segments. The acousto-optic delay line operates at 10 kHz repetition rate with the maximum delay of 10 ps.
This research was supported by RFBR Grant(s) # 18-29-20019

R5: Super-Intense Light Fields and Ultra-Fast Processes

14:30 - 16:30
Session Chair: *A.Savel'ev, Moscow State Univ., Russia*

WeR5-27 14:30-15:00
Ultrafast transient optical and structural property modifications induced by ultrashort intense light pulses at XUV wavelengths *(Invited paper)*
U. Teubner[1,2], S. Toleikis[3], V. Tkachenko[1,4], B. Ziaja[4,5]; [1]Inst. f. Laser und Optik, Hochschule Emden/Leer-Univ. of Applied Sciences, Germany; [2]Institut für Physik, Carl von Ossietzky Universität, Germany; [3]Deutsches Elektronen-Synchrotron DESY, Germany; [4]Center for Free-Electron Laser Science, DESY, Germany; [5]Inst. of Nuclear Physics PAS, Poland
Intense fs-XUV laser-induced transient optical properties following free electron generation are investigated experimentally and theoretically. Electron-dynamics and resulting transient changes of the reflectivity and transmissivity and recently also the change of phase of an additional fs-probe pulse is considered. This completes the information of optical properties during the interaction process, which is of importance for basic research and diagnostic purposes.

WeR5-28 15:00-15:15
Controllable circular patterns on silicon induced by bubble-diffracted femtosecond laser pulses in liquid
S. A. Romashevskiy, S. I. Ashitkov, Joint Institute for High Temperatures of the Russian Academy of Sciences (JIHT RAS), Russia
A new technique of silicon nanostructuring in liquid with a pair of Gaussian-shaped femtosecond laser pulses is reported. This enables producing circular ripples characterized by high surface-relief modulation, undersurface annular nanocavities, and interfacial smoothness. The mechanism of high-frequency spatial modulation of the laser radiation via scattering of the second pulse by the bubble, induced by the first pulse, is proposed.

WeR5-29 15:15-15:30
Femtosecond heating of metals and terahertz generation in damaging regimes
D.A. Fadeev[1], I.V. Oladyshkin[1], B.V. Shishkin[1], P.A. Yunin[2], V.A. Mironov[1]; [1]Inst. of Applied Physics RAS, [2]Inst. for Physics of Microstructures RAS, Russia
We report on the observation of terahertz (THz) signal during the femtosecond laser ablation of metals. Strong correlation between the regimes of ablation and THz generation was found for different metals (copper, zinc, nickel and others). According to previous results, the interconnection of these two effects is caused by their thermal nature.
This research was supported by RFBR Grant(s) # 18-42-520023 r_a

WeR5-30 15:30-15:45
Formation of periodic structure on amorphous silicon films by femtosecond laser pulses
A. V. Dostovalov[1,2], A.A. Kuchmizhak[3,4], K. A. Bronnikov[1,2], E. Mitsai[3,5] V. P. Korolkov[1,2], S. A. Babin[1,2]; [1]Inst. of Automation and Electrometry SB RAS, [2]Novosibirsk State Univ., [3]Inst. of Automation and Control Processes, Far Eastern Branch, RAS, [4]Far Eastern Federal Univ., [5]Inst. of Chemistry, Far Eastern Branch, RAS, Russia
In this paper, we report formation of laser-induced periodic surface structures (LIPSS) on amorphous silicon (a-Si) films of various thickness by their lateral scanning with fs laser pulses shaped to astigmatic Gaussian beam. Diverse LIPSS morphologies with characteristic periods ranging from 150 to 1000 nm were found to form upon variation of scanning speed and laser power.
This research was supported by RFBR Grant(s) # 19-32-90235

WeR5-32 16:00-16:15
Picocoulomb electron bunches emitted from the metal tip on Ti:Sa femtosecond laser irradiation
N.A. Abramovskii[1,2], A.A. Murzanev[1], A.V. Romashkin[1], A.N.Stepanov[1]; [1]Inst. of Applied Physics RAS, [2]Lobachevsky State Univ. of Nizhni Novgorod, Russia
The electron emission from a metal tip under the irradiation of a femtosecond laser pulse with μJ energy level is studied. The electron bunch charge emitted from the cathode first increases with increasing laser pulse energy proportionally to the fourth power and then the dependence saturates. The maximum value of the emitted charge is on the order of 10 pC.

WeR5-33 16:15-16:30
Investigation of the instabilities of an expanding plasma created during ablation of solid targets by intense femtosecond laser pulses
A.N. Stepanov[1], M.A. Garasev[1], Vl.V. Kocharovsky[1], A.I. Korytin[1], A.A. Murzanev[1], A.A. Nechaev[1], D.V. Kartashov[2], Z.A. Samsonova[2]; [1]Inst. of Applied Physics RAS, Russia; [2]Friedrich-Schiller Univ. Jena, Germany
The expansion of a laser plasma arising upon irradiation of a solid-state target with intense femtosecond laser radiation is studied. The combined use of interferometry and depolarization measurements allowed to reconstruct the spatial distribution of the plasma density and revealed the development of small-scale instabilities, accompanied by megagauss magnetic field generation. The nature of the observed instabilities is discussed.
This research was supported by RFBR Grant(s) # 18-29-21029. 18-32- 01065

R5: Super-Intense Light Fields and Ultra-Fast Processes

17:00 - 18:45
Session Chair: *V.Tikhonchuk CELIA (France*

WeR5-34 17:00-17:15
Conical IR emission in propagation of sub-terawatt ultrashort UV KrF laser pulse in Xe as coherent stimulated four-wave mixing process
I. V. Smetanin, A. V. Shutov, N. N. Ustinovskii, V. D. Zvorykin, A. V. Bogatskaya, A. M. Popov; Lebedev Physical Inst., Russia
We discuss the physical mechanism of the cone IR emission effect when the intense ultrashort UV KrF laser pulse propagates in Xe gas cell. We treat this mechanism as the resonance enhanced four-wave mixing process which proceeds through the parametric transformation of two pump photons into the pair of IR and VUV photons.
This research was supported by RFBR Grant(s) # 18-02-00730

WeR5-35 17:15-17:30
Terawatt two color filamentation in a low pressure gas: characterization by THz and X-ray generation
M.M. Nazarov[1], A A. V. Mitrofanov[1,2,3,4], D. A. Sidorov-Biryukov[1,2,4], P.A.Sheglov[1], M.V.Chashin[1,2], A.A.Garmatina[1,2], V.M.Gordienko[2], V. Ya. Panchenko[1,2,3]; [1]Kurchatov Inst. National Research Center; [2]Lomonosov Moscow State Univ.; [3]SRC "Crystallography and Photonics" Inst. of Laser and Information Technologies RAS; [4]Russian Quantum Center, Russia
2-TW, 30-fs, 800-nm laser radiation and its second harmonic are used to form a filament in the low-pressure gas cell. It forms a bright source of terahertz pulses. For 20 mbar gas pressure, we registered a hundred-fold increase of THz yield compared with ambient case The dynamics of local intensity was measured by filament foil ablation and X-ray generation techniques.
This research was supported by RFBR Grant(s) # 18-52-16024; 18-02- 40032

WeR5-36 17:30-17:45
Influence of the polarization of a multielectron atom in a strong laser field on ionization and generation of secondary radiation
A. A. Romanov[1,2], A. A. Silaev[1,2], M. V. Frolov[3], N. V. Vvedenskii[1,2]; [1]Inst. of Applied Physics RAS, [2]Univ. of Nizhny Novgorod, [3]Voronezh State Univ., Russia
We show that at high intensities of laser pulses, the atom polarization leads to a significant screening of the external electric field acting on the electrons, decreasing in the ionization probability, and increasing in the amplitude of the generated electron currents both at frequencies much higher and much lower than the optical one.
This research was supported by RFBR Grant(s) # 18-02-01150, 20-32-70213

WeR5-37 17:45-18:00
Femtosecond optical ionization effects on plasma-dust formations
A.A. Sergeev[1], V.V. Sementin[1], A.V. Savin[1], P.Yu. Serdobintsev[2], A.P. Pogoda[1], A.S. Boreysho[1]; [1]Baltic State Technical University «Voenmeh», [2]St Petersburg State Univ, Russia
This paper describes an experiment on charging free-falling particles of titanium dust by femtosecond and nanosecond laser pulses. Feature size of titanium particle is about 40 microns. The problems of multiphoton ionization, the degree of the nonlinear process and the quantum efficiency of the femtosecond charge.

WeR5-38 18:00-18:15
Generation of tunable mid- and far-infrared pulses during gas ionization by two-color chirped laser pulses
A.A. Silaev, A.A. Romanov, N.V. Vvedenskii; Inst. of Applied Physics RAS, Russia
We propose a new method of efficient generation of mid- and far-infrared pulses based on gas ionization by chirped and delayed two-color laser pulses. The method opens the possibility of a simple tuning the generated frequency by changing the time delay between the laser-pulse components.

WeR5-39 18:15-18:30
Quantum vortices in the probability density of a photoelectron pulled out by ultrashort pulse
N.V. Larionov[1,2], A.A. Smirnovsky[1,3]; [1]Peter the Great St. Petersburg Polytechnic Univ., [2]St. Petersburg State Marine Technical Univ., [3]Ioffe Inst., Russia
We study quantum vortices formed by photoelectron produced through barrier-suppression ionization of hydrogen-like atom in the two-dimensional approximation. Two different ways of ionization are considered: ultrashort laser pulse, ultrashort pulse of electric field. The results of calculations for these two mechanisms of ionization are compared, and the differences are discussed.
This research was supported by RFBR Grant(s) # 15-02-07794 A

WeR5-40 18:30-18:45
Silicon Surface Modifications Induced by Single Femtosecond Laser Pulses at Minimally Disruptive Fluences in Air and Water
S. A. Romashevskiy, Joint Institute for High Temperatures of the Russian Academy of Sciences (JIHT RAS)
Silicon surface modifications induced by single femtosecond laser pulses at minimally disruptive fluences near melting threshold in air and water are investigated using atomic-force microscopy. At threshold fluence the modified surface in air is presented by chaotically-located nanobumps and nanopits, while in water they appear to be circumferentially-spaced. Phenomena of cracking, corrugated surface and eruption of material are also observed.

R6: Lasers for Green Photonics and Sustainability

14:30 - 16:00
Session Chair: *P. Loza-Alvarez*, *ICFO, Spain*

WeR6-01 14:30-15:00
Lasers for airborne and spaceborne Lidar missions at Fraunhofer ILT *(Invited paper)*
M. Höfer; Fraunhofer Inst. for Laser Technology ILT, Germany
Since years Fraunhofer ILT is strongly involved in various projects at different TRL levels to design and develop lasers for airborne and spaceborne Lidar applications. We will present an overview of the results of these projects.

WeR6-02 15:00-15:15
Diode laser spectroscopy instrument M-DLS for in situ study of atmosphere near the Martian surface: design, assembly, alignment and calibration
I.I. Vinogradov[1], V.V. Barke[1], I.Sh. Gazizov[2,1], I.V. Golovnin[4,1], V.A. Kazakov[1,2], T.O. Kozlova[1], Yu.V. Lebedev[1], S.V. Malashevich[2,1], V.V. Meshcherinov[2,1], A.V. Nosov[1], A.V. Rodin[2,1], O.Z. Roste[1], M.V. Spiridonov[3], A.A. Venkstern[1], S.G. Zenevich[2,1], J. Cousin[5], G. Durry[5], M. Ghysels-Dubois[5]; [1]Space Research Inst. RAS, [2]Moscow Inst. of Physics and Technology (MIPT), [3]Prokhorov General Physics Inst. RAS, [4]Lomonosov Moscow State Univ., Russia; [5]GSMA, UMR CNRS[7]331, Université de Reims, France
An application of tunable diode laser absorption spectroscopy in combination with integrated cavity output spectroscopy was implemented as a Martian multichannel diode laser spectrometer (M-DLS) instrument. The M-DLS was carefully calibrated and delivered to the ExoMars-2020 Landing Platform for carrying out in situ measurement of D/H, 18O/17O/16O, 13C/12C ratios and H2O, CO2 content variations of atmosphere near the Martian surface.

WeR6-03 15:15-15:30
New-generation eye-safe lidar (<1 μJ/cm-2): from Mars exploration to Earthquake prediction
S.M. Pershin; Prokhorov General Physics Inst. RAS, Russia
In 1991 we developed a new-generation eye-safe lidar (<1 μJ cm-2) based on a GaAlAs diode laser and a gated SPAD receiver. This lidar was involved in the NASA mission “Mars Polar Lander-99” for clouds sensing for the first time to our knowledge. Recently, Earth’s crust deformations and aerosol layers near the Elbrus volcano summit were monitored by the lidar.

WeR6-04 15:30-16:00
Multi-species emitters and differential absorption Lidars for green-house gases monitoring *(Invited paper)*
J.M. Melkonian[1], J.B. Dherbecourt[1], J. Hamperl[1], Th. Hamoudi[1], R. Santagata[1], M. Dalin[1], V. Lebat[1], A. Godard[1], M. Raybaut[1], C. Flamant[2], J. Totems[3], P. Chazette[3], V. Pasiskevicius[4], D. Heinecke[5], H. Schaefer[5], M. Strotkamp[6], F. Geus[6], M. Hoefer[6], S. Rapp[7], H. Sodemann[8], H.C. Steen-Larsen[8]; [1]DPHY, ONERA, Université Paris Saclay, France; [2]LATMOS, UMR[8]190, CNRS-SU-UVSQ, France; [3]LSCE, UMR[1]572, CEA-CNRS-UVSQ, France; [4]Royal Inst. of Technology (KTH), Sweden; [5]SpaceTech GmbH, Germany; [6]Fraunhofer Inst. for Laser Technology, Germany; [7]Innolas Laser GmbH, Germany; [8]Univ. of Bergen and Bjerknes Centre for Climate Research, Norway
We will present our most recent work on differential absorption lidars, for ground and airborne measurements of greenhouse gases. A focus will be given on the development of high-energy, wavelength-tunable single-frequency optical sources in the 2μm-range.

R6: Lasers for Green Photonics and Sustainability

17:00 - 18:45
Session Chair: *P. Loza-Alvarez*, *ICFO, Spain*

WeR6-07 17:00-17:30
Effects of focused NIR lasers on cell behavior and cell membrane *(Invited paper)*
R. Avila[1], E. Tamariz[2], P. Loza-Alvarez[3], N. Medina-Villalobos[2]; [1]Universidad Nacional Autónoma de México, Mexico, [2]Universidad Veracruzana, Mexico, [3]Institut de Ciències Fotòniques, Spain
Infrared laser light is currently used in therapies against pain and inflammation. In a microscopic scale, it has been used experimentally to guide cellular extensions. Here we analyze the effect of a focused 810-nm CW laser on 3T3 fibroblasts plasma membrane and its influence on the projection dynamics and the cytoskeleton of PC12 neurons.

WeR6-08 17:30-17:45
Upconversion nanoparticles for local thermal sensing in complex modified capsules
A.V. Sokovikov[1], D.G. Yurina[1,3], A.O. Zviagintsev[1], T.N. Borodina[1,2], D.G. Shchukin[4], E.V. Khaydukov[1], D.N. Karimov[1]; [1]FSRC "Crystallography and Photonics" RAS, Russia; [2]Sechenov First Moscow State Medical Univ., Russia; [3]National Univ. of Science and Technology MISiS, Russia; [4]Univ. of Liverpool, UK
The lanthanide-doped upconversion nanoparticles (UCNP) suitable for direct measurement of the local temperature of micro-objects with high sensitivity. We studied the temperature change of polymer multilayer capsules with shell comodified by nanodiamonds and UCNPs. The dependence of the local temperature of polyelectrolyte capsules on the microwave radiation treatment time was obtained aiming to demonstrate differences between intracapsules and environment temperature.
This research was supported by RFBR Grant(s) # 19-02-00877, 20-32-70174

WeR6-09 17:45-18:15
High-throughput live imaging using light sheet microscopy *(Invited paper)*
E.J. Gualda, M.Bernardello, M. Marsal, P. Loza Alvarez; ICFO-Instituto de Ciencias Fotónicas, BIST-Barcelona Inst. of Science and Technology, Spain
We have developed a compact, multi-modal light-sheet microscope platform where different kind of experiments may be addressed with a single equipment. We will evaluate the performance of the Flexi-SPIM platform and its ability to carry out high-throughput quantitative analysis with high resolution, high speed and minimal photo-damage on complex 3D cell cultures and the microtubule network during zebrafish development.

WeR6-10 18:15-18:45
Morpho-mechanics of human collagen unveiled by correlative optical microscopy *(Invited paper)*
R. Mercatelli[1,2], S. Mattana[1,3], L. Capozzoli[4], F. Ratto[5], F. Rossi[6], R. Pini[6], D. Fioretto[6,7], F.S. Pavone[1,3,8], S. Caponi[7,9], and R. Cicchi[1,8]; [1]National Institute of Optics, [2]Aerospazio Tecnologie s.r.l., [3]Univ. of Florence, [4]Center of Electron Microscopy "Laura Bonzi", [5]Inst. of Applied Physics "Nello Carrara", [6]Univ. of Perugia, [7]CEMIN-Center of Excellence for Innovative Nanostructured Material, [8]European Laboratory for Non-linear Spectroscopy (LENS), [9]Inst. of Materials, Italy
We report a correlative study performed by all-optical microscopies, disclosing the supramolecular collagen morphology correlated with its biomechanical and biochemical analyses in human corneal tissue, using SHG Brillouin and Raman micro-spectroscopy.

R7: Free Electron Lasers

14:15 - 16:30
Session Chair: *S.L. Molodtsov*, *European XFEL, Germany*

WeR7-01 14:15-14:45
Ultrafast dynamics of spatial magnetic fluctuations in Co/Pt multilayers studied at European XFEL *(Invited paper)*
M.V. Baidakova[1,2], R. Carley[3], R. Gort[3], G. Grübe l4, L. Le Guyader[3], E. Jal[5], E.Yu. Lobanova[1,2], L. Mercadier[3], G. Mercurio[3], S.L. Molodtsov[1,3,6], L. Müller[7], A. Philippi-Kobs[4], D. Potorochin[1,4,6], M. Riepp[4], W. Roseker[4], A. Scherz[3], J. Schlappa[3], S.M. Suturin[2], B. Van Kuiken[3], A. Yaroslavtsev[3] and I.I. Pronin[1,2]; [1]ITMO Univ., Russia; [2]Ioffe Inst., Russia; [3]European XFEL, Germany; [4]DESY, Hamburg, Germany; [5]Sorbonne Univ., France; [6]TU Freiberg, Germany; [7]Univ. of Hamburg, Germany
One of the intriguing problems of modern magnetism is unravelling the non-equilibrium spin dynamics following laser excitation on the nanometer length scale. In this work the ultrafast magnetic behavior of thin Co/Pt multilayers is studied by resonant magnetic SAXS in transmission geometry. We have for the first time observed a very bright transient scattering from nanometer scale magnetic fluctuations

WeR7-02 14:45-15:00
Single-shot temporal characterization of SASE XUV pulses at FLASH FEL
R. Ivanov[1], I. Bermudez[1], J. Liu[2], J. Roensch-Schulenburg[1], M.V. Yurkov[1], N. M. Kabachnik[3], A.K. Kasansky[4], and S. Düsterer[1]; [1]Deutsches Elektronen-Synchrotron (DESY), Germany, [2]European XFEL GmbH, Germany, [3]Skobeltsyn Inst. of Nuclear Physics, Lomonosov Moscow State Univ., Russia, [4]University of the Basque Country UPV/EHU, Spain
We present a Terahertz field driven streak camera with the capability to deliver the XUV pulse duration and the arrival time information with ~10 fs resolution for each FEL pulse at FLASH. Pulse durations between 350 fs and <15 fs have been measured for different FLASH FEL settings. The arrival time showed the precision with which FLASH can be operated.

WeR7-03 15:00-15:15
Time-resolved resonant inelastic soft X-ray scattering spectrometer at the Free Electron Laser FLASH
S. Dziarzhytski[1], M. Beye[1], R. Engel[1], J. Schunck[1], H. Weigelt[1], M. Rübhausen[2], P. Miedema[1] and G. Brenner[1]; [1]Deutsches Elektronen Synchrotron (DESY); [2]Universität Hamburg, Germany
The TRIXS (Time-Resolved Inelastic soft X-ray Scattering) end-station of the PG1 monochromator beamline at the Free-electron Laser in Hamburg FLASH at DESY was developed for optical pump–XUV probe dynamics studies of solids. It covers a photon energy range of 36-210 eV with an energy resolution of 55-100 meV and a time resolution of 250 fs FWHM.

WeR7-04 15:15-15:30
Diffractive optics technologies for the control of high-power terahertz laser beams
V.S. Pavelyev[1,2], S.N. Khonina[1,2], K.N. Tukmakov[1], S.A. Degtyarev[1,2], A.S. Reshetnikov[1], B.A. Knyazev[3,4], Yu.Yu. Choporova[3,4]; [1]Samara Univ.; [2]IPSI RAS – Samara Branch of the FSRC "Crystallography and Photonics" RAS; [3]Budker Inst. of Nuclear Physics SB RAS; [4]Novosibirsk State Univ., Russia
Diffractive optics technologies are opening up new possibilities for power terahertz laser radiation controlling. Silicon diffractive optical elements are used for focusing of a terahertz laser beam into pre-given domains, for forming beams with needed transverse mode content, as well as for terahertz beam polarization transforming.

WeR7-05 15:30-15:45
On the way to time-resolved X-ray optical experiments in NRC «Kurchatov Institute»
F.V. Potemkin[1], E.I. Mareev[1], M.M. Nazarov[3], E.A. Fomin[3], A.I. Stirin[3], V.N. Korchuganov[3], V.Ya. Panchenko[2,3], M.V. Kovalchuk[2,3]; [1]Lomonosov Moscow State Univ.; [2]FSKC «Crystallography and Photonics» RAS; [3]National Research Centre «Kurchatov Institute», Russia
We report on a synchronization of synchrotron radiation source "KSSR-Kurchatov" with sub-PW femtosecond laser using developed active phase locking system with integrated proportional-integral-derivative controller for compensating both phase jitter and drift. The stability of the system paves the way to perform long-term pump-probe X-ray optical experiments with a temporal resolution about 30 ps in NRC «Kurchatov Institute».
This research was supported by RFBR Grant(s) # 18-02-40018, 19-29-12037

WeR7-06 15:45-16:00
Lifetimes of shallow donor states in germanium
R. Kh. Zhukavin[1], K. A. Kovalevskii[1], Yu. Yu. Choporova[2, 3], V. V. Tsyplenkov[1], V. V. Gerasimov[2, 3] P. A. Bushuikin[1], B. A. Knyazev[2, 3] N. V. Abrosimov [4], S. G. Pavlov[4], H.-W. Hübers[4, 5], V. N. Shastin[1]; [1]Inst. for Physics of Microstructures, Russia; [2]Budker Inst. of Nuclear Physics, Russia; [3]Novosibirsk State Univ., Russia; [4]Leibniz-Inst für Kristallzüctung, Germany; [5]Inst. of Optical Sensor Systems, Germany; [6]Humboldt-Universität zu Berlin, Germany
The relaxation times of excited states of shallow donors in germanium have been studied by the pump–probe method using radiation of free-electron laser. The influence of uniaxial stress on relaxation times at low temperatures was investigated. Typical lifetimes of the odd parity states belong to nanosecond range. The uniaxial stress results in increase of lifetimes for particular donor states.

WeR7-07 16:00-16:30

HIgh-resolution X-ray phase-contrast imaging of plasma hydrodynamics phenomena with XFEL probe

(Invited paper)

S. Pikuz[1,2], G. Rigon[3], B. Albertazzi[3], P. Mabey[3,5], S. Makarov[1,4], T. Pikuz[1,5], V. Bouffetier[6], N. Ozaki[7,8], T. Vinci[3], E. Falize[9], Y. Inubushi[10,11], N. Kamimura[7], K. Katagiri[7], M. Manuel[12], K. Miyanishi[11], O. Poujade[9], Y. Umeda[7], K. Sueda[11], T. Togashi[10,11], M. Yabashi[10,11], T. Yabuuchi[10,11], G. Gregori[13], R. Kodama[7], A. Casner[6], M. Koenig[3]; [1]Joint Inst. for High Temperature RAS, Russia; [2]National Research Nuclear Univ. "MEPhI", Russia; [3]LULI, CNRS, CEA, Ecole Polytechnique; UPMC, Univ Paris[0]6: Sorbonne Universites; Institut Polytechnique de Paris, France; [4]Lomonosov Moscow State Univ., Russia; [5]Osaka Univ., Japan; [6]Univ. de Bordeaux-CNRS-CEA, CELIA, UMR[5]107, France; [7]Osaka Univ., Japan; [8]Inst. of Laser Engineering, Osaka Univ., Japan; [9]CEA-DAM, DIF, France;[10]- Japan Synchrotron Radiation Research Inst., Japan;[11]- RIKEN SPring-8 Center, Japan;[12]- General Atomics, Inertial Fusion Technologies, USA;[13]- Univ. of Oxford, UK

Using X-ray FEL and fluorescent crystal detection the development of plasma instabilities in laser generated plasma flows is studied with unprecedented resolution. For the first time a plasma turbulent spectrum is measured down to Kolmogorov scale.

R8: Nonlinear Photonics: Fundamentals and Applications

11:30 - 13:30
Session Chair: *I. Babushkin, St. Petersburg State Univ., Russia*

WeR8-19 11:30-12:00
High energy pulse dynamics in multimode GRIN fibers *(Invited paper)*
M. Zitelli[1], F. Mangini[2], M. Ferraro[1], R. Crescenzi[1], F. Frezza[1], D.S. Kharenko[3], A. Niang[2], S. Wabnitz[1]; [1]Sapienza Univ., Italy; [2]Brescia Univ., Italy; [3]Novosibirsk State Univ., Russia
High energy, ultra-short multimode soliton pulse fission is observed and numerically studied in multimode GRIN fibers, showing complex dynamics bringing to multiple fundamental solitons that do not entirely follow standard single mode soliton perturbation theory predictions.

WeR8-20 12:00-12:15
Coherent propagation and amplification of intense wave beams in a deformed multi-core fiber
A.A. Balakin, A.G. Litvak, S.A. Skobelev; Inst. of Applied Physics RAS, Russia
The transformation of the out-of-phase wave field distribution at deformations of a multi-core fiber (MCF) is studied. Nonlinear supermodes are found, which are weakly sensitive to MCF deformations for high-power beams. Amplification of found out-of-phase beams in active MCF leads to equalization of wave amplitudes in all cores at powers exceeding the critical value even in a strongly deformed MCF.

WeR8-21 12:15-12:30
SBS gain suppression in ordinary single-mode optical fibers with improved multimode acoustic design
S.V. Tsvetkov[1], M.M. Khudyakov[1], A.S. Lobanov[2], D.S. Lipatov[2], M.M. Bubnov[1], M.E. Likhachev[1]; [1]Fiber Optics Research Center RAS, [2]Inst. of Chemistry of High Purity Substances RAS, Russia
More than the order of the SBS gain suppression can be achieved in ordinary step-index single-mode optical fibers due to a wide spectral redistribution and effective equalization of impacts of a relatively large number of acoustic mode fields in the nonlinear Brillouin interaction between them and the fundamental optic mode intensity, using the proper acoustic index profile design.

WeR8-22 12:30-12:45
Nanosecond Raman laser at 2840 nm based on a Methane-filled revolver fiber
A.V. Gladyshev, M.S. Astapovich, Yu.P. Yatsenko, A.F. Kosolapov, I.A. Bufetov; Fiber Optics Research Center RAS, Russia
High-average-power gas fiber Raman laser operating at 2840 nm is demonstrated. The Raman laser is based on methane-filled hollow-core revolver silica fiber pumped by Er-doped fiber laser at 1560 nm. Average output power of about 0.6 W is generated at the Stokes wavelength.

WeR8-23 12:45-13:00
Fully connected feed-forward neural network based nonlinearity compensation method for polarization multiplexed transmission systems
S. A. Bogdanov[1], O. S. Sidelnikov[1], M. P. Fedoruk[1,2], S. K. Turitsyn[1,3]; [1]Novosibirsk State Univ., Russia; [2]Inst. of Computational Technologies SB RAS, Russia; [3]Aston Univ., UK
In this work we propose a receiver-side nonlinearity compensation method based on fully connected feed-forward neural networks applicable to polarization-division multiplexing transmission systems. We consider different neural network architectures and show that the use of information from both polarizations allows to effectively compensate the accumulated nonlinear distortions.

WeR8-24 13:00-13:15
Optical frequency comb based on semiconductor optical amplifier fiber laser
H.J. Kbashi; Aston Univ., UK
We experimentally demonstrate the generation of optical frequency comb based on SOA-NPR fiber laser. MZI filter is inserted into the cavity to serve as the comb selection device. The frequency comb can be tuned in a certain range of millimeter wave from 37 GHz to 90 GHz. The proposed system may find applications in 5G, radio-over-fiber systems, and LiDAR applications

WeR8-25 13:15-13:30
Ultra-large mode deflection in a Lithium Niobate waveguide based on thermo-optic effect
Lei Cai[1], Huihui Lu[1], Dong Cao[2], Xiaoping Zheng[3], Yongchun Zhong[1], Zhe Chen[1,2,4]; [1]Jinan University; [2]Rocketech Technology Corp. Ltd.; [3]Tsinghua Univ.; [4]SUNLUX IOT Technology (Guangdong) Inc., China
We propose a high-efficient thermo-optic mode deflection device based on annealed proton exchange (APE) waveguides in lithium niobate (LN) with microstructured electrodes. Mode deflection of this device is up to 9.92μm/V for a wavelength of 1064nm. Furthermore, the mode deflection could be modulated dynamically by the thermo-optic effect and double frequency effect was firstly observed in this device.

R8: Nonlinear Photonics: Fundamentals and Applications

14:30 - 16:00
Session Chair: *L.A. Melnikov, Yuri Gagarin State Technical Univ. of Saratov, Russia*

WeR8-26 14:30-15:00
Modulational instability in nonlinear topological waveguide arrays *(Invited paper)*
D. Leykam; Inst. for Basic Science, Korea
We theoretically study spatial modulational instability in topological waveguide arrays with saturable Kerr nonlinearity. We demonstrate different regimes of instability depending on the beam intensity and topological phase: generation of vector solitons at low intensity, and discrete solitons at high intensity.

WeR8-27 15:00-15:30
Gain-through-loss in nonlinear fibers: Modulation instabilities and tunable frequency combs *(Invited paper)*
F. Bessin[1], A.M. Perego[2], K. Staliunas[3,4], S. Turitsin[2,5], A. Kudlinski[1], M. Conforti[1], A. Mussot[1]; [1]Univ. Lille, France; [2]Aston Univ., UK; [3]ICREA, Spain; [4]UPC, Terrassa (Barcelona), Spain; [5]Novosibirsk State Univ., Russia
We propose a new counterintuitive mechanism of modulation instability: asymmetric, with respect to pump, losses can induce gain of sideband modes in absence of phase matching. The mechanism is experimentally demonstrated to generate frequency combs with tunable frequencies.

WeR8-28 15:30-16:00
Integrated optical ultrafast neurophotonic chip for universal computing *(Invited paper)*
A. Fratalocchi; KAUST Univ., Saudi Arabia
In this invited talk I will review our recent theoretical and experimental research on the development of an integrated artificial intelligent optical processor based on universal learning.

R8: Nonlinear Photonics: Fundamentals and Applications

17:00 - 19:00
Session Chair: *L.A. Melnikov, Yuri Gagarin State Technical Univ. of Saratov, Russia*

WeR8-30 17:00-17:15
Optical communications via dispersion oscillating fibers
A.A. Sysoliatin[1], A.I. Konyukhov[2]; [1]Prokhorov General Physics Inst.f RAS, [2]Saratov State Univ., Russia
We propose to use dispersion oscillating fiber to encode a signal in soliton communication lines through an efficient control Zakharov-Shabat eigenvalues. The splitting of optical breather and merge of solitons can be obtained even under the strong effect of stimulated Raman scattering. We believe this technique based on use of dispersion oscillating fiber will grant unprecedented control over soliton eigenstates.
This research was supported by RFBR Grant(s) # 19-52-45012

WeR8-31 17:15-17:30
Octave spanning infrared supercontinuum generation in direct laser written waveguide
A.G. Okhrimchuk[1,3], E. V. Sorokin[1,2], I. Astrauskas[2], A. D. Pryamikov[1,3], G. K. Alagashev[1,3], V. V. Dorofeev[4]; [1]Fiber Optics Research Center RAS, Russia; [2]TU Wien, Institute of Photonics, Austria; [3]Mendeleev Univ. of Chemical Technology of Russia, Russia; [4]Devyatykh Inst. of Chemistry of High Purity Substances RAS, Russia
A depressed cladding waveguide was written by the femtosecond laser beam in the dry tellurite glass of 70TeO2 – 22WO3 – 8Bi2O3 composition. Supercontinuum was generated in the 1.5 – 3.4 μm range under pumping at 2.2 μm by 260 fs pulses. Theoretical simulations of non-linear propagation of ultra-shot pulses are in good agreement with experimental results.

WeR8-32 17:30-17:45
Raman generation of femtosecond pulses in a Methane-filled revolver fiber
A.V. Gladyshev[1], M.S. Astapovich[1], Yu.P. Yatsenko[1], A.F. Kosolapov[1], A.G. Okhrimchuk[1,2], I.A. Bufetov[1]; [1]Fiber Optics Research Center RAS; [2]Mendeleev Univ. of Chemical Technology of Russia, Russia
The influence of the pump pulse frequency chirp on the stimulated Raman scattering of femtosecond pulses in a methane-filled hollow-core fiber is investigated. Regimes of both narrowband Stokes wave generation and multiband supercontinuum generation are experimentally demonstrated. A quantum efficiency of 41 % and a Stokes pulse width of 590 fs are obtained for the 1026-to-1464 nm Raman conversion.

WeR8-33 17:45-18:00
Supercontinuum generation in a helical waveguide inscribed by a femtosecond laser beam in YAG crystal
A.G. Okhrimchuk[1,2], V.V. Likhov[2], G.K. Alagashev[2], A.D. Pryamikov[1,2]; [1]Fiber Optics Research Center RAS, [2]Mendeleev Univ. of Chemical Technology of Russia, Russia
The switch on and the switch of thresholds for supercontinuum generation were observed in the helical waveguide inscribed by the femtosecond laser beam in YAG:Nd crystal.

WeR8-34 18:00-18:30
Optical wave and vortex turbulence *(Invited paper)*
S. Nazarenko[5], J. Laurie[1], V. Lvov[2], M. Onotato[3], D. Proment[4], S. Residori[5], U. Bortolozzo[5], J. Skipp[6]; [1]Aston Univ., UK; [2]Weizmann Inst., Israel; [3]Torino Univ., Italy; [4]Univ. of East Anglia, UK; [5]INPHYNI, France; [6]Warwick Univ., UK
I will review theoretical and experimental work on optical wave turbulence. Fluid properties of light, including wave turbulence and quantised randomly moving vortices will be discussed.

WeR8-35 18:30-18:45
Short pulse propagation in dispersive quasi-PT-symmetric photonic crystal
D.M. Tsvetkov[1], V.A. Bushuev[1], V.V. Konotop[2], B.I. Mantsyzov[1]; [1]Lomonosov Moscow State Univ., Russia; [2]Universidade de Lisboa, Portugal
We consider interaction of a short optical pulse with one dimensional PT-symmetric photonic crystal with periodically modulated permittivity and periodic gain-and-loss landscape. It is found that if the medium is quasi PT-symmetric, in vicinity of exceptional point, the pulse propagation manifests strong unidirectional reflection and invisibility. Due to strong frequency selectivity, quasi-PT-symmetric photonic crystal manifests efficient filtering of back radiation.
This research was supported by RFBR Grant(s) # 18-02-00556

WeR8-36 18:45-19:00
Role of pulse duration under the ultrashort laser impact on bulk silicon
E.I. Mareev[1,2,3], K.V. Lvov[1,4], B.V. Rumiantsev[1,2], E.A. Migal[1,2], I.D. Novikov[1,2], S.Yu. Stremoukhov[1,3] and F.V. Potemkin[1,4]; [1]Lomonosov Moscow State Univ., [2]International Laser Center, Lomonosov Moscow State Univ., [3]Inst. of Photonic Technologies, Federal Scientific Research Center "Crystallography and Photonics" RAS, [4]National Research Centre 'Kurchatov Institute', Russia
We both theoretically and experientially characterize the nonlinear interaction of ultrashort laser pulse with bulk Si. The achieved deposited energy density has the maximal value for ps laser pulses and saturates at the level of 1kJ/cm^3.
This research was supported by RFBR Grant(s) # 18-32-20016

R10: Nonlinear and Quantum Integrated Optics

09:00 - 10:30
Session Chair*: B. Wetzel, XLIM Research Inst., France*

WeR10-01 09:00-09:15
Generation and application of cascade four-wave mixing in the extreme ultraviolet
Lap Van Dao, Khuong Ba Dinh, Thong Huy Chau, Khoa Anh Tran, P. Hannaford; Swinburne Univ. of Technology, Australia
Using two multiple-cycle optical pulses with incommensurate frequencies in a collinear configuration, a cascaded four-wave mixing extreme ultraviolet (EUV) field can be created because the EUV pulse produced by phase-matched high order harmonic generation in combination with the other two optical pulses produce the phase-matched four-wave mixing process along the propagating direction.

WeR10-02 09:15-09:30
Reduction of instabilities in Lithium Niobate integrated acousto-optic frequency shift modulators
A.V. Varlamov, P.M. Agrusov, I.V. Il'ichev, V.V. Lebedev, A.V. Shamrai; Ioffe Inst., Russia
The influence of standing acoustic waves and parasitic traveling surface acoustic waves on instabilities of optical signals at the output of an integrated acousto-optic frequency shift modulators is considered. The method for signal stabilization is suggested and verified.

WeR10-03 09:30-09:45
Continuous-wave stimulated Raman spectroscopy for bio-samples
R.B. Andrade[1], H. Kerdoncuff[2], K. Berg-Sørensen[1], T. Gehring[1], M. Lassen[2], U.L. Andersen[1]; [1]Technical Univ. of Denmark, [2]Danish Fundamental Metrology, Denmark.
Stimulated Raman spectroscopy has become a powerful tool to study the molecular bonds with high sensitivity, resolution and speed. We demonstrate an increase of the sensitivity of Raman spectroscopy by means of amplitude squeezed state of light.

WeR10-04 09:45-10:00
Dual wavelength coupler for second-harmonic generation in gallium phosphide microdisks
A. Lorenzo-Ruiz, C. Cornet, A. Beck, Y. Léger; Univ. Rennes, INSA Rennes, CNRS, Institut FOTON – UMR[6]082, France
During the last decade, second harmonic generation (SHG) in III-V semiconductor microdisks has been demonstrated to be an efficient way to achieve frequency conversion with compact devices. Optimized coupling of both wavelengths to these devices still remains challenging. Here we study the impact of the coupling parameters on the SHG with vertical coupling between integrated waveguides and III-V microdisk resonators.

WeR10-05 10:00-10:30
Nonlinear dielectric metasurfaces for imaging and quantum applications *(Invited paper)*
A.A. Sukhorukov; Australian National Univ., Australia
We present the theoretical and experimental advances on classical sum-frequency conversion and quantum photon-pair generation through spontaneous parametric down-conversion in nonlinear metasurfaces, underpinning quantum entanglement engineering at sub-wavelength scale for photon shaping with tailored polarization and spatial correlations. We also outline the applications of metasurfaces for the manipulation and measurement of multi-photon quantum states for free-space quantum imaging and communications.

R10: Nonlinear and Quantum Integrated Optics

14:30 - 16:15
Session Chair: *M. Kues, Leibniz Univ. Hannover, Germany*

WeR10-07 14:30-15:00
Generation and manipulation of quantum states of light with AlGaAs chips *(Invited paper)*
S. Francesconi[1], A. Raymond[1], F. Appas[1], G. Maltese[1], A. Lemaître[2], M. Amanti[1], F. Baboux[1], S. Ducci[1]; [1]Université de Paris, CNRS-UMR[7]162, [2]Centre de Nanosciences et de Nanotechnologies, CNRS, Université Paris-Sud, Université Paris-Saclay, France
We present our results on the generation of quantum states of light with AlGaAs devices working at room temperature and telecom wavelength. The manipulation of the biphoton wavefunction allows to generate quantum frequency combs and to engineer exchange statistics with a single chip. These results open interesting perspectives for a large variety of quantum information tasks.

WeR10-08 15:00-15:15
Ghost polarimetry based on entangled quantum states
D.P. Agapov, I.A. Belovolov, S.A. Magnitskiy, A.S. Chirkin; Lomonosov Moscow State Univ., Russia,
The first experimental implementation of ghost polarimetry using quantum light is presented. The object is irradiated by one of the photons of an entangled pair generated by SPDC source. Objects whose polarization properties can be interpreted as linear dichroism are used. The coincidence counting technique is used to measure the distribution of the polarization properties of the object.
This research was supported by RFBR Grant(s) # 18-02-00849

WeR10-09 15:15-15:30
Quantum correlation of optical-terahertz biphotons generated via spontaneous parametric down-conversion.
A.A. Leontyev, K.A. Kuznetsov, A.M. Rudyak, P.A. Prudkovskii, G.Kh. Kitaeva; Lomonosov Moscow State Univ., Russia
We study the statistical properties of optical - terahertz biphotons generated by means of spontaneous parametric down conversion. Numerical dependences of the second-order correlation function is obtained depending on the THz frequency. Statistical distributions of the detector's readings in idler and signal channels are analyzed experimentally.

WeR10-10 15:30-15:45
Polarization-entangled photon pairs generation via interference of nonorthogonal quantum states
D.N. Frolovtsev, S.A. Magnitskiy; Lomonosov Moscow State Univ., Russia
We report a new method for generation of polarization-entangled photon pairs in maximally entangled polarization states. Our approach is based on quantum interference between two non-orthogonal polarization quantum states of photon pairs. We present conditions for generation a maximally entangled state, and investigate the entanglement dependence on the phase between the interfering states theoretically and experimentally
This research was supported by RFBR Grant(s) # 18-02-00849

WeR10-11 15:45-16:15
Nonlinear and quantum dynamics with WGM microresonators *(Invited paper)*
Y.K. Chembo; Univ. Maryland, USA
High-Q microresonators in the nonlinear or quantum regime are expected to enable disruptive technologies in photonics engineering. In this communication, we present our latest results in this field and discuss some of the challenges ahead.

R10: Nonlinear and Quantum Integrated Optics

17:00 - 19:00
Session Chair: *B. Wetzel, XLIM Research Inst., France*

WeR10-12 17:00-17:30
Quadratic optical frequency combs: towards a new platform for multi-octave microcombs *(Invited paper)*
S. Wabnitz[1,5], T. Hansson[1], P. Parra-Rivas[2], F. Leo[2], M. Erkintalo[3], S. Mosca[4], M. Parisi[4], I. Ricciardi[4], M. De Rosa[4]; [1]Linkoping Univ., Sweden; [2]ULB, Belgium; [3]Auckland Univ., New Zealand; [4]CNR-INO, Italy
Optical frequency comb sources based on three-wave-mixing in quadratic nonlinear materials allow for reduced pump power threshold and extended spectral coverage. We review recent progress on quadratic optical frequency combs based on second-harmonic generation and optical parametric oscillation.

WeR10-13 17:30-18:00
Chasing dissipative light-bullets in vertical external-cavity surface-emitting lasers *(Invited paper)*
A. Bartolo[1], P. Camelin[1], C. Schelte[2,3], A. Verschelde[1], A. Garnache[4], G. Beaudoin[5], I. Sagnes[5], G. Huyet[1], M. Marconi[1], J. Javaloyes[2], S. V. Gurevich[2,3], M. Giudici[1]; [1]Université Côte d'Azur, CNRS, Institut de Physique de Nice UMR[7]010, France; [2]Univ. de les Illes Balears, Spain; [3]Univ. of Münster, Germany; [4]Univ. of Montpellier, France; [5]Centre de Nanosciences et de Nanotechnologies, C2N UMR[9]001, CNRS, Université Paris Sud, Université Paris-Saclay, France
We demonstrate Temporal Localized Structures in a self-imaging passive mode-locked system based on an optically-pumped VECSEL. Both the gain mirror and the SESAM have been engineered to match the parameters requirement for achieving time localization according to a theoretical model based upon Delay Algebraic Equations. Our result paves the way towards the observation of dissipative light bullets.

WeR10-14 18:00-18:15
Monolithic piezoelectric control of integrated soliton microcombs
J. Liu[1], H. Tian[2], E. Lucas[1], A.S. Raja[1], G. Lihachev[1], R.N. Wang[1], J. He[1], T. Liu[1], M.H. Anderson[1], W. Weng[1], S.A. Bhave[2], T.J. Kippenberg[1]; [1]Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland; [2]Purdue Univ., USA
We demonstrate piezoelectric actuators monolithically integrated on ultralow-loss silicon nitride waveguides that are MHz bandwidth, ultra low power and bi-polar. Varying the voltage applied on the actuator allows tuning the microresonator, and is used to initiate, switch, stabilize and tightly phase lock a single soliton microcomb.

WeR10-16 18:15-18:45
Nonlinear self-guiding of light in biological suspensions *(Invited paper)*
Rekha Gautam[1,2], Yinxiao Xiang[1,3], A. Bezryadina[1,4], J. Lamstein[1], Yi Liang[1], Guo Liang[1], T. Hansson[5], B. Wetzel[5], R. Morandotti[5], Zhigang Chen[1,3]; [1]San Francisco State Univ., USA; [2]Vanderbilt Univ., USA; [3]Nankai Univ., China; [4]California State Univ. Northridge, USA; [5]Université du Québec, Canada
In this talk, we will present a brief overview of our work on a few types of soft-matter systems with synthetic optical nonlinearities, with a focus on recent work on nonlinear optics with biological suspensions, including self-guiding of light in colloidal suspensions of living cells, where the tunable nonlinearity is largely attributed to the optical forces acting on the cells.

WeR10-17 18:45-19:00
Quantum temperature sensor based on superradiant phase-transition
A.Y. Bazhenov, A.P. Alodjants; ITMO Univ., Russia
We study superradiant phase transition (SPT) phenomena for high-precision quantum thermometry applications in bio-photonics. We fully describe superradiant field amplitude (cavity photon number) that represents the order parameter and exhibits the second order phase transition, which can be used for initialization of operating regimes in temperature sensorics

WeR10-16 18:15-18:45
Nonlinear self-guiding of light in biological suspensions *(Invited paper)*
Rekha Gautam[1,2], Yinxiao Xiang[1,3], A. Bezryadina[1,4], J. Lamstein[1], Yi Liang[1], Guo Liang[1], T. Hansson[5], B. Wetzel[5], R. Morandotti[5], Zhigang Chen[1,3]; [1]San Francisco State Univ., USA; [2]Vanderbilt Univ., USA; [3]Nankai Univ., China; [4]California State Univ. Northridge, USA; [5]Université du Québec, Canada
In this talk, we will present a brief overview of our work on a few types of soft-matter systems with synthetic optical nonlinearities, with a focus on recent work on nonlinear optics with biological suspensions, including self-guiding of light in colloidal suspensions of living cells, where the tunable nonlinearity is largely attributed to the optical forces acting on the cells.

R1: Solid-State Lasers

14:30 - 16:45 **Ultrafast and CW lasers**
Session Chair: Uwe Griebner,
Max-Born-Inst., Germany

ThR1-36 14:30-15:00
High-power nonmode-locked femtosecond laser sources at GHz repetition rates *(Invited paper)*
L. Pontagnier[1], G. Santarelli, E. Cormier[1,2]; [1]Laboratoire Photonique, Numérique et Nanosciences (LP2N), Université Bordeaux–IOGS–CNRS (UMR[5]298),[3]3400 Talence, France; [2]Institut Universitaire de France
We report on the recent development of a versatile electro-optical source producing sub-picosecond pulses at tunable GHz repetition rates and the ability to operate in burst mode. Applications are presented and discussed.

ThR1-37 15:00-15:15
Ultrafast mid-IR Fe:ZnSe laser
A.V. Pushkin[1], E.A. Migal[1], S. Tokita[2], Yu.V. Korostelin[3], F.V. Potemkin[1]; [1]Lomonosov Moscow State Univ., Russia; [2]Inst. of Laser Engineering, Osaka Univ., Japan; [3]Lebedev Physical Inst. RAS, Russia
We report the graphene mode-locked Fe:ZnSe laser. It delivers 415 mW average power output radiation at a wavelength of 4.4 μm being pumped by fiber Er:ZBLAN laser. A pulse duration of 732 fs retrieved from the first-order autocorrelation function. Such simple and effective ultrafast mid-IR high-repetition-rate coherent sources are designed to become a valuable tool in various fields of photonics.
This research was supported by RFBR Grant(s) # 18-52-50019

ThR1-38 15:15-15:45
Towards a 100 TW, sub-5-fs, CEP-stable optical parametric synthesizer for attosecond and laser-plasma physics *(Invited paper)*
Laszlo Veisz[1,2], Peter Fischer[1], Daniel E. Cardenas[2], Alexander Muschet[1], Aitor De Andres[1], Roushdey Salh[1]; [1]Umeå University, Sweden; [2]Max-Planck-Inst. für Quantenoptik, Germany
We report on an optical parametric synthesizer producing relativistic intensity pulses with sub-two-optical-cycle duration. The 580-1000 nm bandwidth is synthesized from two optical parametric chirped pulse amplifiers with complementary spectral ranges. Basic applications in nonlinear attosecond XUV physics and relativistic nanophotonics are demonstrated. An upgrade is ongoing towards 100 TW peak power and carrier-envelope phase stabilization.

ThR1-39 15:45-16:00
Vibration influence on wavelength stability of solid-state YbEr:phosphate glass laser
T.V. Choban1, A.A. Zhirnov[2,1], V.L. Tolstoguzov[1], S.V. Tikhomirov[3], A.B. Pnev[1], V.E. Karasik[1], C. Svelto[4]; [1]Bauman Moscow State Technical Univ., [2]Kotelnikov Inst. of Radioengineering and Electronics RAS, Russia; [3]All-Russia Research Inst. of Optophysical Measurements, Russia; [4]DEIB, Politecnico di Milano, Italy
We report on a study of vibration influence on narrow linewidth solid-state laser setup wavelength stability. This parameter is crucial for laser application of different areas, e.g. fiber sensors. Definition of requirements to cavity components mechanical stability is important for further improvements and using of solid-state lasers in fiber sensors.

ThR1-40 16:00-16:15
Spectroscopic study and first laser operation of monoclinic Yb3+,Li+:ZnWO4 crystal
A.A. Volokitina[1,2], K.A. Subbotin[3,4], P.A. Loiko[2], A.I. Titov[3,4], D.A.Lis[3], S.Slimi[1], R.M. Solé[1], S.P. David[5], V. Jambunathan[5], A. Lucianetti[5], T. Mocek[5], U. Griebner[6], V. Petrov[6], M. Aguiló[1], F. Díaz[1], X. Mateos[1] and E. Zharikov[3]; [1]FiCMA-FiCNA-EMaS, Universitat Rovira i Virgili (URV), Spain; [2]ITMO Univ., Russia; [3]Prokhorov General Physics Inst. RAS, [4]Mendeleev Univ. of Chemical Technology, Russia; [5]HiLASE Centre, Inst. of Physics CAS, Czech Republic; [6]Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany
Monoclinic Yb3+,Li+:ZnWO4 crystals were grown by Czochralski and their structure is refined. The spectroscopic properties of Yb3+ ions were studied with polarized light, and the scheme of Stark splitting of Yb3+ manifolds in these crystals was determined. The Raman spectra were measured. A diode-pumped 2.90 W laser action at 1059 nm in the crystals was demonstrated
This research was supported by RFBR Grant(s) # 18-02-01058

ThR1-41 16:15-16:30
Generation of tunable THz radiation at the difference frequency in a single crystal ZnGeP2
A.A.Sirotki[1], N.N. Yudin[2,3], V.V.Dyomin[2], M.M. Zinovev[2,3]; [1]Prokhorov General Physics Inst. RAS, [2]National Research Tomsk State Univ., [3]V.E. Zuev Inst. of Atmospheric Optics SB RAS, Russia
Terahertz radiation was obtained using a difference frequency generation in a single crystal ZnGeP2 with pumping intracavity degenerate optical parametric oscillator. The THz radiation was tuned in the wavelength range of 120-270 μm. The maximum average power of THz radiation was ~ 3.3 nW and peak power was 0.4 mW (λ = 181 μm).

ThR1-42 16:30-16:45
Fibre-delivered red-diode-pumped >7W TEM00 Alexandrite laser
G. Tawy[1], M. J. Damzen[1], A. Minassian[2]; [1]Imperial College London, [2]Unilase Ltd, UK
We demonstrate a record high power 7.4W red-diode-pumped Alexandrite laser in TEM00 operation using a compact fibre-delivered system. Wavelength tuning at 725-808nm is demonstrated with >1W over 730-805nm for the very first time for a diode-pumped Alexandrite laser.

R1: Solid-State Lasers

17:00 - 19:00 **Pulsed and CW lasers**
Session Chair: Uwe Morgner,
Ultrafast Laser Optics Inst. für Quantenoptik Leibnitz Univ., Germany

ThR1-43 17:00-17:30
High-power ultrafast industrial thin-disk lasers *(Invited paper)*
P. Kroetz, C. Wandt, C. Herkommer, R. Jung, S. Klingebiel, C.Y. Teisset, K. Michel, T. Metzger; Trumpf Scientific Lasers, Germany
Ultrafast amplifiers using TRUMPF industrial thin-disk technology deliver record pulse energies of >200 mJ at 5 kHz, with a pulse duration below 500 fs. KW Multipass amplifiers and concepts for nonlinear compression of pulses to <50 fs will be discussed.

ThR1-44 17:30-17:45
Nonsymmetric thermal lenses of amplifiers and beam quality of 5 J pulsed laser system
E.O. Batura, M.V. Bogdanovich, A.V. Grigor'ev, V.N. Dudikov, A.M. Kot, A.G. Ryabtsev, G.I. Ryabtsev, P.V. Shpak, M.A. Shchemelev
Influence the LDM arrangement on properties of transversally pumped Nd:YAG solid–state lasers emitting the 5J pulses was investigated. It was shown that output characteristics of the powerful lasers can be improved by rational arrangement of LDMs around the side active element surface. The results obtained are explained by mechanism of creation of distorted thermal lenses in Nd:YAG active medium.

ThR1-45 17:45-18:00
Solid-state tunable ultraviolet laser sources based on fluoride crystals
V. V. Semashko, A. K. Naumov, A. S. Nizamutdinov, S. L Korableva, M. A. Marisov, A. A. Shavelev; Kazan Federal Univ., Russia
The review of experimental results improving the tuning and energy properties of UV lasers based on crystals with the scheelite-type (LiY1-xLuxF4) and colquiriite-type (LiCa1-xSrxAlF6) structures doped by Ce3+ and Cr3+ ions is presented. Prospects of developing and using of these lasers in optosensorics, biomedicine, and security systems are discussed.

ThR1-46 00:37-18:15
Recovery of excess laser noise photon-number distribution from photocounting statistics
P.P. Gostev, S.A. Magnitskiy, A.S. Chirkin; Lomonosov Moscow State Univ.,Russia
We propose a method to recover photon-number statistics of excess noise in laser radiation from measured photocounting statistics. The method based on the multi-objective optimization approach applied to blind deconvolution problem to determine excess noise distribution from the convolution of this one and poissonian photon-number distribution of laser radiation.
This research was supported by RFBR Grant(s) # 18-02-00-849

ThR1-47 18:15-18:30
Laser operation of Yb3+-doped Lu-based oxide ceramics: a comparative study
L. Basyrova[1,2,3], P. Loiko[3], R. Maksimov[4,5], J. M. Serres[1], V. Shitov[5], M. Baranov[2], M. Aguiló[1], F. Díaz[1], U. Griebner[6], V. Petrov[6], X. Mateos[1]; [1]FiCMA-FiCNA-EMaS, Universitat Rovira i Virgili (URV), Spain; [2]ITMO Univ., Russia; [3]CIMAP, CNRS, Université de Caen Normandie, France; [4]Ural Federal Univ., Russia; [5]Inst. of Electrophysics UB RAS, Russia; [6]Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany
We report on a detailed comparative study of micro-structure, optical properties, spectroscopy and laser performance of two Lu-based oxide transparent ceramics produced from laser-ablated nanoparticles - Yb:Lu3Al5O12 and Yb:Lu2O3. A compact diode-pumped Yb:Lu3Al5O12 ceramic laser generated 5.65 W at 1031 nm with a slope efficiency of 67%.
This research was supported by RFBR Grant(s) # 19-03-00855

ThR1-48 18:30-18:45
Mathematical model of LiYLuF4:Ce active medium
N.F. Rakhimov, A.S. Nizamutdinov, V.V. Semashko, M.A. Marisov, I.I. Farukhshin, A.A. Shakirov; Kazan Federal Univ., Russia
we created a mathematical model of the active medium LiY0.3Lu0.7F4: Ce 1% for a detailed understanding of the interaction of color centers with laser radiation, and for predicting the behavior of this active medium under various conditions such as temperature, resonator size, and pump pulse power.

ThR1-49 18:45-19:00
Lasing in the slurry-like active media
O. Burdukova[1], N. Bykovsky[1], B. Chichkov[2], B. Denker[3], V. Konyushkin[3], Yu. Kopylov[1,4], K. Lopukhin[1,4], V. Petukhov[1], Yu. Senatsky[1], P. Zverev[3]; [1]P.N. Lebedev Physics Inst. RAS, Russia; [2]Leibniz Univ. Hannover, Germany; [3]A.M. Prokhorov General Physics Inst. RAS, [4]V.A. Kotel'nikov Inst. of Radioengineering and Electronics RAS, Russia.
Experiments on lasing in slurry-like active media on index-matched mixtures of laser crystal or glass particles with immersion liquids are reported.10ns pulses up to 0.1 mJ at λ≈680nm were obtained from a laser on a test cuvette containing LiF particles with F2 color centers (sized 200 -1000 μm) in a vaseline oil/heptane mixture pumped by a Coumarin 120 dye laser.
This research was supported by RFBR Grant(s) # 18-02-00285

R2: High Power Lasers - Fiber, Solid State, Gas and Hybrid

09:00 - 11:00
Session Chair: *F.A. Starikov,*
RFNC – The All-Russian Research Inst. of Experimental Physics, Russia

ThR2-13 09:00-09:15
Bend-insensitive Bi-doped fiber for a compact laser operating at 1.3-μm wavelength region
E.G. Firstova[1], A.M. Khegai[1], Ya.J. Ososkov[1], K.E. Riumkin[1], A.S. Lobanov[2], S.V. Alyshev[1] M.A. Melkumov[1], V.F. Khopin[2], A.N. Guryanov[2], S.V. Firstov[1]; [1]Fiber Optics Research Center RAS; [2]Inst. of Chemistry of High-Purity Substances RAS, Russia
For the first time, we fabricated and studied optical characteristics of a bend-insensitive bismuth-doped P2O5 – SiO2 glass core fiber operating in a spectral region of 1.3 – 1.4 μm having a depressed cladding design.

ThR2-14 09:15-09:30
Dual-wavelength soliton dumbbell-shaped Thulium-doped fiber laser
A.D. Zverev[1], V.A. Kamynin[2], A.I. Trikshev[2], Y.G. Gladush[3], E.M. Khabushev[3], D.V.Krasnikov[3], A.G. Nasibulin[3,4], A.A. Mastin[5], P.A. Ryabochkina[5], V.G. Voronin[1], V.B. Tsvetkov[2,6]; [1]Lomonosov Moscow State Univ.; [2]General Physics Inst. RAS; [3]SkolTech, Russia; [4]Aalto Univ., Finland; [5]Ogarev MSU, Russia; [6]MEPhI, Russia
Dual-wavelength ultra-short pulses generation in the dumbbell-shaped thulium fiber laser was demonstrated. The mode-locking regime was achieved by using single-walled carbon nanotubes in the laser cavity. Output power was up to 6 mW and the main repetition rate was around 5.3 MHz.
This research was supported by RFBR Grant(s) # 18-42-130001p_a

ThR2-15 09:30-09:45
Up to 4kW narrow linewidth CW diffraction-limited laser generated from fiber amplifiers in robust monolithic format
Honghuan Lin, Qiuhui Chu, Yi Shi, Yun Luo, Jin Wen, Rumao Tao, Jianjun Wang, Feng Jing; Research Center of Laser Fusion, CAEP, China
A 4kW-level monolithic narrow linewidth fiber amplifier has been demonstrated. The 20dB RMS linewidth at the maximal output power is about 0.41nm, and the M2 is measured to be less than 1.6 at 3.9kW. To the best of our knowledge, this is the first report of 4kW near-diffraction-limited narrow linewidth monolithic fiber lasers.

ThR2-16 09:45-10:00
Thulium-doped Tellurite fiber amplifier at a wavelength of 2270 nm
B.I. Denker[1], S.A. Filatova[1], B.I. Galagan[1], V.A. Kamynin[1], V.V. Koltashev[2], S.E. Sverchkov[1], I.V. Zhluktova[1], V.B. Tsvetkov[1,3]; [1]Prokhorov General Physics Inst. RAS; [2]Fiber Optics Research Center RAS; [3]National Research Nuclear Univ. 'MEPhI', Russia
Gain properties of Tm-doped tellurite fiber at 2270 nm were investigated. The signal source was the spectrally selected part of supercontinuum from a heavily GeO2 doped silica fiber. It was pumped by ultrashort pulses from the self-made holmium-doped fiber laser system. Twofold amplification of the input signal was obtained.
This research was supported by RFBR Grant(s) # 20-02-00425

ThR2-17 10:00-10:15
Coherent amplification of peak-power-scalable out-of-phase supermode in Yb-doped multicore fiber
N. A. Kalinin[1,2], A. V. Andrianov[1], E. A. Anashkina[1,2], O. N. Egorova[3], D. S. Lipatov[4], A. V. Kim[1], S. L. Semjonov[5], A. G. Litvak[1]; [1]Inst. of Applied Physics RAS; [2]Lobachevsky State Univ. of Nizhny Novgorod; [3]Prokhorov General Physics Inst. RAS; [4]Devyatykh Inst. of Chemistry of High-Purity Substances RAS; [5]Fiber Optics Research Center RAS, Russia
We demonstrate selective excitation and coherent amplification in Yb-doped multicore fiber of the out-of-phase supermode that has equal intensities but interleaved 0/π phases in neighboring cores. In a six-core fiber, we amplified pulses up to ~1 μJ with out-of-phase mode content >80%. Numerical simulation demonstrated the possibility of the out-of-phase supermode amplification above the self-focusing power limit for bulk silica.

ThR2-18 10:15-10:30
All-normal dispersion, all-fiber mode-locked Yb-doped fiber laser based on spectral bandpass filter
Sung Yoon Cho, Min Yong Jeon; Chungnam National Univ., Korea
In this paper, we report an all-fiber passively mode-locked Yb-doped fiber laser in the all normal dispersion region. The total group delay dispersion (GDD) of the laser cavity was measured to be about 0.1771 ps2. Directly measured pulse duration and compressed pulse duration are measured to be 5.46 ps and 283 fs respectively, assuming Gaussian pulse shape.

ThR2-19 10:30-10:45

High power monolithic spindle-shaped ytterbium-doped fiber laser oscillator

Lingfa Zeng[1], Xiaoming Xi[1,2,3], Xiaolin Wang[1,2,3], Yun Ye[1], Hanwei Zhang[1,2,3], Baolai Yang[1,2,3], Chen Shi[1,2,3], Peng Wang[1,2,3], Xiaojun Xu[1,2,3]; [1]National Univ. of Defense Technology; [2]State Key Laboratory of Pulsed Power Laser Technology; [3]Hunan Provincial Key Laboratory of High Energy Laser Technology, China

We constructed a monolithic fiber laser oscillator based on a spindle-shaped ytterbium-doped fiber. Under the condition of counter pump with 976nm LDs, an output laser of 1836W with an optical to optical efficiency of 83.6% has been obtained with the beam quality of M2<1.6 .

ThR2-20 10:45-11:00

Wideband 26 dB bismuth-doped fiber amplifier in the range 1.3-1.44 μm

A.M. Khegai[1], Y.Zh. Ososkov[1,2], S.V. Firstov[1], S.V. Alyshev[1], K.E. Riumkin[1], V.F. Khopin[3], F.V. Afanasiev[3], A.S. Lobanov[3], A.N. Guryanov[3], O.I. Medvedkov[1,4], M.A. Melkumov[1]; [1]Fiber Optics Research Center RAS; [2]Prokhorov General Physics Inst. RAS; [3]Devyatykh Inst. of Chemistry of High-Purity Substances RAS; FORC-Photonics, Russia

We present a wideband fiber amplifier with a flat gain spectrum ranging from 1306 to 1441 nm at a 3 dB level from maximum of 26 dB based on bismuth-doped active fibers with phosphosilicate and germanosilicate glass core. Combination of pumping at 1180 nm and gain clamping at 1280 nm was used to achieve a wider gain spectrum.

This research was supported by RFBR Grant(s) # 18-32-00438

R2: High Power Lasers - Fiber, Solid State, Gas and Hybrid

11:30 - 13:30
Session Chair: *F.A. Starikov,*
RFNC – The All-Russian Research Inst. of Experimental Physics, Russia

ThR2-21 11:30-12:00
40 TW laser system in the visible spectrum range *(Invited paper)*
V.F. Losev; Inst. of High Current Electronics SB RAS, Russia
IIncreasing the peak power of THL-100 hybrid laser system are presented about. The SH spectrum was broadened in a nonlinear crystal, its radiation pulse was extended in the prism stretcher to 1.8 ps and amplified in the XeF(C-A) amplifier. At the output of laser system 1.2 J energy and 29.4 fs pulse duration were obtained.
This research was supported by RFBR Grant(s) # 18-08-00383a

ThR2-22 12:00-12:15
Laser performance status of the Integration Test Bed
J.P. Zhao, Z.Y. Zong, S. Li, Y. Liang, D.E. Wang, X.X. Chai, Y.W. Xia, Y.L. Jiang, B. Zhang, X. Zhang, B. Chen, K.X. Zheng, X.F. Wei, Q.H. Zhu; Laser Fusion Research Center, CAEP, China
The Integration Test Bed (ITB) is a large-aperture single-beam Nd: glass laser system. The third phase designed output of the ITB is 20kJ with the peak power of 4.5TW at 1053nm and 9.8kJ with 2.6TW at 351nm. This paper will briefly introduce the latest verification progress.

ThR2-23 12:15-12:30
Picosecond hybrid laser based on semiconductor DFB laser, fiber and Nd:YVO4 amplifiers - limits of output peak power scaling
I. A. Gorbunov, O. V. Kulagin; Inst. of Applied Physics RAS, Russia
We present a compact picosecond hybrid laser for satellite ranging based on semiconductor DFB laser oscillator, Yb-doped fiber and Nd:YVO4 bulk amplifiers. The output of 2.1 mJ, 25 ps pulses at 1 kHz repetition rate, 532 nm second harmonic wavelength and a near diffraction limited beam quality M2<1.5 was obtained, limits of peak power scaling in each amplifier were investigated.

ThR2-24 12:30-12:45
CPA-free high power narrow linewidth fiber-based laser system with pulse sequence flexibility
A.B. Petrov[1,2], M.A. Odnoblyudov[2,3], R. Gumenyuk[4], J. Rissanen[3], A.V. Gorbachev[2], V. Filippov[3]; [1]ITMO Univ., Russia; [2]Peter the Great St.Petersburg Polytechnic Univ., Russia; [3]Ampliconyx Ltd, Finland; [4]Tampere Univ., Finland
We demonstrate a compact picosecond CPA-free system based on a gain-switched semiconductor laser diode as a seed source and a Yb-doped polarization-maintaining double-clad tapered fiber (T-DCF) delivering 45 ps pulses with over 1 MW peak power and average output power in excess of 100 W preserving near diffraction-limited beam quality and a linewidth of less than 100 pm.

ThR2-25 12:45-13:00
Hybrid laser technologies for the additive manufacturing of marine engineering parts
V.K. Bukato, N.A. Nosyrev, N.A. Steshenkova; JSC "Shipbuilding and Shiprepair Technology Center" (JSC "SSTC"), Russia
Article describes modern approaches for creation of new marine engineering products including hybrid laser technologies for the additive manufacturing with direct laser deposition and laser wire additive process and their combination.

ThR2-26 13:00-13:15
Pumping of gas mixtures by the products of 6Li(n,α)3H nuclear reaction in the nuclear reactor core
K. Samarkhanov[1], E.G. Batyrbekov[1], M.U. Khasenov[2], Yu.N. Gordienko[3], Yu.V. Ponkratov[3], Ye.Yu. Tulubayev[3], V.S. Bochkov[3]; [1]National Nuclear Center of the Republic of Kazakhstan; [2]Nazarbayev Univ.; [3]Inst. of Atomic Energy, Branch of the National Nuclear Center of the Republic of Kazakhstan, Kazakhstan
The study was carried out at the IVG.1M stationary reactor core. As a source of charged particles, lithium of a natural enrichment with an impurity content of less than 0.1% was used. The emission spectra during alkali metal sputtering into noble gases excited by products of 6Li(n,α)3H nuclear reaction were studied.

ThR2-27 13:15-13:30
Optimization of high peak, high average power laser amplifier with cryogenic cooling
G.V. Kuptsov[1,2], V.A. Petrov[1,2], V.V. Petrov[1,2,3], A.V. Laptev[1]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State Technical Univ.; [3]Novosibirsk State National Research Univ., Russia
A numerical three-dimensional non-stationary model describing laser amplification process with account of the dependencies of properties of active element on temperature distribution was developed. Laser amplification process in cryogenically cooled high peak, high average power amplifier was simulated and it is shown that optimization of pump parameters allows one to obtain up to 50% more energy at output of amplifier.
This research was supported by RFBR Grant(s) # 19-42-543007

R2: High Power Lasers - Fiber, Solid State, Gas and Hybrid

14:30 - 16:30
Session Chair: Yu.M. Klimachev.
Lebedev Physical Inst. RAS, Russia

ThR2-28 14:30-15:00
Deformable mirrors for high-power lasers *(Invited paper)*
A.V. Kudryashov[1,2], V.V. Toporovsky[1,2], V.V. Samarkin[1], A.L. Rukosuev[1], J.V. Sheldakova[1]; [1]Inst. of Geosphere Dynamics RAS, [2]Moscow Polytechnic Univ., Russia
The development of laser technique and various applications of laser radiation requires the use of devices that can modify the wavefront of laser beams. In these cases, the use of deformable mirrors is simply very important. We consider that two types of wavefront correctors are the most well-suitable for such an application: bimorph deformable mirrors and stacked-actuator (SADM) ones.

ThR2-29 15:00-15:15
Magneto-optical properties of sesquioxide ceramics
I.L. Snetkov[1], A.I. Yakovlev[1], D.A. Permin[2], S.S. Balabanov[2], J. Li[3], O.V. Palashov[1]; [1]FRC Inst. of Applied Physics RAS, Russia; [2]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia; [3]Shanghai Inst. of Ceramics CAS, China
The report presents studying results of optical and magneto-optical properties of transparent sesquioxide ceramics REE2O3 (REE=Tb, Dy, Ho, Er). Dependences of the Verdet constant on wavelength and temperature are measured and analytical approximations are founded. The range of applicability and the prospects of use in modern laser systems for each ceramic material are determined.
This research was supported by RFBR Grant(s) # 19-52-53014

ThR2-30 15:15-15:30
High sensitive dual core photonic crystal fiber magnetic field sensor
M. De, S. Das, V.K. Singh; Indian Inst. of Technology (ISM), India
A high sensitive magnetic field sensor based on a square lattice dual core photonic crystal fiber using coupled mode theory is reported. It has sensitivity 730.49 pm/Oe. High sensitivity and ease of use making it suitable for manufacturing portable devises.

ThR2-31 15:30-15:45
Laser radiation resistance of active centers in bismuth-doped GeO2-SiO2-glass core fibers
A.V. Kharakhordin[1], K.E. Riumkin[1], S.V. Alyshev[1], A.M. Khegai[1], M.A. Melkumov[1], A.S. Lobanov[2], V.F. Khopin[2], A.N. Guryanov[2], and S.V. Firstov[1,3]; [1]Fiber Optics Research Center RAS; [2]Inst. of Chemistry of High-Purity Substances RAS, [3]Ogarev Mordovian State Univ., Russia
We report experimental results and numerical calculations regarding the stability of laser-active bismuth-related centers in Bi-doped GeO2–SiO2 glass fibers to laser radiation at 1550 nm (at different temperatures).

ThR2-32 15:45-16:00
Time behavior of NH3 laser THz emission under optical pumping by “long” pulse CO2 laser
A.A. Ionin[1], I. O. Kinyaevskiy[1], Yu.M. Klimachev[1], A.A. Kotkov[1], A.A. Kozlov[1], J.-F. Lampin[2], Yu.A. Mityagin[1], S.A. Savinov[1], A.M. Sagitova[1], D.V. Sinitsyn[1], I.A. Chebotarev[1]; [1]Lebedev Physical Inst. RAS, Russia; [2]Inst. of Electronics, Microelectronics and Nanotechnology, IEMN, France
A waveform of pulsed terahertz lasing of ammonia molecules was measured with nanosecond resolution under optical pumping by “long” pulse EBSD CO2 laser on 9R (30) and 9R (16) transitions. Delay time of the NH3 laser emission relative to the beginning of the pump pulse was ~2 μs, and duration ranged 10-20 μs depending on CO2 laser pulse energy.
This research was supported by RFBR Grant(s) # 18-52-16019

ThR2-33 16:00-16:15
Laser hardening of inner and external conical threaded surfaces
M.V. Kuznetsov, M.V. Larin, O.I. Grinin, A.O. Voropaev, V.G. Protsenko; State Marine Technical Univ., Russia
Results of the research influence parameters of the mode on the geometry and hardness of the hardening layer at the laser hardening of inner and external conical threaded surfaces from 40 HFMA steel are shown in the publication.

ThR2-34 16:15-16:30
Novel planar tube single-mode waveguide for High-Power applications.
V.A. Shulepov, S.M. Aksarin, A. Mukhtubaev, V.E. Strigalev, I.K. Meshkovskiy, M.A. Eronyan, A.U. Kulesh; ITMO Univ., Russia
This work is dedicated to a planar tube waveguide develop and its optical properties experimental research. Single mode planar waveguide with large optical mode up to 30 um width obtained by MCVD method on the inner surface of a quartz tube. Hi 30dB polarization extinction with 1550 nm wavelength was been measured with optical path up to 200 mm.

R3: Semiconductor Lasers, Materials and Applications

14:30 - 16:45
Session Chair: *R. Hogg, Univ. of Glasgow, UK*

ThR3-23 14:30-15:00
Mid-IR stimulated emission in HgCdTe QW heterostructures with dielectric and phonon waveguides *(Invited paper)*
S.V. Morozov; Inst. for Physics of Microstructures RAS, Russia
Stimulated emission at wavelengths up to 24 μm (12.5 THz) and down to 2.8 μm is demonstrated from HgCdTe quantum well heterostructures. Non-radiative Auger recombination is show to be mitigated due to relativistic energy spectrum. In the short wavelength range SE down to 3.5 μm is demonstrated at temperatures available with Peltier coolers.

ThR3-24 15:00-15:15
Room-temperature CW THz-emitting two-chip semiconductor disk laser
H. Guoyu[1,2], K.A. Fedorova[1], C. Kriso[1], M. Wichmann[1], F. Zhang[1], W. Stolz[1], A. Rahimi-Iman[1]; [1]Philipps-Univ. Marburg, Germany; [2]Beijing Univ. of Technology, China
We demonstrate a room-temperature, continuous-wave laser source providing 1-THz output by difference-frequency generation in a periodically-poled lithium niobate crystal using two serially-connected similar semiconductor disk laser chips in one cavity for power-scalability.

ThR3-25 15:15-15:30
THz quantum cascade lasers based on GaAs/AlGaAs and HgCdTe material systems
R. A. Khabibullin[1], N.V. Shchavruk[1], D.S. Ponomarev[1], D.V. Ushakov[2], A.A. Afonenko[2], O.Yu. Volkov[3], V.V. Pavlovskiy[3], K.V. Maremyanin[4], A.A. Dubinov[4]; [1]Mokerov Inst. of Ultra High Frequency Semiconductor Electronics RAS, Russia; [2]Belarusian State Univ., Belarus; [3]Inst. of Radio-Engineering and Electronics RAS, [4]Inst. for Physics of Microstructures RAS, Russia
We have designed and fabricated 2.3 THz QCL with active module based on 4 QWs GaAs/Al0.15Ga0.85As. The light-current-voltage characteristics, emission spectra and far-field distribution of the emission intensity of the fabricated THz QCL are investigated. We evaluate the potential of the Hg1-xCdxTe structures as a gain medium for QCL operating at frequencies above 6 THz.
This research was supported by RFBR Grant(s) # 8-52-00011_Bel

ThR3-26 15:30-15:45
High power quantum-cascade lasers for 8 μm spectral region
V.V. Dudelev[1], D.A. Mikhailov1, A.V. Babichev[1], A.G. Gladyshev[2], S.N. Losev[1], I.I. Novikov[2], A.V. Lyutetskiy[1], S.O. Slipchenko[1], N.A. Pikhtin[1], L.Ya. Karachinsky[2], A.Yu. Egorov[3], G.S. Sokolovskii[1]; [1]Ioffe Inst.; [2]Connector Optics LLC; [3]ITMO Univ., Russia
High power quantum-cascade lasers emitting near 8 μm are studied. The optical power from one facet exceeding 1 W is demonstrated at room temperature.

ThR3-27 15:45-16:00
Room-temperature CW tunable-THz semiconductor disk laser
K.A. Fedorova[1], H. Guoyu[1,2], M. Wichmann[1], C. Kriso[1], F. Zhang[1], W. Stolz[1], A. Rahimi-Iman[1]; [1]Philipps-Univ. Marburg, Germany; [2]Beijing Univ. of Technology, China
We demonstrate a compact, room-temperature, continuous-wave, tunable THz-generating laser source in the 0.8–1.1 THz spectral region based on intracavity difference-frequency generation in an aperiodically-poled lithium niobate crystal using a dual-color semiconductor disk laser.

ThR3-28 16:00-16:15
Generation and detection of THz radiation by antennas based on topological insulators Bi2-xSbxTe3-ySey
D.A. Safronenkov[1], K.A. Kuznetsov[1,2], P.I. Kuznetsov[2], , A.A. Ezhov[1], G.Kh. Kitaeva[1]; [1]Lomonosov Moscow State Univ., [2]Kotelnikov IRE RAS (Fryazino branch), Russia
Using terahertz time-domain spectroscopy, thin films of topological insulators Bi2-xSbxTe3-ySey of various thicknesses and chemical compositions were studied. An increase in the power of THz wave radiation was demonstrated by applying an external electric field to electrodes deposited on a topological insulator. The possibility of detecting THz wave radiation using antennas based on topological insulators is being considered.
This research was supported by RFBR Grant(s) # 18-29-20101, 19-02-00598

ThR3-29 16:15-16:45
Quantum dot materials as the enabling approach for compact Terahertz setup *(Invited paper)*
A. Gorodetsky[1,2], S. Smirnov[3], A. Yadav[3], N. Bazieva[3]; [1]ITMO Univ., Russia; [2]Univ. of Birmingham, [3]Aston Univ., UK
We demonstrate the potential of the InAs/GaAs Quantum-Dot based setups to become an efficient approach to compact, room-temperature operating CW and pulsed terahertz setups for spectroscopy, imaging and data transfer. Quantum-Dot based photoconductive antennas enable pumping with compact Quantum-Dot semiconductor lasers, both in ultrafast and tunable dual-wavelength regime. Ultimately, the antennas can be deposited directly onto laser chip.

R3: Semiconductor Lasers, Materials and Applications

17:00 - 19:00
Session Chair: *G.S. Sokolovskii*, *Ioffe Inst., Russia*

ThR3-30 17:00-17:30
Hybrid lasers for spectroscopy *(Invited paper)*
Liam O'Faolain; Cork Inst. of Technology, Ireland
The hybrid laser paradigm is providing a new family of lasers that have unique advantages for spectroscopy. The hybrid laser comprises a gain chip, a waveguide and a resonant Photonic Crystal mirror.

ThR3-31 17:30-18:00
Advances in III-V/Si photonic integration technology *(Invited paper)*
M. Guina; Tampere Univ., Finland
Penetration of PIC technology to applications outside datacom requires wavelength versatility and broader functionality. To this end, the presentation will review recent advances in developing GaSb/Si light sources for mid-IR sensing, new strategies enabling reliable hybrid-integration of III-V optoelectronics with silicon-photonics circuitry, as well as a new approach enabling monolithic integration of infrared quantum-wells on Si.

ThR3-32 18:00-18:15
Optical gain and high-power operation of edge-emitting lasers based on quantum well-dots
M.V. Maximov[1], N.Yu. Gordeev[2], A.S. Payusov[2], Yu.M. Shernyakov[2], S.A. Mintairov[1,2], N.A. Kalyuzhnyy[2], A.M. Nadtochiy[1], A.A. Serin[2], G.O. Kornyshov[1], A.E. Zhukov[3]; [1]Alferov Univ.; [2]Ioffe Inst.; [3]National Research Univ. Higher School of Economics, Russia
We study lasers based on InGaAs/GaAs nanostructures of mixed (0D/2D) dimensionality (quantum well-dots, QWDs). QWDs represent a dense array of carrier-localizing indium-rich regions inside In-depleted residual layer. Modal gain of QWD ground state transition as high as 75 cm-1 per layer and laser output power of 14.2 and 51 W in CW and in pulsed modes, respectively were obtained.

ThR3-33 18:15-18:30
Auger suppression and far-infrared lasing in HgTe quantum wells near the topological transition
D. Svintsov[1], G. Alymov[1], V. Rumyantsev[2], S. Morozov[2], V. Aleshkin[2], V. Gavrilenko[2];[1]. Moscow Inst. of Physics and Technology, [2]Inst. for Physics of Microstructures RAS, Russia
We demonstrate strong suppression of Auger recombination in HgTe quantum wells with thickness below the topological transition. It occurs due to formation of Dirac-type electron-hole dispersion imposing energy-momentum restrictions on recombining carriers. We develop a theory of lasing that agrees with experimental data on stimulated emission at 20 μm, and shows its possibility up to 50 μm at 77 K.
This research was supported by RFBR Grant(s) # 19-37-70031

ThR3-34 18:30-19:00
Hybrid solutions for the advanced high power laser technologies *(Invited paper)*
R. Gumenyuk; Tampere Univ., Finland
In this talk, I will present an overview of the modern tendency in the design of solid-state short-pulsed and high-power laser systems for industrial applications based on the integration of different technological fields.

R6: Lasers for Green Photonics and Sustainability

15:00 - 16:30
Session Chair: *V. Pasiskevicius*, *KTH, Sweden*

ThR6-12 15:00-15:30
Lidar profiling biological targets- detection limits and dynamic range. *(Invited paper)*
M. Brydegaard[1,2], B. Kouakou[1,2], S. Jansson[1,2], J. Rydell[2], J. Zoueu[3]; [1]Dept. of Physics, Lund Laser Centre, Lund Univ., Sweden; [2]Dept. of Biology, Center for Animal Movement Research, Lund Univ., Sweden; [3]National Polytechnic Inst. Félix Houphouët-Boigny, Ivory Coast
Here we present recent advances and applications of profiling biological targets with Scheimpflug lidar. In particular we demonstrate applications for profiling the aerofauna and classifying various groups of species. Based on lidar data over the Ivorian countryside we investigate range dependent detection limits by comparing data with distinct sample rates and pulse energies.

ThR6-13 15:30-16:00
On the spectroscopic properties of plants and the assignment of Vegetation Indices to specific crops *(Invited paper)*
A. Reyes, F.D. Montenegro, M.A. Mejía, J.A. Aponza, A.M. Hurtado, B. M. Montoya, R.Y. Pomeo, C.A. Galindez, E. Solarte; Universidad del Valle, Colombia
Studies on experimental, controlled designed, and real crops of Hot-Chili and Sugarcane, to look for the spectral vegetation indexes that strong correlated with the crop biophysical and biochemical properties, are presented. Results show that accepted vegetation indexes don´t produce the accurate information nor the correlations announced with plant´s properties or crop conditions; opening possibilities for new indexes and assignment protocols.

ThR6-15 16:00-16:15
Photophoresis and its effect on the aerosol stratification in the atmosphere
A.A. Cheremisin; Voevodsky Inst. of Chemical Kinetics and Combustion SB RAS, Russia
The results of theoretical and experimental studies of photophoresis of aerosol particles and clusters are discussed in this report. Photophoresis can affect aerosol stratification in the atmosphere.

ThR6-16 16:15-16:30
Laser diagnostics of dynamic water stratifications
A.V. Vedyashkina[1], I.N. Pavlov[2], I.L. Raskovskaya[2], B.S. Rinkevichyus[2]; [1]JSC "Special Research Bureau of Moscow Power Engineering Institute", [2]National Research Univ. "MPEI", Russia
The paper presents developed techniques and results of laser visualization and quantitative research of physical processes in boundary regions and bulk aquatic media, accompanied by phenomena that generate its optical inhomogeneity. Laboratory experiments were conducted and the inverse problems of refraction and reflection of laser radiation were considered in order to detect and diagnose dynamic salt, density and temperature stratifications.

R6: Lasers for Green Photonics and Sustainability

17:15 - 18:30
Session Chair: *V. Pasiskevicius*, *KTH, Sweden*

ThR6-17 17:15-17:30
Eye-safe LIDAR sensing through dense fog
S.M. Pershin[1], M.Ya. Grishin[1,2], V.A. Zavozin[1], V.N. Lednev[1], V.S. Makarov[3], P.A. Sdvizhenskii[1], A.V. Turin[3]; [1]Prokhorov General Physics Inst. RAS, [2]Moscow Inst. of Physics and Technology, [3]Space Research Inst. RAS, Russia
A new LIDAR based technology for navigation in dense fog conditions was suggested. A compact lidar with eye-safe radiation level was designed and developed to demonstrate the feasibility detecting object through dense fog. The developed LIDAR provided high sensitivity to variations of fog density including sensing through multilayer fogs.

ThR6-19 17:30-17:45
Tectonic aerosol sensing by lidar as a new technique for Earth's crust deformation monitoring
S.M. Pershin[1], A.L. Sobisevich[2], M.Ya. Grishin[1,3], V.A. Zavozin[1], V.V. Kuzminov[4], V.N. Lednev[1], D.V. Likhodeev[2]; [1]Prokhorov General Physics Inst. RAS; [2]Schmidt Inst. of Physics of the Earth RAS; [3]Moscow Inst. of Physics and Technology (National Research Univ.); [4]Inst. for Nuclear Research RAS, Russia
A new-generation eye-safe lidar has been developed for tectonic aerosol sensing. The lidar was installed inside an adit of Baksan Neutrino Observatory to quantify tectonic aerosol fluctuations. As aerosol fluctuations are induced by Earth's crust deformations, a laser strainmeter was used to measure the deformations. A correlation of strainmeter and aerosol lidar signals was observed during low-frequency Earth's crust deformations.

ThR6-20 17:45-18:00
Active Thermal Imaging for Remote Inspection of the Subsurface Structure of an Object
P.I. Abramov, E.V. Kuznetsov, P.Y. Lobanov, O.E. Sidoryuk, L.A. Skvortsov; JSC Stelmakh Polyus Research Inst., Russia
The issues of developing visualization systems for hidden subsurface structures of various objects using laser pulse thermography are considered. The image of the samples under study was recorded both during the heating of the surface by laser radiation, and the cooling period after the interruption of the pulse exposure. The results of mathematical modeling were compared with experimental images.

ThR6-21 18:00-18:15
Ho-doped fiber laser with wavelength self-sweeping near 2.06 μm for CO2 spectroscopy.
A.D. Vladimirskaya[1,2], M.I. Skvorsov[1,3], A.A. Wolf[1,3], V.A. Kaminin[4], I.A. Lobach[1,3], S.I. Kablukov[1,3]; [1]Inst. of Automation and Electrometry SB RAS; [2]Novosibirsk State Technical Univ.; [3]Novosibirsk State Univ.; [4]Prokhorov Inst. of General Physics, Russia
We report the first results on wavelength self-sweeping operation of a Holmium-doped fiber laser near 2.06 μm with sweeping range of ~ 4 nm and sweeping rate of ~4 nm/sec. The developed source is suitable for spectroscopy of carbon dioxide in contrast to previously designed self-sweeping lasers operating near 2 μm spectral range.
This research was supported by RFBR Grant(s) # 20-32-70058

ThR6-23 18:15-18:30
Quantitative Analysis of 12CO2, 13CO2, 12CH4 and 13CH4 Gases by Raman Spectroscopy
V.V. Vitkin[1], I.K. Chubchenko[1,2], E.E. Popov[1], A.V. Polishchuk[1], P.A. Loiko[3]; [1]ITMO Univ., Russia; [2]Mendeleyev Inst. for Metrology (VNIIM), Russia; [3]CIMAP, CNRS, France
A method of quantitative analysis of 12CO2, 13CO2, 12CH4 and 13CH4 gases based on Raman spectroscopy is developed. The Raman spectra of isotopically enriched (>99.5%) gases are measured and compared. The concentration detection limit and the measurement uncertainty are estimated.

R8: Nonlinear Photonics: Fundamentals and Applications

09:00 - 11:15
Session Chair: *N.N. Rosanov*, *Ioffe Inst., Russia*

ThR8-37 09:00-09:30
Terahertz photonics of dense medium: from gas to liquid *(Invited paper)*
A.V. Balakin[1], O.G. Kosareva[1], I.A. Kotelnikov[2,3], N.A. Kuzechkin[1,4], B.V. Lakatosh[5], V.V. Medvedev[5], A.B. Savelev[1], P.M. Solyankin[4], I.P. Tsygvintsev[6], A.P. Shkurinov[1]; [1]Lomonosov Moscow State Univ.; [2]Budker Inst. of Nuclear Physics; [3]Novosibirsk State Univ.; [4]Inst. on Laser and Information Technologies RAS, Branch of the FSRC "Crystallography and Photonics" RAS; [5]Inst. for Spectroscopy RAS; [6]Keldysh Inst. of Applied Mathematics, Russia
In this paper, we talk about the specific properties of the generation of terahertz (THz) radiation with the use of femtosecond laser pulses with substances in various phase states. These will be gases at various pressures and phase stagnations, liquid metals and nano-gas cluster jets.

ThR8-38 09:30-10:00
The nonlinearity of the refractive index of condensed matter in the terahertz spectral range *(Invited paper)*
S.A. Kozlov[1], M.V. Melnik[1], M.O. Zhukova[1], I.O. Vorontsova[1], S.E. Putilin[1], A.N. Tcypkin[1], X.-Ch Zhang[2], R.W. Boyd[3]; [1]ITMO Univ., Russia; [2]Univ. of Rochester, USA; [3]Univ. of Ottawa, Canada
It has been shown theoretically and experimentally that solids and liquids have a high nonlinearity of the refractive index in the terahertz frequency range. The vibrational contribution to the third-order susceptibility of media in the THz range is several orders higher than the typical electronic one in the optical and IR range.
This research was supported by RFBR Grant(s) # 19-02-00154

ThR8-39 10:00-10:15
Optimization of terahertz production from femtosecond multi- and superfilaments in air
E. Mitina[1]; D. Pushkarev[1]; A. A. Ushakov[1,3]; D. Uryupina[1]; O. Kosareva[1,2]; A. Savel'ev[1]; [1]Lomonosov Moscow State Univ., [2]International Laser Center, [3]Prokhorov General Physics Inst. RAS, Russia
The experimental results of energy deposition into the medium measurements and THz radiation measurements in case of two-color filamentation and filamentation in the presence of external electric field are presented. We considered different focusing conditions (NA=0.00218..0.00014) with the size of the beam equals to 8 mm. Two-color radiation was made by placing BBO crystal into the converging beam.
This research was supported by RFBR Grant(s) # This work was supported by RFBF under grant #18-02-00954 and #18-52-16020, BASIS Foundation for the Advancement of Theoretical Physics and Mathematics (19-2-6-261-1).

ThR8-40 10:15-10:30
Terahertz-field-induced optical second harmonic generation in isotropic media: theory and application
S.B. Bodrov[1,2], Yu.A. Sergeev[2], A.I. Korytin[2], E.A. Burova[1], M.I. Bakunov[1] and A.N. Stepanov[2]; [1]Univ. of Nizhny Novgorod; [2]Inst. of Applied Physics RAS, Russia
We develop a theory of second harmonic generation of femtosecond laser radiation induced by the electric field of a copropagating terahertz pulse in an isotropic material. The theoretical predictions are verified experimentally. On the basis of the results obtained, we propose and experimentally demonstrate a new method to detect inhomogeneities in transparent materials.

ThR8-41 10:30-10:45
Electro-optic detection of terahertz waves in a prism-coupled lithium niobate layer with overcoming the effect of inherent birefringence
A.I. Shugurov, M.I. Bakunov; Univ. of Nizhniy Novgorod, Russia
We propose and experimentally demonstrate efficient high-resolution electro-optic sampling detection of broadband terahertz pulses in a lithium niobate crystal in a new configuration, where the probe laser beam propagates along the optical axis of the crystal. This configuration allows to overcome the negative effect of strong inherent birefringence of lithium niobate.

ThR8-42 10:45-11:00
Spectra of terahertz radiation generated in single-color filament
G.E. Rizaev[1], D.V. Mokrousova[1], S.A. Savinov[1], A.V. Koribut[1], L.V. Seleznev[1], Ya.V. Grudtsyn[1], D.E. Shipilo[1,2], N.A. Panov[1,2], O.G. Kosareva[1,2], Yu.A. Mityagin[1], A.A. Ionin[1]; [1]Lebedev Physical Inst. RAS; [2]Faculty of Physics and International Laser Center, Lomonosov Moscow State Univ., Russia
Spectra of THz radiation generated in a single-color filament are experimentally studied. It is shown that the spectra of THz emission depend on the wavelength of laser radiation and the focusing conditions and do not depend on the pulse energy.
This research was supported by RFBR Grant(s) # 20-02-00114, 18-02-00954, 18-52-16020

ThR8-43 11:00-11:15
Resonant supercontinuum generation in normal and anomalous dispersion
M.H. Anderson[1], R. Bouchand[1], J. Liu[1], G. Lihachev[1], W. Weng[1], E. Obrzud[2,3], T. Herr[2], T. J. Kippenberg[1]; [1]EPFL; [2]CSEM; [3]Univ. of Geneva, Switzerland
We demonstrate broadband resonant supercontinuum generation based on stable bright soliton formation in Si3N4 microresonators with either anomalous or normal dispersion. The frequency combs have an electronically detectable repetition rate of 28 GHz, and span over 2,000 comb teeth.

R8: Nonlinear Photonics: Fundamentals and Applications

11:30 - 13:30
Session Chair: *N.N. Rosanov*, *Ioffe Inst., Russia*

ThR8-44 11:30-12:00
Dirac-like photonic structures: from pseudospin to topology *(Invited paper)*
Z. Chen; Nankai Univ., China
I will present some of our recent work based on Dirac-like photonic structures, including pseudospin excitation and valley vortex states. I will then focus on discussing pseudospin-orbit angular momentum conversion and universal momentum-to-real-space mapping of topological singularities arising from the interplay of Berry phase, pseudospin, and orbital angular momentum of light.

ThR8-45 12:00-12:30
Advances in THz generation by nonlinear metasurfaces *(Invited paper)*
T. Ellenbogen; Tel Aviv Univ., Israel
Recently it was shown that nonlinear metasurfaces can be used to generate broadband THz radiation. I will discuss the underlying mechanisms and present the latest advancements in their ability to generate THz waveforms by demand.

ThR8-46 12:30-13:00
Nonlinear optical interactions of topological modes *(Invited paper)*
Zhihao Lan, Jian Wei You, Nicolae C. Panoiu; Univ. College London, UK
I will review recent results regarding nonlinear interactions of topological optical modes. Thus, I will demonstrate that SHG and THG are achieved via one-way edge-modes, as well as slow-light nonlinearity enhancement and harmonic generation upon interaction of backward-propagating edge-modes. Finally, FWM of topological modes of graphene and SHG upon interaction of valley-Hall topological modes of PhCs will be discussed.

ThR8-47 13:00-13:30
Tailored light generation in nonlinear metasurfaces *(Invited paper)*
T. Pertsch; Fridrich Schiller Univ. Jena, Germany
We investigate the nonlinear optical properties of nanostructured metasurfaces and isolated nanoresonators from Lithium Niobate and GaAs. Particularly, we aim at realizing quantum sources for applications in quantum imaging and sensing, which requires tailoring of the entanglement of generated photon pairs via spontaneous parametric down-conversion. In the presentation, we review the latest progress in this field.

R8: Nonlinear Photonics: Fundamentals and Applications

14:45 - 16:30
Session Chair: *Ya.V. Kartashov*, *Inst. of Spectroscopy RAS, Russia*

ThR8-48 14:45-15:15
Symmetry breaking of solitons in parity-time-symmetric optical systems *(Invited paper)*
J. Yang; Univ. of Vermont, USA
We report a new type of symmetry-breaking bifurcation of solitons in optical systems with parity-time-symmetric potentials, where two bifurcated branches of asymmetric solitons exhibit opposite stability. This bifurcation can be exploited to achieve unidirectional light propagation in parity-time-symmetric systems.

ThR8-49 15:15-15:30
Two frequency heteronuclear soliton molecules
O. Melchert[1,2], S. Willms[1,2], S. Bose[2], A. Yulin[3], B. Roth[1], F. Mitschke[4], U. Morgner[1,2], I. Babushkin[1,2], A. Demircan[1,2]; [1]Cluster of Excellence PhoenixD, Germany; [2]Leibniz Universität Hannover, Germany; [3]ITMO Univ., Russia; [4]Inst. for Physics, Univ. of Rostock, Germany
We demonstrate a novel type of ultrashort optical soliton bound states with molecule-like properties. These two-color solitons exhibit a strong binding energy, dipole-like radiation, and show dynamics of controlled soliton evaporation. Furthermore, the given interaction concept enables a classical analog of trapped states in an attractive quantum potential.

ThR8-50 15:30-15:45
Characterization of dissipative soliton resonance in passively mode-locked fiber laser
M. Kemel, G. Semaan, M. Salhi, A. Nady, F. Sanchez; Angers Univ., France
Passively mode-locked fiber laser enables the generation of dissipative soliton resonance (DSR) pulse. DSR pulse manifests a square envelope with no fine structures and the pulse energy increases indefinitely without any wave-breaking. Here, we successfully demonstrated a reliable experimental setup to investigate the coherence of square pulses and thereby verifying whether it is in DSR regime.

ThR8-51 15:45-16:00
Dissipative Kerr solitons in a photonic dimer
A. Tikan[1], J. Riemensberger[1], K. Komagata[1], S. Honl[2], M. Churaev[1], C. Skehan[1], H. Guo[1], R. N. Wang[1], J. Liu[1], P. Seidler[2], T. J. Kippenberg[1]; [1]Inst. of Physics, Ecole Polytechnique Federale de Lausanne (EPFL), [2]IBM Research - Zurich, Switzerland
We study nonlinear dynamics emerging in a photonic microring dimer. It is shown that four-wave mixing pathways between the dimer supermodes lead to novel nonlinear phenomena going beyond the single resonator physics.

ThR8-52 16:00-16:30
Topological solitons in lasers and laser media with saturable absorption *(Invited paper)*
N.A. Veretenov[1], S.V. Fedorov[1], N.N.Rosanov[1,2]; [1]Ioffe Inst.; [2]ITMO Univ., Russia
The 3D topological dissipative solitons predicted recently by the authors can go from one stable state to another if the linear gain coefficient varies. It's possible due to the overlapping stability domains for solitons with various topologies and also thanks to the existence of excited soliton states with the same topology but with different energies.

R8: Nonlinear Photonics: Fundamentals and Applications

17:00 - 19:00
Session Chair: *Ya.V. Kartashov*, *Inst. of Spectroscopy RAS, Russia*

ThR8-53 17:00-17:30
Vector topological edge solitons in Floquet insulators *(Invited paper)*
S.K. Ivanov[1,2], Y.V. Kartashov[2,3], A. Szameit[4], L. Torner[3], V.V. Konotop[5]; [1]Moscow Inst. of Physics and Technology, [2]Inst. of Spectroscopy RAS, Russia; [3]ICFO-Institut de Ciencies Fotoniques, The Barcelona Inst. of Science and Technology, Spain; [4]Univ. of Rostock, Germany; [5]Univ. de Lisboa, Portugal
We introduce topological vector edge solitons in a Floquet insulator. The representative feature of such photonic insulator is that it simultaneously supports two topologically protected Floquet edge states. In the presence of nonlinearity either bright or dark scalar Floquet edge soliton can exist. Two edge states enable the existence of stable topological vector edge solitons.

ThR8-54 17:30-18:00
Self-induced transparency mode-locking: towards to single-cycle pulses *(Invited paper)*
R.M. Arkhipov[1,2], M.V. Arkhipov[1], A.A. Shimko[1], I. Babushkin[3,4], N.N. Rosanov[2]; [1]St. Petersburg State Univ., Russia; [2]Ioffe Inst., Russia; [3]Leibniz Univ. Hannover, Germany; [4]Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering—Innovation across Disciplines), Germany
Self-induced transparency passive mode-locking in a Ti:sapphire laser containing a coherent absorber cell with Rb and Cs vapors were studied experimentally. The possibility of single-cycle pulse generation via self-induced transparency regime in lasers with ultra-short cavities were studied theoretically.

ThR8-55 18:00-18:15
Nonlinear Dynamics in a Long Cavity Semiconductor Laser
S. Slepneva[1,2,3], A. Roche[1,2,3], U. Gouda[1,2,3], A. Pimenov[4], A. Kovalev[5], M. Marconi[1], M. Giudici[1], E. Viktorov[5], A. Vladimirov[4], G. Huyet1; [1]Univ. Côte d'Azur, CNRS, INPHYNI, France; [2]Cork Inst. of Technology, Ireland; [3]Tyndall National Inst., Ireland; [4]Weierstrass Inst., Germany; [5]ITMO Univ., Russia
We present the study on the dynamics of a semiconductor laser with a tunable filter and a ring single-mode fiber long cavity. Theoretically and experimentally, we analyse laser dynamics in various operation regimes, including the formation of coherent structures. The laser turn on dynamics is studied, as well as different scenarios of coherence deterioration in such lasers are examined.

ThR8-56 18:15-18:30
Vibrational instability and Raman laser
V.Yu. Shishkov[1,2,3], E.S. Andrianov[1,2], A.A. Pukhov[1,2,3], A.P. Vinogradov[1,2,3], A.A. Lisyansky[4,5]; [1]Dukhov Research Inst. of Automatics (VNIIA), Russia; [2]Moscow Inst. of Physics and Technology, Russia; [3]Inst. for Theoretical and Applied Electromagnetics, Russia; [4]Queens College of the City Univ. of New York, USA; [5]The Graduate Center of the City Univ. of New York, USA
The phenomena of a Raman laser and vibrational instability recently observed in the SERS experiment are considered. We show that both phenomena are the result of unique self-oscillations of the electromagnetic field in resonator and nuclei vibrations in the molecule.

ThR8-57 18:30-18:45
Experimental observation of rogue-waves in a system of dissipative self-induced transparency solitons in a Ti:sapphire laser
R.M. Arkhipov[1,2], M.V. Arkhipov[1], A.A.Shimko[1], I. Babushkin[3,4], A. Demircan[3,4], U. Morgner[3,4], N.N. Rosanov[2]; [1]St. Petersburg State Univ., Russia; [2]Ioffe Inst., Russia; [3]Leibniz Univ. Hannover, Germany; [4]Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering—Innovation across Disciplines), Germany
This work reports the observation of rogue waves in a Ti: sapphire laser containing a coherent absorber cell with Rb and Cs vapors. Extreme events were observed with an interval of one to ten seconds when several dissipative self-induced transparency solitons could be simultaneously present in the cavity. An extremely rare event was the fusion of solitons into one.
This research was supported by RFBR Grant(s) # 20-02-00872a

ThR8-58 18:45-19:00
Floquet topological insulator laser
S.K. Ivanov[1,2], Yiqi Zhang[3], Ya.V. Kartashov[2,4], D.V. Skryabin[5]; [1]Moscow Inst. of Physics and Technology, Russia; [2]Inst. of Spectroscopy, Russia; [3]Xi'an Jiaotong Univ., China; [4]ICFO-The Institute of Photonic Sciences, Spain; [5]Univ. of Bath, UK
We introduce the class of topological lasers based on the photonic Floquet topological insulator platform. We consider truncated array of helical waveguides, where the pseudo-magnetic field arises due to twisting of the waveguides along the propagation direction that breaks the time-reversal symmetry and opens up a topological gap.
This research was supported by RFBR Grant(s) # 18-502-12080

ThR1-p01

High-efficient Q-switched compact diode-pumped MIR lasers

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Compact (75 mm diameter and 200 mm length) DPSS MIR lasers with Q-switching based on Er:YAG, Er,Cr:YSGG and Ho,Yb,Cr:YSGG crystals have been designed. Those lasers provided the following parameters: pulse width 60 ns, peak power up to 1 MW and repetition rate 50 Hz. The Fe:ZnSe(ZnS) crystals pumping by radiation of designed lasers with the efficiency near 40% was demonstrated.

ThR1-p02

Synthesis, structure and luminescence of transparent “mixed” ceramics Dy3+:(Lu,Y,La)2O3

L. Basyrova[1,3], S. Balabanov[2], V. Koshkin[2], D. Permin[2], M. Baranov[1], P. Loiko[3]; [1]ITMO Univ., [2]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, [3]CIMAP, CNRS, Université de Caen Normandie, France

Transparent “mixed” sesquioxide ceramics 1–10 mol% Dy3+:(Lu,Y,La)2O3 were produced by vacuum sintering at 1780 °C. The micro-structure, Raman spectra, optical absorption and luminescence of ceramics were studies. Dy3+-doped ceramics are promising for visible (yellow) lasers.

ThR1-p03

Synthesis and investigation of composite Yb-doped Y2O3–Sc2O3 laser ceramics

L.R. Basyrova[1], V.A. Shitov[2], A.N. Orlov[2], R.N. Maksimov[2,3]; [1]CIMAP, CNRS, Univ. de Caen Normandie, France; [2]Inst. of Electrophysics UB RAS, Russia; [3]Ural Federal Univ., Russia

Yb-doped (YxSc1-x)2O3 solid solution (x~0÷1) transparent ceramics with an optical transmittance of over 81% in VIS and NIR were fabricated via solid-state sintering of mixed sesquioxide nanoparticles synthesized by laser ablation. The absorption and emission spectra of Yb:(YxSc1-x)2O3 solid solutions are intermediate between those of the single compositions with an evident broadening of the emission peak near 1035 nm.

This research was supported by RFBR Grant(s) # 18-03-00649 A

ThR1-p04

Spectroscopic and laser properties of the Ho3+ ions optical centers in CaF2 and SrF2 crystals

K.A.Pierpoint, O.K.Alimov, M.E.Doroshenko, A.G.Papashvili, V.A.Konyushkin, A.V.Nekhoroshikh; Prokhorov General Physics Inst. RAS, Russia

Different Ho3+ ion optical centers in CaF2 and SrF2 crystals were separated and their spectroscopic properties at the 5I8↔5I7 laser 2.1 μm transition were investigated at 14K. For the first time room temperature lasing is obtained in Ho:SrF2 crystal under resonant (1948nm) pumping.

ThR1-p05

Diode-pumped highly efficient Yb:(Y,Sc)2O3 mixed sesquioxide ceramic lasers

E.V. Tikhonov[1], R.N. Maksimov[1,2], G. Toci [3], A. Pirri[4], B. Patrizi[3], V.V. Osipov[1], V.A. Shitov[1], M. Vannini[3]; [1]Inst. of Electrophysics UrB RAS, Russia; [2]Ural Federal Univ. Russia; [3]Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche, INO-CNR, Italy; [4]Istituto di Fisica Applicata “N. Carrara”, Consiglio Nazionale delle Ricerche, IFAC-CNR, Italy

The first highly efficient laser action was demonstrated in Yb-doped (Y,Sc)2O3 transparent ceramics under QCW diode pumping at 929.4 nm. The ceramics were fabricated using vacuum sintering of mixed sesquioxide nanoparticles with various Y/Sc balances synthesized by laser ablation. For (Yb0.058Sc0.508Y0.434)2O3 ceramic we measured an output power of 5 W at 1086 nm while the highest slope efficiency was 61.3%.

This research was supported by RFBR Grant(s) # 18-53-7815 Ital_t

ThR1-p06

Lutetium-Yttrium Aluminum garnet doped with ytterbium – perspective ceramic material for high powered lasers

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Main properties of ytterbium doped lutetium-yttrium aluminum garnet ceramics with different ratios of lutetium to yttrium substitution (x=0-1) and different levels of ytterbium doping (5-15%) are investigated. On the base of this results optimal composition including the level of ytterbium doping were proposed and discussed.

This research was supported by RFBR Grant(s) # 18-02-00285

ThR1-p07

Halide perovskite microdisk lasing via femtosecond laser writing

Xiaoyu Tian[1], Qiang Cao[1,2]; [1]The Institute of Technological Sciences, Wuhan Univ., [2]Key Laboratory of Hydraulic Machinery Transient, Ministry of Education, Wuhan Univ., China

The lasing of halide perovskites have recently attracted attention for the mysterious lasing mechanism and the pursuing of low-cost integrated optics, while the underlying mechanism and the controllable fabrication of perovskite lasers are still challenging. Herein, we present controllable fabrication of Formamidinium lead iodide perovskite microdisk lasers by femtosecond laser direct. The lasing Mechanism is studied by time-integrated measurements.

ThR1-p08

Numerical model of repetitively pulsed Cr:ZnSe laser allowing for thermal effects

V.A.Garyutkin, G.M.Mischenko; RFNC-VNIIEF, Russia

Numerical Cr:ZnSe laser model in cylindrical geometry is developed. This model makes it possible to accurately calculate laser energy in repetitively pulsed mode for tens of wavelengths and a few transverse modes taking into account active medium heating.

ThR1-p09

Novel molybdate laser crystal with a layered structure: orthorombic Er3+:KY(MoO4)2

A. Volokitina[1,2], P. Loiko[3], A. Pavlyuk[4], R. M. Solé[2], M. Aguiló[2], F. Díaz[2], X. Mateos[2]; [1]ITMO Univ., Russia; [2]Univ. Rovira i Virgili (URV), Spain; [3]Univ. de Caen Normandie, France; [4]Nikolaev Insti. of Inorganic Chemistry, Russia

Potassium yttrium double molybdate crystals, 1.5 at.% Er3+:KY(MoO4)2, are grown by the Czochralski method. They are orthorhombic and feature a layered structure. The absorption and emission properties of Er3+ ions are studied for polarized light. The maximum σSE = 0.81×10-20 cm2 at 1617.7 nm. The Er3+:KY(MoO4)2 crystals showing a perfect cleavage are promising for eye-safe microchip lasers.

This research was supported by RFBR Grant(s) # 19-32-90199

ThR1-p10

Tunable room temperature pulsed Fe^{2+}:CdTe single crystal laser

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We demonstrate the laser performance of a Fe:CdTe single crystal pumped by a Q-switched Er:YAG laser at room temperature. The Fe:CdTe laser produced 2 mJ of output energy at the central wavelength of 5.55 um with slope efficiency of 16% with respect to absorbed pump energy. The tunability was demonstrated in the wavelength range from 5.1 to 6.3 um.

This research was supported by RFBR Grant(s) # The reported study was funded by RFBR, according to the research project No. 17-08-00495.

ThR1-p11

Brillouin-Erbium random fiber lasers with multiple wavelengths and wide wavelength tunability

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We demonstrate half-open-cavity multiwavelength Brillouin-erbium random fiber lasers with improved performance in terms of the generated Stokes order number and wavelength tuning range. By changing the position of the used erbium-doped fiber gain, maximum eighteen Stokes orders have been generated and the broadest wavelength tunability of 54 nm is achieved in such lasers.

ThR1-p12

Low-threshold random fiber laser based on a random-distributed-grating array

Jiancheng Deng, Mengmeng Han, Zuowei Xu, Yueqing, Du, and Xuewen Shu; Huazhong Univ. of Science and Technology, China

We report a stable and low-threshold Er-doped random fiber laser based on a femtosecond-laser-inscribed random-distributed-grating array (RDGA) as the random feedback. The threshold of the laser was significantly reduced to 5.7 mW and the linewidth was ~ 0.4 pm near the threshold as the Anderson localization effect existing in the RDGA significantly improved the laser quality factor.

ThR1-p13

Passively Q-switched Tm:KYW laser with Cr:ZnSe saturable absorber

V.E. Kisel[1], N.V. Gusakova[1], M.P. Demesh[1], E.M.Gavrishchuk[2], S.A. Rodin[2], D.V. Savin[2], N.V. Kuleshov[1]; [1]Belarusian Nnational Technical Univ., Belarus; [2]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

We present a compact diode-pumped Tm:KYW laser passively Q-switched with polycrystalline CVD Cr:ZnSe saturable absorber. The laser operates at around 1910 nm and 1940 nm and produces pulses with duration as short as 10 ns and energy up to 40 μJ.

ThR1-p14

Study of the specific absorption losses and lasing in Nd:YAG ceramics

S.M. Vatnik[1], I.A. Vedin[1], Yu.L. Kopylov[2], K.V. Lopukhin[2], S.G. Kazantsev[3], M.A. Pankov[3], S.L. Lysenko[3], V.V. Osipov[4]; [1]Inst. of Laser Physics SB RAS, [2]Kotel'nikov Inst. of Radio Engineering and Electronics RAS, [3]State Scientific-Research Test Laser Centre "Raduga", [4]Inst. of Electrophysics, Ural Branch of RAS, Russia

Specific absorption losses in the samples of Nd:YAG (1%–2%) optical ceramics synthesized at the IEP (Ekaterinburg), IREE (Fryazino) and SSR TLC Raduga (Raduzhnyi) are measured by laser calorimetry method. It was shown that the slope efficiency η approximately logarithmically depends on the specific absorption losses α, η ~ 0.26-0.094ln(α) in the range 10-3cm-1 <α<10-1cm-1.

ThR1-p15

Low-loss mJ-level Nd:YAG regenerative amplifier

A. Davtian[1], V. Koval[1,2], E. Viktorov[1], A. Kornev[2]; [1]ITMO Univ.; [2]Lasers and Optical Systems Co. Ltd., Russia

We report on the experimental study of the extraction efficiency of an end-diode-pumped Nd:YAG regenerative amplifier with picosecond output pulse energy of several mJ. Minimizing of round-trip power loss down to 6% provides 75% extraction efficiency and 5.9 mJ 35 ps output pulse energy.

ThR1-p16

Estimation of the thermal state and the destruction limits of the Cr:LiSAF laser active medium

V.V. Krasnyh, I.A. Kiselev, A.A. Sergeev; Baltic State Technical Univ. «Voenmeh», Russia

The article includes estimation of thermal operating conditions of laser with an Cr:LiSAF active medium. The results of thermal state simulation depending on the pump intensity are presented. The stress-strain state of active medium is determined with taking into account the thermal calculation and crystal anisotropy. Destruction criteria are considered with taking into account the crystal grid defects.

ThR1-p17

Three-dimensional spatially resolved technique for characterizing laser-induced optical film defect damage

Chong Shan[1], Yanqi Gao[1], Yuanan Zhao[2], Xiaohui Zhao1, Jianda Shao[2]; [1]Shanghai Institute of Laser Plasma, China Academy of Engineering Physics. China; [2]Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

The low laser-induced damage threshold (LIDT) of the films is a major obstacle to their application in high-power laser systems. An accurate LIDT is not only provided a safe range for optical films application, but also provides an important information to improve the optical films' laser resistance ability. We propose a new test method for improving the test accuracy.

ThR1-p18

Crystals (materials) for high bright laser systems

M. Košelja; Inst. of Physics CAS, Czech Republic

High Bright Laser Systems such as European Projects ELI are looking for large laser elements with better properties to glass or ceramics. Presented work will describe actual situation in crystal growth and possible challenges to obtain large laser crystals based on YAG matrice up to 10 inches.

ThR1-p19

Nanosecond passively Q-switched 2.3 μm Tm:YLF laser using gold nanorods as saturable absorber

Haitao Huang, Shiqiang Wang, Haiwei Chen, Fei Wang and Deyuan Shen; Jiangsu Normal Univ., China

A 785 nm diode-pumped nanosecond passively Q-switched 2.3 μm Tm:YLF laser using gold nanorods as saturable absorber was demonstrated.

ThR1-p20

Energy transfer in Cr-Fe co-doped ZnSe polycrystals

K.N.Firsov[1], E.M.Gavrishchuk[2,3], V.B.Ikonnikov[2], I.G.Kononov[1], T.V.Kotereva[2], S.V.Kurashkin[2], S.V.Podlesnykh[1], S.A.Rodin[2], D.V.Savin[2], A.A. Sirotkin[1], N.A. Timofeeva[2];[1] Prokhorov General Physics Inst. RAS,[2] G.G. Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

The paper discusses the prospects of creating a mid-infrared laser with polycrystalline active element at room temperature, in which the excitation of Fe2+ ions will be carried out by transferring energy from Cr2+ ions.

This research was supported by RFBR Grant(s) # 18-08-00793

ThR1-p21

Noise rejection during mode-locking in a solid-state laser gyroscope based on YAG:Cr4+

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A solid-state laser gyroscope based on YAG:Cr4+ operating in the mode-locking regime presents in this paper. The physical mechanisms of noise rejection and coupling reducing of counter propagating waves in the gyroscope during mode locking are analyzed. The conditions for stable bi-directional generation are determined.

This research was supported by RFBR Grant(s) # 20-07-00962 A

ThR1-p22

Silver and monovalent thallium halides solid solution doped with REE for laser technology

A.E. Lvov, D.D. Salimgareev, A.A. Yuzhakova, L. V. Zhukova, D.A. Krasnov, A.S. Korsakov; Ural Federal Univ., Russia

This work is devoted to the synthesis and study of the optical and luminescent properties of rare earth elements doped materials based on solid solutions of silver halides and monovalent thallium, which are transparent in the infrared range from 1.0 to 40.0 ÷ 50.0 μm.

ThR1-p23

Characterization of perspective active medium based on mixed crystals Ce3+:LiCaXSr1-XAlF6

A.A. Shavelev[1], A.S. Nizamutdinov[1], A.A. Shakirov[1], M.A. Marisov[1], E.I. Madirov[1], E.V. Lukinova[1], N.F. Rakhimov[1], P.A. Popov[2], V.V. Semashko[1]; [1]Kazan Federal Univ., [2]Petrovsky Bryansk State Univ., Russia

The aim of this work is characterization of perspective active media based on mixed crystals Ce3+:LiCaXSr1-XAlF6. Also the optical studies ions in the UV spectral range and effect of the various types of the doping centers on the laser characteristics in the Ce3+:LiCaXSr1-XAlF6 mixed crystals were studied.

ThR1-p24

The passive Q-switch mode in Cr:LISAF laser

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Work demonstrates passive Q-switch mode in Cr:LiSAF laser, compared to free running mode. We demonstrate 20 mJ in 480 ns pulse for LiF:F2- saturable absorber with 58% initial transmission. While in free running mode 997 mJ are achieved.

ThR1-p25

0.4 J / 35 ps Nd:YAG laser for Lunar laser ranging

A.F.Kornev[1], R.V.Balmashnov[1], I.G.Kuchma[1], V.V.Koval[2]; [1]«Lasers & Optical systems» Co. Ltd., St. Petersburg, [2]ITMO Univ., Russia

We developed a 0.4 J diode-pumped 1064 nm Nd:YAG MOPA laser with pulse duration of 35 ps. The master oscillator was based on laser scheme with regenerative amplification of DFB laser diode radiation. The two-pass two-stage power amplifier was built on two Nd:YAG laser rods. The SHG efficiency up to 83% was achieved in 17x17x7 mm3 LBO crystal.

ThR1-p26

Czochralski growth, impurity compositions and coloration of a new promising tungstate laser crystals

S.K. Pavlov[1,2], K.A. Subbotin[1,2], A.I. Titov[1,2], E.N. Mozhevitina[1], M.P. Zykova[1], E.V. Chernova[2], D.A. Lis[2], I.Kh. Avetissov[1], E.V. Zharikov[2]; [1]Mendeleev Univ. of Chemical Technology; [2]Prokhorov General Physics Inst. RAS, Russia

The reasons of ZnWO4 and NaGd(WO4)2 laser crystals coloration were studied by measurement of impurity compositions of the grown crystals and of the initial chemicals, as well as by optical absorption and photoluminescence spectroscopy. The coloration of ZnWO4 crystals appears due to the usage of Pt/Rh crucibles, while the reason of greenish coloration of NaGd(WO4)2 crystals is accidental chromium impurity.

ThR1-p27

Mid-IR simultaneous lasing of Cr2+ and Fe2+ ions at 2.4 and 4.2 μm in Cr2+,Fe2+:Zn(1-x)Mn(x)Se (x = 0.05) pumped by Er:YLF laser at 1.73 μm

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We report a novel Cr2+,Fe2+:Zn(1-x)Mn(x)Se (x = 0.05) single crystal gain-switched laser simultaneous generation at two different wavelength ranges at around ~2.4 μm and ~4.2 μm. The Fe2+ ions oscillation maximal mean output energy of 83 μJ at 78 K with pulse repetition rate of 1 Hz and the pulse duration of ~5.5 μs was demonstrated.

ThR1-p28

Reducing timing jitter of LD-pumped passively Q–switch Yb,Er-glass laser

E.O. Batura[1], Yu.K. Bobretsova[2], M.V. Bogdanovich[1], D.A. Veselov[2], A.V. Grigor'ev[1], V.N. Dudikov[1], A.M. Kot[1], N.A. Pikhtin[2], A.G. Ryabtsev[1], G.I. Ryabtsev[1], S.O. Slipchenko[2], P.V. Shpak[1]; [1]B.I. Stepanov Inst. of Physics NASB, Belarus; [2]Ioffe Physical Technical Inst. RAS, Russia

Timing dynamics of the LD–pumped passive Q–switch Yb,Er- laser was investigated under exposure of Q–switch by radiation of the semiconductor module. The impact on the Q–switch the external radiation with energy fluence of 0.15-0.16 J/cm2 changes the lasing start time and the timing jitter. Q-switch external illumination can reduce the jitter by more than five times.

ThR1-p29

Kinetics of the luminescence decay of impurity Fe2+ centers in ZnSe upon excitation by an electron beam

N.N. Il'ichev[1], A.A. Gladilin[1], E.S. Gulyamova[1], V.P. Kalinushkin[1], S.A. Mironov[1], A.V. Sidorin[1], P.P. Pashinin[1], V.V. Tumorin[1], E.M. Gavrishchuk[2], D.V. Savin[2], S. A. Rodin[2], V. B. Ikonnikov[2], M.V. Chukichev[3];[1] Prokhorov General Physics Inst. RAS,[2] G.G. Devyatykh Inst. of Chemistry of High-Purity Substances RAS,[3] Lomonosov Moscow State Univ., Russia

It is measured the kinetics of the luminescence of Fe2+ in ZnSe at liquid nitrogen temperature at excitation by short pulse of accelerated electrons. An explanation of the observed dependence is presented, which is based on Auger effect of quenching the excited state of the Fe2+ ion by free electrons of the electric current in the volume of the sample.

This research was supported by RFBR Grant(s) # 9-02-00294a;18-29-20048

ThR1-p30

Thermooptical effect in Cr:ZnSe crystals

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We estimated thermal aberrations in Cr:ZnSe crystal exposed to continuous-wave electromagnetic radiation at a wavelength of 1904 nm. Using the SIMULIA Abaqus software suite, deformation of this material during its heating due to absorption of part of the radiation was simulated numerically. Moreover, thermal lensing in Cr:ZnSe was studied in the experiment.

ThR1-p31

10W 90ps Nd:YAG MOPA laser with microchip master oscillator

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10 W level 90 ps MOPA laser with pulse repetition rate up to 700 kHz was developed. Passively Q-switched Nd:YVO4 microchip 1064 nm laser was used as a master oscillator. Double-rod double-end-pumping configuration of two-pass Nd:YAG ring power amplifier was used to achieve high gain with efficient energy extraction. High quality laser beam with M2<1.3 was obtained.

ThR1-p32

10W 90ps Nd:YAG MOPA laser with microchip master Comparison of Pockels cell based on X-cut and Y-cut KTP crystals under intense picosecond radiation

V. V. Koval[1], A. F. Kornev[2], V. A. Rusov[3]; [1]ITMO Univ., Russia; [2]"Lasers & Optical Systems" Co. Ltd., Russia; [3]Vavilov State Optical Inst., Russia

Pockels cells based on Y-cut and X-cut KTP crystals were compared under intense 35 ps 1064 nm laser radiation. The acceptable operating ranges of the incident peak intensity for two types of Pockels cells were determined.

ThR1-p33

Influence of thulium concentration in KYW and KLuW crystals on spectroscopic and laser properties

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We present the spectroscopy and laser performance of Tm:KYW and Tm:KLuW crystals with different doping concentrations of 0.7 at.% - 13.2 at.%. Maximum optical-to-optical efficiency of 60% with output power of 790 mW was obtained with Tm:KLuW laser under diode pumping at 802 nm. The optimum thulium concentrations in KYW and KLuW crystals were calculated basing on determined spectroscopic parameters.

ThR1-p34

High-spatial-resolution distributed temperature sensing system based on a mode-locked fiber laser

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We perform the first results of experiments aimed at the design of a high-spatial-resolution distributed temperature sensing system (DTS) based on an ultra-short pulse mode-locked fiber laser. We have developed an experimental prototype of DTS with the spatial resolution of ~ 0.5 m, sensor length of 3 m and ±1 °C temperature measurement error.

This research was supported by RFBR Grant(s) # 19-32-90185

ThR1-p35

1.94 μm, 1.97 μm and 2.064 μm wavelength operation of CW and passively-Q-switched Tm3+:Lu2O3 ceramics lasers under in-band fiber-laser pumping

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A Tm3+:Lu2O3 ceramics laser in-band pumped by a fiber laser at 1.67 μm was operated in CW and Q-switched multi-wavelength regimes at 1.94 μm, 1.97 μm and 2.066 μm. The passive Q-switched mode of the ceramics laser was achieved using a Cr2+:ZnSe saturable absorber.

This research was supported by RFBR Grant(s) # 19-52-53046

ThR1-p36

2.7-μm Er3+:Y2O3 ceramics laser in CW and Fe2+:ZnSe passively Q-switched modes

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Laser operation of the Er3+:Y2O3 ceramics pumped by 976 nm laser diode in CW and passively Q-switched modes was studied. The CW laser power at 2.7 μm reached 1.2 W at 8°C temperature. The passively Q-switched operation in kHz repetitively-pulsed mode was obtained by a polycrystalline Fe2+:ZnSe saturable absorber.

This research was supported by RFBR Grant(s) # 19-52-53046

ThR1-p37

Novel multipurpose Brewster-cut acousto-optical KGW Q-switch for powerful 1-3-μm lasers

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Active Q-switching experiments are achieved with a new type of multipurpose Brewster-cut acousto-optical Q-switch based on KGW crystal. High-efficient powerful nanosecond Q-switched 1-3 micron lasers were investigated. The maximum pulse energy of 12 mJat 1.064 micron, 28.5 mJ at 2.09 micron and 32 mJ at 2.78 micron was achieved.

ThR1-p38

Formation of spatial parameters for second harmonic generation with walk-off comp

S.G. Grechin, D.G. Kochiev, A.A. Sirotkin, I.V. Smirnov, V.D. Volosov; Prokhorov General Physics Inst. RAS, Russia

The results of theoretical and experimental investigations of spatial parameters of second harmonic radiation in the optical scheme with walk-off compensation are presented. The study is carried out for different lengths of crystal combinations.

ThR1-p39

Multilayer interference coatings with the Gaussian profile for Nd:YAG lasers provided by electron beam and ion beam technique.

A.N. Kozhevnikov, V.V. Novopashin, A.V. Shestakov; "Polyus" Research Inst. of M.F. Stelmah, JSC, Russia

This paper shows the ability enougth simple method of obtaining of dielectric graded reflectivity mirrors mirrors at common vacuum set-up. The obtained results show that the fabrication graded mirror has maximum reflectance at the 1050 - 1270 nm wavelength range and can be used in the Nd:YAG laser applications, especially those requiring the uniform illumination.

ThR1-p40

Cladding-pumped Er-doped fiber with absorbing inclusions for suppression of high-order modes

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A novel method of higher order modes suppression in a large mode area double clad Er-doped fiber is proposed and demonstrated. For this aim absorbing inclusions (Tm-doped rods) were inserted into the first cladding of the Er-doped fiber to achieve a resonant coupling between high order modes and modes located in the inclusions.

ThR1-p41

Continuous-wave short-cavity laser based on the Er-Yb-codoped phosphorosilicate optical fiber

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The novel Er-Yb-codoped phosphosilicate optical fiber intentionally developed for short-cavity lasers applications was demonstrated. The sufficient UV-photosensitivity (~10-3 refractive index change) for direct inscribing effective Bragg gratings inside the fiber core was achieved. The single-frequency continuous-wave laser with a total cavity length of 2.5 cm was implemented entirely in a short segment of this fiber.

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ThR1-p42

CW spectral narrow band Nd-disk laser with degenerate cavity configuration

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Mode selecting degenerate cavity for Nd-disk laser with three-beam diode pumping and without additional intracavity optics was investigated. TEM00 lasing with spectral width 900 MHz was achieved without use of any intracavity selectors.

ThR1-p43

Raman scattering in orthovanadate crystals at both high and low frequency anionic group vibrations and 40-fold SRS pulse shortening below 1 ps

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Characteristics of Raman scattering in different orthovanadate crystals at both stretching and bending Raman modes are studied. A possibility of the strongest 40-fold pulse shortening down to 0.8 ps in the synchronously pumped crystalline Raman laser with combined frequency shift is shown.

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ThR1-p44

Efficient multi-frequency Nd:YAP laser

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Multi-frequency generation of diode pumped Nd:YAP laser with an intracavity half-wave plate was investigated. Dual-wavelength oscillation at the wavelengths of 1064.5 + 1072.6 nm and of 1072.6 + 1079.5 nm and switching to triple-wavelength oscillation with the slope efficiency upto 32.5 % was demonstrated. The measurements of M2 equaled to 1.68 proved high spatial quality of the output laser radiation.

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ThR1-p45

0.6 J/ 3 ns 946 nm Nd:YAG laser

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We developed a 946 nm Nd:YAG laser with output energy of 0.6 J/3 ns at repetition rate of 50 Hz. The laser consists of single frequency laser diode, pulse slicer based on Pockels cell, high gain regenerative preamplifier and zero diffraction length ring cavity regenerative power amplifier with image rotation.

ThR1-p46

Optical comb peculiarities of high-energy chirped-pulse Erbium-doped all-fiber ring laser

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We have studied optical comb peculiarities of a high-energy chirped-pulse Er-doped all-fiber laser. A relatively low repetition rate of ~7.9 MHz with signal-to-noise ratio ~ 69 dB and a pulse width of 24.6 ps was achieved. We have measured the relative intensity noise of the laser, which is < –107 dBc/Hz in the range of 3 Hz -1 000 kHz.

This research was supported by RFBR Grant(s) # 19-32-90185

ThR1-p47

Pulse shortening in synchronously-pumped mode-locked Yb-fiber lasers

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Gain-induced pulse shortening in synchronously-pumped Yb-fiber lasers was studied. We show that simple sine-wave low-index (~0.5) modulation of pump power can result in shaping of discrete laser pulses which are much shorter than modulation period. Thus, ~200-ns pulses were generated with sub-MHz sine-wave modulation of pump power. Numerical modelling predicts pulse shortening in excess of 10 times with high-index modulation.

ThR1-p48

Interferometric study of thermal induced deformations of Nd:YVO4 disc element under the action of multipoint diode pumping

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One-dimensional description of thermo–optical deformations in the Nd:YVO4 thin disc under the action of nine-beam laser diode pumping was carried out. It was shown that transverse distribution of the optical path change is well described by a Gaussian function.

ThR1-p49

X-ray structural research of CaF2-ErF3, CaF2-YbF3, CaxSr1-xF2 crystals

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X-ray diffraction studies of crystals CaF2-ErF3, CaF2-YbF3, CaxSr1-xF2 were carried out at various concentrations of rare-earth elements. Phase analysis performed by the data base PDF-2. The structural characteristics of the found phases were refined using the full-profile analysis (Rietveld method). The dependence of the lattice constant on the impurity concentration is revealed.

ThR1-p50

Spectroscopy of Nd doped yttrium scandate crystal fiber

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We present the results of fluorescence and fluorescence excitation measurements of a 0.1 at.% Nd3+:YScO3 crystal fiber. The results show two complex local positions of Nd3+ in the bixbyite-type crystal structure with lifetimes t1 = 290 and t2 = 250 us (4F3/2 manifold) at temperature T = 77 K.

ThR1-p51

Optical properties of 50 at.% Er3+:YAG ceramics

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The luminescence and absorption measurements of a 50 at.% Er3+:YAG ceramics, pure and doped by Sc synthesized at different conditions. The results show that YAG ceramics without Sc have optical properties close to Er3+:YAG single crystal.

ThR1-p52

Electronic control of lasing regimes in an all-fiber cavity with an electro-optic switch-coupler

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We report a method for electronic control of regimes in lasers with all-fiber cavities. It relies on incorporation of a waveguide electro-optic switch which acts simultaneously as a variable coupler and an intensity modulator. Nanosecond pulses at 1540 nm were generated at kHz and MHz repetition rates in a hybrid semiconductor-fiber laser switchable to mode-locked, harmonically mode-locked, and cavity-dumping regimes.

This research was supported by RFBR Grant(s) # 19-42-540013, 18-29-20025

ThR2-p01

All-fiberized narrowband laser with tunable spectral linewidth

A.N. Slobozhanin, M.G. Slobozhanina, A.V. Bochkov; RFNC-VNIITF, Russia

In this work presents all-fiberized narrowband laser whose construction principle allows to suppress the noise at frequencies different from the signal (arising due to amplification of spontaneous emission). As a result, it was possible to increase the level of the output power laser radiation with no distortion/broadening of the spectral linewidth.

ThR2-p02

Analysis of the processes of interection of photons in the spectral of the pump and laser radiation with Yb3+ fiber amplifier medium

M.G. Slobozhanina, A.V. Bochkov; RFNC-VNIITF, Russia

In this work based on conservation laws, kinetic equations for changes in ion populations in different energy states are written down, as well as equations how optical radiation intensity (and power) is changing in the optical fiber core is sequentially derived. Physical limitations of the given approach are also considered.

ThR2-p03

Temperature diagnostics of a gas-dynamic laser based on the hydrocarbon-air mixture

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Gas-dynamic lasers based on hydrocarbon-air mixture combustion have a complex structure of the gas flow in the working volume. To ensure stable laser operation, high-precision temperature measurement of the gas flow in the combustor is necessary. This paper proposes an optical method for measuring local temperature of the gas flow based on soot and C2* emission spectroscopy.

ThR2-p04

Temporal dynamics of Holmium-doped fiber laser with an intracavity Mach–Zehnder interferometer

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An all-fiber scheme of Holmium laser with active Q-switching, implemented by an intracavity Mach-Zehnder interferometer, was realized. Influence of the cavity output mirror reflection coefficient (4, 20%), modulation voltage, different pump power levels on the pulse duration was investigated. The minimum pulse duration of 0.62 μs was obtained in a scheme with an output Bragg grating reflection coefficient of 20%.

ThR2-p05

High power all-fiber laser oscillator based on saddle-shaped gian fiber

Yun Ye[1], Xiaoming Xi[1,2,3], Xianfeng Lin[4], Lingfa Zeng[1], Baolai Yang[1,2,3], Hanwei Zhang[1,2,3], Chen Shi[1,2,3], Xiaolin Wang[1,2,3], Pu Zhou[1,2,3], Jinyan Li[4], Xiaojun Xu[1,2,3]; 1- National Univ. of Defense Technology, [2]State Key Laboratory of Pulsed Power Laser Technology, [3]Hunan Provincial Key Laboratory of High Energy Laser Technology, [4]Huazhong Univ. of Science and Technology, China

We propose a novel saddle-shaped Yb-doped fiber design for taking into account both transverse mode instability (TMI) and stimulated Raman scattering (SRS) in a high power all-fiber laser oscillator. Through adopting bidirectional-pump configure, the maximum output power of the fiber oscillator is scaled up to 1263 W without any sign of TMI and SRS effect.

ThR2-p06

Amplification on the plasma of He-like nitrogen ions created by an extended high-current Z-discharge

N.V. Kalinin, M.V. Timshina; Ioffe Inst., Russia

The report presents the results for numerical modeling of the active medium of short-wavelength radiation sources. The main interest was paid to transition 3-2 in He-like nitrogen ions. With the help of the developed level kinetics model and non-stationary one-dimensional two-temperature magneto-radiation-hydrodynamic model the inversions of the ion level populations and amplification coefficients were calculated.

This research was supported by RFBR Grant(s) # 18-08-01066

ThR2-p07

Influence of the defect position in the Bragg grating in an optical fiber on the intensity of fiber laser generation

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The optimal position of the defect in the Bragg grating, for DFB fiber laser is investigated. It is shown that with increase of the length or the strength of the grattings, the optimal positionto the middle of the lattice. The optimal position of the defect depends on the ratio of the working pump power to the threshold one.

ThR2-p08

Single-mode double-clad fiber with spectrally-selective propagation loss due to resonant coupling to absorbing inclusions

T.A. Kochergina, S.S. Aleshkina, M.M. Bubnov, M.E. Likhachev; Prokhorov General Physics Institute of the Russian Academy of Sciences, Dianov Fiber Optics Research Center;

We consider a novel approach for suppression of signal propagation at undesirable wavelengths. It is based on distortion and absorption of the operating fundamental mode in highly absorbing rods, inserted into the fiber cladding. A fiber (promising for fiber lasers at 976 nm) with a high absorption at wavelength of above 1000 nm and low losses near 976nm was designed.

ThR2-p09

The formation of the spatial structure of a diffuse discharge in excimer lasers at high pump powers

Yu.N. Panchenko, M.V. Andreev, A.V. Puchikin, S.A. Yampolskaya, V.F. Losev; High Current Electronics Inst. SB RAS, Russia

The results of studies on the formation of a diffuse discharge in XeCl laser with a maximum specific pumping power of 5 MW/cm3 are presented. It is shown that the highest specific energy extraction ~ 15 J/l from the active medium is realized in a structured discharge.

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ThR2-p10

Miniature wavefront correctors based on monolithic piezostack block

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Stacked-actuator deformable mirrors (SADM) allow to compensate for wide range of wavefront distortions. They are distinguished for large stroke ofactuators, high operational speed, the possibility of correction for small-scale aberrations. The SADM with 6x6 actuators with aperture 30x30 mm was developed. The thickness of mirror substrate was 1 mm. The maximal stroke of the SADM was about 5 microns.

ThR2-p11

Laser beam profiling using pigtailed piezoelectric crystal

E.V. Kolotushin[1], A.V. Konyashkin[1,2], O.A. Ryabushkin[1,2]; [1]Moscow Inst. of Physics and Technology (National Research University), [2]Fryazino branch of Kotelnikov Inst. of Radio-engineering and Electronics RAS, Russia

Transverse intensity distribution of laser radiation was measured using piezoelectric lithium niobate crystal. The optical fiber with its output pigtailed to the crystal was used for scanning the beam cross-section. For each position the incident optical power was determined by measuring the induced piezoelectric resonance frequency shift of the crystal conditioned by its heating due to optical absorption.

ThR2-p12

500W narrow linewidth cylindrical vector beams generated from all-fiber linearly-polarized laser by metasurface extracavity conversion

Rumao Tao, Lianghua Xie, Cao Guo, Qiuhui Chu, Yu Liu, Shan Huang, Huaqin Song, Wenjie Wu, Benjian Shen, Min Li, Xi Feng, Xuan Tang, Honghuan Lin, Jianjun Wang; Research Center of Laser Fusion, CAEP, China

500W cylindrical vector laser beam at 1030nm has been generated from a narrow linewidth all-fiber linearly-polarized laser by metasurface extracavity conversion . At maximum output power, the modal and polarization purity is beyond 94%. The temperature rise of the metasurface is less than 30℃, which means that the system can be further power scaled in the near future.

ThR2-p13

Non-steady-state wave model of laser oscillator with multilevel population kinetics

A.A. Khlebnikov, F.A. Starikov, M.V. Volkov, RFNC-VNIIEF, Russia

Non-steady-state physical-mathematical and numerical wave 3D models of laser oscillator have been developed. The spectral transfer of the pumping radiation has been calculated in the geometrical-optical approximation. The effect of incoherent multimode laser radiation divergence decreasing as a result of «thermal» lens compensation in the resonator has been demonstrated with the program.

ThR2-p14

Nontrivial symmetric configurations of laser beams for direct drive ICF

S.V. Bondarenko, L.V. Solnyshkova; RFNC-VNIIEF, Russia

We propose a nontrivial method to design a system of laser beams, which achieves a very high uniformity of radiation on a direct-drive target. We found optimal configurations of laser beams, which maintain tetrahedral and cubic-octahedral rotation symmetry, and explored their ability to achieve a desired drive uniformity.

ThR2-p15

The effect of parasitic ASE on the gain coefficient of a high-power neodymium laser

L.V. Solnyshkova, F.A. Starikov; RFNC-VNIIEF, Russia

The steady-state 3D numerical model of parasitic amplified spontaneous emission in the active element of a high-power neodymium laser has been developed. The numerical calculations of spontaneous emission transfer through the neodymium slab with amplification have been made, which allows us to determine the decreasing of the gain coefficient at slab's edges. Calculated results agree with the results of measurements.

ThR2-p16

Model of fiber laser unit heating considering thermo-optical properties of silicone polymers

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Thermo-optical characteristics of silicone polymers significantly affect fiber laser heating due to absorption of pump and laser radiation. Heating of the Yb-doped fiber laser unit was investigated experimentally. Numerical model of fiber laser unit heating was created. Part of the optical power converted into heat during laser operation was estimated.

ThR2-p17

The soliton mode-lock fiber laser pulse energy dependence from saturable absorber parameters

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In the present work, the dependences of the maximum pulse energy in a single-pulse mode were obtained by numerically solving the Schrödinger equation for a soliton fiber laser. It is shown that the maximum pulse energy is achieved in a laser with an absorber characterized by a maximum saturation power and a minimum relaxation time.

This research was supported by RFBR Grant(s) # 18-42-130001r_a

ThR2-p18

Transverse mode instability threshold dependence on the bandwidth and central wavelengths of the FBGs in the high power monolithic fiber laser oscillator

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We report an experimental study of the TMI threshold dependence on the bandwidth and wavelength of FBGs in a high power fiber laser oscillator. By switching FBGs with different reflection bandwidth and center wavelength, the TMI thresholds of the fiber laser oscillator are respectively measured and the dependence of TMI thresholds on the FBG parameters is summarized.

ThR2-p19

Experimental study of the transverse mode instability in a 1.8kW fiber laser amplifier based on gain-tailored large mode area ytterbium-doped fiber

Chen Shi[1,2,3], Baolai Yang[1,2,3], Yun Ye[1,2,3], Hanwei Zhang[1,2,3], Xiaolin Wang[1,2,3], Pu Zhou[1,2,3]; [1]National Univ. of Defense Technology, [2]State Key Laboratory of Pulsed Power Laser Technology, [3]Hunan Provincial Key Laboratory of High Energy Laser Technology, China

In this work, we have experimentally investigated the transverse mode instability in a kW-level fiber laser amplifier, which employs gain-tailored 30/400μm ytterbium-doped fiber. The doped ytterbium ions are confined in the central 70% area in the core. The fiber laser amplifier is scaled to a maximum output laser power of 1.8kW, and the TMI characteristics are observed at ~1.7kW.

ThR2-p20

Absorptance measurement of LBO crystals at high intensity levels of 1070 nm radiation using radiofrequency impedance spectroscopy

I.V. Grishchenko[1], Yu.S. Stirmanov[2], A.V. Konyashkin[1,2], O.A. Ryabushkin[1,2]; [1]Moscow Inst. of Physics and Technology, [2]Fryazino Branch of Kotelnikov Inst. of Radioengineering and Electronics RAS, Russia

Piezoelectric resonance laser calorimetry technique was used for the determination of the optical absorption coefficients of LBO crystal interacting with continuous-wave laser radiation at 1070 nm wavelength in the 10 MW/cm^2 – 100 MW/cm^2 intensity range

ThR2-p21

Development of laserjet-head and measurement tools for water-guided hybrid laser system

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We experimentally developed a waterjet guided laser system including the design of laserjet-head and the measurement tools. Using those of devices, we achieved over 90mm laminar-jet stream to deploy the hybrid laser system for hard material processing applications.

ThR2-p22

Crystals of CaF2-SrF2-4 mol.% YbF3 solid solutions for laser applications.

S.N. Ushakov[1,2], M.A. Uslamina[2], K.N. Nishchev[2], P.P. Fedorov[1], S.V. Kuznetsov[1]; [1]Prokhorov General Physics Inst. RAS, GPI RAS, [2]National Research Mordovia State Univ., Russia

The absorption spectra of Yb3+ ions in a series of Ca(1-X)SrXF2 crystals were studied: 4mol%YbF3 with x varying from 0 to 1. The largest peak absorption cross section for the optical centers of Yb3+ ion clusters is characteristic of congruently melting crystals. The compositions of crystals with the maximum inhomogeneous broadening of spectral lines are determined.

ThR2-p23

Simulation of heating optical elements by radiation of high-power technological fiber lasers

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Simulation results of optical elements heating which occurs in transformation of high-power fiber laser radiation in CW mode are presented.

ThR2-p24

High-energy low-temporal-coherence instantaneous broadband pulse system

Yong Cui, Yanqi Gao, Daxing Rao, Wei Feng, Dong Liu, Fujian Li, Haitao Shi, Jiani Liu, Zhan Sui; Shanghai Inst. of Laser Plasma, CAEP, China

We propose and experimentally demonstrate a scheme of achieving high-energy low-temporal-coherence instantaneous broadband light pulses. The pulse with large bandwidth (10.2 nm) and high energy (35 J) in the high gain (more than 107 times) laser system was safely created. The coherence time of the output pulse is 318 fs with a 3 ns pulse duration.

ThR2-p25

Curved copper-coated optical fiber sensor for precise laser power measurements

I.O. Khramov[1], R.I. Shaidullin[1,2], O.A. Ryabushkin[1,2]; [1]Moscow Inst. of Physics and Technology; [2]Fryazino branch of Kotelnikov Inst. of Radio-Engineering and Electronics, Russia

A method for fiber laser power measurement using a copper-coated optical fiber is proposed. Optical radiation transmitting through the sensor fiber is partially scattered and absorbed in the metal layer. Its electrical resistance change proportional to the induced heating is measured. The sensitivity can be adjusted by changing the fiber curvature radius. The numerical model of fiber heating was proposed.

ThR2-p26

Study of volume discharge for OPRGL

Yu. Adamenkov, K.N. Firsov, I.G. Kononov, S.M. Nefedov, S.V. Podlesnykh; General Physics Inst. RAS, Russia

Discussion about RF-, MW- and self-sustained discharge for Ar* optically-pumped rare-gas laser (OPRGL). The possibility of self-sustained discharge implementation for effective Ar excitation in OPRGL active media has been demonstrated.

ThR2-p27

Low-coherence laser driver technology

Yanqi Gao, Lailin Ji, Daxing Rao, Yong Cui, Xiaohui Zhao, Lan Xia, Wei Feng, Dong Liu, Haitao Shi, Fujian Li, Weixin Ma, Xiuhuang Huang, Zhan Sui, Wenbing Pei, Sizu Fu; Shanghai Inst. of Laser Plasma, CAEP, China

The instability of the laser plasma interaction is expected to be greatly suppressed by reducing the coherence of the output pulse of the high-power laser facilities. The method for obtaining low-coherent light source that meets the experimental requirements with precise time and spectral adjustment capabilities is presented.

ThR2-p28

Measurement of laser radiation attenuation in metallized optical fibers in visible and near-IR spectral ranges

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A novel method for high-sensitive measurements of optical attenuation in metal-coated optical fibers in a wide range of wavelengths is demonstrated. To study the dependences of optical losses on the fiber structure a number of single-mode and multimode metallized fibers with different geometry were investigated.

ThR2-p29

Degradation of syloxane polymers under the condition of heating by powerful laser radiation exiting through the side surface of an optical fiber

P.S. Cherpak, G.Yu. Ivanov, I.A. Larionov, V.A. Tyrtyshnyy; Moscow Inst. of Physics and Technology, Russia

The results of experiments on determination of the optical absorption coefficient at different wavelengths in a polysiloxane polymer, used in fiber optics, are presented. The process of thermal degradation as a result of exposure to high-power laser radiation under various temperature conditions was studied.

ThR2-p30

Laser Gaussian beam divergence depending on random phase distortions of the field.

V.I. Kislov, E.N. Ofitserov; Prokhorov General Physics Inst. RAS, Russia

The focused laser beam divergence with random phase distortions of the field was theoretically investigated. In the original model, radiation as the sum of two statistically independent terms: deterministic and random with zero average statistical value was represented. Relations for calculating the beam divergence depending on the statistical characteristics of the phase distortions of the field are obtained.

ThR2-p31

Measurement of weak absorption in optical materials by the PCI method

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A setup has been created, that allows measurement absorption in optically transparent materials by the photo-thermal common-path interferometry up to 10-6 см -1 which allows the separate determination of the surface and volume optical absorption coefficients. At the setup, absorption was detected in the K8 optical glass and the promising nonlinear crystal YCOB.

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ThR2-p32

Investigation of a fiber laser cavity under conditions of two-frequency generation

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The output power of an erbium and ytterbium codoped laser is limited by the effect of spurious generation at a wavelength of 1000 nm. In this paper a model of laser generation at two wavelengths is presented. It allows optimizing circuit parameters and fiber characteristics, such as the concentration of Er and Yb to increase the maximum possible pump power

ThR2-p33

The effect of optical losses on the CW Oxygen-Iodine laser power efficiency

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The cw oxygen-iodine lasers operating modes mapping method, which permits to determine the dimensional parameters at which high power efficiency is achieved when the kinetic and optical losses are known, has been modified.

ThR2-p34

Spectral and lasing characteristics of heavily doped Fe:ZnSe single-crystal lasers

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Characteristics of a room temperature Fe:ZnSe laser with heavily doped active element are studied. It is shown that heavily doped single-crystal Fe:ZnSe laser can be efficiently excited by a radiation of a Cr:ZnSe laser without wavelength tuning to the long-wavelength region.

This research was supported by RFBR Grant(s) # 18-08-00793

ThR2-p35

Heat treatment of bismuth-doped fibers as a way to improve their laser properties

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The alteration of the laser properties of bismuth-doped high-GeO2 fibers brought about by thermal treatment was investigated experimentally and simulated numerically. We have demonstrated that thermal treatment can be beneficial for the shortening of the active fiber length due to an increased concentration of the laser-active centers.

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ThR2-p36

Material of the discharge channel walls and average radiation power low pressure nitrogen laser

B.A. Kozlov, S.A. P'yanchenkov, V.I. Seredinov; Ryazan State Radio Engineering Univ., Russia

Effects of deactivation coatings and degree of roughness of the walls of the discharge channel on the maximum pulse repetition rate and the average radiation power of low-pressure nitrogen lasers were studied. Such compounds as boric acid, graphite and chromium oxide have the highest efficiency of deactivation of metastable states of molecular nitrogen.

ThR2-p37

Small–sized sealed–off TEA–CO2 laser with a high energy pumping density

B.A. Kozlov, Mai The Nguyen; Ryazan State Radio Engineering Univ., Russia

The effect of carbon coatings of cathodes for igniting volume discharges in CO2- laser mixtures of atmospheric pressure on the discharge current magnitude and density of pumping energy is studied. It was found that carbon coatings on the working surfaces of the cathodes leads to an increase in the current, pumping energy and laser radiation energy up to 2 times.

ThR2-p38

Pulse–periodical TEA laser based on IR transitions of neitral xenon atoms

B.A. Kozlov, Mai The Nguyen, T.I. Nekrasova; Ryazan State Radio Engineering Univ., Russia

The investigation results of TEA – Xe laser operating at pulse repetition rates up to 2 kHz are presented. The influence of macro- and microinhomogeneities of the volume discharge plasma and gas-dynamic processes in the near-electrode layers on the ignition frequency of the volume discharge and the average radiation power level were determined.

ThR2-p39

Generation characteristics of a super–atmospheric pressure CO2 laser in a pulse–periodical regime

B.A.Kozlov[1], Mai The Nguyen[1], A.Ya.Payurov[2]; [1]Ryazan State Radio Engineering Univ.; [2]AA "Plasma", Russia

The conditions of stable volume discharges formation in CO2 - laser mixtures at total pressures up to 5 atmospheres at pulse repetition frequencies up to 2 kHz are determined. Generation characteristics of a TE-CO2 laser with an active volume of 1,5×1×30 cm3 were studied. The maximum laser radiation power 140 W was achieved at 5kHz at full pressure 5atm.

ThR2-p40

Metal vapor active elements with the controlled output parameters

M.V. Trigub, N.A. Vasnev, V.O. Troitskii; Zuev Inst. of Atmospheric Optics SB RAS, Russia

The paper presents the results of research and development of the lab mode of continious controled CuBr active element. The model consists of 2 power supplies, the CuBr active element with lagre volume of active zone, unstable caviti and the controle system. The every pulse output energy contorled mode was realized in the model.

ThR2-p41

UV high-power inductive N2 laser

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For the first time, when the nitrogen was pumped by a pulsed inductive discharge, generation energy of 11 mJ was obtained with pulse duration 10 ± 1 ns (FWHM). Pulse power exceeded 1 MW. The maximum value of the efficiency of the deposited energy was about 0.39%. Laser generation was obtained at two wavelengths of 337.1 and 357.7 nm.

This research was supported by RFBR Grant(s) # 16-02-00316 A

ThR2-p42

Compromise between wavefront distortions and gain in high power laser amplfiier

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The dynamics of phase distortions during laser amplification in the cryogenically cooled active elements with high power diode pump was modeled and analyzed. The possibility of significant reduction of wavefront distortions with small decrease of the gain coefficient by choosing the optimal values of the pump radiation radius is shown.

This research was supported by RFBR Grant(s) # 19-42-543007

ThR2-p43

Temperature of optical discharge in hollow-core optical fibers

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The plasma temperature of an optical discharge maintained by laser radiation in the hollow-core optical fiber was measured for the first time. Optical discharge in our experiments was initiated and maintained by Nd:YAG laser with a peak power of ~1 MW. The average temperature of the optical discharge reaches a value of about 15 kK.

This research was supported by RFBR Grant(s) # 18-02-00324

ThR2-p44

Microwave pumped multi-frequency planar mid-IR lasers

A.P. Mineev, S.M. Nefedov, P.P. Pashinin, P.A. Goncharov, V.V. Kiselev, O.M. Stelmakh; Prokhorov General Physics Inst. RAS, Russia

Radiation characteristics of pulse periodic planar HF, DF, HF-DF, Xe and HF-DF-Xe(Kr) lasers excited by microwave discharge with diffusion cooling, depending on the pump parameters, were studied: average input power ~ 5 W, duration (10–40 μs) and pulse repetition rate (50–400 Hz), composition and pressure of the working gas mixture in the range of 30–200 Torr.

ThR2-p45

Investigation of a CW planar laser with an unstable resonator and additional feedback

A.P. Mineev, S.M. Nefedov, P.P. Pashinin, P.A. Goncharov, V.V. Kiselev, O.M. Stelmakh; Prokhorov General Physics Inst. RAS, Russia

The properties of a cw planar CO laser with an unstable resonator and additional optical elements located outside the working model of the laser were studied experimentally and using numerical simulation. It is shown that it is possible to increase the output power and control the spectral characteristics by acting on the peripheral region of the unstable resonator.

ThR2-p46

Hybrid cavity optically coupled continuous-wave IR lasers

A.P. Mineev, S.M. Nefedov, P.P. Pashinin, P.A. Goncharov, V.V. Kiselev, O.M. Stelmakh; Prokhorov General Physics Inst. RAS, Russia

The possibility of synchronizing the laser fields of two CO and two CO2 lasers with hybrid resonators and a coupling element placed outside these lasers was experimentally studied. It is shown that during joint generation, the fields of two lasers match, namely, the temporal and spectral characteristics of the radiation intensities match in the existing generation mode.

ThR2-p47

10 μJ nanosecond pulsed Ytterbium fiber laser with arbitrary pulse shape

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We report on Yb-doped fiber laser capable of generating temporally shaped pulses at 1064 nm with 4-ns shaping resolution. The pulses are generated by modulation of a continuous-wave laser and subsequent amplification by a 2-stage fiber amplifier. Such laser can be used as seed in more powerful solid state laser systems.

ThR2-p48

Increasing of the erosion resistance of the rotor steam turbine blades using laser cladding

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The work describes the results of the research of the influence of the mode parameters on the metallurgy of deposited layers, mechanical characteristics and deformations of the samples at the laser cladding Co-base alloy on the martensitic structural class 15Cr11MoW. Influence of the laser cladding trajectory on the deformation of the sample was researched.

ThR2-p49

Single frequency TEA-CO2 laser with over 1 GW/cm2 focused radiation intensity

V.R. Sorochenko; Prokhorov General Physics Inst. RAS, Russia

The single frequency TEA CO2 laser with intracavity SF6 cell as longitudinal modes selector is described. At optimal SF6 pressure and resonator tuning to 10P16 line smooth laser pulse with shot-to-shot instability of peak power/energy less than +/-10% was generated. Focused laser radiation intensity can be smoothly varied in the margins of 200 times with maximum value over 1 GW/cm2.

ThR2-p50

Compact laser with 20 fs, 2.1 mJ pulses at 100 Hz repetition rate

P. Mackonis, A.M. Rodin, A. Petrulenas, V. Girdauskas; Center for Physical Sciences and Technology, Lithuania

We present a compact TW-class laser containing Yb:YAG DPSS pumping source and supercontinuum seeded three OPCPA stages. 2.1 mJ pulse energy, beam quality of M2 < 1.3 and compression to 20 fs are demonstrated. The experimental layout was assembled on an optical breadboard measuring 1 × 3 m2.

WeR3-p01

Single mode narrow spectrum DBR laser (1040nm)

V.V. Zolotarev, A.V. Rozhkov A.Yu. Leshko, S.O. Slipchenko, N.A. Pikhtin, P.S. Kop`ev; Ioffe Inst., Russia

Single-mode ridge waveguide semiconductor lasers based on AlGaAs/GaAs/InGaAs heterostructure with a surface distributed Bragg reflector were developed. Calculation of reflection spectrum was carried out. Waveguide ridge with width of 5 mkm and Bragg grating with a period of 2 mkm was formed. Experimental spectrum width did not exceed 0.3 nm both at continuous wave and pulse of 100 ns pump.

This research was supported by RFBR Grant(s) # no grant number

WeR3-p02

Generation of surface plasmon polaritons in CrI3-based systems

A.A. Pervishko[1]; [1]Skoltech, Russia

Recent ab-initio calculations of CrI3 conductivity tensor allow one to expect the surface electromagnetic waves generation in this structure. We find the emergence of surface plasmon polaritons in the system formed by CrI3 layer in the Kretschmann-Raether geometry and provide an estimate for the critical angle by a study of reflectance spectrum for different layer thicknesses.

WeR3-p03

Measurement of Free-Carrier Absorption Cross-Sections for Laser Diode Waveguide Materials

Yu.K. Bobretsova, D.A. Veselov, N.A. Rudova, V.A. Kapitonov, S.O. Slipchenko, N.A. Pikhtin; Ioffe Inst., Russia

An experimental technique for measurement of free-carrier absorption has been developed. It allows measuring the values of the FCA cross-section for various materials and at different temperatures. The first experimental results are presented.

This research was supported by RFBR Grant(s) # 19-32-90070

WeR3-p04

Optimization of AlGaAs/GaAs QWs for high efficiency laser bars and arrays

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The influence of growth procedure on the luminescent properties of AlGaAs/GaAs quantum wells are investigated and discussed. The output power of the 5-mm laser bars reached 210 W, and the efficiency was 70 %. The output optical power of the array was 2.7 kW at a pump current of 100 A, and the maximum efficiency reached 62 %.

WeR3-p05

The technique for QCLs heating dynamics measurements

V.V. Dudelev[1], D.A. Mikhailov[1], A.V. Babichev[2], V. Yu. Mylnikov[1], A.G. Gladyshev[2], S.N. Losev[1], I.I. Novikov[2], A.V. Lyutetskiy[1], S.O. Slipchenko[1], N.A. Pikhtin[1], L.Ya. Karachinsky[2], A.Yu. Egorov[3], G.S. Sokolovskii[1]; [1]Ioffe Inst.; [2]Connector Optics LLC; [3]ITMO Univ., Russia

The study presents a technique for measurement of heating dynamics of quantum-cascade laser active region at short pulsed pumping.

WeR3-p06

Dynamics of frequency combs generation by QCLs in 8 μm wavelength range

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Frequency comb generation by quantum-cascade lasers generating at 8 μm is demonstrated. Time resolved spectral measurements show generation of all modes of frequency comb during full length of flat section of pumping pulse.

WeR3-p07

VCSEL wavelength stabilization with an external resonator based on fiber Bragg grating

V.A. Shulepov, S.M. Aksarin, V.E. Strigalev; ITMO Univ., Russia

This work is dedicated to stabilizing the 1.55 um VCSEL wavelength by creating an external resonator based on FBG. The influence of the length and grating reflection coefficient on the VCSEL spectral characteristics has been studied. It has been experimentally confirmed that the use of an external resonator on a fiber Bragg grating makes it possible to stabilize laser radiation.

WeR3-p08

Creation and Investigation of a SESAM and DSAM mirrors for Yb:KYW laser

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Creation of a two types of optical shutter: semiconductor mirrors with saturable absorption and dielectric mirror with the same saturable absorber transferred on its surface. Investigation of the mirrors with help of Yb:KYW laser.

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WeR3-p09

Binary operating characteristics in quantum well lasers

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We discuss theoretically a fascinating phenomenon that may occur in quantum well lasers in the presence of internal optical loss. Depending on temperature and structure parameters, an extra 'unconventional' branch can emerge in the laser operating characteristics (in particular, in the light-current characteristic) in addition to the 'conventional' branch.

WeR3-p10

Semiconductor lasers with an integrated control element

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Lasers based on epitaxial integrating heterostructures consisting of a control element (thyristor) and a semiconductor laser have been demonstrated. Single emitting section laser-thyristor with turn-on voltage of 20 V have been demonstrated output power of 45 W in a pulsed mode. Use of monolithically integration of two laser sections in such device increases the optical output power to 90 W.

WeR3-p11

Strain-compensated active region of high-power laser diodes based on AlxGayIn1-x-yAs/InP

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High-power multimode laser diodes based on AlxGayIn1-x-yAs/InP were developed and tested. The use of optimized elastic-stressed active region allowed to achieve cw output power exceeds 4 W at pump current of 15 A and 20 W at 80 A in pulsed mode (100 ns, 5 kHz)

WeR3-p12

Numerical study of light-current characteristics of laser diode with an ultrathin waveguide under high drive current using the energy balance model

O.S. Soboleva, V.S. Golovin, S.O. Slipchenko, N.A. Pikhtin; Ioffe Inst., Russia

For the first time, the use of an energy balance model including a saturation of drift velocity was proposed for the simulation of high-power laser heterostructure with an ultrathin waveguide. The limitations of the drift-diffusion model associated with the local dependence of the electron mobility on the electric field are shown. Higher internal optical losses are obtained using energy-balance model.

WeR3-p13

Theoretical analysis of spatial current turn-on dynamics in high-power AlGaAs/GaAs laser-thyristors with an optical feedback

O.S. Soboleva, V.S. Yuferev, A.A. Podoskin, P.S. Gavrina, D.N. Romanovich, K.V. Bakhvalov, V.A. Strelets, S.O. Slipchenko, N.A. Pikhtin; Ioffe Inst., Russia

A numerical study of laser-thyristors spatial current turn-on dynamics is carried out. It is shown that the presence of optical feedback can reduce the maximum current density in the current filament and local heating in the structure. This effect is present when the photogeneration rate in the p-base of the laser-thyristor is comparable to the impact ionization rate.

WeR3-p14

Laser/heterothyristor hybrid assemblies based on AlGaAs/GaAs heterostructures for high-power and ns-laser-pulse-width operation

S.O. Slipchenko[1], A.A. Podoskin[1], V. S. Golovin[1], P.S. Gavrina[1], V. V. Shamakhov[1], I.N. Arsentiev[1], A.D. Bondarev[1], D. N. Nikolaev[1], V. V. Zolotarev[1], N. A. Pikhtin[1], T.A. Bagaev[2], M.A. Ladugin[2], A.A. Marmalyuk[2], V.A. Simakov[2]; [1]Ioffe Inst., [2]Stel'makh Research and Development Inst. POLYUS, Russia

High-power lasers and mini diode laser bars based on AlGaAs/InGaAs/GaAs heterostructures (1060 nm) demonstrate high-efficient generation of pulses with durations in the range of 1-100 ns. It is shown that the use of heterothyristor arrays increases the pump current and output optical power.

WeR3-p15

Design of semiconductor lasers for generation of high-power sub-ns laser pulses in the gain switching mode

S.O. Slipchenko, A.A. Podoskin, V. S. Golovin, V. V. Shamakhov, I.N. Arsentiev, L.S Vaviliva, A.V. Lyutetskiy, D. N. Nikolaev, N. A. Pikhtin, P.S. Kop`ev; Ioffe Inst., Russia

An analysis of a series of laser heterostructures with different active-region designs and cavity parameters is performed to solve the problem of generating sub-ns pulses with different characteristics. The use of multiple quantum well heterostructures provided the generation of pulses with a peak power of up to 30 W and a pulse width of 100-200 ps.

WeR3-p16

Design of an efficient optically-pumped edge-emitting semiconductor laser using a coupled-waveguide structure with optimal choice of materials

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We propose an efficient and compact design of an in-plane optically-pumped edge-emitting semiconductor laser using a coupled-waveguide structure. Steady-state characteristics of the proposed device have been simulated using a numerical model. By an appropriate design of the coupled-waveguide structure and an optimum choice of the material composition, a high pump power conversion efficiency can be achieved.

WeR3-p17

Reservoir computing based on laser subject to optoelectronic feedback

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We study delay-based photonic reservoir computing using a semiconductor laser with an optoelectronic feedback. We investigate the connection between the bifurcation landscape of this system with the computational performance of the reservoir. There are multiple Hopf bifurcation branches possessing the parity asymmetry with relation to the feedback sign. We observe the corresponding difference in the normalized means square error (NMSE).

WeR3-p18

High power low coherent semiconductor light sources

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Light-emitting modules based on SLDs with median wavelength of 850 nm and free space output power of up to 150 mW were studied. MOPA system with blue-shifted SLD as a master oscillator permitted to broaden spectral bandwidth up to 50 nm. Combined light source based on two MOPA systems with spectral FWHM of more than 100 nm was realized.

WeR3-p19

NIR Superluminescent diodes based on Al-free SQW heterostructure

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Superluminescent diodes (SLDs) of spectral range 730 – 790 nm with strained single quantum-well (SQW) active layer were studied theoretically and experimentally. SLDs have demonstrated broadband emission spectrum with FWHM of up to 60 nm and free space CW output power of up to 150 mW at 25 °C.

WeR3-p20

Multi-quantum well active regions for the 750-950 nm superluminescent diodes.

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The variation of the MQW active regions parameters allowed widely change the achievable output optical power and the spectrum of SLDs. The differential quantum efficiency was increased and the spectrum became narrow for SLDs with different quantity of QWs (from SQW to TQW). Using asymmetric double QWs structures the SLDs with a broad bell-shaped emission spectrum were developed.

WeR3-p21

Effects of target feature on laser range finder's ranging performance

Yan Jin, Dong Li, Jinfeng Jiang; AVIC Manufacturing Technology Inst., China

Laser range finder's ranging performance theoretical models of diffuse target and cooperative feature are established based on laser ranging equation. Effects of cooperative target on ranging performance are discussed at different atmospheric visibility and different beam divergence angle. Results show that cooperative target can increase the ranging performance, decrease the laser emission power efficiently, and ensure personnel safety accordingly.

WeR3-p22

Portable system of night surveillance with infrared illumination

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The experimental sample of portable system of night surveillance has been developed. For illumination of objects pulsed semiconductor lasers are used. The developed system, combining an increased visibility range and stealth, as well as portability, can be used for detection and recognition of objects at video surveillance of the territory, rescue operations, in the interests of law enforcement agencies, etc.

WeR3-p23

Obtaining oxygen-free thin AlN films on GaAs (100) substrates by reactive ion-plasma deposition

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The results of work on the obtaining of oxygen-free thin AlN films on the GaAs substrate by reactive ion-plasma sputtering are presented. EDS, interferometry, and ellipsometry investigations show that at a vacuum of the order of ~10-7 Torr it is possible to obtain completely oxygen-free films with a high refractive index, which can potentially be used as effective passivating coatings.

WeR3-p24

Application of semiconductor laser emitters to thickness measurements

V. I. Shlychkov; Ural State Univ., Russia

To reduce measurement error of laser thickness gauges and to provide reasons for the choice of acceptance angle for receiving the signal from the controlled surface, the value of a laser emitter signal was studied as the signal was reflected from the laser-indicated spot on the rough surface of metal roll. The measurements were taken at different wavelengths.

WeR3-p25

Near field dynamics of a 1060 nm single-mode laser diode based on InGaAs/AlGaAs/GaAs

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Near field dynamics of a 1060 nm single-mode laser diode based on InGaAs/AlGaAs/GaAs is studied. Constructive and destructive interference was observed in the near-field photoresponse at current densities that correspond to the threshold conditions fulfillment for a higher-order mode in the case of a narrow stripe laser diode.

This research was supported by RFBR Grant(s) # no RFBR grant number

WeR3-p26

Simulation of the AlGaAs/GaAs laser thyristor turn-on dynamics using energy-balance model

N.A. Pikhtin, O.S. Soboleva, A.V. Rozhkov, A.Yu.Leshko, V.S. Golovin and S.O. Slipchenko; Ioffe Inst., Russia

The laser generation and the current dynamics in high-power laser-thyristor is studied using drift-diffusion and energy-balance models. It is observed that the drift-diffusion model significantly overestimates the contribution of impact ionization process in a narrow heterojunction electric field region. The use of the energy-balance model allows us to obtain the simulated laser-thyristor dynamics close to the experimental one.

WeR3-p27

Comparative analysis of various multi-sectoral HPHT diamonds using laser-induced breakdown spectroscopy

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Comparative analysis of atomic and molecular bands in plasma emission spectra of various multi-sectoral HPHT diamond plates was performed. It was shown that laser-induced breakdown spectroscopy is an effective approach to determination of crystallographic orientations of growth sectors of diamonds and impurities incorporation level.

WeR3-p28

Optimal parameters for laser stabilization via self-injection locking to high-Q resonator

R.R.Galiev[1,2], N.M. Kondratiev[1], V.E. Lobanov[1], I.A. Bilenko[1,2]; [1]Russian Quantum Center, [2]Lomonosov Moscow State Univ., Russia

We revealed optimal parameters of the system providing the most efficient laser stabilization via self-injection locking to high-Q optical microresonator. Optimal combination of locking phase, laser frequency detuning, coupling efficiency for a wide range of backscattering coefficient were found. Different regimes corresponding to strong and weak backscattering were demonstrated. Different methods allowing to reduce influence of microresonator nonlinearity were discussed.

WeR3-p29

Modeling of high-Q closed mode structures switching dynamics in large rectangular cavities

A.A. Podoskin, D.N. Romanovich, I.S. Shashkin, P.S. Gavrina, Z.N. Sokolova, S.O. Slipchenko, N.A. Pikhtin; Ioffe Inst., Russia

The results of modeling the laser generation controlled switching between high-Q closed mode structures in large rectangular cavities (up to 1x1mm) based on AlGaAs/InGaAs/GaAs heterostructures are presented. The model is based on rate equations. The basic principle of lasing switching is the controlled change in the internal optical loss due to the quantum-confined Stark effect.

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WeR3-p30

Visualization and study of the switching processes dynamics in electrically bistable AlGaAs/GaAs/InGaAs thin-base laser-thyristors

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The results of turn-on process inhomogeneities visualization in AlGaAs/GaAs/InGaAs thin-base laser-thyristor is presented. Based on the data obtained, the dynamic characteristics of turn-on processes under various operating conditions of the studied devices were evaluated. Variable parameters: supply voltage, control current and pulse repetition rate.

WeR3-p31

600-W laser bars based on heterostructures with strained InAlGaAs and GaAsP quantum wells of spectral range 800-820 nm

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In present paper the laser bars characteristics of the laser bars of spectral range 800-820 nm with different quantum wells have been compared. It was demonstrated that heterostructures with strained InAlGaAs and GaAsP quantum wells has better performance than that with heterostructures with lattice-matched AlGaAs quantum wells

WeR3-p32

Continuous wave 100-W laser bars (up to 60% wall-plug efficiency) based on (In)GaAsP/GaInP/GaAs heterostructures, emitting at a wavelength of 760-780 nm

M.A. Ladugin[1], A.Yu. Andreev[1], I.V. Yarotskaya[1], A.A. Marmalyuk[1], A.A. Kozyrev[2], L.I. Shestak[2], G.T. Mikayelyan[2]; [1]Sigm plus Co.; [2]NPP Inject Co., Russia

The effective design of (In)GaAsP/AlGaInP/GaAs semiconductor heterostructures, which allows to fabricate laser diodes, emitting at 780 nm, were developed. The MOVPE growth conditions of these heterostructures have been discussed. It was demonstrated that reduced threshold current and increased external differential efficiency could be achieved. The detailed results of laser diodes and bars manufactured from these heterostructures are presented.

WeR3-p33

Characteristic temperatures of the semiconductor lasers based on heterostructures with narrow and broadened waveguides

M.A. Ladugin, A.A. Marmalyuk; Stel'mah RDI «Polyus», Russia

Main parameters and their temperature dependencies for semiconductor lasers based on different types of heterostructures, emitting at spectral range 790-850 nm, have been analyzed and discussed. It was found that a lower value of the characteristic parameter T0 is common thing for semiconductor lasers made from heterostructures with a broadened waveguide in comparison with heterostructures with a narrow waveguide.

WeR3-p34

Red phosphors based on Mn-doped fluorochlorozirconate glasses for warm white LEDs

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The optical properties of fluorozirconate and fluorochlorozirconate glasses doped with manganese have been studied. The 300 K luminescence spectrum of the fluoride glass contains a broad green emission band of the divalent manganese. Partial chlorine substitution for fluorine leads to a redshift of the luminescence bands due to changes in the local environment of the divalent manganese ions.

WeR3-p35

Photochemical 2D-structuring mid-infrared flexible plates made of silver halide polycrystals

E.A. Korsakova, O.N. Pakhomenko, M.S. Korsakov, L.V. Zhukova; Ural Federal Univ., Russia

By means of multistage hot pressing, we manufactured flexible polycrystalline silver halide plates with dimensions of up to 150 mm and a thickness of up to 100. Using laser radiation at the wavelengths corresponding to the short-wave absorption edge, we investigated the possibility of the plates' surface and bulk structure photochemical modification and its suitability for producing diffractive optical elements.

WeR3-p36

Spatial resolution improvement for phi-OTDR sensors via weak fiber Bragg gratings

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The method of a spatial resolution improvement for common phi-OTDR system is proposed. The suggested method allows to decrease the size of acquisition points in the fiber sensor due to the special arrangement of weak Fiber Bragg Gratings (wFBG). The scheme of phi-OTDR doesn't need any changes, moreover it does not possess the limitation of an acousto-optic modulator switching frequency.

This research was supported by RFBR Grant(s) # 19-32-90185

WeR3-p37

Semiconductor-based photonic-crystal waveguides for nonlinear light conversion

G.M. Savchenko, G.S. Sokolovskii; Ioffe Inst., Russia

Semiconductor waveguide structures are proposed that provide true phase matching during second harmonic generation and difference frequency generation. A one-dimensional semiconductor photonic crystal was used as the core of the waveguide. The dispersion of electromagnetic waves in such a structure is studied taking into account the material dispersion of the refractive index, as well as the waveguide dispersion

WeR3-p38

Studying atypical application of long-wavelength VCSEL in a photodetector mode

M.E. Belkin, A.V. Alyoshin, D.A. Fofanov; MIREA - Russian Technological Univ., Russia

In this paper, the results of an experimental study for a long wavelength vertical cavity surface-emitting laser of a wafer-fused construction as an effective resonant cavity enhanced photodetector of analog optical signals are described.

WeR3-p39

Self-injection locking of commercially available high-power DFB laser diode to high-Q crystalline microresonator.

A.S. Gorodnitskiy[1,2], K.N. Minkov[1], I.A. Bilenko[1,3]; [1]Russian Quantum Center, [2]Moscow Inst. of Physics and Technology, [3]Lomonosov Moscow State Univ., Russia

We present the experiments result of the self-injection locking of a commercially available 1550 nm high power DFB laser diode to a high-Q whispering gallery mode (WGM) crystalline microresonator with Rayleigh backscattering. Also the graphics of RIN and phase noise are demonstrated.

WeR3-p40

Cascaded fourth and second harmonic generation with a fractional order of periodical poling

V.Yu. Mylnikov, N.S. Averkiev, G.S. Sokolovskii; Ioffe Inst., Russia

We theoretically demonstrate cascaded fourth and second harmonic generation in a periodically-poled nonlinear crystal with a fractional order of phase-matching period.

WeR3-p41

Research on a type of laser directed infrared contermeasure system

Dong Li[1], Yan Jin[1]; [1]AVIC Manufacturing Technology Inst., China

A type of laser directed infrared countermeasure system uses the advanced laser DIRCM technology, which can provide warning and laser countermeasure when the missile is approaching the aircraft. The jamming mechanism of the DIRCM system were studied and the relevant laser countermeasure tests were carried out. The results showed that the DIRCM system could effectively interfere the infrared imaging seeker.

WeR3-p42

Study of InGaAs/AlGaAs/GaAs semiconductor lasers with a buried mesa

V.S. Golovin, V.V. Shamakhov, D.N. Nikolaev, D.A. Veselov, A.Yu. Lunev, V.Yu. Mikhailov, S.O. Slipchenko, N.A. Pikhtin; Ioffe Inst., Russia

An InGaAs/AlGaAs/GaAs laser heterostructure with a buried mesa was MOCVD grown on a GaAs (100) substrate at a temperature of 750°C. 100-μm-aperture-width lasers were fabricated on its basis and their light characteristics were studied. The achieved total maximum output power (from both facets) was 2.1 and 23 W in the continuous wave and pulsed lasing modes, respectively.

WeR3-p43

Laser heterostructures with a broadened MQW waveguide for high-power and sub-ns-laser-pulse-width operation

S.O. Slipchenko, A.A. Podoskin, V.V. Shamakhov, V.S. Golovin, I.N. Arsentiev, A.D. Bondarev, D.N. Nikolaev, N.A. Pikhtin, P.S. Kop`ev; Ioffe Inst., Russia

Design of a structure with QWs distributed in a broadened multimode waveguide layer is presented, which ensures mode selection, preserves the fundamental mode, provides minimum difference of optical confinement factors between QWs for matching the threshold conditions. A peak optical power of 15 W is demonstrated with a pulse width of 80 ps.

WeR3-p44

Modelling subnanosecond pulse generation by gain switching of high-power semiconductor lasers

V.S. Golovin, S.O. Slipchenko, N.A. Pikhtin, P.S. Kop'ev; Ioffe Inst., Russia

We analyse dynamic behaviour of broad-area edge-emitting semiconductor lasers under pulsed excitation. Our calculations show that in order to obtain high-power single-pulse output it is desirable to increase active area thickness and decrease optical confinement factor. Optimal values are defined by vertical refractive index profile and pulsed current source capabilities.

WeR3-p45

Electron beam pumped pulsed ultraviolet emitter (~ 300 nm) based on CaF2

N.A. Gamov, V.B. Studionov, E.V. Zhdanova, M.M. Zverev; MIREA - Russian Technological Univ., Russia

The parameters of radiation of fluorite CaF2 pumped by pulsed electron beam are presented. UV radiation at a wavelength of 300 nm, a pulse power of up to 1 W at an electron energy of 39 keV, a beam current of 60 mA with a pulse duration of about 200 ns have been obtained.

This research was supported by RFBR Grant(s) # 18-02-00436

WeR3-p46

High-power AlGaInN LEDs operated under high pulsed current density (up to 7 kA/cm2)

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Efficiency, emission spectra, time characteristics of different design high-power blue LEDs have been investigated under high pump current density up to 7 kA/cm2 and pulse duration 100 ns. Analysis of the pulse-behavior of the LEDs reveals revealed that the main drop in efficiency and a change in the spectrum occurs to current densities of ~1A/cm2 and have a non-thermal character.

WeR3-p47

Single-color pump-probe setup at the NovoFEL facility for measuring the temporal dynamics of relaxation in germanium

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The short, narrow-band THz pulses produced by the Novosibirsk free electron laser (NovoFEL) in combination with a pump-probe experimental setup are a powerful tool to reveal information on the dynamics of resonant processes. In this work, we present our experimental setup and show some recent results on the relaxation of electronic impurity states in germanium at low temperatures.

WeR3-p48

Suppression of instability of wide-aperture laser by external optical injection

E.A. Yarunova[1,2], A. A. Krents[1,2], N. E. Molevich[1,2]; [1]Samara National Research Univ., [2]Lebedev Physical Inst. (Samara branch), Russia

This paper investigates the spatiotemporal dynamics of a broad-area laser with modulation of the pump parameter and external optical injection. It is shown that injection suppresses both the wave instability inherent in semiconductor and solid-state lasers and the Faraday instability arising as a result of modulation of the pump parameter.

This research was supported by RFBR Grant(s) # The study was supported in part by Ministry of Education and Science of Russia by State assignment to educational and research institutions under Projects No. FSSS-2020-0014 and No. 0023-2019-0003.

WeR4-p01

Chip-Modulator for the all-electic laser beam angular control by quantum-confined Stark effect

V.V. Zolotarev, I.S. Shashkin, L.S. Vavilova, A.V. Lyutetskiy, S.O. Slipchenko, N.A. Pikhtin; Ioffe inst., Russia

Ultrafast all-electric laser beam angular scan system was developed. Chip-modulator based on quantum-confined semiconductor waveguide heterostructure with surface diffraction grating was investigated. Theoretical and experimental studies of absorption and refractive index modulation of two tunnel-coupled quantum wells were carried out. High value refractive index modulation at low absorption spectral range was demonstrated.

This research was supported by RFBR Grant(s) # no grant number

WeR4-p02

Numerical analysis of surface Bragg grating parameters for the all-electic laser beam angular modulator

V.V. Zolotarev, I.S. Shashkin, L.S. Vavilova, A.V. Lyutetskiy, S.O. Slipchenko, N.A. Pikhtin Ioffe inst., Russia

Calculation of the design parameters of modulator-chip based on heterostructure with a surface Bragg grating, which provide widest field of view, and highest resolution for angle modulation was performed. The simulation shows the capability of laser beam steering more than 5 degrees with a resolution of more than 100 points with laser beam divergence of about 0.03º.

This research was supported by RFBR Grant(s) # no grant number

WeR4-p03

Mathematical model of polarization extinction distortion of laser radiation in magneto-optical crystal due to multiple reflections from the faces

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An analytical model describing the change in polarization state of the light passing through the magneto-optical crystal is demonstrated. Dependence of polarization extinction ratio on reflection coefficient of the crystal faces, phase delay between reflected beams and Faraday rotation angle is considered.

WeR4-p04

The complex of equipment for measuring the frequency of lasers in the wavelength range from 500 to 1050 nm

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The report is about the complex of equipment for measuring a frequency of lasers in the wavelength range from 500 to 1050 nm

WeR4-p05

Robustness to misalignment of four-mirror ring nonplanar cavities

E. A. Polukeev[1,2], Yu. Yu. Broslavets[1,2], A. A. Fomichev[1,2]; [1]Moscow Inst. of Physics and Technology (National Research Univ.). [2]JSC "Lasex", Russia

The paper considers the robustness of the optical axis position in four-mirror ring nonplanar cavities to their misalignment. Various types of cavities are comprised. The aim of the work is to determine the resonator with greater robustness

WeR4-p06

Efficient upconverter of infrared radiation

M.V. Chernov, A.A. Lyapin, A.M. Kuzmin; MRSU, Russia

The structural, physical and spectral-luminescent properties of the upconversion polymer material obtained by extrusion were investigated in this work. This material is able of effectively converting infrared radiation in the spectral range of 0.78-1.07 μm and 1.45-1.64 μm into visible luminescence. Developed luminescent film can used to increase the efficiency of solar cells and visualize infrared laser radiation.

WeR4-p07

High power and water resistance infrared laser beam visualizers

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Visualizers of infrared laser with high moisture resistance and damage threshold were developed. The structural, mechanical and spectral properties of visualizers have been investigated. The spectral range was 0.75-2.1 μm. Visualizers have the high spectral sensitivity (8 μW /cm2 at 1 μm, 750 μW /cm2 at 1.9 μm). The sensors are suitable for monitoring large-aperture and high power laser beams

WeR4-p08

The tip-tilt wave front corrector under hardware control

S.V. Khokhlov, R.A. Shnyagin, F.A. Starikov, RFNC-VNIIEF, Russia

The results of experimental works on creation of the closed-loop adaptive optical system have been described. The control unit has been developed. The results of experiments on the dynamic wavefront tip-tilt correction at the system bandwidth of 2 kHz are reported. The basic characteristics of the adaptive system are measured, and ways of increasing its efficiency are proposed.

WeR4-p09

Adaptive mirrors for phase correction of the laser beam passed through an airway

V.K. Blagonravov, A.A. Vereshchagin, M.A. Glukhov, D.E. Guk, M.O. Koltygin, R.S. Kuzin, F.A. Starikov, R.A. Shnyagin; RFNC-VNIIEF, Russia

The numerical simulation on determination of the necessary number of adaptive mirror's actuators has been carried out. The stacked actuators' response functions of 107- and 203-element adaptive mirrors have been experimentally determined as well. Meanwhile by means of 107-element adaptive mirror it is possible to obtain a corrected laser beam with the Strehl ratio St=0.65.

WeR4-p10

Numerical simulations of dynamic phase correction of laser radiation by the adaptive system with the Shack-Hartmann wavefront sensor

M.V. Volkov, F.A. Starikov, R.A. Shnyagin; RFNC-VNIIEF, Russia

The dynamical phase correction of laser radiation distorted by atmospheric turbulence in the adaptive optical system (AOS) with Shack-Hartmann wavefront sensor is numerically investigated. The criterions of correction efficiency have been obtained depending on the relation between the bandwidths of AOS and turbulence. The ideal as well as actual adaptive mirrors are considered.

WeR4-p11

Phase locking of 7-channel cw fiber laser with dynamic phase distortions by using stochastic parallel gradient algorithm at the system bandwidth 450 kHz

M.V. Volkov, S.G. Garanin, T.I. Kozlova, M.I. Konovaltsov, A.V. Kopalkin, R.S. Lebedev, F.A. Starikov, O.L. Techko, S.V. Tyutin, S.V. Khokhlov, V.S. Tsykin; RFNC-VNIIEF, Russia

The results of experimental research of coherent phase locking of 7-channel laser radiation passed through the turbulent medium with temporal scale τturb depending on the phasing time τph at the system bandwidth 450 kHz has been presented.

WeR4-p12

Spatial resolution of adaptive optical system elements and correction efficiency of laser beam with turbulent phase distortion

M.V. Volkov, V.A. Bogachev, F.A. Starikov; RFNC-VNIIEF, Russia

Numerical investigation of laser beam phase correction in the turbulent atmosphere by adaptive optical system with Shack-Hartmann wavefront sensor has been performed. The criterions of correction efficiency depending on the adaptive mirror and wavefront sensor spatial resolution have been determined for various values of Fried parameter.

WeR4-p13

The efficiency of multi-channel laser radiation focusing through the optically inhomogeneous medium under its phasing on the system output and in the target-in-the-loop technique

M.V. Volkov1,2, O.L. Kuzikov1,2, F.A. Starikov1,2;[1] RFNC - VNIIEF; [2]Sarov Physical and Technical Inst. of National Research Nuclear Univ. MEPHI, Russia

Numerical investigations of the multi-channel laser radiation focusing through the optically inhomogeneous medium at the phasing on the system output and in the case of target-in-the-loop technique on basis stochastic parallel gradient (SPG) algorithm have been performed. The efficiency of focusing has been investigated depending on the ratio of Fried parameter to the subaperture size.

WeR4-p14

Resolution enhancement of the stellar imaging adaptive system by using an artificial guide star

V.A. Bogachev, A.A. Vereshchagin, M.V. Volkov, S.G. Garanin, M.A. Gluhov, D.E. Guk, M.O. Koltigin, A.V. Kopalkin, R.S. Kuzin, S.M. Kulikov, F.A. Starikov; Inst. of Laser Physics Research, RFNC-VNIIEF, Russia

The results of resolution enhancement of the stellar imaging system by using a Rayleigh laser guide star are presented. The estimation of residual phase error value of adaptive correction is carried out at various position of a laser guide star.

WeR4-p15

An experimental setup for the research of piezoelectric actuators with mechanical reduction

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The article describes the experimental hardware-software complex for solving the problems of identifying device parameters and developing control algorithms. It has been experimentally shown that the hardware-software complex allows automate studies of the dynamic characteristics of the control object and to develop control algorithms for multilayer piezoactuators in real time on field samples.

WeR4-p16

Control of coherent light by voltage-tunable diffraction optical elements based on lithium niobate crystals with tailored domain patterns

V.Ya. Shur[1], A.A. Esin[1], A.R. Akhmatkhanov[1], V.S. Pavelyev[2]; [1]Ural Federal Univ., [2]Image Processing Systems Inst. RAS, Russia

We present the design and realization of electrical field-controlled diffraction optical elements (DOE) in lithium niobate (LN) with precisely tailored ferroelectric domain structure. The DOE creation is based on investigation of domain growth in LN. The following tunable DOEs have been created and tested: (1) 2D diffraction grating, (2) hexagonal zone plate, (3) bidomain element for TEM00-TEM01 mode transformation.

WeR4-p17

Affordable laser imaging instrumentation for persistent runway monitoring

A.B. Utkin[1,2], T. Rocha da Silva[1], P. Reis[3]; [1]INOV INESC Inovação; [2]CeFEMA, Universidade de Lisboa; [3]ANA - Aeroportos de Portugal, Portugal

An affordable system for runway pavement health assessment is being developed in Portugal within the framework of the MPP — Persistent Runway Monitoring project (European Commission Partnership Agreement "Portugal 2020"). As a component of this system, a laser imaging setup was designed to provide efficient and nearly real-time evaluation of the runway conditions and prompt detection of foreign object debris.

WeR4-p18

FPGA-based adaptive optical system for atmospheric applications

A.L. Rukosuev[1], V.N. Belousov[2], I.V. Galaktionov[1], A.N. Nikitin[1], A.V. Kudryashov[1], V.V. Samarkin[1], J.V. Sheldakova[1]; [1]Inst. of Geosphere Dynamics RAS, Russia, [2]LyraTech Ltd., Russia

One of the methods to improve the performance of adaptive optical systems intended for atmosphere applications is to use FPGA as the main control element of all system. FPGA layout, closed-loop algorithm, time diagram etc. are presented.

WeR4-p19

Study of the crystallization process of low-soluble compounds using laser analyzers

I.A. Pochitalkina, P.A. Kekin, A.E. Kovalenko; Mendeleev Univ. of Chemical Technology of Russia (MUCTR), Russia

Studying the nucleation of sparingly soluble substances using «Nanotrac ULTRA» and «SLS 1100» laser particle analyzers allowed us to develop a new methodological approach to determining the individual stages of the crystallization process. The simplicity and versatility of techniques can be considered fast and slow response from unified common positions and eliminate subjective factors inherent analytical determination.

WeR4-p20

Application of a streak camera to measure actual temporal shape of nanosecond laser pulses

M.V. Kanzyuba, V.B. Lebedev, G.G. Feldman; VNIIOFI, Russia

A new type K016M streak camera developed at VNIIOFI was used to measure the temporal shape of individual pulses emitted by commercial nanosecond pulsed solid-state laser. It has been shown that the streak camera having picosecond temporal resolution can reveal the fine structure of temporal shape of the laser pulse that is not detected by oscilloscopic measurement.

WeR4-p21

Real-time quality control of optical elements within laser facilities

G.S. Rogozhnikov[1,2] , V.V. Romanov[1], I.V. Mishina[1], A.E. Plokhotnik[1]; [1]FSUE "Russian Federal Nuclear Center - VNIIEF", Russia; [2]SarFTI NRNU MEPHI, Russia

Method of real-time control of optical elements in complex laser facilities has been proposed. The method is based on the admixing of terahertz radiation to the laser radiation and introduction of intermediate check-ups of laser-terahertz beam quality along the beam path.

WeR4-p22

Measuring of the parameters of non-uniform spatial polarization of THz laser radiation

N.G. Kokodii[1,2], S.V. Pogorelov[2], I.V.Krasovskyi[2]; [1]Karazin Kharkiv National Univ., Ukraine; [2]National Univ. of Pharmacy, Ukraine

Measuring method of parameters of laser radiation spatial-ly inhomogeneous polarization was proposed. The matrix receiver with polarizer at the input was used. Laser radia-tion with radial polarization in the terahertz range (wave-length is 0.432 mm) was measured.

WeR4-p23

Optical manipulation of multiple particles using acousto-optical deflector

A.A. Yablkova, G.N. Martynov, A.A. Kozlov, A.S. Machihin; Scientific and Techological Center of Unique Intrumentation RAS, Russia

In this work, the problems of using acousto-optical deflector AOD for automated optical manipulation of microobjects are investigated. Optical tweezer with a developed AOD were assembled, and software for the implementation of multitrapping was created.

WeR4-p24

Effectiveness research of the mirror with adjustable curvature

S.G. Garanin, V.G. Rogachev, E.A. Kudryashov, G.N. Kachalin, A.S. Mokeev, D.S. Timaev, V.M. Yamschikov; RFNC - VNIIEF, Russia

This paper presents the study results of the mirror with adjustable curvature. The key dependencies are shown of the reflecting properties for different fixing types and in comparison with other types of mirrors. Conclusions about the most effective type of mirror are drawn.

WeR4-p25

Generation of vortex fields using a sector spiral plate based on ferroelectric liquid crystals

S.P. Kotova, E.P. Pozhidaev, S.A. Samagin, A.M. Mayorova; A.A Pichkasova; Lebedev Physical Inst., Samara Branch; Lebedev Physical Inst., Russia

The quality of the formation of axially symmetric vortex fields using a 12-sector spiral plate based on the orientational Kerr effect in ferroelectric liquid crystals with a switching frequency of up to 2 kHz is studied. The structure of the inhomogeneous state of light field polarization in the near and far diffraction zones is analyzed.

WeR4-p26

Four-frequency Zeeman laser gyro's counterpropagating waves signals processing methods

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This work was carried out for Zeeman four-frequency laser gyro's accuracy increasing. In order to obtain beat signals from two pairs of generated waves the laser gyro is complemented with an optical radiation mixer, which distributes the orthogonal circular polarizations waves rays to different photodetectors.

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WeR4-p27

Raman gas analyzer with a confocal interferometer

V.V. Vitkin[1], V.V. Vasiliev[2], A.V. Polishchuk[1], K.M. Grigorenko[1], V.V. Kurikova; [1]ITMO Univ., [2]Lebedev Physical Inst. RAS, Russia

Paper presents simple solution for raising intensity of radiation in a beam waist of a Raman gas analyzer. Laser linewidth used equals ~21.2MHz. The interferometer length is limited by a cuvette size. To compensate instabilities of interferometer length one of the mirrors is set on a piezo transducer. Transmittance used as a feedback loop signal to maximize the coupling.

WeR4-p28

High NA spectrograph for a Raman gas analyzer

V.V. Vitkin[1], E.E. Popov[1], A.A. Kharitonov[1,2], I.N. Kaliteevsky[2] and V.M. Polyakov[2]; [1]ITMO Univ., [2]GK R-AERO Ltd Co, Russia

This paper introduces a high numerical aperture (NA) spectrograph for a Raman gas analyzer. Linear dispersion is 5 nm/mm, spectral resolution is 0.04 nm, the full spectral range is 563-670 nm.

WeR4-p29

Application of copper-coated optical fibers for high-power laser beam profile measurements

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In this paper we introduce a novel approach for the measurement of the intensity profile of high-power laser radiation, which does not require any preliminary attenuation, based on the application of the matrix made of multimode copper-coated optical fibers.

WeR4-p30

Biconical optical fiber fabrication

E.A. Vyuzhanina[1, 2], D.G. Gilev D. G.[1,3], V.K. Struk[1], V.V. Krishtop[1]; [1]Perm Scientific-Industrial Instrument Making Company, [2]Perm National Research Polytechnic Univ., [3]Perm State Univ., Russia

Biconical fiber was obtained by locally heating by using a butane burner a single-mode optical fiber to the melting point (~ 1700 °) and pulling. Photos of the biconical fiber were obtained using a scanning electron microscope. A diameter of fiber is about 3 microns in the constriction, which makes it possible to excite whispering gallery modes high quality resonators.

WeR4-p31

Echelette based method of CGH synthesis and its application for aberrations measurement

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A holographic wavefront sensor based on echelette grating model realized by a phase only SLM is presented. This scheme allows optical aberration measurement with high precision. The presented optical scheme and CGH synthesis algorithms were validated with numerical simulations and experiments.

WeR4-p32

Lensless scheme of a holographic wavefront sensor

G.K. Krasin1, N.G. Stsepuro[1], M.S. Kovalev1, E.Yu. Zlokazov[1,2]; [1]Bauman Moscow State Technical Univ., Russia; [2]National Research Nuclear Univ. "MEPhI", Russia

A scheme of a compact holographic wavefront sensor based on combination of computer-generated hologram and computer-generated Fresnel lens is presented. This scheme allows optical aberration measurement with high precision. The presented optical scheme is tested and compared to a scheme with physical Fourier lens.

WeR4-p33

Aspects of development an adaptive optics system for a small telescopes

V.V. Lavrinov, L.N. Lavrinova, A.A. Selin; Zuev Inst. of Atmospheric Optics SB RAS, Russia

When developing an adaptive optics system for small telescopes, the following factors can be noted that affect the efficiency of distortion correction: design features of the optoelectronic system, expressed in the vignetting of optical planes; "Strong" turbulence on the optical propagation path. This work presents the results of numerical simulation and the results obtained in a real atmosphere.

WeR4-p34

Features of digital image processing in the Shack-Hartman wave front sensor

V.V. Lavrinov, L.N. Lavrinova, D.V. Kazakov, M.A. Kucherenko; Zuev Inst. of Atmospheric Optics SB RAS, Russia

The results of numerical studies of the effectiveness of centering algorithms for focal spots of a hartmannogram depending on the dimension of the lens raster and the intensity of atmospheric turbulence are presented. The design features of the optoelectronic system are taken into account: the round shape of the input aperture and the presence of shielding in the telescope.

WeR4-p35

Helicopter LIDAR for flight safety during search and rescue activities

S.A. Matveev., S.Yu. Strakhov, D.S. Bronds, A.V. Trilis; Baltic State Technical Univ., Russia

Ensuring the safety of helicopter flights at low altitudes and landing in difficult conditions during search and rescue operations is a very important task. This task is complicated if search and rescue activities are carried out in an unfamiliar area with limited visibility. To solve this problem, lightweight compact LIDAR was developed with high ability to detect obstacles to flights.

WeR4-p36

Adaptation of a phase front correction system based on a bimorph mirror to compensate for non-linear phase distortions

A. Kotov[1], S. Perevalov[1], M. Starodubtsev[1], A. Soloviev[1], A. Alexandrov[2], I. Galaktionov[2], V. Samarkin[2], A. Kudryashov[2], A. Kochetkov[1], V. Ginzburg[1], A. Shaikin[1], I Yakovlev[1], E. Khazanov[1]; Russia

The paper presents the results of a wavefront correction system based on a deformable bimorph mirror on a PEARL sub-petawatt laser complex. An improvement in the quality of focusing up to Strehl number = 0.7 is demonstrated. Aberration anticipation mode for single shots is discussed, which is relevant in systems using nonlinear postcompression beam manipulations, such as SHG, etc.

WeR4-p37

Bimorph deformable mirror vs LCOS-SLM for laser beam focusing through the moderately scattering medium

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Efficiency of bimorph deformable mirror with 48 control electrodes and LCOS-SLM with 1920x1080 pixels resolution for scattered laser beam focusing were investigated. Numerical and experimental results of the focusing improvement showed that it is possible to increase the peak intensity of the far-field focal spot up to 60 %.

This research was supported by RFBR Grant(s) # № 16-07-01276

WeR4-p38

Implementation of energy and information exchange using laser radiation in the control system of transformable space antennas

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The article discusses the structure and fundamental features of remote energy-exchange using laser radiation to control the shape of large space antennas, used laser sources and detectors, the optimal combination of open and fiber-optical channels of the antenna design and the design of compact executive module for controlling the antenna elements, including a highly receiver, energy storage and micromechanical drive.

WeR4-p39

Photoelectric response in titanium nitride films

S.A Pliastcov, G.G. Anchutkin, A.A. Ashirov, D.O. Gagarinova; ITMO Univ., Russia

We first observed the photoelectric response on TiN films. Experimental studies have shown that a sensitive element based on TiN allows us to simultaneously obtain information about the energy and time parameters of laser radiation. The developed sensor can be used to determine the values of the parameters of the pulses of laser radiation.

WeR4-p40

Light-driven optical switch for 193 nm laser beam

R.D. Aglyamov, A.V. Lovchev, O.A. Morozov, A.K. Naumov; Kazan Federal Univ., Russia

The excited-state absorption phenomenon is generally considered as negative in laser physics. We want to show an example of a useful practical application this phenomenon as light-driven optical switch. Neodymium ions activated fluoride crystals as a material were used.

WeR4-p41

The control of the energy and geometric laser beam centers position

A.E. Shepelev[1], N.M. Krasnov[2], A.A. Antipov[1,2], A.G. Putilov[1,2], A.V. Osipov[1,2]; [1]Inst. on Laser and Information Technologies RAS, Branch of Federal Scientific Research Center "Crystallography and Photonics" RAS, [2]Vladimir State Univ., Russia

The urgency of laser beam control tasks in various spheres of its application is noted. The algorithm of the coordinate determining of the laser beam geometric and energy centers and its implementation in the package of applications for solving problems of technical calculations MathLab are presented.

This research was supported by RFBR Grant(s) # 19-29-10022

WeR4-p42

Polarization analysis of encircled energy function for quality control of large-aperture KDP crystals

A.V. Kirsanov, E.V. Vlasov, A.P. Zinoviev, V.O. Zotov, I.V. Kuzmin, V.V. Lozchkarev, G.A. Luchinin, A.I. Pavlikov; Inst. of Applied Physics RAS, Russia

Large-aperture KDP crystals quality is analyzed using the encircled energy function EE(d). We have supplemented the classical EE(d) function by polarization analysis. We have learned to grow, process and coat crystals so well that in most cases of crystal analysis we see good EE(d), but in some polarizations there is difference between the radiation passing through the crystal.

WeR4-p43

Magneto-optical cerium-doped ternary phosphate glass

A. Babkina[1], E. Kulpina[1], A. Starobor[2], K. Zyryanova[1], Y. Fedorov[1], N. Nikonorov[1], Y. Sgibnev[1], K. Oreshkina[1];[1] – ITMO Univ.; [2]Inst. of Applied Physics RAS, Russia

The results of synthesis and study of the cerium concentration effect of optical, spectral and magneto-optical properties of ternary phosphate glasses are presented. Glass absorbance spectra demonstrated maximum 2 cm-1 level in wide optical transmittance window of 350-2500 nm. The maximum values of Verdet constant (11 rad/T/m at 1064 nm) are reached with increasing cerium concentration up to 25 mol.%.

WeR5-p01

Cross-correlator schemes for diagnostic of visible and UV shaped laser pulses

I.V. Kuzmin, S.Yu. Mironov, M.A. Martyanov, A.K. Potemkin, E.A. Khazanov; Inst. of Applied Physics RAS, Russia

Theoretical model of scanning cross-correlator used for diagnostic 3D profiled laser pulses was developed. The parameters of nonlinear crystals and the required accuracy of its alignment for correct measurements were determined with help of based on the model numerical simulations.

WeR5-p02

Homogeneous irradiation of internal inverted corona target surface with mirror reflector

V.M. Yamshchikov, V.G. Rogachev; Inst. of Laser Physics, RFNC-VNIIEF, Russia

This report presents numerical results of optimal reflecting surface that secure uniform distribution of laser energy on inner inverted corona target surface. At the certain indicatrix the surface of the reflector is calculated and degree of uniformity of distribution of laser energy is presented.

WeR5-p03

Superradiance in Rb-vapor

S.A. Pulkin, A.A. Kalinichev, A. Sheluheev, D.A. Ivanov , T.Yu. Ivanova, M.V. Balabas, I.K. Korshok, A.G. Antipov, S.V. Uvarova, N.S. Pulkin; [1]St. Petersburg State Univ., Russia

Theoretical simulation and experimental researches of different phenomena connected to induced superradiance are carried out

WeR5-p04

The research of radioactive exposure compensation on optical material for optical fibers by powerful laser radiation

R.V. Davydov[1] , D.S. Dmitrieva[2] , V.M. Pilipova[2] , V.Yu. Rud[3,4] , V.V. Davydov[1,4] , V.I. Dudkin[2] , E.I. Andreeva[2]; [1]Peter the Great St. Petersburg Polytechnical Univ., [2]Bonch-Bruevich St. Petersburg State Univ. of Telecommunications, [3]Ioffe Inst., [4]All Russian Research Inst. of Phytopathology, Russia

The dependences of radiation-induced losses from doses of absorbed γ-radiation on a standard optical fiber SMF with a core (SiO 2 – GeO 2) are investigated. The influence of laser radiation power to the time of optic fiber transparence recovery (relaxation of coloring centers) is established. The method of γ- radiation influence compensation is proposed.

WeR5-p05

Multilayer volumetric modification of quartz glass by femtosecond laser radiation

R.V. Chkalov, A.S. Chernikov, D.G. Vasilchenkova; Vladimir State Univ., Russia

The paper describes the possibility of modifying transparent solid media by ultrashort laser pulses of femtosecond duration. The results of multilayer ordered structures formation in a bulk of the glass samples are demonstrated. Examples of modification of a refractive index by means of ultrashot laser pulses are shown.

WeR5-p06

Nanoantennas interfaces formation by selective laser ablation of thin-film coatings

R.V. Chkalov, K.S. Khorkov, D.G. Vasilchenkova; Vladimir State Univ., Russia

The paper is devoted to the problem of creating nanoantennas interfaces for optoplasmonics tasks. The possibility of using femtosecond laser radiation for precision micromachining of thin films is described. Example of optical antenna interface formed by controlled laser ablation of thin metal coating is shown.

WeR5-p07

Laser processing of titanium surface in n-hexane vapor using the electrostatic ablation products removal method

D.A. Kochuev, R.V. Chkalov, D.G. Vasilchenkova; Vladimir State Univ., Russia

This work describes the original method of laser synthesis of microspheres coated with titanium carbide. The formation of microspheres is carried out by the action of femtosecond laser radiation on the surface of a titanium target in a two-component reaction medium. The presented synthesis method provides long-term storage of the obtained powders in atmospheric conditions.

WeR5-p08

Modification of high laser harmonics by over-dense plasma cluster media

A.A. Andreev[1,2,3], Zs. Lecz[2], N.S. Pulkin[1], U. Teubner[3]; [1]St. Petersburg State Univ., Russia; [2]ELI-ALPS, Hungary; [3]Emden TH, Germany

We analyse the possibility of directed scattering and angular filtering of intense short wavelength radiation (laser harmonics) in the XUV range by Mie scattering in the suitable cluster jet.

WeR5-p09

Characteristic X-Ray radiography of super-dense high-temperature laser plasma

A. Andreev[1,3], D. Bespalov[1], K. Platonov[2], M.Sedov[1]; [1]St. Petersburg State Univ., Russia; [2]SPbTU, Russia; [3]MBI, Germany

The K-α and Ly-α/He-α line emission X-ray sources for diagnostics of the compressed state of laser plasma was proposed, and its optimal parameters were calculated under the conditions required for nuclear fusion

WeR5-p10

Resonant production of ultrarelativistic electron-positron pairs by a gamma-quantum in the field of nucleus and pulsed laser wave

N.R. Larin, V.V. Dubov, S.P. Roshchupkin; Peter the Great St. Petersburg Polytechnic Univ., Russia

Resonant photoproduction of ultrarelativistic electron-positron pairs in the field of nucleus and plane quasi-monochromatic electromagnetic wave of weak intensity is studied theoretically. Resonant kinematics of the first few resonances is analyzed in details. Kinematic regions where there is no interference of channels a and b of this process were found.

WeR5-p11

Role of focusing conditions on the control of coherent radiation spectral properties under mid-IR filamentation

K.V. Lvov[1,2], S.Yu. Stremoukhov[1,2], F.V. Potemkin[1]; [1]Lomonosov Moscow State Univ., Russia; [2]National Research Center "Kurchatov Inst.", Russia

We report numerically the role of the focusing on the generation of anti-Stokes wing and harmonics in fluorites (CaF2) during the propagation of mid-IR femtosecond laser pulses. We show the increase of electron plasma density and intensity of the generated spectrum short-wavelength region under tighter focusing condition.

This research was supported by RFBR Grant(s) # 18-02-40014

WeR5-p12

Photoacoustic energy conversion efficiency under femtosecond filamentation in water: dependence on temperature and filamentation regime

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We report a study of the photoacoustic energy conversion efficiency (PAECE, the ratio of acoustic wave energy to the laser pulse energy) under femtosecond filamentation in water. On the basis of obtained acoustic signals induced by the filament the dependencies of PAECE on the water temperature and filamentation regime were determined.

This research was supported by RFBR Grant(s) # 18-32-00696

WeR5-p13

Femtosecond laser interaction with titanium at different pressures in the n-hexane medium

A.V. Ivashchenko, M.A. Tarasova, D.A. Kochuev, K.S. Khorkov; Vladimir State Univ., Russia

Experiments on the effects of femtosecond laser radiation on titanium targets in a liquid hydrocarbon medium were carried out. The structures obtained were investigated optical and scanning electron microscopy.

WeR5-p14

Femtosecond laser micromachining complex

R.V. Chkalov, A.S. Chernikov, D.G. Vasilchenkova; Vladimir State Univ., Russia

The possibilities of integration of isolated nodes and functional components into a single high-tech femtosecond laser system operating under the software control are considered. The examples of using the complex for controlled micro- and nanostructuring of surfaces, formation of ordered structures in a volume of material, precision processing by means of femtosecond laser radiation are described.

WeR5-p15

Raman compression of laser pulses at spontaneous Raman amplification

A.A. Balakin, S.A. Skobelev; Inst. of Applied Physics RAS, Russia

The laser pulse compression method is proposed basing on spontaneous Raman scattering in plasma with an ionization front running toward the laser pump pulse. Sharpness of the ionization front and the dependence of the Raman increment on transverse wave numbers give well localized and well focusable output pulse. Three-dimensional numerical simulations show the feasibility of this regime.

WeR5-p16

Resonant process of the ultrarelativistic electron-positron pair creation by gamma quanta in the field of a plane electromagnetic wave

V.D. Serov, V.V. Dubov, S.P. Roshchupkin; Peter the Great St. Petersburg Polytechnic Univ., Russia

The resonant process of creation of the ultrarelativistic electron-positron pair by hard gamma quanta in the field of a weak electromagnetic wave was studied theoretically. Resonant kinematics was studied in details. Resonant differential cross section was obtained. It is shown that the resonant differential cross section of the process can significantly exceed the corresponding cross section without an external field.

WeR5-p17

Laser-plasma electron acceleration in a transitional regime of plasma wakefield excitation

N.A.Andreyuk, N.P.Pyatakov, B.P.Yakutov, RFNC-VNIIEF, Russia

We show the results of a numerical simulation, in which electrons are accelerated in a transitional regime of plasma wakefield generation. This transition from laser wakefield acceleration to plasma wakefield acceleration allows the second accelerated bunch to gain higher maximum energy, which exceeds 500 MeV.

WeR5-p18

Measurement of the electron temperature of laser-induced plasma channels in argon and investigation of the spatial distribution of laser radiation

M.A. Tarasova, K.S. Khorkov, D.A. Kochuev, A.V. Ivashchenko; Vladimir State Univ., Russia

This paper investigates the properties of laser-induced plasma channels formed by femto-second laser radiation in a gas. Experiments were performed to change the intensity distribution of laser radiation in the cross section of the beam. For this purpose, a dynamic optical unit has been developed that allows moving laser radiation

WeR5-p19

Interaction of plasma-dust formations with ultrashort laser pulses

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The paper presents experimental results on charging free-falling particles of titanium dust about 40 microns in size using femtosecond and nanosecond laser pulses. The results include the ratio of the achieved dust particle charge under various conditions: beam size, energy, and laser pulse duration. The effects of interaction of femtosecond and nanosecond charging are discussed.

WeR5-p20

Resonant electron-positron pair production by an electron in the field of a plane electromagnetic wave

G.K. Sizykh[1,2], V.V. Dubov[1], S. P. Roshchupkin[1]; [1]Peter the Great St. Petersburg Polytechnic Univ.; [2]Alferov Univ., Russia

The resonant electron-positron pair production by an ultrarelativistic electron in the field of a weak plane electromagnetic wave is theoretically studied. Resonant kinematics of the process is studied in detail. It is shown that the resonant differential cross section significantly exceeds the non-resonant one.

ThR6-p01

Determination of probability of irreversible damage expansion in organic glass by laser radiation.

E.A. Sinicyna[1] , D.A. Puz'ko[1] , V.Yu. Rud[2, 3] , V.V. Davydov[1, 3] , V.I. Sviatkina[1]; [1]Peter the Great St. Petersburg Polytechnical Univ.; [2]Ioffe Inst.; [3]All Russian Research Inst. of Phytopathology, Russia

By analyzing the nature of changes in speckle images (propagation of blackouts and their direction), it is possible to estimate with high probability the crack start time (irreversible damage under the influence of the load). The registration of speckle images from transmitted and reflected scattered laser radiation significantly increases the reliability of our results.

ThR6-p02

Study of radiation spectrum compact rf-excited CO2 laser for photoacoustic application

A.A. Markelov[1,2,3], A.I. Karapuzikov[1,3], M.B. Miroshnichenko[1,2], A.A. Boyko[1,2,3]; [1]Special Technologies, [2]Inst. of Strength Physics and Materials Science SB RAS, [3]Inst. of Laser Physics SB RAS, Russia

The influence of the gas mixture pressure and the output mirror transmittance of a pulse-periodic small-sized waveguide CO2 laser with non-selective resonator on the number of generation lines is studied. The experimental results show that by choosing these parameters, one can significantly change the spectral composition of the laser radiation.

This research was supported by RFBR Grant(s) # 19-32-60055

ThR6-p03

Excitation energy structure of the photosysthem II reaction center: excitons and charge-separated states

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Based on the linear and transient absorption spectroscopy experiments, as well as applying the differential evolution optimizer, the photosystem II reaction center exciton model of energy transport and charge separation processes was created by fitting the data. The modified Redfield theory is used to calculate the relaxation rates. The spatial arrangement of chlorophylls was taken from the latest crystal structure.

This research was supported by RFBR Grant(s) # 19-01-00696

ThR6-p04

Lidar aircraft landing system

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This report discusses existing methods for unmanned landing of civil aircraft. Their main disadvantages and advantages are evaluated. A new method is proposed, which is based on the use of system-based lidar. An assessment is made of the energy parameters of the lidar for sounding at a distance of over ten kilometers.

ThR6-p05

Low energy states of cyanobacterial photosystem I antenna complexes

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Monomeric and trimeric pigment-protein antenna complexes of photosystem I (PSI) isolated from cyanobacteria Arthrospira platensis were studied both experimentally and theoretically. An exciton model was proposed to explain one of PSI spectral features: low energy states, whose energies are red-shifted in comparison with those of PSI reaction center. We present results of the modeling of linear and transient absorption spectroscopy

This research was supported by RFBR Grant(s) # 19-01-00696

ThR6-p06

VIS-NIR high speed imaging with the metal vapor brightness amplifiers

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The new method of high speed vis nir imaging is discussed. The method based on the use of active optical signal transformers - metal vapors active elements. The abilities of NIR imaging with the use of active manganese medium is studied.

ThR6-p07

Laser induced fluorescence spectroscopy for crude oils characterization

V.M. Polyakov[1], A.L. Pavlova[1], I.N. Kaliteevskiy[1], A.O. Vinogradov[1], A. A. Kharitonov[1,2], A.E. Prokofiev[1], D. S. Denk[1], S.I. Tomashevich[1,3]; [1]GK R-AERO Ltd Co, Saint-Petersburg, Russian Federation; [2]Faculty of Laser Photonics and Optoelectronics, ITMO University, Saint-Petersburg, Russian Federation; [3]Faculty of Control Systems and Robotics, ITMO University, Saint-Petersburg, Russian Federation

Laser induced fluorescence spectroscopy was used for crude oil samples characterization. The fluorescence signals were collected and analyzed by spectrometer Vision2GO-600. The fluorescence spectra bands at 550/610 nm and 570 nm were obtained using optical excitation sources at 470 nm and 532 nm wavelengths. The differences in spectra of crude oil samples were discussed.

ThR6-p08

Portable Raman sensor for geological expeditions

B.Y. Karas[1], A Kancer[2], E Miharev[1], A.S. Grishkanich[1,3], A.P.Zhevlakov[3]; [1]St. Petersburg Electrotechnical Univ. "LETI", [2]ITMO Univ., [3]Polyus Scientific Research Inst., Russia

Raman gas analyzer in the ultraviolet region of the spectrum based on a solid-state small-sized Nd Yag laser with a wavelength of 266 nm is presented. During the experiments, the threshold sensitivity for the detection of hydrocarbons CH4, C2H6, C3H8, i/n -C4H10, i/n -C5H12 was reached at a distance of 5 m at 2 ppm and 5 ppm for H2S.

ThR6-p09

Semiempirical model of laser-speckled light patterns formed in a focus area of optical system

Y.A. Rezunkov, L.A. Reiankova; NII OEP JSC, Russia

In the paper, a semiempirical model of laser-speckled light patterns formed in a focus region of an optical system, which is a part of the equipment, is considered. Such parameters as the errors of two types 1 and 2 are estimated on the basis of the model, which define the equipment operation modes.

ThR6-p10

Spectral and energy calibration of hyperspectral lidar

L.A. Konopel'ko[1,2], V.V. Elizarov[3], A.S. Grishkanich[3], V.A. Pozdnyakova[2], A.P. Zhevlakov[2,3]; [1]Vendeleev Inst. of Metrology, [2]ITMO Univ., [3]Vavilov State Optical Inst., Russia.

Remote exploration and monitoring of beta - and alpha-radionuclides in atmosphere is important issue. Calibration technique of coherent anti-Stocks Raman lidar designed for the detection of radioactive isotopes according to the wavelength scale, hyperspectral resolution and sensitivity in combination with a dynamic range of detected echo signals is reported.

ThR6-p11

Nearfield free-space visible light communication system via smartphone screen

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We developed encoding and decoding algorithms for data transmission using visible light as an information carrier. Modern smartphone LED screen were used as a transmitter. Dynamically changed multicolor images were generated according to digital information signal and displayed utilizing the screen. These images had been discerned by full-HD Web camera. The system demonstrated capacity 0.7 Mbps on 20 cm.

ThR6-p12

Plastic optical fiber AC voltage sensor

J. Prabowo, H. Seo, J. Park; Keimyung Univ., Korea

A plastic Optical fiber(POF) AC voltage sensor based on a polymer dispersed liquid crystal(PDLC) is investigated. The research results show that the plastic Optical fiber AC voltage sensor based on the polymer dispersed liquid crystal can be used to measure the amplitude of AC voltage.

ThR6-p13

Raman spectroscopy of the pentad of isotopically-enriched methane 13CH4

I.K. Chubchenko[1,2], V.V. Vitkin[1], E.E. Popov[1], A.V. Polishchuk[1], P.A. Loiko[3]; [1]ITMO Univ.; [2]Mendeleyev Inst. for Metrology (VNIIM), Russia; [3]CIMAP, CNRS, Université de Caen Normandie, France

We report on the Raman spectrum of chemically pure and isotopically enriched (>99.9% 13C) methane 13CH4 gas measured using a specially developed Raman gas spectrometer intended for the qualitative analysis of atmosphere impurities. The spectrum is measured in the range of 2700–3400 cm-1 (the pentad) revealing the most intense peak at ~2915 cm-1.

ThR6-p14

Human breath Raman analysis

E.E. Popov, V.V. Kurikova; ITMO Univ., Russia

Raman spectrometer for human breath analysis is presented in this paper. Raman spectrum of human breath is measured. Components of gas mixture are identified. CO2, O2, N2, CH4 gases are identified.

ThR7-p01

The time-delay compensating XUV double-grating monochromator beamline at FLASH2: status and developments

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A double-grating monochromator beamline with ultrafast response is currently under construction for the soft x-ray free-electron laser FLASH. Employing two variable-line-spacing gratings in a time-delay-compensating configuration allows one to correct for the pulse-front tilt, thus preserving the initial ultrashort FEL pulse duration. Here, we report on the design parameters and the status of the time-delay compensating XUV monochromator at FLASH.

ThR7-p02

Mach-Zehnder and Michelson interferometers for formation laser pulses with periodic intensity modulation

I.V. Kuzmin, S.Yu. Mironov, M.A. Martyanov, A.K. Potemkin, E.A. Khazanov; Inst. of Applied Physics RAS, Russia

A possibility of an implementation of Mach-Zehnder and Michelson interferometers for formation laser pulses with periodic intensity modulation is considered analytically.

ThR7-p03

Study of spectral characteristics of silver halide polycrystals at terahertz frequencies

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In this study, we investigated the spectral characteristics of AgCl-AgBr polycrystals at terahertz frequencies. To our knowledge, it has been conducted for the first time. It was revealed that the crystals have THz transmission bands and their transmission percentage is quite high. This opens up new horizons for the application of silver halide fibers in various terahertz systems.

ThR7-p04

Gas monitor detector for free-electron lasers and high-order harmonic sources

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A gas monitor detector has been developed which measures of absolute photon pulse energy and photon beam position at free-electron lasers. The detector measures the intensity in a wide dynamic range from spontaneous undulator to FEL radiation and provides a temporal resolution from 5ns to 200 ns. The detector is also suitable to characterize high-order harmonic photon sources.

ThR7-p05

Tuning of THz stimulated emission from uniaxially stressed optically pumped Si:Bi

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We present the results of investigations devoted to the intracenter excitation of uniaxially stressed Si:Bi. The stress results in splitting and shift of the states leading to appearance of several lasing transitions with some of them being Raman active. The cases of uniaxial stress along [001] and [011] have been studied and the results demonstrating new frequencies are presented.

ThR7-p06

New insights into the laser-assisted photoelectric effect from solid-state surfaces

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We report on time-resolved soft X-ray photoelectron spectroscopy at the Si 2p core level conducted at the X-ray Free-Electron Laser FLASH. The sideband formation is modeled with a modified response function and the global fit is found to be in excellent agreement in the energy as well as time domain with the experimental signal.

ThR7-p07

On the possibility of modeling of photon-photon interaction at the European X-ray Free Electron Laser.

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We consider the possibility of performing the experimental research in the field of fundamental physics based on European X-ray Free Electron Laser (E-XFEL). The possibility of experimental registration of reaction $\gamma + \gamma \rightarrow e+ + e-$ product are reviewed. Also, astrophysical applications are discussed.

ThR8-p01

Behavior of local ablation rate under femtosecond filament micromachining solid target with decreasing gas pressure

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It was found that the behavior of the average ablation rate of the cu foil exposed by the Ti:Sa femtosecond laser filament at a constant P / Pcr ratio in the gas pressure range of 0.1-1 atm indicates an increase in fluense and intensity in the filament.

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ThR8-p02

Methods of stabilization of central wavelength of Erbium-doped fiber source for high-accuracy fiber optic gyroscope

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This paper presents the method of stabilization of the erbium-doped fiber source, which allows changing the parameters of the output light (the central wavelength, the temperature coefficient of the central wavelength) at the constant output power by changing the optic powers of the two laser diodes.

ThR8-p03

Numerical simulation of spatio-temporal coupling effect in femtosecond laser pulse propagated through multi-layer scattering media

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Variation of spatial, temporal and spectral parameters of femtosecond laser pulse propagated through scattering media was studied. It was shown that diffraction on disordered media results in increase of the laser pulse duration and decrease in its spectrum width. Moreover variation of these parameters is inhomogeneous among the laser beam cross-section.

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ThR8-p04

Quantum fluctuations in the Raman Fiber amplifier

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The results of numerical modeling of pulses in Raman fiber amplifier accounting quantum fluctuations of pump and Stockes fields. Methods of transport equations for complex amplitudes of the fields and "backward" propagation for solution of equations for operators described quantum fluctuations. It was shown there exists optimal fiber length which corresponds to minimal fluctuations of the Stockes pulse.

ThR8-p05

Quantum fluctuations of a soliton pair produced via two-soliton fission in dispersion oscillations fibers

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Quantum fluctuations of soliton pulses produced via two-soliton fission in the optical dispersion oscillating fiber were investigated using perturbation analysis and backward propagation method. It was shown that in the fiber with periodic dispersion two-soliton pulses decay to two entangled pulses. These pulses can be used as the temporal slots for the transmission of information in telecommunications using quantum protocols.

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ThR8-p06

Highly nonlinear tellurite glasses for mid-IR applications

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Tellurium dioxide based glasses with a low hydroxyl groups concentration were synthesized in an atmosphere of dried oxygen from initial high purity oxides. Large high-quality optical elements were manufactured and investigated from the point of view of nonlinear propagation of ultrashot pulses in the mid-IR range. Optical homogeneity, thermophysical, optical, including nonlinear properties were studied.

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ThR8-p07

Statistical occurrence of soliton content in the conventional optical WDM signals

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Random process corresponding to the information content of conventional optical WDM signal statistically creates conditions leading to soliton occurrence. We quantify statistics of soliton component occurrence in standard telecom signals considering return-to-zero pulse carrying multiple WDM channels with QPSK, 16-, 64- and 1024-QAM modulation.

ThR8-p08

New Effects in Picosecond Stimulated Raman Scattering Near the Liquid-Air Interface

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We report the effect of new Raman laser discovered at picosecond laser pumping due to crucial reduction of Raman threshold on the interface of liquid-air in comparison with the bulk liquid. For the first time, the new spectral component near 3000 cm-1 was observed at the water-air interface as a parametric ring around the axial beam component at 3400 cm-1.

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ThR8-p09

Statistics of pulse energy fluctuations in a Raman laser with a multimode pump source

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The 1st Stokes pulse energy fluctuations of a solid-state Raman laser was found to describe by essentially non-Gaussian statistics if the length of its cavity is matched with that of a nanosecond multimode pump laser. The observed statistical data are discussed within the framework of developed numerical model.

ThR8-p10

Properites of parametric generation pumping by Nd:YAG laser with SMAOM

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The paper presents the results of parametric generation in synchronously pumped singly-resonant OPO and in superluminescent regime pumped by Nd:YAG laser with simultaneous mode locking and Q-switching (SMAOM method). The results of studies of the output characteristics of such parametric generators are presented.

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ThR8-p11

Application of frequency shifting for stabilization of passive harmonic mode-locking in fiber ring laser

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We propose the model of harmonically mode-locked soliton fiber ring laser based on the nonlinear polarization rotation taking into account the gain depletion and recovery effects. To suppress time jitter and stabilize harmonic mode-locking operation a method using a small frequency shift followed by the laser radiation filtering is described.

ThR8-p12

Generation dual-wavelength pulses in a double-clad Er/Yb fiber laser

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Dual-wavelength noise-like pulses were generated in a double-clad Er/Yb fiber laser with passive mode locking based on nonlinear polarization rotation (NPR). Their spectral and temporal characteristics are also investigated.

ThR8-p13

Exploiting hysteresis effect for electronic adjusting of fiber mode-locked laser

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Here we investigate a hysteresis-based approach to adjust duration of the pulses generated inside modified eight-figure fiber cavity. Hysteresis phenomena appears while setting pumping powers of two amplifying fibers at both loops of the laser cavity. Exploiting hysteresis effect, we diminish a pulse duration from 81 ps to 49 ps and study temporal stability of the pulse trains.

ThR8-p14

Capability of frequency conversion in BGGS and BGGSe crystals

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Numerical analysis of function capabilities for nonlinear optical frequency conversion (harmonic generation, sum- and difference-frequency generation, parametric oscillation and amplification) in new nonlinear crystals BaGa2GeS6 and BaGa2GeSe6 in their transparency range was performed. The most efficient frequency mixing schemes were defined.

ThR8-p15

Comparison of mid-IR nonlinear crystals with integral figure of merit

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Here, we estimate the conversion efficiency of a set of mid-IR crystals using a simple integral criterion that was verified on experimental data and gave good agreement. We considered FOM for two general cases: broadband and narrowband frequency conversion.

ThR8-p16

Advanced Single-Sideband Light Intensity Modulation Formats

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We present a family of new single-sideband modulation formats of a dual-electrode Mach-Zehnder modulator for generating of optical signals that are resistant to dispersion-induced power degradation

ThR8-p17

Optimization of angular distributions of terahertz waves generated in laser-driven nonlinear-optical processes

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Angular distributions are studied for terahertz waves generated via parametric difference-frequency generation, optical rectification of femtosecond laser pulses, and generation of optical-terahertz biphotons by spontaneous parametric down-conversion. The results obtained make it possible to determine the form of angular distributions inside the crystal, and after passing through a silicon interface element mounted on the side surface of the crystal.

This research was supported by RFBR Grant(s) # 19-02-00598, 20-02-00621

ThR8-p18

Effective coherent anti-Stokes components generation using biharmonic pumping in the gigahertz range

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A scheme for the efficient generation of anti-Stokes components of stimulated low-frequency Raman scattering using biharmonic pumping is proposed and implemented. Suspensions of submicron particles of various nature were used as the active medium. The calculation of the values of the natural acoustic frequencies of submicron particles using the Lamb theory showed good agreement between the calculated and experimental values.

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ThR8-p19

Temperature dependence of optical phonons in Guanylurea Hydrogen Phosphite Crystal in the terahertz frequency range

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The monoclinic organic crystal of guanylurea hydrogen phosphite (GUHP) was considered. The absorption and refractive properties of an optically negative biaxial crystal were investigated. The terahertz time-domain spectroscopy under cryogenic conditions was carried out for observation of the temperature dependence of the phonon structure of GUHP crystal.

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ThR8-p20

Laser action at negative population inversion

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We propose a new type of pulse laser operating at always negative values of population inversion. Such laser action is achieved by periodic variation of pump power. Our study is based on both analytical analysis and numerical simulation of Maxwell-Bloch equations for single-mode laser.

ThR8-p21

Laser cleaning of the archaeological copper alloy objects

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The pulsed laser cleaning with surface control of archeological objects was performed. The surface control is based on optical microscopy, Raman spectroscopy, Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM-EDX) and X-ray diffraction. For laser cleaning experimental conditions were identified, needed for successful layer-by-layer contamination cleaning and for preservation from making damage to objects.

ThR8-p22

Rogue waves in laser with positive optoelectronic feedback

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We study a theoretical model describing a laser with a positive optoelectronic feedback. Strong time-delayed positive optoelectronic feedback driving losses of the laser leads to rare pulses with extremely large amplitude, called rogue waves.

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ThR8-p23

Investigate of hybrid mode-locked in a long-cavity ytterbium-doped fiber laser

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Long-cavity ytterbium-doped fiber laser operating in the hybrid mode-locked regime was demonstrated. Self-starting and self-similarity of the laser output were achieved. Experiments were performed from the amplifying and frequency doubling of hybrid mode-locked laser radiation.

This research was supported by RFBR Grant(s) # 19-32-90205

ThR8-p24

Laser-induced damage threshold of dark yellow phase BaGa4Se7 crystal at 1053 nm

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Laser induced damage in dark yellow phase of BaGa4Se7 (BGSe) crystal has been investigated at the wavelengths of 1053 nm. Damage by multiple pulse irradiation (500 pulses) has been studied and the probabilistic behavior of the damage is discussed

This research was supported by RFBR Grant(s) # 19-32-60055, 18-32-00105

ThR8-p25

A fully-integrated broadband 150 GHz soliton microcomb using SiN microresonator

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We developed a method to generate broadband soliton microcombs using ordinary multifrequency laser diode and high-Q SiN microresonator. This approach provides an opportunity for generating of low-noise frequency combs with the spectrum width around 135 nm due to self-injection locking regime. This technique, compatible with semiconductor laser diode technology, achieves a route towards scalable manufacturing of microcombs for high-volume applications.

ThR8-p26

Nonlinear pulse combining and compression using twisted hexagonal multi-core fibers

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We demonstrate numerically and analytically that the twisting of the 7-core hexagonal fiber leads to an increase in the efficiency of pulse combining and to reducing the distance along the fiber to the combining point.

ThR8-p27

Surface plasmon polariton generation in graphene on semiconductor film structure

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The possibility of surface plasmon polaritons generation in ‘graphene on semiconductor film’ structure is shown. The amplification is created by drift current in the graphene. Positive feedback is realized due to reflections from the edges of the active waveguide, one of which is made in the form of a rectangular groove on the film surface.

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ThR8-p28

Mode converter based on tapered insertion of special fiber

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We propose to use a short fiber insertion of a special fiber between standard fibers as a mode converter, which is controlled by tapering the insertion. We have simulated and measured transmission of modes through such a fiber section. Tapering allows one to precisely control the length of fiber insertion and adds flexibility in obtaining spectra desirable for sensing applications.

ThR8-p29

Modulation Instability of Surface Plasmon Polaritons in Semiconductor Film

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The effect of the modulation instability of surface plasmon polaritons in semiconductor film with current pumping is demonstrated. It is shown that the modulation instability effect could be used for the generation of SPP pulses with a repetition rate in the gigahertz range.

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ThR8-p30

Self-mixing effects in a modulated VCSEL in the bistability domain induced by optical feedback

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The effect of isotropic optical feedback (IOF) on the polarization dynamics of a single-mode VCSEL is experimentally investigated. For the moderate pump current weak IOF results in the appearance of bistability in which due to self-mixing effects the periodic current modulation induces polarization switchings in each half-period of the modulation which frequency depends on the amplitude and the signal shape.

ThR8-p31

Periodically-polled KTiOAsO4 structures for optical parametric oscillator pumped by 1053 nm DPSS nanosecond laser

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Periodically polled KTiOAsO4 (PPKTA) structures were manufactured and PPKTA-optical parametric oscillator pumped by 1053 nm DPSS laser was demonstrated

ThR8-p32

Thermo-optical properties of potassium titanyl phosphate in terahertz radiation

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In this work we study potassium titanyl phosphate crystals with different conductivity at temperatures from -180°C to 150°C in the terahertz range. The refractive indices for the three optical axes are determined and approximated by the Sellmeier equation. The observed properties are characterized by several absorption lines lying along different optical axes which represent the relevant potassium sublattice phonon modes.

ThR8-p33

The influence of the pre-plasma effect on the enhancement of the THz waves generation during liquid jets double pulse excitation with various laser pulse parameters

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A difference in the dependences of the THz radiation energy on the pump pulse duration in cases of single-pulse and double-pulse excitation of various liquids is revealed experimentally and justified by the numerical simulation. The possibility of reaching optical-to-terahertz conversion efficiency up to 0.1% is demonstrated under optimal conditions.

ThR8-p34

Stimulated Raman scattering spectrum narrowing under picosecond pulse train pumping

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A multiple narrowing of the stimulated Raman scattering (SRS) spectrum in water has been observed (350-400 cm-1 to 100 cm-1) when pumped by 64-ps laser pulses train (λ=540 nm). Additionally, laser pulses temporal broadening has been detected when exciting SRS in water. Duration of the Stokes component pulses in the incident direction has been measured and amounted to ~77 ps.

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ThR8-p35

Filament plasma length and angular THz radiation pattern

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Experimentally measured angular THz radiation pattern emitted from filament plasma at the same focal condition is shown to be independent from the plasma channel length

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ThR8-p36

Laser system for compact quantum frequency standards based on pulsed optical pumping

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We present a laser system for a compact rubidium quantum frequency based on pulsed optical pumping technique. Different schemes for locking the DBR diode laser to one of the 87Rb D2-line sub-Doppler resonances are considered.

ThR8-p37

49-fold self-phase modulation induced spectrum compression of picosecond pulses in dispersion-shifted telecom fiber

A.A. Krylov, A.K. Senatorov, Yu.P. Yatsenko; Fiber Optics Research Center RAS, Russia

By fiber length and peak power optimization, we achieved record 49-fold self-phase modulation induced spectrum compression of 38 ps, 2.1 nJ negatively chirped Gaussian pulses with compressed spectrum width of 0.23 nm and ≈50% energy confinement at 1560 nm wavelength, leading to ≈13-times spectral brightness magnification.

ThR8-p38

Applicability of the rotating wave approximation to a multilevel atomic system driven by a polychromatic field

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We study the distortions in the dispersion and absorption spectra that arise when rotating wave approximation (RWA) is applied to multilevel atomic system driven by a polychromatic field. The density matrix equations are solved numerically without applying the RWA and when using it. The obtained polarization spectra we compare with each other in terms of maximum and frequency-averaged deviations.

ThR8-p39

Designing of a fiber mode-locked laser cavity by stochastic optimizationalgorithm

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We demonstrate the results of numerical design of a modified fiber 8-figure laser cavity based on particle swarm algorithm. To show - potential of the method we test it to find architectures of laser cavity generating pulses with desired time duration and spectral width in the range of 5 - 100 ps and 0.2 – 20 nm.

ThR8-p40

Spectral enhancement of ps pulses in phosphor-silicate Raman oscillator

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The paper demonstrates spectral enhancement of Raman pulses converted from 50-ps pulses from a semiconductor laser. Reliable and precise tuning of the repetition rate of the laser pulse train provided by external triggering of a semiconductor source allowed tuning the optical spectrum of Raman pulses in a wide range of 1207–1276 nm. Raman pulse average power was 350 mW.

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ThR8-p41

Mapping of the pulse states of a fiber laser with ionic liquid gated carbon nanotube saturable absorber

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This work investigates a space of pulse states reachable by electronic control of ionic liquid gated carbon nanotube absorber (ILGNA) implemented inside fiber modelocked laser. Adjustment of a voltage applied on ILGNA and a current of a pumping diode provides a convenient way to switch between Q-switch, Mode-locking and Q-switch mode-locking regimes.

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ThR8-p42

Quantum fluctuations and synchronization of a laser soliton with external radiation

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The effect of pump noise of a laser with saturable absorption on stability of a laser soliton is considered. It is shown that absorber does not lead to a loss of the possibility of quantum squeezing of quadrature components. Holding radiation makes it possible to measure the field quadratures under conditions of the external beam synchronization with the laser soliton.

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ThR8-p43

Z-scan measurements of the multiphoton absorption coefficient and nonlinear refractive index of ZnTe and GaP in the near-IR

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Wavelength dependencies of the multiphoton absorption coefficient and nonlinear refractive index of undoped ZnTe and GaP crystals in the range 800-2200 nm have been measured by means of the Z-scan technique employing 50 fs laser pulses. Anisotropy of the nonlinear refractive index was observed and theoretically explained in terms of the crystal symmetry.

ThR8-p44

Optical second harmonic generation by nonlinear mixing of femtosecond laser radiation and terahertz field in gases

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The second harmonic generationof the 800 nm femtosecond laser radiation in ambient air and helium in the presence of picosecond terahertz radiation has been investigated both theoretically and experimentally. The second harmonic energy was measured as a function of the time delay between the optical and terahertz pulses for different interaction distances. The results are explained theoretically.

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ThR8-p45

Optical harmonic generation in the vicinity of molecular resonances by mid-IR laser field

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We present a novel approach for tailoring nonlinear response by mixing gases with resonant media. Efficiency of 1% for third harmonic and 0.3% for higher ones (from 5th to 11th) is achieved in Xe-CO2 mixture pumped by resonant femtosecond 4.4 μm pulses. Theoretical calculations predict opportunities for simultaneous phase matching of large number XUV harmonics (up to 1001st order).

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ThR8-p46

Self-reconstruction of femtosecond laser filament after free propagation in linear medium

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In the present work we investigated experimentally and numerically the formation and self-reconstruction of single-cycle light bullet (LB) in process of Near-IR and Mid-IR femtosecond filamentation. We showed that single-cycle Mid-IR LBs are extremely robust formations and are capable to the complete spatiotemporal self-reconstruction in nonlinear dispersive media after propagation through an air gap up to 1000 μm in free-space.

ThR8-p47

Lidar infrared remote monitoring of atmosphere anthropogenic pollution

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We present an instrument concept for lidar monitoring of industrial atmospheric pollution, based on the commonly used technique for tunable diode laser spectroscopy (TDLS), termed wavelength modulation spectroscopy (WMS). This instrument is being developed to determine the presence of technogenic pollution of atmospheric air in concentrations that pose a danger to nature, as well as human life and health.

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ThR8-p48

Chirp measurement with FM discriminator

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We report an enhanced method to measure chirp of periodic optical signal. We use optical filters, fast photodetector and sampling oscilloscope for this purpose. A comparison with other commonly used techniques of chirp characterization showed a good agreement.

ThR8-p49

Investigation of Terahertz waves generation and propagation in liquid nitrogen

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We present a complex study of terahertz generation in liquid nitrogen (LN) excited with high power femtosecond laser pulses and its interaction with light pulses under joint propagation in LN. Presented results of experimental research are supported by careful theoretical examination.

ThR8-p50

Classical and nonclassical properties of optical solitons propagating in tellurite fibers

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We study classical and nonclassical properties of optical solitons propagating in tellurite suspended-core fibers. It is shown that for those fibers anomalous dispersion and nonlinear Kerr coefficients can be orders of magnitude larger than the for standard silica fibers. Using ~100-fs pulses can lead to soliton self-frequency shift, but using pulses with ps durations can lead to observing quantum-squeezing effects.

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ThR8-p51

Formation of sustainable multi-bound solitons in an all-fiber Erbium-doped laser with a highly-nonlinear cavity

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We have studied the multi-bound soliton generation with 20 bound dechirped pulses with a duration of ~ 240 fs at a repetition rate of ~ 11.3 MHz (with an SNR of ~ 73.3 dB), the RIN is <-140 dBc/Hz, and the Allan deviation of the repetition frequency does not exceed ~1.3•10-8 with a time-averaging window of ~ 100 s.

This research was supported by RFBR Grant(s) # 18-32-20017

ThR8-p52

Avalanche-like up-conversion at nonlinear coupling of pumping channels: effect of ions concentration

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In this report we demonstrate that the main feature of this avalanche-like effect, namely, the nonlinear dependence of up-conversion intensity on the pump power level, persists also at much higher concentrations.

ThR8-p53

Soliton collision and reshaping of eigenvalue spectrum using local perturbation

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We study collision of soliton pair in model of nonlinear Schrödinger equation. The soliton collision is disturbed by the local perturbation of the fiber dispersion. The analysis of the eigenvalues of Zakharov–Shabat spectral problem is given. Peculiar features include soliton fusion into a breather and conversion of solitons at rest into a pair with outward velocities.

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ThR8-p54

Generation of high-power THz pulses in ZnGeP2 under near-IR pump

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THz wave generation is investigated in nonlinear ZnGeP2 crystals under the fs pulse pump at 800 nm and 950 nm. Transmission and absorption spectra are investigated for the samples under the study. Dispersion of the ZGP in the THz range were measured and approximated in the form of Sellmeier equations. PM conditions were calculated. Experiment are good correlated with estimates.

ThR8-p55

Laser-induced damage threshold of Barium chalcogenides crystals at 2091 nm

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Examination of the laser-induced damage threshold of the BaGa4Se7 and BaGa2GeSe6 nonlinear-optical crystals was made by the R-on-1 procedure. A Ho:YAG laser radiation at 2091 nm with pulse duration 13-17 ns and varied pulse repetition rate, 2 kHz, 5 kHz and 10 kHz, was used for testing.

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ThR8-p56

Thermal shift of resonant frequencies in silica and tellurite microspheres: modeling and experiment

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We studied theoretically and experimentally thermal frequency shifts of whispering gallery modes in silica and tellurite microresonators. Temperature distributions and corresponding shifts were calculated. The shift obtained in a silica microsphere generating optical frequency comb (width>300 nm) and independent estimates showed that thermal and Kerr effects contributed comparable. For a tellurite microsphere without comb generation, the thermal effect dominated.

This research was supported by RFBR Grant(s) # 20-03-00874

ThR8-p57

A new scheme of THz generation by tilted-pulse-front pumping of a LiNbO3 plane-parallel plate

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A new type of optical-to-terahertz converter, which is based on tilted-pulse-front pumping of a LiNbO3 plane-parallel plate clamped between two dielectric prisms, has been proposed and investigated both theoretically and experimentally. The new scheme can be advantageous for improving the quality of the generated terahertz beam.

ThR8-p58

Terahertz radiation emission as a result of femtosecond laser beam interaction with liquid metal droplets

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Terahertz radiation emission from the photoexcited metallic microdroplets was observed for the first time. We found two separated in time femtosecond pulses excitation scheme to be efficient for such targets, while signal at one-pulse excitation was negligible. Spectral and polarization properties of the emitted terahertz radiation and its dependence on delay between pulses were measured.

ThR8-p59

A fiber bundle fabrication from crystals of the AgBr - TlBr0.46I0.54 system for laser technology

A. A. Yuzhakova, D.D. Salimgareev, L.V. Zhukova, A.E. Lvov, A.S. Korsakov; Ural Federal Univ., Russia

The article is devoted to the manufacture of fiber bundle for the mid-infrared range by extrusion from crystals of the AgBr - TlBr0.46I0.54 system. The fabricated bundle have improved spectral transmittance, optical loss, and spatial resolution characteristics - the main fiber bundle performance indicators.

This research was supported by RFBR Grant(s) # 18-73-10063

ThR8-p60

Photonic crystal fiber modeling with different inserts rings based on crystal system AgBr-TlI

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In this work, were studied photonic crystal fibers for the mid-infrared range based on the AgBr-TlI crystal system with one, two, and three insert rings. It would be found that with an increase of the inserts number, an intensity rise and the effective area reduction of the mode field are observed.

ThR8-p61

Evolution of intensive light pulses in a nonlinear medium with the Raman effect

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We study the evolution of intensive light pulses in nonlinear single-mode fibers. The dynamics of light in such fibers is described by the nonlinear Schrodinger equation with the Raman term, due to stimulated Raman self-scattering. It is shown that dispersive shock waves are formed during the evolution of sufficiently intensive pulses.

ThR8-p62

Two-photon absorption in Na2W2O7 crystal

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Two-photon absorption in disodium ditungstate crystal under irradiation with picoseconds laser pulses with the wavelength of 523.5 nm is investigated. Due to high value of the two-photon absorption coefficient this process should be considered in Raman laser design for the visible spectral region.

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ThR8-p63

Source of narrowly directed THz radiation for remote sensing systems

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The results of experimental studies on the creation of a powerful source of narrowly directed THz radiation suitable for use in remote sensing systems are presented. A GaSe crystal is used as a radiation source when pumped by pulses of an fs laser with a wavelength of 950 nm.

ThR8-p64

Characterization of silicon whispering gallery mode resonator using self-injection locking regime

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We observed the self-injection locking of DFB diode laser to a whispering gallery mode resonator in mid-IR. Linear theory of the self-injection locking was proved to be sufficient for describing experimental results. We proposed the technique of determination in the self-injection locking regime parameters of the whispering gallery mode resonator that are important and hard to measure in such case.

ThR8-p65

An influence of nonlinear phenomena in the laser plasma upon efficiency of an EUV radiation source for nanolithography

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Laser light absorption in the laser-produced plasma has been found to decrease as the laser beam diameter decreases. The phenomenon is explained with a decrease in the plasma density due to a hydrodynamic expansion. In turn, weakening the absorption worsens performance of an EUV source based on the laser spark.

This research was supported by RFBR Grant(s) # 18-08-00716

ThR8-p66

A D-shaped elliptical hollow core fiber SPR sensor

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A D-shaped elliptical hollow core fiber surface plasmon resonance (SPR) sensor is proposed and analyzed here using gold and titanium oxide layer. It is found that this sensor gives four times better sensitivity than standard single mode fiber SPR sensor.

ThR8-p67

Measurement of temperature gradient in periodically poled Lithium Niobate crystal during second harmonic generation

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Longitudinal temperature gradient of periodically poled lithium niobate crystal in process of second harmonic generation was measured using several transparent tiny piezoelectric crystals as temperature sensors. Temperature of each sensor was measured noncontactly using its temperature dependent piezoelectric resonance frequencies.

ThR8-p68

Transient stimulated Raman amplification of IR supercontinuum wing in KGW crystal

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Stimulated Raman amplification of IR supercontinuum wing in KGd(WO4)2 (KGW) crystal is studied under 1.2 ps pump pulse transient excitation conditions. Several Raman active lines of KGW crystal were involved in the formation of the overall amplification bandwidth of up to 25 nm what is 15 times larger than the pumping pulse spectral band.

ThR8-p69

Fiber Bragg grating fabrication by femtosecond laser pulses

A.S. Chernikov, R.V. Chkalov, D.G. Vasilchenkova; Vladimir State Univ., Russia

We report on the fabrication of second, third and fourth order fiber Bragg gratings (FBGs) in standard single mode fiber through the polymer coating using point-by-point and line-by-line writing techniques by femtosecond laser pulses. The spectral characteristics of FBGs were explored by changing period of grating, grating length and pulse energy.

ThR8-p70

Plasmonic hook: a new curved surface wave generated by dielectric Janus particle

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In this report, we introduce a new class of flat dielectric graded index Janus particle for generation of curved surface plasmon wave - the plasmonic hook.

This research was supported by RFBR Grant(s) # 20-57-S52001

TuR9-p01

Aluminum dioxide monolayer films with low absorption and defect density

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A series of aluminum dioxide monolayer films are deposited by reactive electron-beam evaporation with varying deposition rates and oxygen partial pressures, and the conventional evaporated alumina monolayer is used as a comparison.The film using the reactive evaporate technique can have a lower 355nm weak absorptive coefficient (1/8) and a lower surface defect density of around 1/3.

TuR9-p02

Carbon luminescence structure catalysts for organic dyes degradation

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Carbon luminescence structures (CLS) can be synthesized by the hydrothermal method from organic materials and used as a catalisator for pollutant degradation under sunlight irradiation. The organic dye was used as a model compound. The catalytic activity of CLSs was studied. Dye degradation was achieved for 120 min. Cost-effective and bio-compatible CLSs are promising catalytic agents for environment protection.

TuR9-p03

Chiral surface nanostructures produced by direct laser ablation with specially designed laser beams

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We demonstrated the possibility to produce chiral surface relief via direct pulsed laser ablation of various targets (including bulk silicon and thin films of plasmon-active materials) by “structured” laser beams with specially designed intensity profiles. Our findings open a pathway towards easy-to-implement inexpensive fabrication of chiral all-plasmonic and dielectric nanostructures for advanced nanophotonic applications.

TuR9-p04

Synthesis of Au-decorated TiO2 nanospheres by nanosecond laser ablation in liquid media

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We demonstrated formation of spherical-shaped titania (TiO2) nanoparticles decorated with Au nanoclusters via visible-light nanosecond-pulse irradiation of commercially available TiO2 nanopowders dispersed in an aqueous solution of chloroauric acid. Generation of such hybrid nanostructures was found to be caused by laser-induced remelting of TiO2 nanoparticles stimulated by adsorbed Au nanoclusters, that enhances absorption of visible laser radiation by titania.

TuR9-p05

Chromium-doped borate glass-ceramics: Luminescent properties and concentration effects

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Mixed-alkali-alumina-borate glasses doped with Cr2O3 are prepared by conventional melt-quenching technique. Luminescent glass-ceramics is derived by volume crystallization of the precursor glass via two-stage heat treatment providing the nucleation of LiAl7B4O17: Cr3+ nanocrystals. The photoluminescence spectra consist of three intense bands in the 685 – 715 nm region. The maximum quantum yield value under 532 nm excitation is 41%.

TuR9-p06

Crystallization and spectroscopy of transparent glass-ceramics with Tm:YNbO4 nanocrystals

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Transparent lithium aluminosilicate glass-ceramics containing nanosized (8-15 nm) crystals of tetragonal and monoclinic rare-earth orthoniobates, Tm:YNbO4, and β-quartz solid solutions are developed. Their spectroscopic properties in regard to the phase transformations are studied.

This research was supported by RFBR Grant(s) # 19-03-00855

TuR9-p07

Diamond-NaGdF4: Eu and Diamond-YAG: Ce composites as photo- and X-Ray luminescent materials for photonics

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The Diamond-NaGdF4: Eu and Diamond-YAG: Ce film composites were produced by chemical vapor deposition to be used as a source of intensive photo- and X-ray luminescence for radiation monitoring screens.

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TuR9-p08

Down-conversion luminescence studies of CaF2, SrF2, Ba4Y3F17, GdF3, YF3, NaYF4 doped Yb or Pr/Ce/Eu ions for photonics

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We determined compositions with high down-conversion characteristics from UV and blue spectral range to Yb luminescence based on luminescence studies, which are promising for efficiency increasing of silicon solar cells.

TuR9-p09

Full description of the YSAG: Yb optical ceramics production, namely, compositions, powder morphology, and pressing conditions.

S.V. Kuznetsov[1], F.F. Malyavin[2], M.S. Nikova[2], A.A. Kravtsov[2], I.S. Chikulina[2], D.S Vakalov[2], V.A. Tarala[2]; [1]Prokhorov General Physics Inst. RAS, [2]North Caucasus Federal Univ., Russia

High-transparent YSAG: Yb ceramics with 80% transmittance was developed. The compositions, powder morphology, and pressing conditions compositions for reproducible production are determined.

TuR9-p10

Donor centres involved into downconversion in Yb-doped molybdate and tungstate single crystals

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Different versions of quantum cutting mechanisms in Yb doped Scheelite-like molybdate and tungstate single crystals were studied, with participation of various schemes of donor-acceptor interaction (various kinds of donor centres: self-trapped excitons at molybdate/tungstate complexes; high-lying excited states of Yb3+ ion; Yb2+ ion; traps based on cation and oxygen vacancies; accidental impurities.). The most part of the versions were rejected.

TuR9-p11

Down-conversion luminescence and photodynamic processes in Ba4Y3F17: Ce: Yb and YF3: Ce: Yb luminophores

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The down-conversion luminescence of Yb3+ in YF3 and Ba4Y3F17 doped with Ce/Yb pair appears to be efficient and is ruled by photodynamic processes of excited state absorption, formation and destruction of color centers and charge transfer.

TuR9-p12

Dramathical change relaxation pathway in Eu(III) complex with highly fluorinated ligand carbon chain revealed by an ultrafast laser absorption spectroscopy driven by minor structure variations

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We investigate four Eu3+ coordination compounds with ligand environment including β–diketones with fluorinated chains containing different number of fluorine atoms. Based on ultrafast transient absorption measurements, we first demonstrate that extended fluorinated chains activate new energy transfer pathways involving higher excited triplet level. We develop a consistent model describing excitation energy transfer and relaxation pathways for β–diketonate complexes

TuR9-p13

Hybrid organic–inorganic nanoscale films based on tris-(8-hydroxyquinoline)gallium

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New hybrid thin-film structures were obtained on the basis of organic phosphor and inorganic compounds. The exchange reaction between the components was initiated by laser radiation, causing the changes of optical properties.

TuR9-p14

Effect of CeO2 on bismuth active centers in Bi2O3-GeO2 glasses

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Bismuth-germanium oxide glasses with the addition of cerium oxide were synthesized and their spectral characteristics were studied. It was shown that the ceria addition leads to decreasing the number of bismuth active centers due to the ceria oxidative effect. The degree of exposure to ceria depends both on its concentration and on the content of bismuth oxide in the glass.

TuR9-p15

Effect of extra laser irradiation on the photocatalytic properties of TiO2 obtained by pulsed laser ablation

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In this work we study the effect of extra laser irradiation during the preparation by pulsed laser ablation in water on the structure and physicochemical properties of titanium dioxide. Extra laser irradiation leads to a decrease in particle size, a change in structure, and as a result, a change in optical and photocatalytic properties.

TuR9-p16

Efficient approaches for separation and purification of luminescent carbon nanostructures

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Luminescent carbon nanostructures have received an increasing attention due to the possibility of modification, low toxicity, turntable luminescent properties. One of the popular challenges is an obtainment of a mixture of products with different properties. This is complicated the applying these structures in highly sensitive analytical methods. In this work, we proposed methods of carbon nanostructures separation and purification.

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TuR9-p17

Extruded crystalline single mode fibers with optical losses lower than 1dB/m for CO2 lasers

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Low optical loss extruded nano-structured all solid metal halides crystalline fibers for 5-15 mkm wavelength region are presented. For the first time single mode crystalline fibers for CO2 laser wavelength 10.6 mkm was obtained with lowest optical losses 0.55 dB/m at 10.6 mkm. The extruded crystalline fibers with step index profile have composition: core –AgCl0.25AgBr0.75 , cladding AgCl0.5AgBr0.5.

TuR9-p18

Factors influencing the length distributions of vapor-liquid-solid nanowires

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In this work, we discuss the main factors influencing the length distributions within the ensembles of nanowires from a general perspective based on nucleation theory.

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TuR9-p19

Stabilization of wurtzite crystal phase in arsenide nanowires via elastic stress

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Arsenides of boron group metals at standard conditions typically have only one stable phase – zinc blende. Despite it GaAs nanowires frequently grow in crystal phase of wurtzite. In this paper we show that elastic stress could be the factor responsible for nanowire growth in the metastable phase.

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TuR9-p20

Few-layer graphene: growth and potential applications in electronics.

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Utilizing vicinal SiC/Si(001) wafers one can synthesize self-aligned graphene nanoribbons that exhibit energy transport gap on the order of 1 eV, large positive in-plane magnetoresistance, and the potential to work as a spin filter, opening opportunities for electronic and spintronic applications.

This work was supported by the RFBR (Grant No. 20-02-00489).

TuR9-p21

Nanocolumn-like 3D photonic crystals of anodic valve metal oxides

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Nowadays anodic oxides of valve metals with a column-like nanostructure: tantalum, niobium, tungsten and zirconium anodic oxides are of great interest. In this work, we will demonstrate the possibilities of the formation of such photonic crystals with high reflectance within photonic band gap via the anodization of bilayer systems of Al/Ta and Al/Nb on silicon and glass substrates.

TuR9-p22

Gaussian beam algorithm for full spheroidal objects

V.I. Bredikhin; Inst. of Applied Physics RAS, Russia

Algorithm for describing focusing properties of transparent sphere using Gaussian beam approximation is presented. Code for calculating spheres from ~ λ to thousands of λ is created. Results are compared with obtained earlier by more sophisticated methods. Computations for spheres having diameters up to hundreds of micrometers in vacuum and in absorbing media are also presented.

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TuR9-p23

Graphene on cubic-SiC(001): synthesis and functionalization

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In the current report, we present research of epitaxial few-layer graphene growth on cubic-SiC(001). Its properties and atomic structure were studied by photoemission spectroscopy, scanning tunneling microscopy, and low-energy electron diffraction. Further employment of the diazonium chemistry allowed carrying out a covalent modification of graphene by an organic dye which has resulted in a considerable change of its electronic structure.

TuR9-p24

Highly transparent crystalline ceramic based on two solid solutions of the AgBr - TlI system

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The work is devoted to obtaining crystalline ceramics highly transparent in the range from 1.0 to 67.0 μm based on two phases of the AgBr - TlI system solid solutions. Material, such as a new crystalline ceramic based on two solid solutions, allows combining several properties, such as effective transparency in a wide infrared range and high resistance.

TuR9-p25

Laser formation of noble metal nanoparticles using alexandrite tunable narrow-band laser

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In this work, a method for the formation of Au, Ag and bimetallic Au-Ag nanoparticles/clusters using laser with tunable wavelength is discussed. Nanoparticles of noble metals were obtained by laser ablation targets of gold and silver in liquid and the size control results in the determination of optical properties of such nanostructures

TuR9-p26

Luminescence thermometry based on YF3:Nd3+,Yb3+ crystalline microparticles

M.S.Pudovkin, A.K. Ginkel, E.V. Lukinova, V.V. Semashko; Kazan (Volga region) Federal Univ., Russia

The YF3:Nd3+ (CNd = 0.5 mol. %), Yb3+ (CYb = 0, 2, 4, 8 mol.%) crystalline microparticles are orthorhombic microcrystals. In the experiments, it was shown that the shape of the luminescence spectra significantly depends on temperature. The maximum absolute temperature sensitivity was 0.08 K-1 at 100 K.

TuR9-p27

Luminescent glass with lead perovskite quantum dots for solar concentrators

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The results of synthesis and investigation of spectral properties of luminescent borogermanate glass with cesium lead halide perovskite quantum dots are presented. Changing the glass composition and heat treatment conditions one can observe a tunable luminescence of cesium lead halide nanocrystals in the entire visible spectrum range.

TuR9-p28

Luminescent hybrid materials based on metal-organic phosphors in oxyfluorid glasses or oxides and fluorides polycrystals

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Hybrid organo-inorganic materials based stable phosphors — 8-hydroxyquinolates and diketonates of metals by glass-melt technique, solid-phase synthesis and co-precipitation with different fluorinating agent were synthesized. The photoluminescence spectra of the obtained hybrid materials were studied. A comparison was made with the spectral-luminescent properties of hybrid materials obtained by the different methods.

TuR9-p29

Luminescent properties of Eu/Gd-codoped transparent lead fluoroborate glass-ceramics

D.A. Velichkina, K.I. Runina, A.V. Khomyakov, O.B. Petrova; Mendeleev Univ. of Chemical Technology, Russia

Lead fluoroborate glasses co-doped with Eu3+/Gd3+ - have been synthesized. Glass-ceramics have been made by heat-treatment. In a glass-ceramic the rare-earth ions were located in fluoride crystal nanoparticles distributed in a glass. The changes in structural, mechanical, optical and luminescent properties of the glass-ceramics were revealed in comparison with the initial glasses.

TuR9-p30

Structure and luminescent properties of solid solutions in the PbF2–EuF3 and PbF2–ErF3 systems

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The structure and spectral-luminescent properties of solid solutions in the PbF2–EuF3 and PbF2–ErF3 systems obtained by both solid-phase reaction and co-precipitation from solutions are investigated. The boundaries of the existence of a solid solution at a high and low temperature are determined. The differences in the luminescence spectra for solid solutions obtained by different methods are studied.

TuR9-p31

Novel transparent glass-ceramics based on Fe2+:MgAl2O4 spinel nanocrystals

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Transparent glass-ceramics of the magnesium aluminosilicate system based on Fe2+-doped MgAl2O4 spinel nanosized (4-7 nm) crystals are developed. Their structure and spectroscopic properties are studied. The glass-ceramics are promising as gain materials and saturable absorbers in the mid-infrared (2–3 μm).

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TuR9-p32

Optical characterization of Ag nanoparticles and Si nanostructures created by metal-assisted two-stage chemical etching

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The structures obtained by MACE were characterized by spectroscopic ellipsometry. Two approaches were used for ellipsometry data processing: 1 – the pseudodielectric functions were calculated; 2 – the thickness and fraction parameters of layers were calculated in a multilayer model using the Fresnel equations and transfer matrix method. For two-component layers, the models of effective medium of Maxwell-Garnett and Bruggeman.

TuR9-p33

Optical properties of Cu,F-doped TiO2 nanotube array films

A.N. Morozov, A.S. Vasil`ev, Thant Zin Phyo, I.A. Pochitalkina; Mendeleev Univ. of Chemical Technology, Russia

Highly ordered films of copper and fluorine doped TiO2 nanotube arrays (Cu,F-TiO2 NTs) with a high absorption coefficient in UV-visible region were prepared by the anodization of titanium and solvothermal method. It is shown that the absorption intensity Cu,F-TiO2 NTs in the visible range depends on the copper content and does not depend on the fluorine content.

TuR9-p34

Optical surface plasmon for measuring methylmercury in freshwater

A. Perez, E. Solarte, C.A. Galindez; Universidad del Valle, Colombia

we present an optical transducer for methylmercury. The instrument is developed by depositing a gold, or silver, thin film on plastic waveguides. Preparation of nanomaterials by chemical reduction, with its respective characterization, is included for enhancing the optical spectroscopy. Assemble of the transducer, the optical receiver and optical response is here presented.

TuR9-p35

Pulsed laser deposition of non-stoichiometric silicon oxide at various temperatures

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Non-stoichiometric silicon oxide films were synthesized at various temperatures (25-600 ℃) by pulsed laser deposition in vacuum (P = 3 Pa) using the second harmonic of an Nd:YAG laser (pulse duration 8 ns). The composition and morphology were analyzed by FTIR and SEM. A decrease of film thickness and silicon concentration with temperature increase was established.

TuR9-p36

The deposition of silicon nanostructures by pulsed laser ablation of silicon in the active gas phase

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Using the second harmonic of an Nd:YAG laser (pulse duration 8 ns), silicon suboxide films were synthesized at various pressures of an oxygen-argon mixture (10-60 Pa). The composition (FTIR analysis) and morphology (SEM analysis) were analyzed. It was found that the oxidation of ablation products mainly occurs at the stage of expansion of the laser plume.

TuR9-p37

Effective refractive index of 2D porous composites

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The effective refractive index and the static effective electric permittivity of 2D porous silicon and silicon dioxide have been calculated by using the Floquet – Bloch theorem and the asymptotic averaging method, correspondingly, and compared for different values of a/lambda. We have shown that effective refractive index tends to the static effective electric permittivity in the long wavelength limit.

TuR9-p38

Random lasing excitation in fluorescent oxide powders: the role of initiation and suppression effects

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Random lasing in the layers of dye-doped oxide powders is analyzed in terms of critical values of radiation transfer and gain parameters. Random lasing experiments are combined with analysis of the light pathlength statistics in the examined systems using a low-coherence reference-free reflectometry and diffuse transmittance spectroscopy. The critical conditions of lasing excitation are found depending on the system properties.

TuR9-p39

Shaping optical microresonators on the surface of optical fibers with negative effective radius variations

D.V. Krisanov, I.D. Vatnik, D.V. Churkin; Novosibirsk State Univ., Russia

We proposed a new method for adjusting shape of microresonators on the surface of optical fibers to control the axial propagation of whispering gallery modes. The method comprises local heating of the fiber to the temperatures significantly smaller than the transformation temperature, that introduces negative variations of the refractive indexes.

TuR9-p40

Sn-doped Ge2Sb2Te5 thin films for optical waveguide application

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Ge2Sb2Te5 thin films are widely used for rewritable optical(Blu-Ray)/electrical(PCRAM) storages and nanophotonics devices (modulators, O-ring resonators and plasmonic structures), which applicate to construct all-nanophotonic integrated circuits. We study the effect of tin ion implantation on the structural and optical properties of amorphous Ge2Sb2Te5 thin films, as well as the performance of Si3N4-Mach-Zehnder Interferometer based on them.

TuR9-p41

Substrates for metal-enhanced chemiluminescence (MEC) improved via laser treatment

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Optical properties of silver nanoparticles obtained via physical vapor deposition on transparent dielectric substrates have been simulated numerically and investigated experimentally. Additional laser treatment of MEC substrate was employed to improve chemical and mechanical stability of the films and made them suitable for chemiluminescence experiments.

TuR9-p42

Synthesis and characterization of CuInS2 nanoparticles

E.A. Kozlova[1], V.I. Kochubey[1,2]; [1]Saratov State Univ., [2]Tomsk State Univ., Russia

CuInS2 nanoparticles were synthesized and coated with ZnS. The absorption luminescence spectra of nanoparticles were obtained, as well as the dependences of the luminescence spectra on temperature, the In / Cu ratio, and particle coating. The obtained nanoparticles can be used as temperature sensors for deep incorporation into biological tissue.

TuR9-p43

Zn-ZnO core-shell nanoparticles: numerical simulations and experimental realization

D.R. Dadadganov, M.G. Gushchin, I.A. Gladskikh, N.B. Leonov, T.A. Vartanyan; ITMO Univ., Russia

Zinc nanoparticles ensembles on quartz supports have been fabricated via laser ablation andphysical vapor deposition. A red shift of the plasmon bands relative to the computed values for the isolated semispherical nanoparticles has been observed. After annealing in air zinc nanoparticles turn into zinc oxide nanoparticles suitable for investigation of their luminescent and sensor properties.

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TuR9-p44

Temperature kinetics of asymmetric nanostars under pulsed laser irradiation

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This article reports on the results of modeling the kinetics of heating of plasmon resonant gold nanostars upon their pulsed laser irradiation. The possibilities of increasing the predictability of laser local hyperthermia of biological tissues and optoporation / transfection of cells due to the temperature field photoinduced by gold nanostars are discussed.

TuR9-p45

The approaches to the synthesis of promise up- and down-conversion luminescence materials

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Modern flexible and technological methods for synthesis of promise luminescent materials in the form of nano- and ultrafine powders, ceramics, and glass-ceramics with effective up-and-down conversion luminescence are proposed. The use of compounds of various compositions and combinations of activator ions in them ensures the effective conversion of IR and UV radiation into the visible region of the spectrum.

TuR9-p46

The impact of laser radiation with a wavelength of 1.07 μm on pressed powder media of transparent oxides

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It is shown that the propagation of radiation in a powder medium with an intensity lower than the destruction threshold, the formation of laser plume can be due to scattering of radiation. As a result, in some local areas, the intensity is ten times higher than the intensity of the incident radiation, ensuring the development of optical breakdown.

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TuR9-p47

Tunable photoluminescence of silver molecular clusters in silicate glass for spectral converters and solid state lighting applications

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Influence of sodium-silver ion exchange and subsequent heat treatment durations on photoluminescent properties of silver molecular clusters formed in silicate glass matrix was studied. These parameters allow tuning emission color of the clusters in a wide range. The latter pays the wave for developing solid state light-emitting devices and spectral converters with tunable emission spectrum.

TuR9-p48

Tunable polaritons of spiral nanowire metamaterials

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The tunable spiral nanowire metamaterial at THz frequency is presented, and the surface polaritons are theoretically studied. The Ferrell-Berreman modes can be excited that is impossible with the regular nanowire metamaterials having the circular cross-section of the nanowires.

TuR9-p49

Twinning superlattices in doped GaAs nanowires

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A model is presented for the formation of twinning superlattices in Te-doped and Be-doped self-catalyzed vapor-liquid-solid GaAs nanowires. The period of twinning superlattices and its dependence on the distance from droplet are quantified versus the doping level for both types of doping.

This research was supported by RFBR Grant(s) # 18-02-40006, 19-52-53031, 20-02-00351

TuR10-p01

Acetylene cell as an optical descriminator for phase modulated microwave photonic links

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A microwave photonic link that uses phase modulation and frequency discriminator based on fiber-coupled gas cell filled with acetylene is presented. It is shown that such a link can have both wideband and narrowband frequency response dependent on laser wavelength

TuR10-p02

Spectral broadening of femtosecond optical vortices under filamentation in a medium with anomalous group velocity dispersion

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Filamentation of femtosecond optical vortices at central wavelengths of 1800 nm and higher in fused silica and fluorides was experimentally and numerically studied. The features of broadening of frequency and frequency-angular spectra are considered.

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TuR10-p03

Quantum correlations of solitons in nonlinear Kerr waveguide arrays

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Propagation of soliton-like structures along a one-dimensional nonlinear Kerr waveguide array has been studied taking into account quantum effects. Generation of entanglement between waveguides with maximal intensity has been shown for solitons of certain shape.

TuR10-p04

Temperature tests of the optoelectronic part of quantum key distribution system

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Poster will present research results of high and low temperatures effects on some optoelectronic components that are part of a quantum key distribution system. The temperature stabilization systems of interferometers and the influence of external temperature gradients on the stability of the quantum key distribution were also study.

TuR10-p05

Frequency conversion of laser radiation in pure, mixed and activated KTP crystals and their isomorphs

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A pure KTP crystal and its isomorphs currently enjoy a wide use to convert the laser radiation frequency. But of great practical interest are mixed and activated crystals of this family. This paper presents the results of an analysis of frequency conversion capability in some crystals of this family.

TuR10-p06

Frequency noncritical phase matching for nonlinear frequency conversion of laser radiation

S.G. Grechin, D.G. Kochiev; Prokhorov General Physics Inst. RAS, Russia

Frequency conversion of radiation with a large spectral width, including frequency conversion of femto- and attosecond pulses, is an important problem. This type of conversion requires determination of an optimum phase-matching angle to obtain maximum conversion efficiency without distorting the pulse shape. The presented research results are devoted to these issues.

TuR10-p07

Using an extracavity acousto-optic frequency modulator to stabilize the offset frequency of the fiber optical comb generator

N.A. Koliada[1], V.S. Pivtsov[1,2], D.Yu. Primakov[1], S.A. Farnosov[1], A.S. Dychkov[1], S.A. Kuznetsov[1], A.A. Filonov[1]; [1]Inst. of Laser Physics, SB RAS, [2]Novosibirsk State Technical Univ., Russia

A fiber optical frequency comb generator stabilized to an optical frequency standard based on a single ytterbium ion was created. An extracavity acousto-optic frequency modulator (AOFM) was used to stabilize the comb offset frequency. It allowed increasing the bandwidth of the feedback loop that stabilizes the offset frequency to several tens of kilohertz.

TuR10-p08

Applications of upconversion luminescence of fluoride phosphors for lidar measurements

S.V. Gushchin[1], A.A. Lyapin[1], A.S. Ermakov[1], S.V. Kuznetsov[2], P.A. Ryabochkina[1], V.Yu. Proydakova[2], P.P. Fedorov[2]; [1]National Research Ogarev Mordovia State Univ.; [2]Prokhorov General Physics Inst. RAS, Russia

In preset paper, we investigated the upconversion luminescence (UCL) of fluoride phosphors. Fluorite-type SrF2:Er,Tm phosphors were synthesized by co-precipitation from aqueous nitrate solution technique. Upon laser excitation at 1531.8 nm and 1645 nm UCL of SrF2:Er,Tm phosphors in the visible and near-infrared spectral region were recorded. Application of upconversion phosphors for detection of infrared radiation in lidar systems is discussed.

TuR10-p09

Excitation dynamics of an atomic ensemble located in a waveguide

A.S. Kuraptsev, I.M. Sokolov; Peter the Great St. Petersburg Polytechnic Univ., Russia

We study the dynamics of atomic excitation prepared in a dense ensemble located in a waveguide. We have shown that spontaneous decay can be incomplete under the conditions when the atomic transition frequency is larger than the cutoff frequency of a waveguide and far from the vicinities of the cut-offs.

This research was supported by RFBR Grant(s) # 18-32-20022

TuR10-p10

Shot-noise limited balanced detector for mid-infrared quantum light characterization

T. Gabbrielli[1,2], F. Cappelli[1,2], N. Bruno[1, 2], N. Corrias[1, 2], S. Borri[1, 2], P. De Natale[1,2], A. Zavatta[1,2]; [1]Instit. Nazionale di Ottica (CNR-INO), Italy; [2]European Lab. for Non-linear Spectroscopy (LENS), Italy

The development of a novel shot-noise-limited mid-infrared balanced detector is here presented. This detector will be used for unveiling non-classicalities in the light emitted by Quantum Cascade Lasers.

TuR10-p11

Creation of periodical domain structures in MgO:LiNbO3, MgO:LiTaO3 and KTiOAsO4 crystals for laser light frequency conversion

V.Ya. Shur[1], A.R. Akhmatkhanov[1], M.A. Chuvakova[1], A.A. Esin[1], O.L. Antipov[2], A.A. Boyko[3], D.B. Kolker[3], V.V. Dudelev[4] , V.I. Kuchinskii[4], G.S. Sokolovskiy[4]; [1]Ural Federal Univ.; [2]Inst. of Applied Physics RAS; [3]Novosibirsk State Univ., [4]Ioffe Inst., Russia

The recent achievements in periodical poling of lithium niobate, lithium tantalate and potassium titanyl arsenate crystals are presented. Creation of periodical domain structures is based on deep study of the domain structure evolution and domain wall motion in single crystals and thin films. The emerging promising applications of lithium-niobate-on-insulator (LNOI) system for integrated optics and ridge waveguides creation are discussed.

This research was supported by RFBR Grant(s) # 18-29-20077-MK

TuR10-p12

Cluster effects on nonlinearal and linear properties of supercritical fluids

E.I. Mareev[1,2,3], V.A. Aleshkevich[2], F.V. Potemkin[2,3], A.P. Sviridov[1], V.M. Gordienko[2,3]; [1]Inst. of Photonic Technologies, Federal Scientific Research Center "Crystallography and Photonics" RAS, [2]Lomonosov Moscow State Univ., [3]International Laser Center, Lomonosov Moscow State Univ., Russia

We both theoretically (using molecular dynamics) and experientially study of the nonlinear optical properties of supercritical CO2 and Xe. We show the role of clustering on the nonlinear refractive index and Raman spectrum.

This research was supported by RFBR Grant(s) # 19-32-60072, 18-29-06035, 18-29-06056

TuR10-p13

Generation and registration of polarization-entangled photon pairs in the presence of the Migdall effect

D.N. Frolovtsev, S.A. Magnitskiy; Lomonosov Moscow State Univ., Russia

The polarization quantum states produced by the double-crystal scheme in the presence of the Migdall effect are fully characterized experimentally and theoretically. The Migdall effect and its negative action on the entanglement are investigated. The compensation techniques to fully overcome the negative action of the Migdall effect on the entanglement are developed, and 2.7 times entanglement increase is demonstrated

This research was supported by RFBR Grant(s) # 18-02-00849

TuR10-p14

Optical lattice at 1064 nm for thulium optical clock

D.O. Tregubov[1], A.A. Golovizin[1], E.S. Fedorova[1,2], D.A. Mishin[1,2], D.I. Provorchenko[1], K.Y. Khabarova[1,2], V.N. Sorokin[1], N.N. Kolachevsky[1,2]; [1]Lebedev Physical Inst. RAS; [2]Russian Quantum Center, Russia

Our group is developing compact optical clocks based on thulium atoms. 1140 nm clock transition has extremely low sensitivity to blackbody radiation and a magic wavelength near 1064 nm. The research is underway on the possibility of using 1064 nm as an operational wavelength for optical lattice.

TuR10-p15

Beating Heisenberg limitwith moving matter-wave solitons

D.V. Tsarev[1], Ngo-The Vinh[1], Ray-Kuang Lee[2], A. P. Alodjants[1]; [1]ITMO Univ., Russia; [2]National Tsing Hua Univ., Taiwan

The estimation of some parameters beyond Heisenberg limit is one of the principal problems for current quantum metrology. We proved that Bose–Einstein condensate quantum bright solitons allow SH phase estimation even with coherent probes in the framework of a nonlinear metrology approach. We demonstrated that solitons allow to form N00N-state providing minimal propagation error of kinematic and material parameters.

This research was supported by RFBR Grant(s) # 15-52-52012

TuR10-p16

Electrically switchable planar liquid-crystal elements for applications of integrated photonics

O.S. Kabanova, I.I. Rushnova, E.A. Melnikova, A.L. Tolstik; Belarusian State Univ., Belarus

Planar LC-elements for integrated photonics with controlled optical properties are presented. The effect of total internal reflection at the electrically-controlled refractive interface between LC-domains provided space-polarization control of light beams. Waveguide propagation, splitting, and multiplication of optical signals are implemented. The effect of electrically-controlled shift of the refractive interface is proposed for the spatially-angular deviation of the laser beam.

TuR10-p17

Methods of generalized Ramsey spectroscopy in optically dense polyatomic ensembles

K.A. Barantsev[1], T. Zanon-Willette[2], A. N.Litvinov[1]; [1]Peter the Great St. Petersburg Polytechnic Univ., Russia; [2]Sorbonne Univ., France

In this work we investigate the methods of generalized Ramsey spectroscopy for high precision atomic clocks in the optically dense atomic ensembles. The dependence of the position of the central fringe resonance with a residual uncompensated light shift of the atomic transition is studied when taking into account the attenuation of the radiation intensity in the medium.

TuR10-p18

Improving metrological characteristics in quantum frequency standard with laser pumping

A.P. Valov[1], N.A. Lukashev[1], V.V. Davydov[2, 3], V.A. Kruglov[2], V.S. Reznik[2], V.Yu. Rud[3]; [1]The Bonch-Bruevich St. Petersburg State Univ. of Telecommunications, [2]Peter the Great St. Petersburg Polytechnical Univ., [3]All Russian Research Inst. of Phytopathology, Russia

The necessity of using quantum frequency standard with laser pumping in satellite navigation systems is considered. The experimental results of improving the metrological characteristics of the standard using median filtering are presented.

TuR10-p19

Quantum carpets of non-classical light in Kerr media

S.N. Balybin, O.V. Tikhonova

We consider a solid-state resonator made of a material with third-order nonlinearity, and solve the problem of the interaction of a quantum well with non-classical light inside. To demonstrate strongly the self-phase modulation effect the time-dependent distribution of different values of field quadrature are presented for various initial quantum field conditions.

TuR10-p20

Generation of optical harmonics in fiber-coupled semiconducting polythiophene films

A.V. Ivanenko[1], S.I. Trashkeev[1], N.T. Vasenin[1], B.N. Nyushkov[2,3], L.V. Kulik[4], D.A. Nevostruev[4]; [1]Inst. of Laser Physics, SB RAS, [2]Novosibirsk State Univ. [3]Novosibirsk State Technical Univ., [4]Inst. of Chemical Kinetics and Combustion SB RAS, Russia

Optical nonlinearity of semiconducting organic films based on regioregular polythiophene (RR-P3HT) was explored by means of laser frequency conversion in a fiber-coupled experimental setup. Features of harmonic generation in this medium were revealed and compared with other nonlinear media. Possible enhancement of nonlinear susceptibility of RR-P3HT in high-gradient light fields is discussed as well.

This research was supported by RFBR Grant(s) # FSUS-2020-0036, 18-43-540007

TuR10-p21

Direct laser modification of thin Titanium film for fine-tuning of photonic Lithium Niobate circuits

A.V. Tronev[1], M.V. Parfenov[1,2], I.V. Ilichev[1], P.M. Agruzov[1], A.M. Ionov[3], Orlova N.N.[3], S.I.Bozhko[3], A.V. Shamrai[1]; [1]Ioffe Inst.; [2]Peter the Great St. Petersburg Polytechnic Univ.; [3]ISSP RAS, Russia

A method for precise optical loss adjustment by laser modification of a thin titanium film on the surface of lithium niobate optical waveguides was developed. Precise balancing of Mach-Zehnder modulator was demonstrated and an increase of the extinction ratio from 30 to 48 dB was achieved

TuR10-p22

Superconducting single-photon detector on Lithium Niobate waveguides

A.V. Tronev[1], M.V. Parfenov[1,2], I.V. Ilichev[1], P.M. Agruzov[1], A.M.Ionov[3], Klimov A.I.[4], S.I.Bozhko[3], A.V. Shamrai[1]; [1]Ioffe Inst.; [2]Peter the Great St. Petersburg Polytechnic Univ.; [3]ISSP RAS; [4]NRC "Kurchatov Institute", Russia

Superconducting nanowire single-photon detector on the lithium niobate substrate was demonstrated in integrated optical configuration. New waveguides configurations for improvement of quantum efficiency are discussed.

This research was supported by RFBR Grant(s) # 18-07-01174a

TuR10-p23

Y-branching splitter fabricated in LiNbO3 by proton exchange and femtosecond laser writing

S. Kostritskii[1], Yu. Korkishko[1], V. Fedorov[1], N. Skryabin[2]; [1]RPC Optolink Ltd.; [2]Moscow Inst. of Physics and Technology, Russia.

The combined technique of the femtosecond laser writing and proton exchange has been proposed for fabrication of Y-branching power divider with corrected refractive index profile of channel waveguides. Optimal correction parameters and their influence on temperature stability of these devices based on proton-exchanged LiNbO3 channel waveguides are determined.

TuR10-p24

Volume Bragg grating fabrication by femtosecond laser pulses

A.S. Chernikov, R.V. Chkalov, D.G. Vasilchenkova; Vladimir State Univ., Russia

We report on the fabrication of volume Bragg gratings (VBGs) in the bulk of fused silica glass sample. Various VBGs fabrication approaches including Gaussian laser beam approach and Gaussian-Bessel approach considered.

TuR10-p25

Graphene-based all-fiber electro-optical modulator integrated on coreless side-polishd fiber

L. Zhuo, Y. Zhang, D. Li, Z. Che, W. Zhu, H. Zheng, J. Tang, H. Lu, H. Guan, W. Qiu, J. Zhang, Y. Zhong, Y. Luo, J. Yu, Z. Chen; Jinan Univ., China

We demonstrate a graphene-based all-fiber electro-optical modulator integrated on coreless side-polishd fiber. The electro-optical modulator with a modulation efficiency of modulation of 1.13 dB/V at a wavelength of 1540 nm, which is comparable to state-of-the-art modulators based on graphene. There are two effects in this device to achieve electro-optic modulation: LMR (lossy mode resonance) and electrothermo optic effects.

PD: Post-Deadline

11:30 - 13:30
Session Chair: *G.S. Sokolovskii, Ioffe Inst., Russia*

WePD-01 11:30-11:42
Hyperbolic metamaterials enhanced fiber plasmonic sensor
Hu Shiqi, Chen Yu, Liu Guishi, Zhu Wenguo, Zheng Huadan, Chen Yaofei, Xiaoping Zheng, Dong Cao, Luo Yunhan, Chen Zhe; [1]Key Laboratory of Optoelectronic Information and Sensing Technologies of Guangdong Higher Education Institutes, Jinan Univ.,China; [2]Department of Optoelectronic Engineering, Jinan Univ., China; [3]Rocketech Technology Corp. ltd. China; [4]Tsinghua Univ. China
A plasmonic sensor based on a side-polished few-mode-fiber coated with a layered HMM, which is composed of the alternating layers of Ag and TiO2. The dispersion of the HMM is engineering by optimizing the metal filling fraction (ρ) and the number of bilayers (Nbi) , and their effects on the sensor performances are further analyzed.

WePD-02 11:42-11:54
X-ray time-resolved diagnostics of hot electron generation in shock ignition relevant experiments
E.D. Filippov[1,2], A.S. Martynenko[2,3], M. Cervenak[4,5], L. Antonelli[6], F. Baffigi[7], G. Cristoferetti[7], L.A. Gizzi[7], T. Pisarczyk[8], D. Mancelli[9], V. Ospina[10], M. Krus[4,5], R. Dudzak[4,5], S.A. Pikuz[2,3], D. Batani[3,9], O. Renner[4,5]; [1]Inst. of Applied Physics RAS, Russia; [2]Joint Inst. for High Temperatures RAS, Russia; [3]National Research Nuclear University MEPhI, Russia ; [4]Inst. of Physics & ELI-Beamlines CAS, Czech Republic; [5]Inst. of Plasma Physics CAS, Czech Republic; [6]York Plasma Inst., United Kingdom; [7]National Optical Inst. of National Research Council, Largo Enrico Fermi, Italy; [8]Inst. of Plasma Physics and Laser Microfusion, Poland; [9]Univ. of Bordeaux, France;[10]- Centro de Láseres Pulsados, Spain
The work is dedicated to the investigation of a hot electron generation in a shock ignition relevant experiment by means of x-ray time-resolved diagnostics. We demonstrate the absolute timing of the registered x-ray emission caused by hot electrons, temporal comparison with LPI as well as dynamics of the spatial and temporal characteristics varying the parameters of the laser pulse.
This research was supported by RFBR Grant(s) # 19-32-60008

WePD-03 11:54-12:06
Nonlinear microscopy of organic microresonators
N.V. Mitetelo[1], M.E. Popov[1], E.A. Mamonov[1], D. Venkatakrishnarao[2], J. Ravi[2], R. Chandrasekar[2], T.V. Murzina[1]; [1]Lomonosov Moscow State Univ., Russia; [2]Univ. of Hyderabad, India
We report on the fabrication by a self-assembly technique and nonlinear-optical characterization of binol- and perylene-based resonant microstructures supporting excitation of whispering gallery modes (WGM) with Q-factor up to 700 in photoluminescence (PL) spectrum and waveguiding of nonlinear signal with low loss.
This research was supported by RFBR Grant(s) # 19-32-90265, 18-32-20178

WePD-04 12:06-12:18
Silica-Based Optical Fiber Modified with Gd_2O_3:Nd^{3+} Nanocrystals
A.S. Matrosova[1,2], N.K. Kuzmenko[2], S.K. Evstropiev[1,2,3], V.A. Aseev[2], V.A. Ananyev[1,2], V.V. Demidov[1], N.V. Nikonorov[2], K.V. Dukelskii[1,2,4]; [1]Vavilov State Optical Inst., [2]ITMO Univ., [3]St. Petersburg State Inst. of Technology., [4]Bonch-Bruevich St. Petersburg State Univ. of Telecomunications, Russia
We applied the polymer-salt method of oxide nanoparticles formation for fabricating a silica-based optical fiber activated by Gd2O3:Nd3+ nanocrystals. The crystals were obtained by impregnating the cavity of a capillary with the mixture of aqueous solutions of metal salts and a soluble organic polymer. The filled capillary was thermally treated and drawn into the optical fiber.
This research was supported by RFBR Grant(s) # 19-19-00596

WePD-05 12:06-12:18
Solid-state sub-picosecond master oscilator for high-pressure CO2 laser amplifier
I.O. Kinyaevskiy[1], V.I. Kovalev[1], P.A. Danilov[1], N.A. Smirnov[1], S.I. Kudryashov[1], Ya.V. Grudtsyn[1], A.V. Koribut[1], L.V. Seleznev[1], E.E. Dunaeva[2], A.A. Ionin[1]; [1]P.N. Lebedev Physical Institute of the Russian Academy of Sciences, LPI, Moscow, Russia, [2]Prokhorov General Physics Institute of the Russian Academy of Sciences, GPI, Moscow, Russia
A design of high-efficient solid-state source of sub-picosecond ~10-μm wavelength laser pulse is presented. It is based on difference frequency generation in LiGaS2 nonlinear crystal of ~0.5 μm wavelength laser pulse and its Raman-shifted pulse produced in BaWO4 crystal. Numerical efficiency of the laser system was estimated to be ~1-2% at experimentally demonstrated efficiency of the Raman shifter ~20%.
This research was supported by RFBR Grant(s) # 20-32-70015

WePD-06 12:30-12:42
Waveguide Lattice Based Integrated 4x4 Mode Mixer Element in Glass Chip
S.A. Zhuravitskii, N.N. Skryabin, I.V. Kondratyev, I.V. Dyakonov, M.Yu. Saygin, S.S. Straupe, S.P. Kulik; Lomonosov Moscow State Univ., Quantum Technology Centre, Russia
A new robust architecture for building of universal multiport interferometers was recently proposed. We investigate if a waveguide lattice is suitable as the basic block of this architecture. We fabricated waveguide lattice based integrated 4x4 mode mixer in fused silica chip by using of femtosecond laser writing technology. More than 90% fidelity between modeled and measured data was obtained.

WePD-07 12:42-12:54

Sub-piconewton Optical Force Sensing in a Nano-optomechanical System

Y. Zhang[1], P. Fan[1], L. Zhuo[1], Z. Che[1], D. Li[1], W. Zhu[1,2], H. Zheng[1,2], J. Tang[1], W. Qiu[2], H. Lu[1,2], Y. Luo[1,2], H. Guan[1,2], J. Zhang[1,2], J. Yu[1,2], Z. Chen[1,2]; [1]Department of Optoelectronic Engineering, Jinan Univ.; [2]Guangdong Provincial Key Laboratory of Optical Fiber Sensing and Communications, Jinan Univ., China

This paper demonstrates a sub-piconewton optical force sensing in a nano-optomechanical system. The combination of evanescent coupling and pump-probe technique, a minimum 380.8 fN repulsive optical force can be sensed with the stiffness of a tapered nanofiber (TNF) as low as 5.44 fN/nm.

WePD-08 12:54-13:06

Turn-on Delay of Quantum Cascade Lasers under Pulsed Pumping with Non-zero Rise-time

E.D. Cherotchenko[1], V. V. Dudelev[1], D. A. Mikhailov[1], A. V. Babichev[2,3], A. G. Gladyshev[2], I. I. Novikov[1,2,3], A. V. Lyutetskiy[1], S. O. Slipchenko[1], N. A. Pikhtin[1], L. Ya. Karachinsky[1,2,3], A.Yu. Egorov[3], A. N. Baranov[4], D. V. Denisov[2], V. I. Kuchinskii[1], G. S. Sokolovskii[1]; [1]Ioffe Inst., [2]Connector Optics LLC, [3]ITMO Univ., Russia; [4]Univ. of Montpellier, CNRS, France

We study the turn-on delay of quantum cascade lasers as a function of the amplitude of pulsed electrical pumping with non-zero rise-time. Although observed QCL dynamics is much slower than the theoretical predictions, our numerical simulations qualitatively agree with experiment

WePD-09 13:06-13:18

Machine Learning aided Fiber-Optical System for Liver Cancer Diagnosis in Minimally Invasive Surgical Interventions

E. Zherebtsov[1,2], M. Zajnulina[3], K. Kandurova[2], V. Dremin[2,3], A. Mamoshin[2,4], E. Potapova[2], S. Sokolovski[3], A. Dunaev[2], and E.U. Rafailov[3]; [1]Univ. of Oulu, Finland; [2]Orel State Univ., Russia; [3]Aston Univ., UK; [4]Orel Regional Clinical Hospital, Russia

A flexible fibre optical probe is implemented to record the parameters of endogenous fluorescence during minimally invasive interventions in patients with cancers of hepatoduodenal area. Using machine learning techniques, the obtained spectra are classified to indicate cancerous or healthy tissue. A set of different classifiers has been trained, tested and evaluated.

WePD-10 13:18-13:30

Creation of luminescent quantum systems by coherent pairs of femtosecond laser pulses

E.F. Martynovich[1,2], N.L. Lasareva[1,2]; [1]Irkutsk Branch of Institute of Laser Physics SB RAS, [2]Russia; Irkutsk State University, Russia

The spatial distributions of the concentrations of quantum systems (color centers) created by the action of coherent pairs of laser radiation pulses in transparent crystalline media are investigated. The investigated methods provide spatial selectivity of the interaction of light and matter when creating quantum systems, from the nanometer to millimeter ranges.

This research was supported by RFBR Grant(s) # 19-32-90275; Program of fundamental scientific research of the state academies of sciences for 2013–2020, section II.10.1 Project No. 0307-2016-0004

6th International Symposium on Lasers in Medicine and Biophotonics
Plenary Session

10:20 - 14:00
Session Chair: *I.A.Shcherbakov, Prokhorov General Physics Inst. RAS, Russia*

10:30-11:15 MoSYP-01

Recent progress in the use of nanodiamonds in oncology for active targeting delivery of chemotherapeutic drugs

E. Osawa[1], E. Chow[2], D. Ho[2], H. Huang[3], T. Tanaka[4]; [1]NanoCarbon Research Inst., AREC, Faculty of Textile Science and Technology, Shinshu Univ., Japan; [2]National Univ. of Singapore, Singapore; [3]Shanghai Inst. of Technology, China; [4]National Inst. of Technology, Fukushima College, Japan

We have been developing active targeting drug delivery system for chemotherapy of cancer in later stages. Using nanodiamond as the drug carrier, we succeeded in the medium animal tests without targeting capabilities. We plan to adopt antigen-antibody reactions for active targeting using folic acid functionalities as the built-in antigen. We will present the preliminary computational results.

11:15-12:00 MoSYP-02

Photodiagnosis and targeted photodynamic therapy for the treatment of metastatic melanoma

H. Abrahamse; Univ. of Johannesburg, South Africa

Metastatic melanoma (MM) has a poor prognosis. Combined photodynamic diagnosis (PDD) and therapy (PDT) can be used for both diagnosis and tumor destruction. This study demonstrated that the efficacy of PDT treatment via the bio-active antibody PS drug targeting of MM improved.

12:30-13:15 MoSYP-03

Label-free optical diagnosis of malignant and benign neoplasms with different nosologies and localizations

I.V. Reshetov[1,2], K.I. Zaytsev[3,4], I.N. Dolganova[4,5], E.N. Rimskaya[4], K.G. Kudrin[2], M.A. Schedrina[1], D.S. Ponomarev[7], V.N. Kurlov[5], A.A. Potapov[6], and V.V. Tuchin[8,9]; [1]Inst. for Regenerative Medicine, Sechenov Univ.; [2]Academy of Postgraduate Education FSCC FMBA; [3]Prokhorov General Physics Inst. RAS; [4]Bauman Moscow State Technical Univ.; [5]Inst. of Solid State Physics RAS; [6]Burdenko Neurosurgery Inst.; [7]Inst. of Ultra High Frequency Semiconductor Electronics RAS; [8]Saratov State Univ.; [9]Inst. of Precision Mechanics and Control RAS, Russia

We discuss a potential of combining several optical instruments operating in different spectral ranges for improvement of the sensitivity and specificity of differentiation between healthy (intact) and malignant tissues.

13:15-14:00 MoSYP-04

Laser printing of biomaterials and living cells *Plenary*

B. Chichkov; Leibniz Univ. Hannover, Inst. of Quantum Optics, Germany

In this lecture, we will discuss laser-based techniques applied for precise generation of 3D scaffolds for tissue engineering and for printing living cells into 3D patterns.

SY: Section A. Advanced Laser Medical Systems and Technologies

09:00 - 11:00
Session Chairs:
D.G. Kochiev, A.M.Prokhorov General Physics Inst., RAS, Russia
V.P. Minaev, NTO "IRE-Polus", Russia

TuSYA-01 09:00-09:30
Thulium-doped fiber lasers with direct pumping. Medical perspectives. *(Invited paper)*
A.A. Kolegov[1], A.V. Lappa[2], G.S. Sofienko[1], E.A. Belov[1], D.N. Bagavetdinov[1], A.O. Leshkov[1], Y.V. Ivchenko[1], E.G. Akulinin[1], I.V. Krochek[3], I.A. Abushkin[4], S.V. Sergiyko[3], A.E. Anchugova[2,3], A.S. Zarezina[2]; [1]Russian Federal Nuclear Center–Zababakhin All-Russia Research Inst. of Technical Physics, [2]Chelyabinsk State Univ., [3]South-Ural State Medical Univ., [4]Medical Laser Technologies Center, Russia.
A family of compact tulium fiber lasers of 40 W power and 1.908 and 1.94 mcm wavelengths is presented. There has been implemented the original scheme with one-piece fiber resonator, direct laser-diode pumping, and jointless output of radiation into the working lightguide. The devices are designed to perform operations of a wide class in open and endoscopic surgery.

TuSYA-02 09:30-10:00
Optimization of the endovenous laser coagulation using two-micron laser radiation *(Invited paper)*
S.A. Artemov, A.N. Belyaev, O.S. Bushukina, S.A. Khrushchalina, S.V. Kostin, A.A. Lyapin, P.A. Ryabochkina, A.D. Taratynova; National Research Mordovia State Univ., Russia
Paper provides overview of endovenous laser coagulation (EVLC) clinical techniques using radiation of different wavelengths. Results of in-vivo own EVLC experiments using radiation with wavelength of 1910 nm are presented. It was shown that successful vein occlusion is observed with lower radiation power (4 - 6 W) and minimal damage to perivenous tissues compared to 0.81, 0.98, 1.5-μm radiation.
This research was supported by RFBR Grant(s) # 18-29-20039

TuSYA-03 10:00-10:30
Biological atomic-force microscopy: is it worth it? *(Invited paper)*
P.S. Timashev; Sechenov Univ., Semenov Inst. of Chemical Physics RAS, Inst. of Photonic Technologies, Research Center "Crystallography and Photonics" RAS, Russia
Atomic force microscopy (AFM) and related techniques such as nanoindentation have become a powerful tool in biomedical research. Here, we present our experience in AFM application for fundamental and applied studies related to regenerative medicine.
This research was supported by RFBR Grant(s) # 18-29-06059, 20-02-00712

TuSYA-04 10:30-10:45
EVLO 1.940 microns - a new step in the treatment of varicose veins. *(Invited paper)*
K.A. Kaperiz[1], V.Yu. Bogachev[1,2];[1]. "The First Phlebological Center",[2]. Pirogov Russian National Research Medical Univ., Russia
The experiments showed that radiation with a wavelength of 1.94 μm provides sufficient damage to the venous wall at a significantly lower linear energy density than radiation with a wavelength of 1.55 μm.

TuSYA-05 10:45-11:00
Study of laser radiation blood plasma heating and coagulation
V.P. Minaev[1], V.Yu. Bogachev[2,3], K.A. Kaperiz[2], N.V. Minaev[4]; [1]IRE-Polus Ltd, [2]"The First Phlebological Center", [3]Pirogov Russian National Research Medical Univ., [4]Inst. of Photonic Technologies, FRC "Crystallography and Photonics" RAS, Russia
Investigation results of laser induced blood plasma heating and coagulation are presented. The laser radiation with wavelengths 1.55 and 1.94 μm and fibers with flat end and radial fibers were used.
This research was supported by RFBR Grant(s) # 17-02-00832

SY: Section A. Advanced Laser Medical Systems and Technologies

11:30 - 13:30
Session Chairs:
D.G. Kochiev, A.M.Prokhorov General Physics Inst., RAS, Russia
V.P. Minaev, NTO "IRE-Polus", Russia

TuSYA-06 11:30-12:00
Optical coherence tomography of brains: ex vivo study of healthy and malignant tissues *(Invited paper)*
I.N. Dolganova[1,2], P.V. Aleksandrova[1,2], N.A. Naumova[1,2], P.V. Nikitin[3], K.I. Zaytsev[2,4], S.T. Beshplav[3], V.V. Tuchin[5]; [1]Inst. of Solid State Physics RAS; [2]Bauman Moscow State Technical Univ.; [3]Burdenko Neurosurgery Inst.; [4]Prokhorov General Physics Inst. RAS; [5]Saratov State Univ., Russia
In this talk, we present the results of the ex vivo experimental studies by means of optical coherence tomography of malignant and healthy tissues of brain, including samples of human brain glioma of different grades and rat glioblastoma model. The extraction of features based on attenuation and homogeneity helps to analyze differences of tissues.
This research was supported by RFBR Grant(s) # 18-08-00853

TuSYA-07 12:00-12:30
Optically-controlled measurements of cryodestruction of biological tissues using sapphire shaped crystals *(Invited paper)*
I.N. Dolganova[1,2], A.K. Zotov[1], I.A. Shikunova[1], K.I. Zaytsev[2,3], V.N. Kurlov[1]; [1]Inst. of Solid State Physics RAS; [2]Bauman Moscow State Technical Univ.; [3]Prokhorov General Physics Inst. RAS, Russia
Sapphire appticator for cryosurgery with the ability of monitoring freezing of biological tissue is proposed. The conception is based on diffuse optical spectroscopy. The design of applicator allows to detect spatially resolved optical signals reflected and scattered from tissue. We demonstrate the results of experimental studies using tissue phantoms and ex vivo samples.

TuSYA-08 12:30-12:45
1.55μm laser-induced boiling technology in the treatment of bone cysts in children
I.A. Abushkin[1], V.M. Chudnovsky[2], V.G. Abushkina[1]; [1]Center for Medical Laser Technologies; [2]Ilyichov Pacific Oceanological Inst., Russia
The technology of coagulation of bone cysts in children by the method of laser-induced boiling is presented. The 1.56 μmi laser was more efficient than the 0.97 μm laser. In 5 children with a solitary and one child with an aneurysmal cyst, one session of 1.56 μm laser coagulation was enough to get a good result.

TuSYA-09 12:45-13:00
Photocoagulation of a double 1.55 + 1.94 μm wavelength in the treatment of vascular anomalies
I.A. Abushkin[1], V.M. Chudnovsky[2], V.P. Minaev[3], V.O. Lapin[1], O.A. Romanova[1], M.Y. Galiulin[1]; [1]Center for Medical Laser Technologies, [2]Ilyichev Pacific Oceanological Inst., [3]«IRE-Polus» Ltd, Russia
The results of the treatment of vascular anomalies (hemangiomas and malformations) by interstitial thermotherapy with double 1.55 + 1.94 μm laser radiation are presented. In the experiment and the clinic, it was shown that interstitial coagulation of vascular formations with double 1.55 + 1.94 μm laser radiation is more effective than the previously used 0.97 and 1.56 μm wavelengths.

TuSYA-10 13:00-13:15
Embryo microsurgery with femtosecond laser: novel techniques for assisted reproductive technologies
I.V. Ilina[1], M.A. Filatov[2], Y.V. Khramova[2], D.S. Sitnikov[1,3]; [1]Joint Inst. for High Temperatures RAS; [2]Lomonosov Moscow State Univ.; [3]Moscow Inst. of Physics and Technology, Russia
Two femtosecond laser-based techniques for embryo microsurgery are proposed. The first one uses laser to create code on the embryo envelope and minimize the risk of embryo mix-up. The second one enables laser-assisted hatching to be performed at the early blastocyst stage (when the inner cell mass and the trophoblast are distinguished)to initiate starting of hatching at the prescribed site.
This research was supported by RFBR Grant(s) # 19-32-70036

TuSYA-11 13:15-13:30
Laser mass spectrometry of volatile organic compounds for diagnosis of pathological processes.
A.B. Bukharina[1], M.Y. Kochevalina[2], A.V. Pento[1], Ya.O. Simanovsky[1], E.I. Rodionova[2], S.M. Nikiforov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Kharkevich Inst. for Information Transmission Problems RAS, Russia
A method of mass spectrometric analysis of volatile organic compounds(VOC) of biological samples at atmospheric pressure was developed. The method uses laser plasma radiation for ionization of molecules. Multivariate statistics was used for the mass spectra analysis. The possibility of identification of progressing oncological process in mice with analyzing the composition of VOCs of the urine samples was showcased.
This research was supported by RFBR Grant(s) # 18-32-01018

SY: Section A. Advanced Laser Medical Systems and Technologies

14:30 - 16:30
Session Chairs:
D.G. Kochiev, A.M.Prokhorov General Physics Inst., RAS, Russia
V.P. Minaev, NTO "IRE-Polus", Russia

TuSYA-12 14:30-15:00
Development of novel medical instruments based on sapphire shaped crystals *(Invited paper)*
V.N. Kurlov[1], I.N. Dolganova[1,2], I.A. Shikunova[1], G.M. Katyba[1,2,3], M.A. Shcherina[4], A.K. Zotov[1], K.I. Zaytsev[2,4]; [1]Inst. of Solid State Physics RAS; [2]Bauman Moscow State Technical Univ., [3]Prokhorov General Physics Inst. RAS; [4]Inst. for Regenerative Medicine, Sechenov First Moscow State Medical Univ., Russia
We present a set of medical instruments based on sapphire shaped crystals, which are able to combine several modalities: tissue resection, aspiration, intraoperative diagnosis, laser therapy, and coagulation. They are biocompatible and resist multiple sterilization. Application of the edge-defined film-fed growth technique leads to the fabrication of sapphire instruments with complex form and shape.
This research was supported by RFBR Grant(s) # 18-08-01230, 18-38-20140

TuSYA-13 15:00-15:30
High-efficient DFG of fiber lasers radiation in the spectral region of 3um for soft tissue ablation *(Invited paper)*
I.A. Larionov[1,2], A.S. Gulyashko[1], D.A. Alekseev[1], V.A. Tyrtyshnyy[1]; [1]NTO «IRE-Polus», Russia; [2]Moscow Inst. of Physics and Technology, Russia
High-efficient 3μm wavelength laser source is proposed for soft tissue surgery. Device is based on difference frequency generation of Er and Yb fiber lasers radiation in periodically poled lithium niobate. Average output power exceeds 20W with M2 parameter 1.2. Medical ex vivo experiments have confirmed high ablation rate with small coagulation zone and absence of carbonization in cut region.

TuSYA-14 15:30-15:45
Evaluation of blue diode laser alone and in combination with Tm fiber laser as a tool for laparoscopic surgery
V.A. Arkhipova[1], M.E. Enikeev[2], E.E. Laukhtina[2], A.V. Kurkov[3], V.A. Andreeva[1], I.V. Yaroslavsky[4], G.B. Altschuler[4]; [1]NTO IRE-Polus, [2]Sechenov Univ., Research Inst. for Urology and Reproductive Health, [3]Sechenov Univ., Inst. for Regenerative Medicine, Russia; [4]IPG Medical Corp., USA
We compared the cutting and coagulation efficiency of the blue laser, the Tm laser, and the combination of them during laparoscopic partial nephrectomy (LPN). The combination of the blue and Tm lasers provided the most promising results in terms of resection rate and hemostasis.

TuSYA-15 15:45-16:00
Theoretical and experimental study of temperature fields and tissue response in fractional laser regeneration of cartilage
A.A. Kovalenko[1], V.A. Andreeva[1], E.N. Sobol[2], I.V. Yaroslavsky[2]; [1]NTO IRE-Polus, Russia; [2]IPG Medical Corp., USA
We conducted a theoretical and experimental study of thermal fields created in bovine knee cartilage in vitro by fractional treatment with an Er fiber laser (1.56 μm). The data were used to identify laser parameters suitable for fractional laser procedure to induce cartilage regeneration.

TuSYA-16 16:00-16:15
Three years of clinical experience using super-pulse Tm fiber laser lithotripter for treating urolithiasis
A.G. Martov[1,2], D.V. Ergakov[1,2], M.A. Gyseynov[2], A.S. Andronov[1,2]; [1]Pletnev Clinical Hospital, [2]Inst. of Continuous Medical Education, Russia
We evaluated clinical performance of Super-pulse Thulium Fiber Laser system for lithotripsy of urinary stone tract. 214 subjects were involved in clinical study. Our data show that this system is efficacious and safe for lithotripsy.

TuSYA-17 16:15-16:30
Influence of laser irradiation to the structure of dental implant surface during professional oral hygiene
S.V. Tarasenko, S.I. Repina, R.D. Garipov, E.A. Morozova; Sechenov First Moscow State Medical Univ., Russia
Aim: to compare the surface of implants after laser influence. Materials and methods: The effect of 5 types of surgical lasers on dental implant surface was investigated using scanning electronic microscope. Results: The damage of the surface depended on wavelength and mode and was minimal after Nd:YAG–KTP, CO2 and «IRE-Polus» lasers. Conclusion: Adjusting of the working mode is necessary.

SY: Section A. Advanced Laser Medical Systems and Technologies

17:00 - 17:45
Session Chair:
D.G. Kochiev, A.M.Prokhorov General Physics Inst., RAS, Russia
V.P. Minaev, NTO "IRE-Polus", Russia

TuSYA-18 17:00-17:15
Ultra-precise minimally invasive laser surgery with picosecond laser pulses
V.A. Arkhipova[1], V.A. Andreeva[1], I.V. Yaroslavsky[2], G.B. Altshuler[2]; [1]NTO IRE-Polus, Russia; [2]IPG Medical Corp., USA
We conducted an experimental ex vivo study of feasibility using a picosecond (ps) laser emitting at 1030 nm for precise minimally invasive (micro) surgery. The results indicate that plasma generated by the ps laser enables deep and coagulation-free ablation. Thus, ps laser technology can be of high value for dermatology as well as for other specialties requiring precise cutting.

TuSYA-19 17:15-17:30
Opto-thermal computer modeling of laser-stone interaction during laser lithotripsy
E. Startseva[1,2], V. Andreeva[1], I. Yaroslavsky[3]; [1]NTO "IRE-POLUS", Russia; [2]National Research Nuclear Univ. MEPhI, Russia; [3]IPG Medical, USA

TuSYA-20 17:30-17:45
Optimizing laser litotripsy with super-pulse Tm fiber laser through controlling pulse shape and modulating pulse sequence
A.A. Kovalenko[1], V.A. Andreeva[1], I.V. Yaroslavsky[2], G.B. Altshuler[2]; [1]NTO IRE-Polus, Russia; [2]IPG Medical Corp., USA
Objective of the study was to improve efficiency, safety of laser lithotripsy through both modifying temporal profile of the laser pulses and manipulating various characteristics of the pulse sequence. Modulating the pulse energy and the peak power (amplitude modulation) as well as modulating the repetition rate (frequency and amplitude-frequency modulation) were investigated in vitro using a super-pulse Tm fiber laser.

SY: Section B. Laser Interaction with Cells and Tissues: Clinical Imaging and Spectroscopy

14:30 - 16:30
Session Chair: *V.V. Tuchin, Saratov State University, Saratov, Russia*

TuSYB-01 14:30-15:00
Study of the impact of optical clearing on skin absorption, scattering and autofluorescence properties *(Invited paper)*
W. Blondel[1], S. Zaytsev[1,2], V. Colas[1], G. Khairallah[1,3], P. Rakotomanga[1], C. Soussen[4], E. Genina[2,5], C. Daul[1], V. Tuchin[2,5], M. Amouroux[1]; [1]Univ. de Lorraine, CNRS, CRAN UMR[7]039, France; [2]Saratov State Univ., Russia; [3]Metz-Thionville Regional Hospital, Department of Plastic, Aesthetic and Reconstructive Surgery, France; [4]CentraleSupélec, CNRS, Université Paris-Sud, L2S UMR[8]506, France; [5]Tomsk State Univ., Russia;
In this study, the changes in Spatially Resolved Diffuse Reflectance and AutoFluorescence spectra acquired on ex vivo human skin during optical clearing process (topical application) are investigated and their impact on skin optical properties (absorption, scattering and fluorescence) analyzed using inverse problem solving and multidimensional data processing approaches.
This research was supported by RFBR Grant(s) # 18-52-16025

TuSYB-02 15:00-15:30
Large area brain imaging *(Invited paper)*
F.S.Pavone; Univ. of Florence, Italy
In this work large area reconstruction are obtained using a mesoscale light sheet system for structural analysis and a light sheet two-photon microscope for functional information. Both modalities are capable to sample whole brain with single cell resolution, with light sheet imaging being capable to perform high rate volumetric imaging allowing to map in real time whole-brain calcium dynamics

TuSYB-03 15:30-15:45
Optical properties of brain structures that could be met by neurosurgeon
K.A. Achkasova[1], K.S. Yashin[1], A.A. Moiseev[2], E.B. Kiseleva[1], M.M. Karabut[1], E.V. Zagaynova[1], N.D. Gladkova[1]; [1]Privolzhsky Research Medical Univ.,2- Inst. of Applied Physics RAS, Russia
It is necessary for neurosurgeon to distinguish different structures of the human brain during the surgery what is not always easy. Different human brain structures including cortex, basal ganglia and white matter were studied by cross-polarization optical coherence tomography with following calculation of optical coefficients from the OCT data. Statistically significant differences were found between mentioned brain structures.
This research was supported by RFBR Grant(s) # 18-29-01049_mk

TuSYB-04 15:45-16:00
Superresolution imaging by using far field and near field label free microscopy techniques
G.A. Stanciu, D.E. Tranca, S.G. Stanciu, R. Hristu, A. Toma; Center for Microscopy-Microanalysis and Information Processing, Univ. Politehnica of Bucharest, Romania*
In our work qualitative and quantitative results based on label free imaging in laser scanning microscopy are presented. To image different materials, including biological samples we used a multimodal microscopy system integrating several far field and near field microscopy techniques.

TuSYB-05 16:00-16:15
In vitro test system for studing regeneration based on laser microsurgery of multicellular spheroids
N.V. Kosheleva[1,2].3, I.V. Ilina[4], I.M. Zurina[1,3,5], A.A. Gorkun[1,5], D.S. Sitnikov[4], I.N. Saburina[1,3]; [1]FSBSI "Inst. of General Pathology and Pathophysiology", [2]Lomonosov Moscow State Univ., [3]FSBEI FPE "Russian Medical Academy of Continuous Professional Education", Ministry of Healthcare of Russia, [4]Joint Inst. for High Temperatures RAS, [5]Sechenov Univ., Russia
Technique of laser microsurgery of spheroids from mesenchymal and epithelial cells with nanosecond laser pulses was used to develop a model for studying regeneration in vitro. Reparative processes with wound restoration occurred gradually over seven days due to rearrangement of surviving cells without proliferation. Skin anti-ageing drugs were tested on the developed model of cell spheroid's regeneration.

TuSYB-06 16:15-16:30
Temporal correlation transfer in a head model
V.L. Kuzmin[1], A.Yu. Valkov[1,2], Yu. Zhavoronkov[2]; [1]Peter the Great St. Petersburg Poytechnic Univ., [2]St. Petersburg State Univ. , Russia
The simulation results for the intensity temporal correlation function in a multi-layer head model are presented, permitting to use the diffuse correlation spectroscopy for detection of intracranial hematomas. The novel Monte Carlo algorithm for simulation of radiation transfer in multilayer media is applied generalizing the widely known MCML method. The spatial and temporal plots are calculated numerically.
This research was supported by RFBR Grant(s) # 16-02-00465

SY: Section B. Laser Interaction with Cells and Tissues: Clinical Imaging and Spectroscopy

17:00 - 19:00
Session Chair: ***M.Yu. Kirillin,*** *Privolzhsky Research Medical Univ., Russia*

TuSYB-07 17:00-17:30
Complementary fluorescence and optoacoustic imaging for monitoring of photodynamic therapy of glioma employing BPD based nanoconstructs: pilot animal studies *(Invited paper)*
I. Turchin[1], M. Kirillin[1], D. Kurakina[1], A. Orlova[1], V. Plekhanov[1], E. Sergeeva[1], P. Subochev[1], E. Sergeev[1], V. Perekatova[1], A. Nerush[1], D. Yuzhakova[2], E. Kiseleva[2], M. Shirmanova[2], S. Bano[3], S. Mallidi[3,4], T. Hasan[3]; [1]Inst. of Applied Physics RAS, Russia; [2]Privolzhsky Research Medical Univ., Russia; [3]Wellman Center for Photomedicine, Massachusetts General Hospital, USA; [4]Tufts Univ., USA
We report on a novel approach to monitor photodynamic therapy procedure based on the simultaneous fluorescence and optoacoustic imaging with the use of a liposome nanoconstructs contain benzoporphyrin derivatives and the fluorescent IRDye800 dye. We demonstrate the results of a preliminary in vivo study with combined fluorescence and optoacoustic custom-made setups on a NUDE mouse with human glioblastoma U-87.
This research was supported by RFBR Grant(s) # 17-54-33043 onko-a

TuSYB-08 17:30-18:00
Endogenous and exogenous fluorescence diagnostics of colorectal cancer *(Invited paper)*
E. Borisova[1,2], Ts. Genova[1], N. Penkov[3], H. Valkov[3], B. Vladimirov[3], L. Avramov[1]; [1]Inst. of Electronics, Bulgarian Academy of Sciences, Bulgaria; [2]Saratov State Univ., Russia; [3]University Hospital "Tzaritza Yoanna – ISUL", Bulgaria
We investigated the characteristic endogenous fluorescence spectral differences of cancerous and healthy colorectal tissues, ex vivo using excitation-emission matrices in a broad spectral range (ex.280-500 nm, em. 300-800 nm). For an improvement of the contrast required during in vivo tumours observation, delta aminolevulinic acid was applied as a precursor of protoporphyrin IX (PpIX) for colorectal tumor detection and progress evaluation.

TuSYB-09 18:00-18:30
On the origin of NIR fluorescence in biotissues *(Invited paper)*
E.A. Shirshin; Lomonosov Moscow State Univ., Russia
We aim at elucidating the origin of NIR fluorescence of biotissues, which is ubiquitously observed and rarely used for diagnostical applications. The nature of fluorophores responsible for this signal remains unclear. Here we discuss the possible mechanisms of NIR fluorescence formation based on a set of in vitro and in vivo experiments, focusing on the role of oxidation processes.

TuSYB-10 18:30-18:45
The possibilities of optical methods in the early diagnosis of gliomas
O. Cherkasova[1,2], A. Mankova[3], M. Konnikova[2], P. Solyankin[2], D. Vrazhnov[4,5], Yu. Kistenev[4,6], A. Sinko[2], Y. Peng[7],E. Zavjalov[8]; [1]Inst. of Laser Physics SB RAS, [2]Inst. on Laser and Information Technologies - Branch of the Federal Scientific Research Centre "Crystallography and Photonics" RAS, [3]Lomonosov Moscow State Univ., [4]Tomsk State Univ., [5]Inst. of Strength Physics and Materials Science SB RAS, [6]Siberian State Medical Univ., Russia; [7]Univ. of Shanghai for Science and Technology, China; [8]Federal Research Center "Inst. of Cytology and Genetics SB RAS, Russia
A novel approach based on the Raman and absorption spectroscopy for detection of gliomas molecular markers in brain tissue and blood will be discussed. Using the mice model of the U87 human glioblastoma, we have shown the possibility of glioma development control by a combination of Raman, IR, and Terahertz pulsed spectroscopy.
This research was supported by RFBR Grant(s) # 19-52-55004

TuSYB-11 18:45-19:00
Multi-factor modeling of OCT-scan formation in the presence of scatterer motions
A.L. Matveyev[1], L.A. Matveev[1], A.A. Sovetsky[1], A.A. Zykov[1], A.A. Moiseev[1], G.V. Gelikonov[1], A. Vitkin[2], V.Y. Zaitsev[1]; [1]Inst. of Applied Physics RAS, Russia; [2]Univ. of Toronto and University Health Network, Canada
We present a robust semi-analytical multi-factor model of OCT-scan formation with rigorous accounting for the beam-focusing effects. In view of difficulties in performing highly-controlled phantom experiments, application of the developed realistic numerical model opens very flexible and convenient possibilities for evaluating the influence of scatterer motions of different types using numerically simulated OCT scans.
This research was supported by RFBR Grant(s) # 19-02-00645

SY: Section C. Photonics and Nanobiotechnology

09:30 - 11:00
Session Chairs:
P.I. Nikitin, A.M.Prokhorov General Physics Inst., RAS, Russia
V. Shipunova, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

TuSYC-02 09:30-10:00
Novel plasmonic metamaterials for ultrasensitive optical biosensing *(Invited paper)*
A.V. Kabashin[1,2]; [1]Aix Marseille Univ, CNRS, LP3, France; [2]MEPhI, Inst. of Engineering Physics for Biomedicine (PhysBio), Russia
This presentation will address pathways to improve the performance of plasmonic biosensors. Our approach is based the design of sensing-oriented plasmonic metamaterials, which could outperform natural materials in terms of sensitivity to refractive index variations. The presentation will demonstrate several promising metamaterials for biosensing, which radically improve the sensitivity and obtain novel attractive functionalities for biological sensing/recognition

TuSYC-03 10:00-10:30
Luminescent nanoparticles as labels for bioassay *(Invited paper)*
I.Yu. Goryacheva, A.A.Kokorina, A.M. Abramova, D.V. Shpuntova , E.A.Mordovina, D.V. Tsyupka, A.S. Novikova, D.D. Drozd, P.S. Pidenko, T.S. Ponomaryeva, P.D. Strokin, A.N. Mitrophanova, O.A. Goryacheva; Saratov State Univ., Russia
Luminescent nanoparticles of different nature present a perspective tool for research and analysis. Application in assay allows to increasing of assay sensitivity, comparing to coloured nanoiparticles without the assay procedure complication. Additional perspectives are related with the sensitivity of luminescence nanoparticles to the environment properties, including presence of quenchers. FRET application discussed in details.

TuSYC-04 10:30-11:00
Ultrasensitive interferometric and magnetic analytical systems for simultaneous express detection of multiple disease biomarkers *(Invited paper)*
A.V. Orlov, A.V. Pushkarev, E.N. Mochalova, N.V. Guteneva; Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia
Ultrasensitive analytical systems are developed for simultaneous express detection of multiple molecular diagnostic biomarkers. Both sandwich and competitive immunoassays are realized. The systems are based on registration of nanoparticles by nonlinear magnetization with sensitivity up to a few nano-emu and on optical label-free spectral-correlation method that allows real-time quantitative monitoring of biochemical reactions with widely available single-used sensor chips.

SY: Section C. Photonics and Nanobiotechnology

11:30 - 13:30
Session Chairs:
P.I. Nikitin, A.M.Prokhorov General Physics Inst., RAS, Russia
V. Shipunova, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

TuSYC-05 11:30-12:00
Digital holographic microscopy and tomography in research of cellular response to photodynamic treatment *(Invited paper)*
I.V. Semenova; Ioffe Inst., Russia
An approach is developed to research of cellular response to photodynamic treatment based on digital holographic microscopy and tomography. It allows for noninvasive monitoring of cell cultures over long time and provides quantitative data on major cellular parameters. Experiments were performed on both established cell lines and cell lines developed from tumor material of individual patients with different malignancies.

TuSYC-06 12:00-12:30
"Two-way road": how do QDs affect the cells and how do the cells affect QDs? *(Invited paper)*
E.S. Kornilova[1,3,4], I.K. Litvinov[1], E.A. Leontieva[1], A.O. Orlova[2], T.N. Belyaeva[1]; [1]Inst. of Cytology RAS, [2]ITMO Univ.; [3]Peter the Great St. Petersburg Polytechnic Univ.; [4]St. Petersburg State Univ., Russia
QDs are attractive fluorophores for basic research and biomedical applications. However, QDs are complex physical entities. When introduced into organism and cells, QDs is affected by biological microenvironment. Additionally, QDs themselves can affect cells, altering physiological outcomes, which leads to incorrect results' interpretation and side effects. We summarize our data on interdependence of QDs design and cell response to QDs

TuSYC-07 12:30-13:00
Optical methods for monitoring the interaction of porous silicon nanoparticles with biological objects *(Invited paper)*
L.A. Osminkina, M.B. Gongalsky; Lomonosov Moscow State Univ., Russia
New approaches for visualization of porous silicon nanoparticles interaction with cancer cells are realized in vitro by luminescent confocal microscopy, Raman micro-spectroscopy, two-photon excited fluorescence and coherent anti-Stokes Raman scattering microscopy. It was shown that these photonic methods can be used to study the kinetics of dissolution, as well as the release of drugs from the nanoparticles inside the cells.

TuSYC-08 13:00-13:15
Multimodal upconversion nanoparticles with controlled drug release as drug delivery system
P.A. Demina[1,2], N.V. Sholina[2], R.A. Akasov[2], N.A. Arkharova[2], Y.V. Grigoriev[2], I.M. Asharchuk[2], A.V. Nechaev[3], E.V. Khaydukov[2,1], A.N. Generalova[1,2]; [1]Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, [2]FSRC "Crystallography and Photonics" RAS, [3]MIREA - Russian Technological Univ., Russia
The lanthanide-doped upconversion nanoparticles (UCNPs) gained great attention as nanoplatforms for optical bioimaging and drug delivery systems. In this work, we developed the multimodal system based on UCNPs modified with thermosensitive polymer and Ag nanoparticles (AgNPs), containing chemotherapeutics, such as doxorubicin and flavin mononucleotide, for visualization and therapy. The drug delivery, cytotoxicity and optical properties were studied.
This research was supported by RFBR Grant(s) # 18-29-20064 mk

TuSYC-09 13:15-13:30
Rational design of nanoparticle-based agents for effective targeted drug and gene delivery to eukaryotic cells
E.N. Mochalova; Prokhorov General Physics Inst. RAS, Russia
Nanoparticles functionalized with different bioreceptors have considerable potential for use in targeted drug and gene delivery applications. Here we show a comprehensive strategy for the development of such nanoparticle-based agents. We used a number of optical techniques including confocal microscopy, scanning electron microscopy, and imaging flow cytometry to achieve agents` reliable performance in eukaryotic cell culture.
This research was supported by RFBR Grant(s) # 19-515-06010

SY: Section C. Photonics and Nanobiotechnology

14:30 - 16:30
Session Chairs:
P.I. Nikitin, A.M.Prokhorov General Physics Inst., RAS, Russia
V. Shipunova, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

TuSYC-10 14:30-15:00
Nanophotonic approaches to biosensing applications *(Invited paper)*
A. Rakovich[1], S. Po1, M.P. do Carmo[1], M. Zhao[1], E. Leggett[1], S. Carter-Searjeant[1], H. Walker[2], A. Lauri[2], S. Anguiano[3], M. L. Guyon[3], A. Reynoso[3], L. Urbano[4], E. Cortes[5], P.A. Huidobro[6], P. Manning[7], A. Fainstein[3], S.A. Maier[2,5], M. L. Pedano[3], M. Green[1]; [1]KCL, UK; [2]ICL, UK; [3]CAB, CNEA, Argentina; [4]Univ. of Hertfordshire, UK; [5]LMU, Germany; [6]Univ. de Lisboa, Portugal; [7]Newcastle Univ., UK
I discuss the development of hybrid plasmonic substrates that can be implemented into the Krechmann configuration for simultaneous qualitative and quantitative detection of analytes; the use of techniques based on plasmonic structures that enable control of analyte motion and thus concentration of analytes in the sensing area; and finally, the development of a theranostic agent based on conjugated polymer nanoparticles.

TuSYC-11 15:00-15:30
Layered material platform for surface plasmon resonance biosensing - ultrasensitive detection of toxins and malaria. *(Invited paper)*
A.N. Grigorenko; Univ. of Manchester, UK
We show that the use of graphene and other layered materials for protection and bio-functionalization broadens the range of metals that can be used for plasmonic biosensing and could increase the sensitivity of surface plasmon resonance chips by 3-4 orders of magnitude. Hence, layered materials provide new platform for SPR biosensing, paving the way for compact and ultrasensitive biosensors.

TuSYC-12 15:30-16:00
Magnetic and gold nanoparticles optimized for cancer treatment via cell hitchhiking *(Invited paper)*
M.N. Yakovtseva[1], O. Betzer[2,3], A.V. Lunin[1], E.N. Mochalova[1,4], M. Beiderman[2,3], M. Motiei[2,3], S.D. Zvereva[1], O.B. Proushinskaya[1], T. Sadan[2,3], R. Popovtzer[2,3], M.P.Nikitin[1]; [1]Moscow Inst. of Physics and Technology, Russia; [2]Bar-Ilan Univ., Israel; [3]The Institute of Nanotechnology and Advanced Materials, Bar-Ilan Univ., Israel; [4]Prokhorov General Physics Inst. RAS, Russia
To date, targeting and treatment of cancer by nanoparticles has been limited due to physiological obstructions. A novel approach for prolongation of nanoparticle circulation is cellular 'hitchhiking'. In this work, we studied the main characteristics of nanoagents based on magnetic and gold particles, to ensure optimal physicochemical characteristics. The developed agents promise to overcome some challenges of the cancer treatment.
This research was supported by RFBR Grant(s) # 19-515-06010, 18-32-20222

TuSYC-13 16:00-16:15
Conjugated polymer nanoparticles as multi-modal photodynamic therapy probes
M. Zhao[1], E. Leggett[1], S. Carter-Searjeant[1], S. Po[1], M. P. Carmo[1], L. Urbano[2], P. Manning[3], M. Green[1], A. Rakovich[1]; [1]Kings College London, UK; [2]Univ. of Hertfordshire, UK; [3]Newcastle Univ., UK
We report on the development of a multi-modal photodynamic therapy agent based on nanoparticles of PTB7 conjugated polymer. Several properties of the developed PTB7 nanoparticles will be discussed, including their size, stability, fluorescent properties and generation of reactive oxygen species. Some cellular assays will also be presented to highlight the potential of these nanoparticles as a versatile photodynamic therapy platform.

TuSYC-14 16:15-16:30
Fouling-proof real-time optosensors for polyvalency-based characterization of circulating antibodies
A.V. Pushkarev, K.G. Shevchenko, B.G. Gorshkov, N.V. Zhukov, N.N. Orlova, V.A. Bragina; Prokhorov General Physics Inst. RAS, Russia
Biosensors and an original assay format are developed to completely characterize antibodies in human serum and resolve the bottleneck of label-free measurements of kinetics, which is non-specific binding of serum components. The achieved analytical characteristics which surpass those of the majority of label-based biosensors are further improved by magnetic nanoparticles.

SY: Section C. Photonics and Nanobiotechnology

17:00 - 18:45
Session Chairs:
P.I. Nikitin, A.M.Prokhorov General Physics Inst., RAS, Russia
V. Shipunova, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

TuSYC-15 17:00-17:30
Polariton-assisted control of broadband emission and FRET efficiency of strongly coupled dye label excitons in tunable optical microcavity. *(Invited paper)*
I. Nabiev[1,2]; [1]Univ. de Reims Champagne-Ardenne, France; [2]National Research Nuclear Univ. MEPhI, Russia
Resonance interaction between a localized electromagnetic field and excited states in molecules paves the way to control fundamental properties of matter. Here, we have engineered a tunable optical microcavity with extra-low volume of electromagnetic modes and demonstrated controllable modification of the broad photoluminescence emission and an efficiency of FRET between organic dye labels of biological molecules in strong coupling regime.

TuSYC-16 17:30-17:45
Plasmonic control of analyte motion
M. P. Carmo[1], S. Po[1], M. Zhao[1], A. Lauri[2], P. A. Huidobro[3], A. Rakovich[1]; [1]Kings College London, United Kingdom; [2]Imperial College London, United Kingdom; [3]Universidade de Lisboa, Portugal
Analyte trapping and manipulation have applications in different research fields. Plasmonic nanostructures can concentrate energy to sub-diffraction dimensions and originate optical traps capable of acting on nanometer-size objects, but they lack the ability to manipulate them. Here we present different Brownian ratchet devices that are able to optically trap and manipulate nanometer-sized beads by periodically modulating an external light source.

TuSYC-17 17:45-18:00
Electroconductivity of cartilage in the temperature range from -10°C to 50°C with laser heating
E.M. Kasianenko[1,2], A.I. Omelchenko[1]; [1]Inst. of Photonic Technologies, FSRC "Crystallography and Photonics" RAS, [2]Lomonosov Moscow State Univ., Russia
Dependence of electrical conductivity of cartilage in course of laser heating by pulse periodical radiation and cooling in the condition of natural convection was studied. Various ranges of non-monotonic behaviours of temperature dependency of the conductivity have been revealed. It is shown that measurement of electrical conductivity allows controlling the state of free charges, mobility and concentration of cartilage.
This research was supported by RFBR Grant(s) # 18-29-02124

TuSYC-18 18:00-18:15
3D networks of carbon nanotubes, created by laser treatment for coatings of implantable devices
A.V. Kuksin[1], D.T. Murashko[1], U.E. Kurilova[1], P.N. Vasilevsky[1], A.Yu. Gerasimenko[1,2]; [1]National Research Univ. of Electronic Technology, Russia; [2]First Moscow State Medical University, Russia
This paper presents method for creating three-dimensional networks of single-walled carbon nanotubes by laser welding. Single-walled carbon nanotubes were deposited on SiO2 substrate. After that they were irradiated with pulsed laser. Structural and hardness parameters of networks were studied. Such 3D networks have improved strength, thermal and electrical conductivity, and can be used as framework for coatings in implantable devices.

TuSYC-19 18:15-18:30
Optical waveguide made with usage of plasmonic material that has highly confined travelling mode with moderate losses
I. Nechepurenko[1], E. Chubchev[1], A. Dorofeenko[1,2,3], A. Vinogradov[1,2,3], A.A. Lisyansky[4,5,6]; [1]Dukhov Research Inst. of Automatics (VNIIA), Russia; [2]Inst. for Theoretical and Applied Electromagnetics RAS, Russia, [3]Moscow Inst. of Physics and Technology, Russia, [4]Queens College of the City Univ. of New York, USA, [5]The Graduate Center of the City Univ. of New York, USA
We propose an optical transmission line having both subwavelength cross-sections and mode area. The proposed line can be implemented as a core-shell waveguide. We find the relations between material and geometrical parameters to make a traveling mode highly confined. The required plasmonic shell is rather thin, the losses are moderate and could be easy compensated by using an amplifying material

TuSYC-20 18:30-18:45
Highly versatile and biocompatable intracellular delivery system based on the plasmonic nanoparticles layers and NIR laser exposure
T. Pylaev[1], E.S. Avdeeva[1], B.N. Khlebtsov[1], N.G. Khlebtsov1,2; [1]IBPPM RAS; [2]Saratov State Univ., Russia
Herein we present simple, reusable, and cell-friendly platform that uses plasmonic nanoparticles layers of variable geometry and tunable surface density. The nanoparticle layers show good uniformity with unchanged plasmonic properties and can be easily implemented on the bottoms of multiwell culture plates, coverslips, microslades etc. 2-D plasmonic nanoparticles layers have a broad list of potential applications in modern nanobiotechnology.

SY: Section E. Nanophototheranostics

09:00 - 10:45
Session Chair*: V. Loschenov, Prokhorov General Physics Inst. RAS, Russia*

TuSYE-01 09:00-09:30
Investigation of singlet and triplet oxygen in water and aqueous dispersions of nanosize micelles *(Invited paper)*
A.A. Krasnovsky, A.S. Kozlov, A.S. Benditkis;
In connection with the crucial role of singlet and triplet oxygen in photodynamic oxygenation in biological and chemical systems and also in photodynamic cancer treatment, this paper presents a review of the contemporary information on photonics of triplet and singlet oxygen in water, deuterium oxide and aqueous dispersions of detergent micelles and major methods of their elucidation.

TuSYE-02 09:30-09:45
Intra-articular PDT mechanisms for osteoarthritis treatment
V.I Makarov[1], T.A. Zharova[2], Kogan E.A.[2], Smorchkov M.M.[3], A.V. Lychagin[2], S.V. Ivannikov[2], N.V. Zharkov[2], V.B. Loschenov[1]; [1]Prokhorov General Physics Inst. RAS, [2]Sechenov First Moscow State Medical Univ., [3]Priorov Central Research Inst. of Traumatology and Orthopedics, Russia
This study focuses on investigation of intra-articular photodynamic therapy mechanisms for osteoarthritis treatment. Also, a search for determination of the most effective dose of photosensitizer chlorine e6 for anti-inflammatory photodynamic therapy of osteoarthritis was carried out. The results of photodynamic therapy with Photoditazin at various administered doses in the treatment showed that 3.2 mg/kg photosensitizer dose is the most effective.
This research was supported by RFBR Grant(s) # 18-29-01062

TuSYE-03 09:45-10:00
The investigation of the photodynamic efficiency of chlorine e6 on a model of multicellular tumor spheroids using the developed video fluorescent equipment.
D.S. Farrakhova[1], Yu.S. Maklygina[1], D.V. Yakovlev[2], K.T. Efendiev[3], A.V. Borodkin[1], M.V. Loschenov[1], L. Bezdetnaya[4,5], V.A. Oleinikov[2], A.D. Plyutinskaya[6], T.A. Karmakova[6], A.A. Pankratov[6], V.B. Loschenov[1,3]; [1]Prokhorov General Physics Inst. RAS, [2]Shemyakin and Ovchinnikov Inst. of Bioorganic Chemistry RAS, [3]National Research Nuclear Univ. "MEPhI", Russia; [4]Centre de Recherche en Automatique de Nancy, CNRS, Université de Lorraine, [5]Inst. de Cancérologie de Lorraine, France; [6]National Medical Research Radiological Centre of the Ministry of Health of the Russian Federation, Russia
Cancer is the main problem of all developed and many developing countries of the world and the cause of death and disability of population. Today, the actual problem is receipt of reliable information about the boundaries of malignant neoplasms and the detection of pathology in the early stages.

TuSYE-04 10:00-10:15
Single-fiber system development for simultaneous photodynamic therapy and monitoring the photosensitizer concentration for stereotactic brain operations
D.M. Kustov[1], P.V. Grachev[1], E.I. Kozlikina[1,2], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS [2]National Research Nuclear Univ. MEPhI, Russia
In neurosurgery exists the need to treat deep-seated brain tumors by stereotactic photodynamic therapy. Since access to tumor is limited and carried out through a small diameter hole, the choice a suitable equipment is difficult. To improve the treatment method, we have developed a single-fiber system for delivery laser radiation and determining the photosensitizer concentration in a biological object.
This research was supported by RFBR Grant(s) # The research was supported by the RFBR project No 18-29-01062.

TuSYE-05 10:15-10:30
Shortwave-infrared emitters for biological imaging based on Yb-Er-Tm and Yb-Er-Ho tridoped core-shell NaGdF4 nanoparticles
D.V. Pominova, V.Yu. Proydakova, I.D. Romanishkin, A.V. Ryabova, P.V. Grachev, S.V. Kuznetsov, V.V. Voronov, P.P. Fedorov, V.B. Loschenov; Prokhorov General Physics Inst. RAS, Russia
The shortwave-infrared emitters based on Yb-Er-Tm and Yb-Er-Ho tridoped core-shell NaGdF4 nanoparticles with several tunable intense luminescence bands in in 1000-1600 nm range were obtained. Studies on biological tissue phantoms and biological tissue samples have shown that coating of nanoparticles with passive shell effectively prevents the quenching of their luminescence in biological media.

TuSYE-06 10:30-10:45
Yb-Er-doped nanoparticles synthesis temperature effect on upconversion luminescence lifetime
I.D. Romanishkin, V.Yu. Proydakova, S.V. Kuznetsov, D.V. Pominova; Prokhorov General Physics Inst. RAS, Russia
Rare-earth doped crystalline nanoparticles are promising theranostic agents. Their optical parameters can vary depending on the synthesis process. Dependence of upconversion luminescence lifetime of Yb-Er-doped nanoparticles from their synthesis temperature was studied using Maximum entropy method. Higher synthesis temperature results in longer upconversion luminescence lifetime and its narrower distribution, suggesting higher structural homogeneity.

SY: Section D. Photodynamic Processes in Biology and Medicine

11:30 - 13:15
Session Chair*: V. Loschenov, Prokhorov General Physics Inst. RAS, Russia*

TuSYE-07 11:30-12:00
Metabolic FLIM and oxygen PLIM in theranostic applications *(Invited paper)*
A. Rück[1], P. Schäfer[2], B. von Einem[3], I.S. Kritchenkov[4], S. Kalinina[1]; [1]Univ. Ulm, Germany; [2]Childrens Hospital of Philadelphia, USA; [3]Neurological University Clinic Ulm, Germany; [4]St. Petersburg State Univ., Russia
A common property during tumor development is altered energy metabolism. FLIM of metabolic coenzymes is now accepted to be the most reliable method to determine cell metabolism. The phosphorescence lifetime of newly developed drugs is able to indicate local oxygen changes. Simultaneous imaging of phosphorescence and fluorescence lifetime parameters enables analysis of bioenergetic alterations and oxygen consumption in theranostic applications.

TuSYE-08 12:00-12:15
Application of time-resolved fluorescence microscopy to assess the metabolic state of tissue macrophages in photodynamic therapy
A.V. Ryabova[1], I.D. Romanishkin[1], A.S. Skobeltsin[2], D.V. Pominova[1], V.B. Loschenov[1]; [1]Prokhorov General Physics Inst. RAS, [2]JSC BIOSPEC, Russia
In order to optimize the current clinical evaluation of photodynamic therapy, new approaches based on the use of fluorescence lifetime imaging microscopy to assess the state of the tumor cells microenvironment, which will allow quantifying the parameters determining the mechanisms of the PS, light and oxygen effect on tumor macrophages and tumor cells are explored. Work supported by RFBR, 20-02-00928.
This research was supported by RFBR Grant(s) # 20-02-00928

TuSYE-09 12:14-12:30
The optical estimation of glioma cell composition using fluorescence lifetime imaging
Yu.S. Maklygina[1], I.D. Romanishkin[1], T.A. Savelieva[1,2], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS, [2]National Research Nuclear Univ. "MEPhI", Russia
Gliomas are one of the most common brain tumors occurring in children and adults. Gliomas are primary, diffusely infiltrating brain tumors. There are few effective therapies for these type of cancer, and patients with malignant glioma fare poorly, even after aggressive surgery, chemo- and radiotherapy.
This research was supported by RFBR Grant(s) # 18-29-01062

TuSYE-10 12:30-12:45
Automatic attenuation correction technique for fluorescent analysis of the photosensitizer concentration in biological tissues
T.A. Savelieva[1,2], M.N. Kuryanova[2], E.V. Akhlyustina[2], K.G. Linkov[1], G.A. Meerovich[1,2], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS, [2]National Research Nuclear Univ. MEPhI, Russia
The interpretation of fluorescence spectra is problematic since fluorescence from tissues is affected by absorption and scattering at both the excitation and emission wavelengths. In this regard, we studied the influence of optical properties on the intensity of the fluorescence signal, and we proposed an algorithm for analyzing the concentration of the photosensitizer by the fluorescence signal, leveling this effect.
This research was supported by RFBR Grant(s) # 18-29-01062

TuSYE-11 12:45-13:00
Improving the sharpness of NIR images during mapping sentinel lymph nodes and tissue transplants
P. Grachev[1] , E. Basko[2] , M. Klementeva[2] , A. Moskalev[1] , A. Shiryaev[3] , I. Reshetov[3] , G. Zhemerikin[3] , O. Startseva[3] , D. Melnikov[3] , D. Kornev[3] , L. Amirkhanova[3] , V. Loschenov[1]; [1]Prokhorov General Physics Inst. RAS, [2]National Research Nuclear Univ. MEPhI, [3]First Moscow State Medical Univ., Russia
The Indocyanine Green is used for imaging lymph nodes, lymphatic pathways and blood vessels and tissue boundaries in an interdisciplinary setting. Fluorescent imaging with ICG helps to assess blood flow in the examine areas. Due to optical properties ICG fluorescence can be detect from deep located lymph nodes. Although quality of such images can be improved with deconvolution methods.
This research was supported by RFBR Grant(s) # 17-00-00162 K, 17-00-00159

TuSYE-14 13:00-13:15
Zeolite based magnetic nanocomposites for drug delivery and hyperthermia
V.A. Hovhannisyan[1], S.J. Chen[1], K. Siposova[2], A. Musatov[2], Z. Mitroova[2], P. Kopcansky[2]; [1]College of Photonics, NCTU, Taiwan; [2]Inst. of Experimental Physics SAS, Slovakia
Clinoptilolite zeolite (CZ) nano/microparticles and their interaction with photodynamic dyes are studied by multiphoton microscopy. The release of dyes from CZ in the presence of biomolecules is investigated. Magnetic CZ particles are fabricated and applied to local tissue heating using an alternative magnetic field. The inhibitory and destructive effects of magnetic CZ on protein fibrillation are observed.

SY: Section D. Photodynamic Processes in Biology and Medicine

17:00 - 18:15
Session Chair*: I.M.Belousova, Vavilov State Optical Inst., Russia*

WeSYD-01 17:00-17:30
Update on the Ruthenium coordination complex based photosensitizer TLD1433 in phase I and II clinical trials for Non-muscle invasive Bladder Cancer *(Invited paper)*
L. Lilge[1,2], M. Roufaiel[3], A. Mandel[3], M. Nesbit[1,4], G. Kulkarni[1,4], M.I Jewett[1,4]; [1]University Health Network, [2]Univ. of Toronto, Department of Medical Biophysics, [3]Theralase Technologies Inc., [4]Univ. of Toronto, Department of Urology, Canada
We report on the outcome of a Phase 1B clinical trial for non muscle invasive bladder cancer using TLD1433, a ruthenium coordination complex. 6 patients participated in this clinical trial which contained a drug dose escalation. The high success rate is due to a combination of photosensitizer installation, short wavelength activation by 525 nm light and personalized irradiance dosimetry.

WeSYD-02 17:30-17:45
How to personalize PDT treatment: from dose definition to an actual plan
L. Lilge[1,2], C. Fisher[1], Ch. McFadden[2], D. Molenhuis[2], J. Cassidy[3], A.-A. Yassine[3], F. Schwiegelshohn[3], T. Young-Schultz[3], V. Betz[3]; [1]University Health Network, [2]Univ. of Toronto, Medical Biophysics, [3]Univ. of Toronto, Electrical and Computer Engineering, Canada
A procedure pipeline to achieve personalized PDT treatment, from clinical images to full treatment plan is presented. The treatment plan accommodates anatomical detail and tissue response measures and provides source location and power as output. The plan needs to be invariant to known unknowns such as the photosensitizer concentration and the tissue optical properties.

WeSYD-03 17:45-18:15
Biomedical image processing with thin films of bacteriorhodopsin for breast cancer diagnostics *(Invited paper)*
D.V.G.L.N. Rao; Univ. of Massachusetts, USA
We studied transient Fourier holographic gratings based on photo induced isomerization properties of thin polymer films of the protein complex Bacteriorhodopsin (bR). Real time medical image processing is demonstrated by recording and reconstructing the transient photo isomerization grating formed in the bR film using Fourier holography.

SY: Section B. Laser Interaction with Cells and Tissues: Clinical Imaging and Spectroscopy

09:00 - 11:00

ThSYB-12 09:00-09:30

Overcoming the Abbe diffraction limit in THz spectroscopy and imaging of soft biological tissues *(Invited paper)*

K.I. Zaytsev[1,2], N.V. Chernomyrdin[1,2], G.M. Katyba[2,3], I.N. Dolganova[2,3], V.N. Kurlov[3]; [1]Prokhorov General Physics Inst. RAS, [2]Bauman Moscow State Technical Univ., [3]Inst. of Solid State Physics RAS, Russia

In this work, we consider several novel modalities of THz imaging, which overcome the Abbe diffraction limit and hold strong potential in THz biophotonics. Among them: the THz solid immersion microscopy, the THz imaging relying on photonic jets and photonic hooks, and the THz scanning-probe near-field microscopy based on a flexible sapphire fiber.

This research was supported by RFBR Grant(s) # 18-38-00504

WeSYB-13 09:30-10:00

Remote assessment of human stress state by analyzing of IR-THz radiation from facial areas *(Invited paper)*

E. Berlovskaya[1], O. Cherkasova[2,3], I. Ozheredov[1,3], D. Nikolaev[4], T. Adamovich[5], E. Isaychev[5], S. Isaychev[5], A. Makurenkov[1], A. Varaksin[6], S. Gatilov[6], N. Kurenkov[6], A. Chernorizov[5], A. Shkurinov[1,3]; [1]Lomonosov Moscow State Univ., [2]Inst. of Laser Physics SB RAS, [3]Inst. on Laser and Information Technologies, Branch of the Federal Scientific Research Centre "Crystallography and Photonics" RAS, [4]Inst. for Information Transmission Problems RAS (Kharkevich Inst.), Russia [5]Faculty of Psychology, Lomonosov Moscow State University, Moscow, Russia [6]CJSC Pattern Recognition Research Company, Moscow, Russia

The potential for remote assessment of the human stress state is very important field of research in the area of technologies with a risk of man-made disasters. A new approach to diagnostics of stress state is proposed, based on the analysis of the terahertz contribution while simultaneously recording of the infrared and terahertz emissions from a human face.

This research was supported by RFBR Grant(s) # 17-29-02487

ThSYB-14 10:00-10:30

Terahertz antennas featuring plasmonic and dielectric structures for biomedical applications *(Invited paper)*

D.V. Lavrukhin1,2, I.A. Glinskiy[1,2], N.V. Zenchenko[3], R.A. Khabibullin[1,3], I.V. Minin[4,5], O.V. Minin[4,5], K.I. Zaytsev[2,3], D.S. Ponomarev[1,2]; [1]Mokerov Inst. of Ultra High Frequency Semiconductor Electronics RAS, [2]Prokhorov General Physics Inst. RAS, [3]Bauman Moscow State Technical Univ. [4]Tomsk Polytechnic Univ., [5]National Research Tomsk State Univ., Russia

We report on our recent approaches focused on the enhancement of optical light confinement in photoconductive antennas (PCAs) by implementation of periodic metallic (plasmon-assisted) and dielectric nanostructures into PCA's photoconductive gap.

ThSYB-15 10:30-10:45

Study of dry pellets of blood plasma using THz spectroscopy

A. Lykina[1], M. Konnikova[2], M. Chernyaeva[3], P. Gavrilova[1], I. Mustafin[4], E. Domracheva[3], V. Anfertev[3], D. Vrazhnov[5], V. Prischepa[6], Y. Toropova[7], D. Korolev[7], A. Shkurinov[2]; [1]ITMO University, [2]Lomonosov Moscow State Univ., [3]IPM RAS, [4]Ioffe Inst., [5]Tomsk State Univ., [6]ISPMS SB RAS, [7]Almazov National Medical Research Centre, Russia

Study of a phantom of a biological object for measurements in the THz frequency range. The phantoms were represented as a pellet of blood plasma in the diabetic and the control groups. These objects were analyzed using THz pulsed spectroscopy and a high-resolution THz spectrometer. The components of the dry blood plasma were identified by the detected spectral lines.

This research was supported by RFBR Grant(s) # 17-00-00275, 17-00-00270, 17-00-00272, 17-00-00184, 17-00-00186

ThSYB-16 10:45-11:00

Study of temperature dependence on THz transmission of albumin solution

M.R. Konnikova[1], M.M. Nazarov[2], O.P. Cherkasova[1,3,4]; [1]Institute on Laser and Information Technologies - Branch of the Federal Scientific Research Centre "Crystallography and Photonics" RAS, [2]National Research Center "Kurchatov Institute", [3]Inst. of Laser Physics SB RAS, [4]Novosibirsk State Technical Univ., Russia

The dependence of the THz transmission spectra of bovine serum albumin solution on the temperature is experimentally studied. The differences between BSA solutions absorption with concentrations from 0 to 500 mg/ml with a change in their temperature (from 20 to 80°C) are analyzed. With increasing protein concentration, the transmission amplitude increases, and with increasing solution temperature — it decreases.

This research was supported by RFBR Grant(s) # 17-00-00275, 17-00- 00270, 18-52-00040

SY: Section B. Laser Interaction with Cells and Tissues: Clinical Imaging and Spectroscopy

11:30 - 13:30
Session Chair: *E. Borisova, Inst. of Electronics BAS, Russia*

ThSYB-17 11:30-12:00
Advances in tissue optical clearing: new steps to clinics *(Invited paper)*
V. Tuchin; Saratov State Univ., Tomsk State Univ., Inst. of Precision Mechanics and Control RAS, Bach Inst. of Biochemistry, Research Center of Biotechnology RAS, ITMO Univ., Russia
The enhancement of probing/treatment depth and image contrast for a number of human and animal tissues (skin, gingival mucosa, dura mater, brain tissues, myocardium, muscle, colorectal mucosa, cartilage, etc.) investigated by using immersion optical clearing (OC) will be demonstrated. Diffuse reflectance spectroscopy, collimated transmittance, OCT, photoacoustic microscopy, fluorescence, SHG and Raman microscopies will be shown to be beneficial at OC.

WeSYB-18 12:00-12:30
Tuning the oxidative stress with near infrared irradiation: cellular mechanisms *(Invited paper)*
S.G. Sokolovski[1], E.U. Rafailov[1, 2]; [1]Aston Univ., UK; [2]Saratov State Univ., Russia
The photobiomodulation (PBM) and photodynamic therapy are similar generating oxidative stress (OS). The PBM active spectrum covers 400-1000nm diapason and addresses its energy to electron-chain-enzymes. Whereas 1265nm irradiation capable of inducing OS by direct triplet-to-singlet oxygen transformation has distinguish mechanism(s) involving cytosolic calcium, glutathione enzymes activity changes, DNA damage, mitochondria respiration modulation brings up the specific applications.

ThSYB-19
12:30-13:00 **Line curvature algorithm in laser ektacytometry of red blood cells** *(Invited paper)*
S.Yu. Nikitin, V.D. Ustinov, S.D. Shishkin, M.S. Lebedeva; Lomonosov Moscow State Univ., Russia The problem of measuring red blood cell deformability by laser diffractometry in a shear flow (ektacytometry) is considered. Using numerical modeling we show that in particular case of a bimodal ensemble of erythrocytes the laser ektacytometry enables one to estimate subpopulation of weakly deformable erythrocytes in a blood sample.
This research was supported by RFBR Grant(s) # 17-29-03507

WeSYB-20 13:00-13:15
Studying slow-deformation phenomena in cartilaginous samples using Optical Coherence Elastography
Yu.M. Alexandrovskaya[1,2], O.I. Baum[1,2], A.A. Sovetsvky[2], A.L. Matveyev[2], L.A. Matveev[2], E.N. Sobol[3], V.Yu. Zaitsev[2]; [1]Inst. of Photonic Thechnologies RAS, Centre "Crystallography and Photonics", Russia; [2]Inst. of Applied Physics RAS, Russia; [3]Arcuo Medical Inc, United States
The capabilities of strain mapping based on analysis of complex-valued OCT signal for real-time visualization slow processes in cartilage modified by laser radiation or immersion agent application are presented. The developed OCE-based continuous strain mapping provides a deeper insight in tissue mechanics and opens new prospect for designing medical control systems. **The research was supported by RSF grant 16-15-10274 in part of OCT-method development and RFBR grant 18-29-02124 in part of the laser-assisted implant reshaping.**

ThSYB-21 13:15-13:30
Monitoring of processes involving white blood cells using endogenous fluorescence
B.P. Yakimov[1], A.N. Semenov[1], M.A. Gogoleva[1], S.A. Rodionov[2], A.V. Priezzhev[1], E.A. Shirshin[1,3]; [1]Lomonosov Moscow State Univ., [2]Priorov Central Inst. for Traumatology and Orthopedics, [3]Inst. of Spectroscopy RAS, Russia
The possibility of using spectrally and time-resolved endogenous fluorescent response to monitor processes involving white blood cells was investigated

ThSYB-30 13:30-14:00
Clinical near infrared monitoring of the brain: cererbal oximetry and beyond (Invited paper)
V. Toronov[1,2], S. Lin[2,3], P. Doria[2,3], K. St. Lawrence[4]; [1]Ryerson Univ., [2]Inst. for Biomedical Engineering, Science and Technology, [3]Univ. of Toronto, [4]Univ. of Western Ontario, Canada
We discuss the technical aspects and clinical benefits of using the continues-wave, time-resolved, and hyperspectral NIRS in combination with the diffuse correlation spectroscopy to monitor cerebral perfusion and metabolism in the cardiac arrest patients and in patients with brain injuries.

SY: Section B. Laser Interaction with Cells and Tissues: Clinical Imaging and Spectroscopy

14:30 - 16:30
Session Chair: A. *Lugovtsov, Lomonosov Moscow State Univ., Russia*

ThSYB-22 14:30-15:00
Translation of ALA-induced PPIX for brain tumor interventions *(Invited paper)*
R. Sroka, A. Rühm, N. Markwardt, C. Heckl, M. Aumiller, H. Stepp; University Hospital of Munich, Germany
Malignant gliomas are a devastating brain tumor disease with very poor prognosis. Photoactive drugs and their use for fluorescence guided resection, optical guided biopsy and photodynamic therapy supports innovative treatment modalities in neurosurgery. Besides the medical needs, requests and boundary conditions the physics and the technical developments aiming in clinical applications are presented.

WeSYB-23 15:00-15:30
Development of photodynamic therapy protocols with assistance of optical monitoring techniques *(Invited paper)*
M.Yu. Kirillin[1], A.V. Khilov[1], D.A. Kurakina[1], M.A. Shakhova[1,2], E.A. Sergeeva[1], A.G. Orlova[1], A.E. Meller[1,2], A.M. Mironycheva[2], A.S. Malygina[2], I.L. Shlivko[2], N.Yu. Orlinskaya[2], I.V. Turchin[1], S.V. Gamayunov[3]; [1]Inst. of Applied Physics RAS, [2]Privolzhsky Research Medical Univ., [3]Nizhny Novgorod Regional Clinical Oncology Center, Russia
We report on performance of PDT assisted by optical monitoring techniques: dual-wavelength fluorescence imaging and optical coherence tomography. Both techniques provide complementary information of PS distribution and photobleaching and tissue reaction to PDT. The proposed approach allowed to perform a comparative analysis of different PDT regimens in animal study and develop an improved protocol for PDT of basal cell carcinoma.

WeSYB-24 15:30-16:00
Controlling biological processes by light *(Invited paper)*
A Möglich; Univ. of Bayreuth, Germany
Sensory photoreceptors control diverse biological adaptations to light and can be harnessed for optogenetics, i.e. the control by light of physiological processes. We investigate the structural and mechanistic bases of potoreception in the light-oxygen-voltage and phytochrome photoreceptor families. Pertinent knowledge is applied to the engineering of novel photoreceptors.

ThSYB-25 16:00-16:30
High resolution Raman detection of 12CO2 and 13CO2 isotopes in human breath *(Invited paper)*
A.V. Polishchuk, V.V. Kurikova, K.M. Grigorenko, V.V. Vitkin; ITMO University, Russia
We present an effective system for detecting carbon isotopes 12CO2 and 13CO2 in human breath with an extremely low concentration level of ~0.01%. The Raman detector consists of a 5W-CW-solid-state laser at 532 nm, a focusing system, a gas cell and a high-resolution Czerny-Turner based spectrometer. Such a system is in demand in the medical diagnosis of various diseases.

SY: Section B. Laser Interaction with Cells and Tissues: Clinical Imaging and Spectroscopy

17:00 - 19:00
Session Chair: *Ilya Turchin, Inst. of Applied Physics RAS, Russia*

ThSYB-26 17:00-17:30
Multi-modal Imaging in Live Cell Microscopy *(Invited paper)*
H. Schneckenburger[1], V. Richter[1], C. Cremer[2]; [1]Aalen Univ., [2]Univ. of Heidelberg, Germany
Methods of high resolution deep view microscopy of living cells and tissues are reported. These techniques include Structured Illumination Microscopy (SIM) for optimizing resolution, Light Sheet Fluorescence Microscopy (LSFM) for 3D imaging at low light exposure and a combination of both methods. Applications are concentrated on localization of cellular metabolites, signal transduction as well as cell and tissue diagnostics.

ThSYB-27 17:30-18:00
Optical study of RBCs and platelets aggregation and its correction in arterial hypertension *(Invited paper)*
A.E. Lugovtsov, P.B. Ermolinskiy, A.I. Maslyanitsina, A.N. Semenov, Yu.I. Gurfinkel, L.I. Dyachuk, A.V. Priezzhev; Lomonosov Moscow State Univ., Russia
Using laser techniques we showed that in arterial hypertensive patients, the ability of RBCs and platelets to aggregate is enhanced relative to the control group. The hypothesis that cells aggregation can be corrected (reduced) in AH by integrin IIb/IIIa glycoproteins (IGP) inhibition of fibrinogen adsorption on RBC membrane was verified experimentally.

ThSYB-28 18:00-18:30
Probing of red blood cell dynamics using optical trap combined with micro-Raman spectroscopy *(Invited paper)*
Mithun N[1], Jijo Lukose[1], Ganesh Mohan[2], Shamee Shastry[2], Santhosh Chidangil[1]; [1]Centre of Excellence for Biophotonics, [2]Kasturba Medical College, Manipal Academy of Higher Education (MAHE), India
The response of human live red blood cells suspended in intravenous fluids (IV) is investigated using Raman Tweezers technique. Raman spectral variations were further compared with red blood cells suspended in AB blood plasma. Hemoglobin deoxygenation in red blood cells was observed with increase in laser power in all the intravenous fluids.

WeSYB-29 18:30-19:00
OCE-based quasistatic elasto-spectroscopy to characterize tumors by their linear and nonlinear elasticity *(Invited paper)*
A. Plekhakov[1], E.V. Gubarkova[1], M.A. Sirotkina[1], A.A. Sovetsvky[2], A.L. Matveyev[2], L.A. Matveev[2], N.D. Gladkova[1], E.V. Zagaynova[1], V.Y. Zaitsev[2]; [1]Privolzhsky Research Medical Univ., [2]Inst. of Applied Physics RAS, Russia
We present a novel method, which can be called "elasto-spectroscopy" based on compressional Optical Coherence Elastography. The method relies on initial determining of characteristic stiffness ranges for various morphological components of the tissue by comparing OCE-based stiffness maps and histology. Such pre-calibration allows one to perform morphological segmentation of OCE-images demonstrating excellent correlation with segmentation of conventional histological images.
This research was supported by RFBR Grant(s) # 18-32-20056

SY: Section C. Photonics and Nanobiotechnology

09:15 - 11:00
Session Chairs:
P.I. Nikitin, A.M.Prokhorov General Physics Inst., RAS, Russia
V. Shipunova, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

ThSYC-21 09:15-09:45
Hybrid disk-shaped nanoresonators on metal film for SERS chemical and biosensing *(Invited paper)*
A.K. Sarychev[1], A.V. Ivanov[1], A.N. Lagarkov[1], G. Barbillon[2], I.V. Bykov[1], I.A. Ryzhikov[1]; [1]Inst. for Theoretical and Applied Electrodynamics RAS, Russia; [2]EPF-Ecole d'Ingenieurs, France
We report the SERS signal from gold and silver of nanodisk resonators. The enhancement is obtained by the addition of a silicon layer between the nanodisks. We experimentally investigated the sensitivity of the suggested Au, Ag/Si disk-shaped nanoresonators for SERS sensing. Enhancement factors in the range of five-eight orders on magnitude are found for the detection of thiophenol molecules.

ThSYC-23 09:45-10:00
Optical Label-Free Method for Investigation of Polyvalent Antigen-Antibody Interactions for Diagnostics of Hepatitis B
V.A.Bragina, V.R. Cherkasov, A.V. Babenyshev, A.G. Burenin, D.O. Novichikhin, N.V. Guteneva; Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia
An optical method is developed for quantitative label-free registration of equilibrium and kinetic parameters of polyvalent antigen-antibody interactions in real time. As model of polyvalent antigen, the biomarker of hepatitis B surface antigen (HBsAg) was used. The kinetic parameters of interaction of each antibody with HBsAg were determined to find proper reactants for immunochromatographic assay for quantitative detection of HBsAg.

ThSYC-24 10:00-10:30
Plasmonic silver nanoparticles for theranostics of HER2-positive cancer *(Invited paper)*
V.O. Shipunova, M.M. Belova, P.A. Kotelnikova, S.M. Deyev, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia
We developed the method of green synthesis of silver nanoparticles possessing by surface plasmon resonance. We showed that after light irradiation, particles were able to generate heat and to selectively kill HER2-overexpressing cells being non-toxic without irradiation. The developed cost-effective method of targeted silver nanoparticle synthesis can be considered as effective tool for designing cancer treatment strategies in vivo.

ThSYC-25 10:30-10:45
Membrane-associated heat shock protein Hsp70: a novel theranostic target for nanoparticle-based therapy
M. Shevtsov[1], Y. Marchenko[4], B. Nikolaev[4], L. Yakovleva[4], R. Tagaeva[4], N. Yudintceva[2]; [1]Technical Univ. Munich, Germany; [2]Inst. of Cytology RAS, Russia; [3]First Pavlov State Medical Univ. of St. Petersburg, Russia; [4]Research Inst. of Highly Pure Biopreparations, Russia
Hsp70 is overexpressed on the membrane of tumor cells and serves as a recognition structure for cancer theranostics. Hsp70-targeted nanoparticles of various formulations (superparamagentic nanoparticles, gold nanorods, quantum dots, etc) were designed for diagnostics and therapy of tumors. Combined therapy approaches consisting of immune check-point inhibitors, radiotherapy and targeted nanoparticles further significantly increased animal overall survival in preclinical models.
This research was supported by RFBR Grant(s) # 19-58-55001

WeSYC-26 10:45-11:00
Biocompatible cancer-targeted multimodal bioimaging agents synthesized via acid-promoted transformation
A.V. Lunin[1,2], S.M. Dolotova[2], S.P. Krechetov[3], D.V. Rogozhnikov[3], V.R. Cherkasov[1,3]; [1]Sirius Univ. of Science and Technology, [2]Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, [3]Prokhorov General Physics Inst. RAS, Russia
We demonstrate the strategy to synthesize novel monodisperse biocompatible iron oxide nanoparticles. We show specificity and high imaging abilities of the nanoparticles as visible light- and infrared-active optical labels for in vitro and in vivo studies. The results demonstrate that synthetic strategy could be used to design versatile nanoagents for diagnostics and in vivo imaging.
This research was supported by RFBR Grant(s) # 19-33-51011

SY: Section C. Photonics and Nanobiotechnology

11:30 - 13:30
Session Chairs:
P.I. Nikitin, A.M.Prokhorov General Physics Inst., RAS, Russia
V. Shipunova, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

ThSYC-27 11:30-12:00
Nanostructured theranostic carriers: preparation, properties, applications *(Invited paper)*
D.A. Gorin; Skolkovo Inst. of Science and Technology, Russia
Modern medicine requires to combine the imaging and therapy tools in one object. Two types of nanostructured carriers were elaborated. There are composite carriers containing gold nanorods and/or indocyanine green (ICG) dye. Optimal compositions and structures of nanostructured shells from point of view of photoacoustic and fluorescent signal intensities required for the detection of nanostructured carriers in vivo were found.

ThSYC-28 12:00-12:30
Photoswitchable capsule for cell tracking *(Invited paper)*
P.A. Demina[1], O.A. Sindeeva[1], A.M. Abramova[1], E.S. Prikhozhdenko[1], A.V. Sapelkin[1,2], I.Y. Goryachev[1], G.B. Sukhorukov[1,2,3]; [1]Saratov State Univ., Russia; [2]Queen Mary Univ. of London, United Kingdom; [3]Skolkovo Inst. of Science and Technology, Russia
The talk highlights the fabrication of micron sized capsules enabling optical switch of emitted fluorescence. Mechanism of color switch is based on photo chemistry of encapsulated rhodamine dye induced by carbon nanoparticles formed in capsule wall. Various biological cells are able to internalise these capsules and following switching of capsules appearance gives us a tool for cell tracking over hours/days.

ThSYC-29 12:30-13:00
Biosensing and theranostics based on functionalized magnetic and plasmonic nanoparticles *(Invited paper)*
P.I. Nikitin; Prokhorov General Physics Inst. RAS, Russia
Multiplex biosensing techniques have been developed for rapid measurements of ultra-low concentrations of small molecules, oligonucleotides and cancer biomarkers based on gold and magnetic nanoparticles. New methods have been proposed and demonstrated for targeted drug delivery with nanoparticles to suppress cancer cells in vitro and tumors in animals in vivo, to inhibit the growth of lung metastases of aggressive melanoma.

ThSYC-30 13:00-13:15
Gold nanorods-based oligonucleotides carrier quantitative characterisation
H.J. Łaszewski[1,3], B. Palpant[2], M. Buckle[1], C. Nogues[1]; [1]LBPA UMR CNRS[8]113, ENS Paris-Saclay, [2]LPQM UMR CNRS[8]537, CentraleSupélec, France
Gold nanorods are attracting a lot of attention due to their extraordinary optical properties, and potential use for medical applications. The issue of the attachment of double stranded oligonucleotides onto GNR surfaces is crucial for the development of quantitative DNA/RNA delivery carried by GNRs. This work presents a fluorescence-based characterisation method for assessing the attachment of dsDNA to GNR surfaces.

ThSYC-31 13:15-13:30
Prospective of Laser-Induced Fluorescence as a Non-Invasive Tool for Ecotoxicological Assessments
A.B. Utkin[1,2], B. Duarte[3], M.T. Cabrita[4]; [1]INOV INESC Inovação, Lisbon, Portugal; [2]CeFEMA, Universidade de Lisboa, Lisbon, Portugal; [3]MARE-FCUL, Universidade de Lisboa, Lisbon, Portugal; [4]CEG-IGOT, Universidade de Lisboa, Lisbon, Portugal
This work reports preliminary results of the application of the laser-induced fluorescence technique to ecotoxicological assessments. The research is focused on the investigation of manifestation of the trace-element stress in the fluorescence emission spectra of photosynthetic pigments in marine phototrophs.

SY: Section C. Photonics and Nanobiotechnology

14:30 - 16:30
Session Chairs:
P.I. Nikitin, A.M.Prokhorov General Physics Inst., RAS, Russia
V. Shipunova, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

ThSYC-32 14:30-15:00
Fluorescence time-resolved spectroscopy and macroscopy of tumors *(Invited paper)*
V. Shcheslavskiy[1,2], M. Shirmanova[2], M. Lukina[2], E. Kiseleva[2], A. Gavrina[2], W. Becker[1]; [1]Becker&Hickl GmbH, Germany; [2]Privolzhsky Research Medical Univ., Russia
We present the approaches based on time-resolved luminescence signals recorded by time-correlated single photon counting for investigation of tumors. The combination of different techniques allows to probe both surface of tumors on a macroscale and their internal layers. The experiments deliver information about metabolism and oxygenation of tumors.

ThSYC-33 15:00-15:30
Exploring tumor-stroma interactions using combined autofluorescence and SHG imaging *(Invited paper)*
M.V. Shirmanova[1], M.M. Lukina[1], N.I. Druzhkova[1], V.V. Dudenkova[1], A.I. Gavrina[1], V.E. Zagainov[2], N.I. Ignatova[1], E.V. Zagaynova[1]; [1]Privolzhsky Research Medical Univ.; [2]Privolzhsky Federal District Medical Center, Russia
We present the results of investigation of metabolic activity of cancer cells and fibroblasts and structure of collagen in 3D model in vitro and mouse tumors in vivo. The metabolism was assessed using fluorescence lifetime imaging of the metabolic cofactor NAD(P)H. Second harmonic generation (SHG) imaging was used to analyze the extent and properties of collagen.
This research was supported by RFBR Grant(s) # 17-00-00193

ThSYC-34 15:30-16:00
Acoustic detection of nanoparticle structural stability in physiological media after their laser irradiation *(Invited paper)*
I.V. Zelepukin[1,2], A.A. Popov[1], A.V. Kabashin[1,3], S.M. Deyev[1,2], A.V. Zvyagin[1,4,5]; [1]National Research Nuclear Univ. MEPhI, Russia; [2]Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia; [3]Aix Marseille Univ, CNRS, LP3, France; [4]Sechenov First Moscow State Medical Univ., Russia; [5]ARC Centre of Excellence for Nanoscale BioPhotonics, Macquarie University, Australia
Here we present a method of photoacoustic detection of nanoparticle degradation. To validate the method we used biodegradable silicium nanoparticles, which can absorb light in the Uv-Vis region and generate acoustic waves in response. The photoacoustic method allows measuring kinetic of their degradation in real-time with high limit of detection up to a hundred ng of particles.
This research was supported by RFBR Grant(s) # 19-29-04012

ThSYC-35 16:00-16:15
Hybrid plasmonic-SERS based biosensing
S. Po[1], M.P. Carmo[1], M. Zhao[1], S. Anguiano[2], M.L. Guyon[2], A. Reynoso[2], E. Cortes[3], S. Maier[3], A. Fainstein[2], L. Pedano[2], A. Rakovich[1]; [1]King's College London, UK, [2]Centro Atomico Bariloche, CNEA, Argentina, [3]Ludwig Maximilian Univ. of Munich, Germany
Providing a fast, reliable, and sensitive alternative to methods of detecting and characterising analytes in solution will be invaluable to the healthcare services. We present a method to simultaneously acquire qualitative and quantitative information for a sample, combining SERS and surface plasmonic resonance. The method is based on the use of a plasmonic substrate consisting of a metallic nanoparticle-on-a-film geometry.

ThSYC-36 16:15-16:30
Plasmon resonance enhanced nontoxic nanoagents for in vivo detection of antibiotic resistant bacteria.
E.L. Kolychev[1,2], A. Ringaci[1], A.A. Kotov[1], K.G. Shevchenko[1,2], M.P. Nikitin[1]; [1]Moscow Inst. of Physics & Technology (National Research University), [2]Prokhorov General Physics Inst. RAS, Russia
The rapid progress in the development of methods for the study of biological systems determines the interest in synthesis of optical labels for effective marking of pathogens. The conjugation of magnetic gold-coated nanoparticles and quantum dots was performed using polymeric coatings, which are applied to design of brighter agents and can be used for detection and eradication of pathogens.

SY: Section C. Photonics and Nanobiotechnology

17:00 - 17:30
Session Chairs:
P.I. Nikitin, A.M.Prokhorov General Physics Inst., RAS, Russia
V. Shipunova, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

ThSYC-37 17:00-17:15
High performance fiber plasmonic sensor based on hyperbolic metamaterials
Hu Shiqi, Chen Yu, Liu Guishi, Zhu Wenguo, Zheng Huadan, Chen Yaofei, Xiaoping Zheng, Dong Cao, Luo Yunhan, Chen Zhe; [1]Key Laboratory of Optoelectronic Information and Sensing Technologies of Guangdong Higher Education Institutes, Jinan Univ., [2]Department of Optoelectronic Engineering, Jinan Univ., [3]Rocketech Technology Corp. ltd., [4]Tsinghua Univ., China
We propose and investigate a plasmonic sensor based on a side-polished few-mode-fiber coated with a layered HMM, which is composed of the alternating layers of Ag and TiO2. The highest average sensitivity 5114.3 nm/RIU (RIU: refractive index unit) and the best average figure of merit of 182.0 RIU−1 at ρ=0.7 and Nbi= 3 are achieved.

ThSYC-38 17:15-17:30
Discovery of new luminescent materials using multi-channel parallel synthesis and laser heating strategy
Qian Liu, Jianding Yu, Zhehan Zheng, Xiaoke Xu, Zhenzhen Zhou; Shanghai Inst. of Ceramics CAS, China
This report focuses on an effective method or platform for fast discovery and optimization of inorganic phosphors by liquid-phase multi-channel parallel synthesis of micro/nano phosphors, including the solution injection method with in-situ mixing and drying functions for synthesizing micro/nano phosphor precursors, laser heating treatment, and luminescence property screening technologies, using multi-substituted YAG:Eu as an example.

SY: Section D. Photodynamic Processes in Biology and Medicine

09:00 - 11:00
Session Chair: *A. Krasnovsky, Bach Inst. of Biochemistry RAS, Russia*

ThSYD-04 09:00-09:30
In vitro combined effect of Doxorubicin and sulfonated zinc Phthalocyanine–mediated photodynamic therapy on MCF-7 breast cancer cells *(Invited paper)*
H. Abrahamse; Univ. of Johannesburg, South Africa
Findings from this study showed that combined treatment with doxorubicin and photodynamic therapy was more effective in inhibiting the proliferation and growth of MCF-7 cells. Overall, the results indicate that combination of smaller dose of doxorubicin with photodynamic therapy is a promising combined treatment strategy for breast carcinoma.

ThSYD-05 09:30-10:00
Infrared and visible fluorescence diagnosis for tracheobronchial malignancies *(Invited paper)*
G. Papayan, N. Kazakov, S. Goncharov, A. Strui, A. Akopov
A video endoscopy system intended for fluorescence-based imaging of the tracheobronchial tree in the visible (Vis) and near-infrared (NIR) regions of the spectrum is described.

ThSYD-06 10:00-10:30
Photodynamic therapy in the combined treatment of breast cancer intradermal metastases *(Invited paper)*
M. Gelfond, S. Kondratiev, E. Tkachenko, V. Semiglazov, T. Semiglazova, V. Ivanov, K. Usova, N. Brish; National Medical Research Center of Oncology of the Ministry of Health, Russia
Our experience with photodynamic therapy of intradermal metastases of breast cancer using a semiconductor matrix emitter has proven certain advantages of using this equipment.

ThSYD-07 10:30-11:00
Dynamics of patient-specific malignant cells death at photodynamic treatment in vitro *(Invited paper)*
A.A. Zhikhoreva[1], A.V. Belashov[1], N.A. Avdonkina[2], I.A. Baldueva[2], A.B. Danilova[2], M.L. Gelfond[2], T.L. Nekhaeva[2], I.V. Semenova[1], O.S. Vasyutinskii[1]; [1]Ioffe Inst.; [2]Petrov National Medical Research Center, Ministry of Health of Russia, Russia
We present experimental analysis of cell death dynamics at photodynamic treatment in vitro and reveal features specific for different tumor localizations and individual patients. The analysis is based on monitoring of post-treatment changes in cellular morphology being recorded by means of digital holographic microscopy.

SY: Section D. Photodynamic Processes in Biology and Medicine

11:30 - 13:30
Session Chair: *A. Krasnovsky, Bach Inst. of Biochemistry RAS, Russia*

ThSYD-08 11:30-12:00
Laser-spectroscopic methods, devices and tools for precise diagnosis, treatment and intraoperative navigation in oncology *(Invited paper)*
V.B. Loschenov; Prokhorov General Physics Inst. RAS, Russia
Laser spectroscopic methods, instruments and tools are among the most promising for non-invasive precision monitoring of vital parameters of biological tissue with a quantitative assessment. They are in particular demand when creating new clinical technologies for the removal and postoperative prevention of relapses of malignant tumors. This work was supported by RFBR, № 17-00-00159.
This research was supported by RFBR Grant(s) # 17-00-00159

ThSYD-09 12:00-12:30
Mechanisms of shungite nanocarbon interactions with biological molecules *(Invited paper)*
N.N. Rozhkova[1], A.S. Goryunov[2], S.S. Rozhkov[1]; [1]Inst. of Geology Karelian Research Center RAS, [2]Inst. of Biology Karelian Research Center RAS, Russia
Shungite carbon nanoparticles interaction with albumin has been studied in aqueous dispersion regarding structural-dynamic, thermodynamic, and hydrodynamic effects. Investigation of the effects and understanding of the fundamental mechanisms of interactions of graphene-based carbon, with biological molecules are of primary importance both with respect to the biomedical aspects concerning the regulation of binding and transportation of ligands by proteins.
This research was supported by RFBR Grant(s) # 18-29-19150_mk

ThSYD-10 12:30-13:00
Time-resolved microscopy and photo-mechanical action on bio-related objects *(Invited paper)*
G. Ferrini[1,2]; [1]Interdisciplinary Laboratories for Advanced Materials Physics (I-LAMP), Università Cattolica del Sacro Cuore, [2]Dipartimento di Matematica e Fisica, Università Cattolica del Sacro Cuore, Italy
The techniques to excite and detect mechanical transients in nanostructures using time-resolved microscopy are briefly reviewed. This research is of importance for photodynamic processes that exploit the photo-mechanical action directly on bio-objects or on nanostructures that have diagnostic or therapeutic interest in biology and medicine.

ThSYD-11 13:00-13:30
Experimental study of cell damage induced by ultrashort laser pulses at 1040nm in scanning nonlinear optical microscopy *(Invited paper)*
B. Talone[1], D. Viola[1], C. Camassa[1], E. Jacchetti[2], M. T. Raimondi[2], G. Cerullo[1], D. Polli[1]; [1]Department of Physics, Politecnico di Milano, [2]Department of Chemistry, Materials and Chemical Engineering, Politecnico di Milano, Italy
Experimental study on vital HeLa cells performed to establish the damage threshold induced by sub-200-fs laser pulses at 1040 nm wavelength and 80-MHz repetition rate for nonlinear optical microscopy applications. We analyzed its dependence on laser power, spot size on the sample, pixel dwell time and light exposure modality, with an in-depth analysis on the mechanism of photothermal damage.

SY: Section D. Photodynamic Processes in Biology and Medicine

14:30 - 16:30
Session Chair: *Natalia Rozhkova, Inst. of Geology Karelian Research Center RAS, Russia*

ThSYD-12 14:30-15:00
Oxygen activation in aerated solvents by red and infrared laser radiation: measurement of the absorption spectra of dissolved oxygen molecules *(Invited paper)*
A.A. Krasnovsky, A.S. Kozlov, A.S. Benditkis, S.E. Goncharov; Federal Center for Biotechnology, Bach Inst. of Biochemistry RAS, Russia
With a goal of modelling biological and therapeutic action of lasers, oxygen activation was studied in aerated organic solvents under irradiation by lasers in the wavelength range 600 – 1300 nm using chemical trapping and phosphorescence of singlet oxygen. Different mechanism of singlet oxygen production were revealed. The absorption spectra of dissolved oxygen were obtained.
This research was supported by RFBR Grant(s) # 19-04-00331

ThSYD-13 15:00-15:30
Visible light sensitized bactericidal structures based on titania nanoparticles and quantum dots *(Invited paper)*
A. Orlova[1], E. Kolesova[1], A. Makovetskaya[1], A.Dubavik[1], Y. Gun'ko[2], V. Maslov[1], V. Oleinikov[3], S. Sizova[3], O. Efremenkova[4]; [1]ITMO Univ., Russia; [2]TCD, Ireland; [3]Shemyakin–Ovchinnikov Inst. of Bioorganic Chemistry, Russia; [4]FSBI Gause Inst. of New Antibiotics, Russia
Hybrid structures based on Titania Nanoparticles and three types of CdSe Quantum Dots were formed. Luminescence of QDs and ROS generation of Titania NPs were studied. We show that hybrid structures based on 2.5 nm core CdSe QDs exposed by visible light inhibits the growth of Escherichia coli, Bacillus subtilis and Mycobacterium smegmatis, but not Staphylococcus aureus and Pseudomonas aeruginosa.

ThSYD-14 15:30-16:00
Photophysical aspects of corneal cross-linking. Challenges and prospects *(Invited paper)*
V.A. Serebryakov[1], E.V. Boiko[2,3], V.G. Maslov[4], M.V. Melekhova[2], G.V. Papayan[5,6], T.K. Krisko[1]; [1]Vavilov State Optical Inst.; [2]Fyodorov "Eye Microsurgery" Federal State Institution, St. Petersburg Branch;[3] Kirov Military Medical Academy of the Russian Ministry of Defense; [4]ITMO Univ.; [5]Pavlov First Saint Petersburg State Medical Univ.; [6]Almazov National Medical Research Center, Russia
The review report considers various aspects of cross-linking of the cornea, mainly concerning the photophysical processes occurring in it, including comparison of cross-linking with photodynamic therapy. This approach allowed us to conduct a deeper analysis of cross-linking processes, evaluate problems and justify (verify) the prospects for increasing efficiency and reducing the duration of the treatment procedure.

ThSYD-15 16:00-16:15
Application of digital holographic and fluorescence microscopy for investigation of live cells response to photodynamic treatment using Radachlorin photosensitizer
A.V. Belashov[1], A.A. Zhikhoreva[1], T.N. Belyaeva[2], E.S. Kornilova[2], I.V. Semenova[1], O. S. Vasyutinskii[1]; [1]Ioffe Institute, Russia; [2]Institute of Cytology RAS, Russia
In this paper we present analysis of living cells response to photodynamic treatment using Radachlorin photosensitizer. Its accumulation in cells was controlled using fluorescence microscopy. Digital holographic microscopy was applied for monitoring cells response to photodynamic treatment at different doses. The results obtained can be used for estimation of cells resistivity to intracellularly generated reactive oxygen species.

ThSYD-16 16:15-16:30
Nanodrug conjugate improves photodynamic action on lung cancer stem cells
A. Crous, H. Abrahamse; Univ. of Johannesburg, South Africa
Effects of a newly synthesized nanobioconjugate (NBC) composed of AuNPs, Ab (CD133 IgG) and PS, Al (III) Phthalocyanine Tetrasulfonic Acid (AlPcS4Cl) on lung CSCs have been evaluated

SY: Section D. Photodynamic Processes in Biology and Medicine

17:00 - 19:00
Session Chair: *Natalia Rozhkova, Inst. of Geology Karelian Research Center RAS, Russia*

ThSYD-17 17:00-17:30
Investigation of anisotropic relaxation in excited biomolecules in the pico- and subpicosecond time domain *(Invited paper)*
O.S. Vasyutinskii; Ioffe Inst., Russia
The results of experimental and theoretical studies of energy transfer processes in excited states of several important biologically relevant molecules under excitation with ultrashort laser pulses are presented. As shown, investigation of polarized molecular fluorescence decay and anisotropic transient signals allows for determination of new important information on energy transfer processes in excited molecules and on interaction with microenvironment.
This research was supported by RFBR Grant(s) # 18-03-00038a

ThSYD-18 17:30-17:45
Comparative study of the photocatalytic and bactericidal properties of coatings based on metal oxides nanoparticles
S.K. Evstropiev[1], I.V. Bagrov[2], A.N. Baranov[2], I.M. Belousova[2], K.V. Dukelskii[1,3,4], A.V. Karavaeva[5], V.M. Kiselev[2], N.V. Nikonorov[1]; [1]ITMO Univ., [2]Vavilov State Optical Inst., [3]Bonch-Bruevich St. Petersburg State Univ. of Telecommunications, [4]Vavilov State Optical Institutes, Research and Production Association, [5]St. Petersburg State Chemical-Pharmaceutical Academy, Russia
In this work a comparative study of the photocatalytic and bactericidal properties of coatings on a glass surface based on metal oxides nanoparticles, prepared by the polymer-salt method and using thermal evaporation are given.

ThSYD-19 17:45-18:00
Antibacterial effectiveness of polycationic photosensitizers based on synthetic bacteriochlorins in vivo and in vitro
E.V. Akhlyustina[1], Yu. S. Zhizhimova[2], N.I. Philipova[2], G.A. Meerovich[1,3], I.G. Tiganova[2], E.A. Makarova[4], E.A. Lukyanets[4], Yu.M. Romanova[2], V.B. Loschenov[1,3]; [1]National Research Nuclear Univ. MEPhI, [2]Gamaleya National Research Center of Epidemiology and Microbiology, [3]Prokhorov General Physics Inst. RAS, [4]Organic Intermediates and Dyes Inst., Russia
Photodynamic inactivation (PDI) is able to effectively destroy bacterial cells without developing resistance in response to treatment. The study of antibacterial properties of new photosensitizers (PS) based on polycationic synthetic bacteriochlorins showed their high efficiency in photodynamic inactivation of bacteria and biofilms P. aeruginosa. In animal model APDT with (3-PyBrE)4BCBr4 significantly reduced the time of wounds healing.

ThSYD-20 18:00-18:15
Polarized fluorescence in NADH in water/methanol solutions upon excitation with femtosecond laser pulses
I.A. Gorbunova[1], M.E. Sasin[1], N.O. Bezverkhnii[1], J. Rubayo-Soneira[2], O. S. Vasyutinskii[1]; [1]Ioffe Inst., Russia; [2]InSTEC, Univ. of Havana, Cuba
We studied polarized fluorescence in NADH in water-methanol solutions of various concentrations upon two-photon excitation with femtosecond laser pulses. Fluorescence lifetimes, pre-exponential weight coefficient ratio, rotational diffusion times, and anisotropies have been determined from experiment. The results obtained have been analyzed and compared with those reported earlier elsewhere.
This research was supported by RFBR Grant(s) # 18-53-34001

ThSYD-21 18:15-18:45
Synthesis of core-shell ternary quantum dots - porphyrin conjugates and its photodynamic therapy application *(Invited paper)*
S.O. Oluwafemi; Univ. of Johannesburg, South Africa
Porphyrins are photosensitisers used in photodynamic therapy (PDT) due to their tumour localisation and in situ singlet oxygen generation. However, their limited absorption and aggregation in an aqueous medium affect their effectiveness in PDT. In this presentation, synthesis of ternary quantum dots and its conjugation to porphyrin as an efficient way to overcome photosensitizer shortcoming will be discussed.

ThSYD-22 18:45-19:00
Dual-wavelength fluorescence imaging for photodynamic therapy planning and monitoring
A.V. Khilov[1], D.A. Kurakina[1], E.A. Sergeeva[1], M.A. Shakhova[1,2], A.G. Orlova[1], A.M. Mironycheva[2], A.S. Malygina[2], I.V. Turchin[1], I.L. Shlivko[2], M.Yu. Kirillin[1]; [1]Inst. of Applied Physics RAS, [2]Privolzhsky Research Medical Univ., Russia
We report on perspectives of dual-wavelength fluorescence imaging at 405 nm and 660 nm for PDT procedure assistance aimed at evaluation of chlorin-based photosensitizer accumulation depth for both topical administration and intravenous injection. The study includes Monte Carlo simulations, experiments on tissue phantoms and laboratory animals, and clinical monitoring.
This research was supported by RFBR Grant(s) # 17-15-01264П

SY: Section A. Advanced Laser Medical Systems and Technologies

TuSYA-p01

Thermo-mechanical mechanism of laser-assisted microstructure alteration in cartilaginous tissue

O.I. Baum, E.M. Kasianenko; Inst. of Photonic Technologies, FSRC "Crystallography and Photonics" RAS, Russia

The problem of laser-induced occurrence of thermal stress fields in biological tissues, pore formation and further regeneration have been investigated. Theoretical model predicting the laser mode allowed establishing optimal laser setting for avascular tissue form-correction and cell regeneration due to structure micro-modification have been constructed.

This research was supported by RFBR Grant(s) # 18-29-02124

TuSYA-p02

New laser technology for open-angle glaucoma treatment

O.I. Baum[1], E.M. Kasianenko[1], A.A. Gamidov[2], O.V. Khomchik[2], P.D. Gavrilina[3]; [1]Inst. Photonic Technologies of FSRC "Crystallography and Photonics" RAS, [2]Research Inst. of Eye Diseases, [3]Sechenov First Moscow State Medical Univ., Russia

A positive effect of laser exposure on biological tissue is achieved, as a rule, in a narrow range of laser parameters. In this investigation the theoretical model predicting the laser mode allowed establishing optimal laser setting for treatment of glaucoma with different initial intraocular pressure in glaucomatous eyes is presented.

This research was supported by RFBR Grant(s) # 20-02-00486 A

TuSYA-p03

Numerical modeling of heating of the skin of different phototypes of the dual-wavelengths copper vapor laser radiation

S.B. Topchiy[1], A.E. Pushkareva[2], S.V. Klyuchareva[3]; [1]Lebedev Physics Inst. RAS; [2]ITMO Univ.; [3]Mechnikov North-West State Medical Univ., Russia

The purpose of this study was to develop a computer simulation that demonstrates how the effect of dual-wavelengths CVL selective heating of photoactive chromophores will change for different skin phototypes. The change of the ratio at the CVL wavelengths allows for varying the degree of selective heating of the pigment and the vascular component associated with pigmentation processes

TuSYA-p04

The use of the multi-wave laser medical device "Livadia" for the treatment of inflammation of the epithelial pilonidal cyst in children and adults

O.V. Tikhonevich[1], A.A. Sirotkin[1], G.P. Kuzmin[1], N.E. Gorbatova[2], A.V. Brynsev[2], M.A. Dvornikova[2], A.G.Kuzmina[3], V.P. Kurilov[3]; [1]Prokhorov General Physics Inst. RAS, [2]Inst. of Emergency Children's Surgery and Traumatology, [3]Pushkino Regional Clinical Hospital named after prof. Rozanova, Russia

The multi-wave laser medical device "Livadia" for bactericidal and therapeutic effects on the affected areas of the body was developed at the A.M. Prokhorov Institute of General Physics RAS. The "Livadia"device has been successfully used for interoperative laser therapy and treatment of postoperative wound complications of epithelial pilonidal cysts in adults and children.

TuSYA-p05

Laser surgical apparatus for precision tissue dissection, with the possibility of controlled hemostasis

O.V .Tikhonevich[1], A.A .Sirotkin[1], G.P. Kuzmin[1], N.E. Gorbatova[2]; [1]Prokhorov General Physics Inst. RAS, [2]Inst. of Emergency Children's Surgery and Traumatology, Russia

In this work, we present a laser surgical apparatus for precision dissection of tissues, with the possibility of controlled hemostasis, without thermal damage to tissue structures adjacent to the operating area, and with simultaneous antibacterial effect on the pathogenic wound flora. The laser medical device contains two laser emitters with wavelengths of about 2.7-3 microns and 520-585 nm, respectively.

TuSYA-p06

Development of a laser medical device for the selective removal of pathological vascular structures

O.V. Tikhonevich[1], A.A. Sirotkin[1], N.E. Gorbatova[2], G.P. Kuzmin[1], M.V. Remennikova[3], D.A. Seleznev[4]; [1]Prokhorov General Physics Inst. RAS; [2]Inst. of Emergency Children's Surgery and Traumatology; [3]Perm Federal Research Center UB RASa; [4]Perm Scientific Production Instrument-Making Company, Russia

A laser medical device based on a system of laser diodes with a wavelength of 520-524 nm and a power of more than 3 W has been developed. A laser medical device is designed for selective photodestruction of vascular formations of the skin and subcutaneous tissue.

TuSYA-p07

Effect of high-power pulses of terahertz radiation on cell viability

D.S. Sitnikov[1,2], I.V. Ilina[1], V.A. Revkova[3], M.A. Konoplyannikov[3,4], V.A. Kalsin[3], V.P. Baklaushev[3]; [1]Joint Inst. for High Temperatures RAS, [2]Moscow Inst. of Physics and Technology, [3]Federal Research and Clinical Center of Specialized Medical Care and Medical Technologies of FMBA of Russia, [4]Inst. for Regenerative Medicine, Sechenov Univ., Russia

Here we present the results of studying the viability of human skin fibroblasts exposed to high-power pulses of THz radiation with peak intensity and electric field strength of 32 GW/cm^2 and 3.5 MV/cm for 90 minutes. Activation of the cascade of proapoptotic enzymes (not leading to cell apoptosis) and inhibition of the ROS action on cells were found.

This research was supported by RFBR Grant(s) # 19-02-00762

TuSYA-p09

Laser radiation - ultrasound converters with colloidal coating of the optical fiber distal tip by a single layer of transparent spheres

V. Kamensky, V. Kazakov, V. Bredikhin, A. Pikulin, N. Bityurin; Inst. of Applied Physics RAS, Russia

Optical-acoustic radiation converters on base of optical fibre microsphere coating is problem. 1. Use 0.96 μm spheres, fibre Ø 1 mm. Distilled water is medium. Laser: λ=1.064 μm; 300 ns pulses. 2. 200 μm glass spheres coating. Laser λ = 0.532 μm, impulse 15 ns. The media: water - ink solution α ≈ 100 cm-1 .

This research was supported by RFBR Grant(s) # 18-02-00806a

TuSYA-p10

Opto-thermal fiber guide converter for laser surgery

N.M. Bityurin[2], V.I. Bredikhin[2], V.A. Kamensky[2], O.S. Streltsova[1], Grebenkin[1], V.V. Elagin[1]; [1]Privolzhsky Research Medical Univ., [2]Inst. of Applied Physics RAS, Russia

High temperature opto-thermal fiber converter for laser surgery based on absorbing coating (SAC): Soft tissue, tumor; SAC laser animal surgery technique for the resection of tumors; Urinary stones partitioning; Calculus density stones were fragmented effectively; Temperature regimes, morphological, thermometric data suggest SAC safety for controlled fragmentation of urinary calculi.

This research was supported by RFBR Grant(s) # 18-02-00806a

TuSYA-p11

Optical conveyor for targeting delivery

Zhen Che[1], Yaoming Huang[1], Jianhui Yu[1], Xiaoping Zheng[4], Dong Cao[2], Zhe Chen[1,2,3]; [1]Jinan Univ.; [2]Rocketech Technology Corp. Ltd.; [3]SUNLUX IOT Technology (Guangdong) Inc.; [4]Tsinghua Univ., China

We demonstrated a cost-effective optical conveyor for the transverse confinement and the longitudinal targeting delivery of microparticles.

TuSYA-p12

Self-mixing laser interferometry in medical diagnostics

An.V. Skripal, S.Yu. Dobdin, A.V. Dzhafarov; Saratov State Univ., Russia

We have shown the possibility of using self-mixing laser systems to measure the parameters of eyeball movements, such as tremor and saccades. The possibility of using a self-mixing laser to determine the shape of the pulse wave of the human radial artery is shown. The characteristics of the eardrum oscillations in normal and sensorineural hearing loss were studied.

TuSYA-p13

High-power narrow-band laser for SEOP applications

A.G. Putilov[1,2], A.A. Antipov[1,2], A.E. Shepelev[1], A.V. Osipov[1,2]; [1]ILIT RAS - Branch of FSRC "Crystallography and Photonics" RAS; [2]Vladimir State Univ., Russia

Abstract — This paper consider the possibility of the high-power solid-state laser creating using dispersive elements in a cavity for the excitation of rubidium atoms and further realization of the Spin-Exchange Optical Pumping (SEOP) method resulting in the hyperpolarization of the Xenon atoms.

This research was supported by RFBR Grant(s) # 19-29-10022

WeSYA-p14

Mathematical model of weld formation during laser welding of biological tissues

D.I. Ryabkin[1], A.Y. Gerasimenko[1,2]; [1]National Research Univ. of Electronic Technology, [2]Sechenov First Moscow State Medical Univ., Russia

Mathematical model of weld formation during laser welding of biological tissues is proposed. The model allows to evaluate the weld depth depending on the solder component composition and the laser radiation power density. According to the proposed model, numerical calculation of the weld depth was carried out using solders based on bovine serum albumin, indocyanine green and single-walled carbon nanotubes

WeSYA-p15

Laser formation of nanocomposites with electrically conductive carbon nanotubes networks

N.A. Demidenko[1], N.G. Cherepanova[2], A.E. Semak[2], V.N. Bychkov[2], A.S. Komarchev[2], A.Yu. Gerasimenko[1,3]; [1]National Research Univ. of Electronic Technology; [2]Russian State Agrarian Univ. - Moscow Timiryazev Agricultural Academy; [3]Sechenov First Moscow State Medical Univ., Russia

Electrically conductive networks were formed by laser welding of carbon nanotubes in nanocomposite. An in vivo study of the biocompatibility showed that carbon nanotubes do not have a pathological effect on the morphology of living cells and tissues, also enhance the proliferation of fibroblasts and stimulate the growth of connective and muscle tissue.

WeSYA-p16

Characterization of nanoparticle emission during laser cladding with stainless steel powder

A. Nagy[1], Sz. Kugler[1], I. Kreisz[2], A. Czitrovszky[1]; [1]Wigner Research Centre for Physics, [2]Lasram Engineering Ltd., Hungary

Different measurement methods and instruments ware used to characterize the properties of the generated smoke while building-up a part from different stainless steel alloy powders with powder-based laser cladding technique. The generated smoke contains a considerable amount of ultrafine particles.

WeSYA-p17

Laser induced endogenous fluorescence of skin lipofuscin in patients suffering from keloid scars

I.A. Raznitsyna[1], V.V. Andreeva[2], A.A. Gerzhik[1], M.B. Makmatov-Rys[1], D.A. Rogatkin[1], D.A. Kulikov[1], A.M. Sipkin[2]; [1]Laboratory of Medical and Physics Research, Moscow Regional Research and Clinical Institute "MONIKI"; [2]Department of Facial-Maxilla Surgery, Moscow Regional Research and Clinical Institute "MONIKI", Russia

During investigation of endogenous fluorescence of different types of cicatricial deformities in vivo unexpected results on fluorescence of lipofuscin were obtained. Increased lipofuscin fluorescence was detected in both scar and intact tissues in patients suffering from the keloid scar.

WeSYA-p18

Laser spectrometry of living beings – a system of non-invasive express control methods, early diagnosis and remote monitoring of human elemental status and environmental safety

A.V.Agrafenin[1], A.A.Kuznetsov[2], N.V.Volkova[2]; [1]SciAps Russia Ltd, [2]Omsk State Transport Univ., Russia

Monitoring the bioelement status of living creatures allows us to assess the imbalance in the content of bioelements. Laser spectrometry has received new development due to the improvement of technical means, the emergence of new methods of quantitative analysis using virtual standards. An integrated monitoring approach using mobile spectral instruments is important for monitoring health and safety.

WeSYA-p19

Continuous phase-shifting holographic microscopy in turbid media

G.S. Kalenkov[1], S.G. Kalenkov[2]; [1]Inst. of Geosphere Dynamics RAS; [2]Moscow Polytechnic Univ., Russia

The principal possibility of holographic registration of diffraction fields of micro-objects that passes through a turbulent medium is shown.

TuSYA-p20

Comparison of the results of endovenous laser coagulation (EVLC) using 2-μm radiation and various types of fiber

S.A. Artemov, A.N. Belyaev, O.S. Bushukina, S.A. Khrushchalina, S.V. Kostin, A.A. Lyapin, P.A. Ryabochkina, A.D. Taratynova; National Research Mordovia State Univ., Russia

The results of in-vivo experiments on endovenous laser coagulation (EVLC) using 2-μm radiation and various types of fiber are presented. It was found that the use of a radial fiber with a cylindrical diffuser (forming thin ring) leads to deeper and irreversible damage to the vein compared to a radial fiber with a circular scattering diagram (forming thick ring).

This research was supported by RFBR Grant(s) # 18-29-20039

SY: Section B. Laser Interaction with Cells and Tissues: Clinical Imaging and Spectroscopy

TuSYB-p01

Two approaches in Monte Carlo simulation of laser light transport in turbid biological media

A.P. Tarasov, D.A. Rogatkin; Moscow Regional Research and Clinical Inst. "MONIKI", Russia

Two sets of Monte Carlo simulations of laser light transport in turbid biological media with two different absorption accounting approaches were compared. It was found that the classical approach, which suggests photon termination following the absorption event, is more preferable than another one, which implies photon weighing, at small source-detector distances.

TuSYB-p02

Acceleration of Monte Carlo simulation of light transport in tissues using disk-detector geometry in the backscattering problem

A.P. Tarasov; Moscow Regional Research and Clinical Inst. "MONIKI", Russia

A simple and effective method for acceleration of Monte Carlo simulations of light transport in tissues is considered in the backscattering geometry. It is proposed to replace a conventional square detector with a disk-shaped one. This is applicable when a turbid medium is azimuthally homogeneous with respect to the light source and effective at large source-detector separations.

TuSYB-p03

Comparative study of different types of fixed histological samples using digital holographic microscopy

A.A. Zhikhoreva, A.V. Belashov; Ioffe Inst., Russia

We present result of digital holographic microscopy for investigation of optical properties of various fixed histological samples. It was shown that various types of tissues introduce significantly different patterns of phase shift in the object wave. Further analysis of these patterns can be used for estimation of their optical properties which may be related with physiological characteristics of the tissues.

TuSYB-p04

Skin optical spectroscopy – diagnostics of cancerous and degenerative diseases

E. Borisova[1,2], Ts. Genova[1], V. Mircheva[1], S. Ilyov[1], L. Zakharieva[1], D. Ivanov[1], A. Gisbrecht[1], L. Avramov[1], I. Lihachova[3], A. Lihachovs[3], J. Spigulis[3], I. Bratchenko[4], O. Myakinin[4], V. Zakharov[4], I. Terziev[5], P.Troyanova[5]; [1]Inst. of Electronics, Bulgarian Academy of Sciences, Bulgaria; [2]Saratov State Univ., Russia; [3]Inst. of Atomic Physics and Spectroscopy, Univ. of Latvia, Latvia; [4]Samara National Research Univ., Russia; [5]University Hospital "Tsaritsa Yoanna – ISUL", Bulgaria

Fluorescence, diffuse-reflectance and Raman scattering spectroscopies are integrated in a common multispectral tool, to obtain original experimental data on spectral properties of cutaneous lesions, with subsequent development of algorithms of diagnostics and differentiation of skin pathologies. Cancerous and degenerative cutaneous lesions are investigated to obtain broad picture of spectral properties of skin pathologies leading to severe damages and health problems.

TuSYB-p05

Reconstruction of optical parameters for blood plasma pellets using pulse terahertz holography method

E.L. Odlyanitskiy[1], M.S. Kulya[1], Q. Cassar[2], I.A. Mustafin[3], V.N. Trukhin[3], D.V. Korolev[4], Y.V. Kononova[4], P. Mounaix[2], J.P. Guillet[2], N.V. Petrov[1], O.A. Smolyanskaya[1]; [1]ITMO Univ., Russia; [2]Univ. of Bordeaux, France; [3]Ioffe Inst., Russia; [4]Almazov National Medical Research Centre, Russia

This work describes the possibility for reconstructing the optical properties of a biological object using terahertz pulse time-domain holography method. Pellets made from sublimated blood plasma were used as samples. Eventually, we created a convenient model that based on experimentally measured THz fields. Using this model, it is possible to reconstruct spatial distributed and frequency-dependent optical characteristics.

This research was supported by RFBR Grant(s) # 17-00-00275, 17-00-00272

TuSYB-p06

Determination of egg yolk optical properties at various temperatures using modified integrating spheres method

T.K. Karpova[1], N.V. Kovalenko[1], G.A. Aloian[1], D.M. Mukhankov[2], O.A. Ryabushkin[1,2]; [1]Moscow Inst. of Physics and Technology., [2]Fryazino branch of Kotelnikov Inst. of Radio-engineering and Electronics RAS., Russia

A modification of integrating spheres method was proposed, allowing to measure temperature dependencies of biological tissues optical properties. Measurements of absorption coefficient, scattering coefficient and anisotropy factor of an egg yolk were conducted at different temperatures.

TuSYB-p07

Sensitivity of the laser Doppler flowmetry and incoherent optical flowmetry to low-frequency blood flow oscillations

D.G. Lapitan, D.A. Rogatkin; Moscow Regional Research and Clinical Inst., Russia

The sensitivity of the laser Doppler flowmetry (LDF) and incoherent optical flowmetry (IOF) to blood flow oscillations was studied experimentally. IOF is a method of measuring the perfusion index from a raw photoplethysmographic signal. It was shown that the IOF is approximately 2-10 times more sensitive than LDF.

TuSYB-p08

Design of the acousto-optical system for laser trapping of microscopic particles

M.A. Vinogradov[1], A.A. Yablokova[1,2], P.A. Nosov[1]; [1]Bauman Moscow State Technical Univ., [2]Scientific and Technological Center of Unique Instrumentation RAS, Russia

We address the design and mathematical modeling of acousto-optical (AO) system for laser trapping of microscopic particles. We present an approach to theoretical calculation of the shape, intensity and trajectory of the light trap formed by AO deflection system. Theoretical calculation are confirmed by modeling and experiments.

This research was supported by RFBR Grant(s) # 18-38-20155

TuSYB-p09

Reversible immobilization for synthesis of barcoding particles

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Integration of FACS and DropSeq depends on identifiable barcoding carriers. Here, we describe road to fabrication such carriers using DNA-chip technology and microfluidic chips. This include magnetization procedure for any particle core; design and comparison of microfluidic chips with various magnetic traps, suitable for reversible immobilization and subsequent photochemistry; and successful particle on-chip immobilization and release procedures.

TuSYB-p10

The laser radiation pressure on nanocapsules (the ability to move)

N.G. Kokodii[1,2], S.V. Pogorelov[2], V.A. Timaniuk[2], I.V.Krasovskyi[2], [1]Karazin Kharkiv National Univ., [2]National Univ. of Pharmacy, Ukraine

The task of laser radiation pressure on hollow metal nanorods or carbon, which can be used as capsules for medicines is solved. It is possible to create a laser trap for targets with dimensions much smaller than the wavelength, in which can be placed on medication.

TuSYB-p11

Mobile laser device for express diagnostics of red blood cells size distribution

A.E. Lugovtsov[1], G.S. Kalenkov[2], A.E. Shtanko[3], V.D. Ustinov[1], P.S. Vinnikov[4], S.Yu. Nikitin[1], A.V. Priezzhev[1]; [1]Lomonosov Moscow State Univ.; [2]Inst. of Geosphere Dynamics; [3]MSTU "STANKIN"; [4]Moscow Polytechnic Univ., Russia

An express method, based on principles of laser diffractometry, for measuring the parameters of red blood cells size distribution, such as mean size and its dispersion, is proposed. The compact mobile device has been developed for registering diffraction patterns form blood smears and their automatic analysis.

This research was supported by RFBR Grant(s) # 17-29-03507ofi_m

TuSYB-p12

LED RGB transluminescence lighs sourse to improove cell migration imaging

M.E. Astashev[1], D.A. Serov[1], S.V. Gudkov[2]; [1]Inst. of Cellular Biophysics RAS, [2]Prokhorov General Physics Inst. RAS, Russia

RGB LED light source for phase contrast optical microscopy is introduced. Light source construction based on multimedia projector components makes it obtainable, affordable and repeatable. RGB light source was composed with LED, aspheric condenser lenses and dichroic cube. Images obtained with inverted microscope and digital camera. LED drivers were developed by the authors.

TuSYB-p13

Low-coherence reflectometry of coarse-grained random media

E.V. Ushakova, D.A. Zimnyakov; Yuri Gagarin State Technical Univ. of Saratov, Inst. of Precision Mechanics and Control RAS, Russia

A technique of low-coherence reflectometry is applied to characterization of coarse-grained random media such as evolving foamed liquids. An approach to acquired data analysis is based on the phenomenological model taking into account the decay of the integrated acquired signal with the increase of the transport mean free path of light propagation in a probed medium.

This research was supported by RFBR Grant(s) # 18-29-06024

SY: Section C. Photonics and Nanobiotechnology

TuSYC-p02

Modeling the mass transfer of ophthalmic drugs in soft contact lenses and polymeric hydrogels using laser interferometry technique

E.V. Dorofeeva[1], P.Yu. Lobanov[2], I.S. Manuylovich[2], O.E. Sidoryuk[2]; [1]Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, [2]Stelmakh "Polyus" Research Inst., Russia

The work is devoted to the creation of a technique for estimating the parameters of diffusion processes of drugs in soft contact lenses. Analysis of the mass transfer dynamics was carried out using monitoring of the wavefront distortions of radiation passing through the sample by means of laser phase-shifting interferometry

TuSYC-p03

Multimodal Magnetic Metal-Organic Framework Nanoparticles for Bioimaging and Gene Knockdown

A.V. Babenyshev[1], R.O. Melikov[2], V.R. Cherkasov[1], E.L. Kolychev[1]; [1]Prokhorov General Physics Inst. RAS; [2]Engelhardt Inst. of Molecular Biology RAS, Russia

Using hybrid nanomaterials with multimodal features allow designing advanced agents for targeted drug delivery and bioimaging. We constructed magnetic metal-organic framework nanoparticles optimized to transport small oligonucleotides and act as perspective nanoagents for fluorescent bioimaging and MRI-contrasting. The achieved combination of the optical features with high adsorption capacity is promising for construction of the novel types of theranostic systems.

This research was supported by RFBR Grant(s) # 19-33-70075

TuSYC-p04

Improve the accuracy temperature measurement of NaYF4:Er,Yb upconversion particle by calibration with refinement

E.A. Sagaidachnaya[1], V.I. Kochubey[1,2]; [1]Saratov National Research State Univ., [2]National Research Tomsk State Univ., Russia

Upconversion particles NaYF4:Er,Yb have prospects for application as thermal sensors. A method of increasing the accuracy of particle temperature measurement is proposed. The temperature measurement error decreased from 2.6 to 0.8 °C.

TuSYC-p05

Eu-based phosphorescence lifetime polymer nanothermometer

J.R. Shakirova[1], N.N. Shevchenko[2], S.P. Tunik[1]; [1]St. Petersburg State Univ.; [2]Inst. of Macromolecular Compounds, Russia

In this work, we synthesized a thermoresponsive luminescent europium complex that exhibits dual emission due to a ligand and a chromophore. To exclude the quenching of emitter by water, we incorporated the complex into amine-functionalized polymer nanoparticles by nanoemulsion polymerization. Such a nanothermometer demonstrated the reversibility of lifetime in cycling experiments and the ability to determine the temperature in vitro.

TuSYC-p06

Precise quantitative analysis of cell targeting by particle-based agents using imaging flow cytometry and deep learning object detection

I.A. Kotov[1], E.N. Mochalova[2], E.L. Kolychev[2]; [1]Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, [2]Prokhorov General Physics Inst. RAS, Russia

The method based on convolutional neural networks usage is developed for evaluation of particle-cell interactions. The imaging flow cytometry was used for automatic mining of important cell-particle interaction information. The developed method expands capabilities of spot counting applications in existing imaging techniques and allows to quantify particle-cell and cell-cell interactions.

This research was supported by RFBR Grant(s) # 19-33-70075

TuSYC-p07

Induced fluorescence techniques for plant phenotyping

A.B. Utkin[1,2], A. Cartaxana[3], A. Figueiredo[3], J. Marques da Silva[3]; [1]INOV INESC Inovação; [2]CeFEMA, Universidade de Lisboa; [3]BioISI-FCUL, Universidade de Lisboa, Portugal

A system for semi-automated plant phenotyping is being developed in Portugal within the framework of the INTERPHENO project from the EU Programme "Portugal 2020." As a part of this activity, we tested two induced fluorescence techniques based on the laser and flashlamp excitation to facilitate the recognition of plants and photosynthetic state assessment based on the emission spectra.

TuSYC-p08

The use of optical methods in the detection of nanostructures at different stages of fibrillation

N.R. Rovnyagina[1], G.S. Budylin[2], E.A. Shirshin[1,3]; [1]Lomonosov Moscow State Univ., [2]Inst. of Spectroscopy RAS, [3]National Research Inst. Higher School of Economics, Russia

This work is devoted to development of optical methods for detecting fibrillar nanostructures. Comparison of physical parameters obtained with the use of nanoparticle tracking analysis and fluorescence spectroscopy allowed not only to characterize the aggregation process, but also to draw a conclusion regarding the applicability of these approaches for detecting various fibrillar nanostructures in bioliquids.

TuSYC-p09

Surface-enhanced Raman spectroscopy of urine and plasma: study of background signal

N. Markina, A.V. Markin; Saratov State Univ., Russia

The report is dedicated to the study of SERS spectra of urine and blood plasma. These spectra are responsible for formation of the background signal during SERS-based therapeutic drug monitoring. The influence of various factors on these spectra is also studied and the ways to achieve the control over their intensity are proposed.

TuSYC-p10

Multi-parameter label-free biosensing with self-assembled smart biolayers that transform each sensing channel into a multiplex channel

A.V. Pushkarev, E.N. Mochalova, A.G. Burenin, N.V. Guteneva, P.I. Nikitin; Prokhorov General Physics Inst. RAS, Russia

Smart biomolecular layers that self-assemble on a sensor chip and can logically analyze a presence of several different molecules in the microenvironment to generate a response are developed and demonstrated. In contrast to conventional sensor chips for label-free biosensors, analyzing in each channel only one parameter, the channel with smart layer can analyze several parameters simultaneously.

This research was supported by RFBR Grant(s) # 18-29-09169

TuSYC-p11

Development of fluorescent nanoparticles and investigation of their biodistribution in living laboratory animals

A.V. Pushkarev, S.L. Znoyko, D.O. Novichikhin, N.N. Orlova, I.I. Kondrashov, B.G. Gorshkov; Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia

Nanoparticles are very promising for drug delivery in vivo. However, the factors that affect their biodistribution are yet to be understood. Here, we investigated biodistribution and pharmacokinetics of various fluorescently labelled nano- and microparticles using optical bioimaging.

TuSYC-p12

Photomodification of gold nanostars under nanosecond laser pulses

V.A. Khanadeev[1], S.A. Kushneruk[1,2], A.V. Simonenko[2], G.G. Akchurin[2,3], G.G. Akchurin[2,3], N.G. Khlebtsov[1,2]; [1]Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, [2]Saratov State Univ., [3]Inst. of Precision Mechanics and Control RAS, Russia

Gold nanostars with tunable plasmon resonance are a new type of gold nanoparticles used in laser-induced biomedical applications. We investigated the effect of nanosecond pulsed laser (1064 nm) on the photomodification of gold nanostars of various sizes using TEM and spectroscopy. Photomodification of gold nanostars strongly depends on the position of their plasmonic peak in the extinction spectrum.

TuSYC-p13

Photofragment angular momentum polarization in photolysis of planar molecules with polarized laser light: symmetry properties of the anisotropytransforming coefficients

B.V. Semak, A.A. Semenov, O.S. Vasyutinskii; Ioffe Inst., Russia

Symmetry properties of the anisotropy transforming coefficients describing spin and orbital angular momentum polarization of photofragments produced in photolysis of planar triatomic molecules with polarized laser light have been derived theoretically using the full quantum mechanical approach. The theoretical model was built that explains the results of recent experiments on ozone photolysis at 266 nm.

TuSYC-p14

Phosphorescent Pt(II)-peptide conjugates for cellular microscopy and neuroimaging

A.I. Solomatina[1], A.D. Slobodina[2], O.I. Bolshakova[2], S.V. Sarantseva[2], S.P. Tunik[1]; [1]St. Petersburg State Univ., [2]Konstantinov St. Petersburg Nuclear Physics Inst. of National Research Centre «Kurchatov Institute», Russia

Herein we report the synthesis, characterization of the structure, and photophysical properties of cyclometalated platinum(II) complexes [Pt(N^C)(PPh2(C6H4COOH))Cl] and their conjugates with blood-brain-barrier (BBB) penetrating peptide. Cell imaging and MTT cytotoxicity study of the conjugates was carried out on HeLa and ECV cell cultures. Neuroimaging experiments on Drosophila melanogaster reviled that the compounds penetrate BBB and distribute in the brain.

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TuSYC-p15

Influence of microenvironment on the optical properties of quantum dots based on InP/ZnS and CdSe/ZnS

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Optical properties of quantum dots based on InP and CdSe with organic shells were measured in different environment such as ions solutions and culture medium with serum. Several distinct patterns of luminescence lifetime changes were revealed depending on external factors applied. Besides, the luminescence lifetimes were investigated inside the cultured cells. The obtained data are important for correct biomedical applications.

TuSYC-p16

The evaluation of tumor vascularization as a prognostic factor of plasmonic phothothermal therapy efficiency

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The tumor vascularization in rats with transplanted cholangiocarcinoma was assessed by US power Doppler before plasmonic photothermal therapy (PPT). For PPT, the multiple intravenous injections of PEG-coated gold nanorods and irradiation by 808-nm NIR diode laser were used. We have shown that gold accumulation in tumor and PPT efficiency are associated with the degree of vascularization of a tumor.

TuSYC-p17

A facile synthesis, structural and triple-luminescence properties of a novel fluoroperovskite RbCaF3: Dy3+ phosphor for dosimetry and WLED applications

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Dysprosium activated Rubidium Calcium Fluoride phosphors were synthesized by solid state reaction method. Phase purity of the compound was analyzed by PXRD study. The Photoluminescence emission was obtained at 480 nm under the excitation of 388 nm and luminescence decay time was analysed. The thermoluminescence property of X-ray irradiated RbCaF3:0.6Dy3+ phosphor was analysed by TL reader and radioluminescence was recorded.

TuSYC-p18

Determination of the emitted particle characteristics of a dry powder inhaler using laser based optical measurement techniques

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The characteristics of particles emitted by a DPI depends on the pressure drop in the chamber determined by the inhalation parameters and the geometry of the device. Our aim was to study the effect of the breathing pattern and the presence of an upper airway on the MMAD. The lung deposition of the drug was determined with numerical simulations.

TuSYC-p19

Hybrid magnetic nanoparticles synthesized by the solvothermal method as promising agents for biomedical applications

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Magnetic nanoparticles and various hybrid magnetic nanostructures remain to be of great attention constituting an important class of promising functional compounds. Within the study, we carried out the spectrophotometric analysis of a wide range of core/shell nanoparticles obtained with the solvothermal synthesis in various media in relation to the plasmon properties of individual nanoparticles for their possible biomedical application.

TuSYC-p20

Biocompatible and highly luminescent quantum dots for bioimaging

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Methods for the synthesis of biocompatible and highly luminescent quantum dots are presented. Desirable spectral characteristics of quantum dots were achieved by fine tuning of reaction parameters. Quantum dots were functionalized with a number of biomolecules, synthesized materials were tested in vitro. Obtained results could be useful both in basic and applied research in which bioimaging methods are used.

This research was supported by RFBR Grant(s) # 19-33-51011

TuSYC-p21

pH-responsive iridium(III) complexes as potential probes in Phosphorescent Lifetime Imaging

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Herein we present the synthesis of phosphorescent iridium(III) complexes with emission lifetime response to pH value in the physiologically important range as potential probes for in vitro and in vivo experiments in PLIM mode. To prevent the oxygen quenching of the phosphorescence and interaction with the biological environment the probes are covalently bonded to biocompatible polymer based on N-vinylformamide.

TuSYC-p22

Multifunctional magnetic particle-based nanocarriers with easily modifiable surface for in vivo transfection

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In this study we show a new multifunctional visible magnetic particle-based DNA nanocarrier for effective in vivo transfection. We demonstrate successful gene expression of luminescent protein in mouse lungs and spleen. The biodistribution of the nanocarriers was visualized by magnetic and fluorescent methods and signal from the nanoparticles were observed in lungs, spleen and liver.

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TuSYC-p23

Multimodal nanoparticles for simultaneous delivery of therapeutic agents of different nature

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Numerous metal-organic frameworks have proven to transport effectively a variety of molecules inside their pores. However, the sorption of high molecular weight drugs is limited by the small pore size. Here, we demonstrate the possibility for metal-organic frameworks use in simultaneous encapsulation of a drug and a nucleic acid molecule.

This research was supported by RFBR Grant(s) # 19-33-51011

TuSYC-p24

Multiparametric Characterization and Quantitative Detection of Extracellular Vesicles by a Combination of Optical and Magnetic Techniques

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Novel approaches are proposed for high-throughput multiparametric characterization and quantitative detection of extracellular vesicles (EVs) based on a combination of optical and magnetic techniques. One of them, intended for EVs visualization, employs the imaging flow cytometry with submicron magnetic particles. For quantitative detection of EVs, a magnetic lateral flow assay is developed using the same submicron magnetic particles as labels.

TuSYC-p25

Optically controlled design of bi-functional agents for development of competitive immunoassays of enhanced sensitivity

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Label-free approach is developed based on the spectral-correlation and spectral-phase interferometric methods for characterization and fine-tuning of bi-functional ligands, which can improve the limits of detection of immunoassays by several orders of magnitude. The concept was verified by development and optimization of an ultrasensitive test system for registration of thyroxine (a marker of thyroid diseases).

This research was supported by RFBR Grant(s) # 19-33-70075

TuSYC-p26

The influence of microwave radiation on the pore size in a bilayer lipid membrane

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Using the pore model of a bilayer lipid membrane, it was shown that the microwave action changes the pore size by acting on ion transport through the membrane.

TuSYC-p27

Implementation of optical pulse densitometry sensor

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Determining the rate of elimination of indocyanine green in the blood is the most informative way to evaluate liver function. It is proposed to use optical pulse densitometry as a method of study. The paper presents the development of a non-invasive optical pulse densitometry sensor for measuring light absorption by a tissue at a specific wavelength.

TuSYC-p28

Image processing system of biological liquids for medical diagnostics

M.A. Baranov, E.N. Velichko, E.A. Savchenko; Higher School of Applied Physics and Space Technologies, Inst. of Physics, Nanotechnology and Telecommunications, Peter the Great St. Petersburg Polytechnic Univ., Russia

In the work the image processing system for medical diagnostics in described. The existence of a correlation between some diseases and the geometric parameters of structures in biological films is proved. This article describes an image processing method for analyzing the geometric parameters of structures in films of biological fluids.

TuSYC-p29

Laser scattering technique for blood serum analysis

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The paper is derived to development and approbation of laser correlation spectrometer for diagnostics. Main focus of this work is to investigate molecular sizes in blood serum of healthy and sick donors.

TuSYC-p30

Multimodal Nanostructures for Measuring Ultra-Low Concentrations of Analytes in Complex Mediums

V.A. Bragina, V.R. Cherkasov, A.V. Babenyshev, A.G. Burenin, S.V. Miziev, N.V. Guteneva; Prokhorov General Physics Inst. RAS, Russia

Highly-sensitive lateral flow assay based on multi-modal nanostructures has been developed for detection of staphylococcal enterotoxin B in complex matrices. For optimization of assay parameters, kinetic characterization of immunoreagents, selection of immobilization interfaces and nanoparticles, modified label-free optical biosensors were used. The developed assay is rapid, easy-to-use, compatible with affordable consumables and different sample volumes, does not require sample pretreatment.

TuSYC-p31

Copper nanostructures for surface-enhanced Raman spectroscopy: state-of-art, challenges, and perspectives

N.E. Markina; Saratov State Univ., Russia

This report summarizes the key information regarding to copper-based SERS-active materials (Cu-SERS substrates) and their applicability for SERS-based chemical analysis. The efficiency of Raman enhancement, chemical stability issues, and analytical performance of the Cu-SERS substrates are overviewed and compared with those of the noble-metal-based SERS substrates.

TuSYC-p32

Laser ablation and fragmentation of selenium nanoparticles for use in medicine, biology, and agriculture

S.V. Gudkov, A.V. Simakin, I.I. Rakov, I.V. Baymler, M.I. Zhil`nikova, G.A. Shafeev; Prokhorov General Physics Inst. RAS, Russia

Selenium nanoparticles were obtained using laser ablation and fragmentation. Their elemental composition, dimensions, shape, optical properties, and a number of other physicochemical characteristics were studied. Scenarios of the use of selenium nanoparticles to prevent the development of oxidative stress in mammalian cells are considered. The possibilities of using the obtained nanoparticles as soil fertilizer are investigated.

This research was supported by RFBR Grant(s) # 19-02-00061_a, 18-52-70012 e-Asia_a

TuSYC-p33

Modes of Escherichia coli Dps interaction with DNA and it thermodynamic characteristics

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Here we show that Dps has a different affinity for the two DNA fragments taken from the dps gene regulatory region. We found by atomic force microscopy that Dps predominantly occupies thermodynamically unstable ends of linear double-stranded DNA fragments and has high affinity to the central part of the branched DNA molecule self-assembled from three single-stranded oligonucleotides.

This research was supported by RFBR Grant(s) # 18-52-70012

TuSYC-p34

Synthesis of fluorescent and magnetic liposomes and their application for optical detection of migrating cancer cells

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Simultaneous location and eradication of specific cells in vivo opens the way to novel approaches to study cancer. Herein, we introduce a novel optical approach based on the use of liposomes filled with magnetics and fluorescent dyes. Results of this study can be used to further our understanding of cancer emergence.

This research was supported by RFBR Grant(s) # 18-29-04065

TuSYC-p35

Novel magneto-optical sensors based on anisotropic magnetic nanomaterials for detecting biological agents

D.O. Novichikhin, A.G. Burenin, A.R. Alekbarova, A.V. Orlov; Prokhorov General Physics Inst. RAS, Russia

Biosensors are developed that use nanoparticles with direction-dependent magnetic properties detected optically in real time by a low-coherent interferometry. Antibody-functionalized one- and two-dimensional nanoparticles (nanorods and nanodiscs) were used as anisotropic materials. The biosensors form the signal due to synchronized detection of a shift of the interference spectrum during a periodic actuation of anisotropic particles by an external magnetic field.

This research was supported by RFBR Grant(s) # 18-33-20252

TuSYC-p36

Development of Rapid Multiparametric Methods of Molecular Biosensing for Early Diagnostics and Monitoring of Oncology Diseases

D.O. Novichikhin, A.G. Burenin, I.A. Bakhratov, P.I. Nikitin; Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia

Rapid multiplex methods were proposed for simultaneous measurements of concentrations of a number of different molecular markers of cancer in clinical samples. Low coherent interferometry was used for controllable design of intermolecular interface layers. A unique combination of magnetic nanolabels, original high-sensitive electronic readers, and a variety of 3D porous solid phases for biochemical assays were employed.

This research was supported by RFBR Grant(s) # 18-29-09169

TuSYC-p37

Three-dimensional modular biosensor for express determination of several cardiac markers

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The feasibility of rapid multi-parametric biosensor for simultaneous detection of several cardiac markers in human whole blood, which is not inferior to the characteristics of approaches performed in laboratories and can be used by low-grade medical staff at patient's bedside or in the ambulance is shown. Immunoreagents that provide maximum sensitivity and specificity were selected with a label-free optical sensor.

TuSYC-p38

High-sensitive immunoanalytical platform based on iron oxide nanoparticles and magnetic beads containing composite nanomaterials

A.V. Orlov, A.R. Alekbarova, N.V. Guteneva, S.L. Znoyko; Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia

Kinetic characteristics of the hard-magnetic particles containing composite nanomaterials and soft magnetic iron oxide particles were studied by the spectral-phase interferometry to achieve the maximum dynamic range and minimal non-specific binding in a novel bioanalytical platform. In the platform, the former particles are used as a mobile solid phase controlled by an external field, while the latter – as nanolabels.

This research was supported by RFBR Grant(s) # 18-33-20252

SY: Section D. Photodynamic Processes in Biology and Medicine

WeSYD-p01

Porphyrins' autofluorescence as possible marker of ultraviolet skin damage in mice

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In this study we investigated endogenous fluorescence of ICR mice's skin irradiated with different doses of ultraviolet B and obtained promising results. It was shown that fluorescence of porphyrins had been gradually increasing in different time points after the exposure and this parameter was in positive agreement with the dose of UV.

This research was supported by RFBR Grant(s) # 20-32-70134

WeSYD-p02

Ultrasensitive transient time-resolved monitoring of anisotropic relaxation in NADH with sub-picosecond resolution

Y.M. Beltukov, I.M. Gadzhiev, I.A. Gorbunova, M.E. Sasin, O.S. Vasyutinskii; Ioffe Inst., Russia

A novel ultrasensitive transient time-resolved monitoring method has been developed suitable for studying of fast anisotropic relaxation in electronic excited states of polyatomic and biologically relevant molecules under excitation with femtosecond laser pulses. The method was used for the study of anisotropic relaxation in the first electronic excited state of coenzyme NADH in solutions with various viscosity and polarity.

This research was supported by RFBR Grant(s) # 18-03-00038a

WeSYD-p03

On the photostability of complexes of amphiphilic water-soluble photosensitizers with albumin

I.V. Bagrov, I.M. Belousova, A.V. Dadeko, V.M. Kiselev, T.K. Krisko, T.D. Murav'eva, A.M. Starodubtsev; Vavilov State Optical Inst., Russia

Photostability of albumin complexes, Pluronic F-127 complexes and aqueous solutions of photoditazine and dimegin were investigated. Photodegradation rate of albumin complexes was about four times faster than that of other compositions under study due to desagregation of photosensitizers.

WeSYD-p04

Oxygen sensitive graphene-based carbon films

A.A. Kovalchuk[1], N.N. Rozhkova[1], A.V. Prikhodko[2]; [1]Inst. of Geology of the Karelian Research Centre RAS, [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

An anomaly of the microwave conductivity of films containing graphene-lbased carbon was investigated. Desorption of oxygen was detected in the temperature range 290–360 K for carbon films on substrates coated with In2O3 and ITO

WeSYD-p05

Dynamics of PpIX accumulation in A549, HeLa and 3T3 cell lines.

D.A. Gorbenko[1,2], A.V. Belashov[1], T.N. Belyaeva[3], E.S. Kornilova[3] , I.V. Semenova[1], O.S. Vasyutinskii[1]; [1]Ioffe Inst., [2]ITMO Univ., [3]Inst. of Cytology RAS, Russia

The synthesis and accumulation of PpIX, induced by 5-ALA in HeLa, A549 and 3T3 cells was studied using confocal fluorescence microscopy. The accumulation dynamics of PpIX in cells was determined from the kinetics of its fluorescence intensity. The PpIX synthesis rate was analyzed as function of 5-ALA concentration and incubation time.

WeSYD-p06

Enhancement of Raman signal by the use of BaTiO3 microspheres

I.S. Ruzankina[1,2], G. Ferrini; [1]Uni. Cattolica del Sacro Cuore, Italy; [2]KU Leuven, Belgium

The Raman signal from Si and graphene is enhanced using BaTiO3 microspheres. It is shown that the Raman signal can be enhanced using BaTiO3 microspheres beyond that obtained by the highest numerical aperture objective available on a standard Raman microscope.

WeSYD-p07

Polarized fluorescense of FAD in water and water-methanol solutions.

M.K. Krasnopevtceva, V.P. Belik, I.V. Semenova, A.G. Smolin, O.S. Vasyutinskii; Ioffe Inst., Russia

Time-resolved kinetics of polarized luminescence of FAD were studied in aqueous and water-methanol solutions. Polarization anisotropy, fluorescence lifetimes, and rotational diffusion times have been determined depending upon methanol concentration in solution.

This research was supported by RFBR Grant(s) # 18-53-34001

WeSYD-p08

Polarized fluorescense of alkyl derivatives of fluorescein, MitoFluo and C8-Fl, in solutions with liposomes.

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We present the study of interaction of fluorescein derivatives, MitoFluo and C8-Fl with two types of liposomes modeling cellular and mitochondrial membranes. Polarization anisotropy, fluorescence lifetimes, rotational diffusion times have been determined from time-resolved polarized fluorescence experiments. The analysis of the experimental results shows that both fluorescein derivatives interact with liposomes and MitoFluo embeds in liposomes more effectively than C8-Fl.

This research was supported by RFBR Grant(s) # 18-53-34001

SY: Section E. Nanophototheranostics

TuSYE-p01

Laser spectroscopic method for assessing the effectiveness of photodynamic therapy (controlled PDT)

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This work presents the developed method and equipment for assessing the effectiveness of treatment using PDT. The problem of spectral separation of laser radiation and fluorescence of 5-ALA-induced protoporphyrin IX or Chlorin e6 was solved by selecting a combination of optical filters. The results showed the effectiveness of the new approach and equipment for conducting controlled PDT.

This research was supported by RFBR Grant(s) # 18-29-01062 MK

TuSYE-p02

Hybrid nanostructures for fluorescence diagnostics and photodynamic therapy using two-photon excitation

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The fluorescence diagnosis complexity of cholangiocellular cancer is associated with the parasitic autofluorescence presence of the hepatobiliary system components. Necessary change the red region of the spectrum to the near infrared region. Proposed to use hybrid nanostructures. When quantum nanoplates are excited by a two-photon laser, they transfer energy to the photosensitizer using fluorescence resonance energy transfer interaction.

TuSYE-p03

Tumorigenesis and metastasis scheme from photodynamic therapy perspective

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The effectiveness of photodynamic therapy of tumors can be increased if every specialist will understand the mechanisms behind tumorigenesis and metastasis. To make this process easier, the scheme of processes taking place in the tumor was made. This work was supported by RFBR, № 20-02-00928.

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TuSYE-p04

The approach to optimization parameters of aluminium phthalocyanine-based nanophotosensitizers for phototheranostic

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The use of crystalline nanoparticles of aluminium phthalocyanine (AlPc) as nanophotosensitizers for phototheranostic is a promising direction. The investigations of size dependence, absorption and fluorescence of AlPc nanoparticles on various particle production conditions were carried out, and optimal conditions for obtaining the most effective samples of initial solutions for their testing on cancer and immune cells were found.

TuSYE-p05

Nd3+-doped nanoparticles for visualization in the tissue depth

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Stable aqueous colloidal solutions of Nd3+: LaF3 nanoparticles with strong luminescence in the NIR and visible spectral ranges under NIR laser excitation were synthesized by hydrothermal microwave treatment. The results of their luminescence visualization under system-wide administration to laboratory animals with transplanted tumors are presented. The histological distribution of the nanoparticles is verified by laser upconversion microscopy.

TuSYE-p06

Raman spectroscopy for the development of a method for glial brain tumors diagnostics

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Reducing the frequency of relapses after surgical removal of glial tumors is a non-trivial task due to their infiltrative growth. Raman spectroscopy has the advantages of optical spectroscopy such as speed and non-invasiveness. With reference spectra database of those components that can be expressed in glial tumors, Raman scattering spectroscopy allows multivariate diagnosis of such tumors and their intraoperative demarcation.

This research was supported by RFBR Grant(s) # 18-29-01062

TuSYE-p07

Fluorescence diagnostics and photodynamic therapy of grain crops pathogenic fungi

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The studies show the dynamics of photosensitizers accumulation in various grain areas during germination and their photodynamic activity against pathogenic microflora (Fusarium, Bipolaris, Alternaria). The possibility of pathogenic microflora inactivation using aluminum phthalocyanine was shown.

TuSYE-p08

Laser-induced fluorescent diagnostics and photodynamic therapy of cervical neoplasms

P.M. Alekseeva[1,2], K.T. Efendiev[1], A.A. Shiryaev[3], L.M. Amirkhanova[3], K.G. Linkov[2], V.B. Loschenov[1,2]; [1]National Research Nuclear Univ. MEPhI; [2]Prokhorov General Physics Inst. RAS; [3]Sechenov First Moscow State Medical Univ., University Clinical Hospital no.[1], Russia

The paper presents the results of precise fluorescent diagnostics of cervical neoplasms at PDT using a photosensitizer, chlorin e6. The precise fluorescent diagnostics supposes the combined use of spectral and video fluorescent diagnostics of pathological and normal tissues. PDT was performed and controlled via photobleaching. The results of spectral fluorescent diagnostics well correlate with the results of video fluorescent diagnostics.

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