21^{ST} INTERNATIONAL CONFERENCE LASER OPTICS ICLO 2024

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We wish to thank the following for their contribution to the success of this conference:

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

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N. N. Rosanov, Vavilov State Optical Inst., Russia
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NONLINEAR QUANTUM PHOTONICS

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

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8TH INTERNATIONAL A. M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS

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

GPI

Russian Academy of Sciences

PHYSICS of WAVE PHENOMENA

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21ST INTERNATIONAL CONFERENCE LASER OPTICS ICLO 2024

TOPICS

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

R2 High Power Lasers: Fiber, Solid State, Gas and Hybrid
Advances in high-power fiber, solid state, gas and hybrid lasers • High-power laser architectures including hybrid systems • Novel optical materials for high power applications and systems • Thermal and thermo-optical effects in lasers • High power multichannel laser systems • Fusion lasers and terawatt science • CO_2/CO lasers • Iodine lasers • Chemical lasers • Excimer lasers • Alkali vapor lasers

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

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

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

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

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

R8 Nonlinear Photonics: Fundamentals and Applications
Self-focusing, collapse, and applications • Conservative and dissipative optical spatial and spatio-temporal solitons • Nonlinear optics with structured light, optical vortices • Self-modulation and nonlinear temporal effects • Supercontinuum and frequency comb generation • High-harmonic generation • Nonlinear optics of few- and half-cycle pulses • Fiber optics and telecommunications • Nonlinear effects in multimode fibres • Machine learning • Nonlinear nanophotonics and plasmonics • Nonlinear meta-optics and metamaterials • Nonlinear optical devices, including microresonators, waveguides, and PT-symmetric systems • Nonlinear optomechanics • Nonlinear optics of low-dimensional materials • Nonlinear topological photonics • Topological lasers • Nonlinear photonics with surfaces and interfaces • Nonlinear polaritonics • Nonlinear THz optics

R9 Optical Nanomaterials
Modeling of nanostructures • Advanced methods of nanostructure synthesis • One-dimensional growth of semiconductor nanowires • Wide band gap nanostructures • Epitaxial quantum dots and related structures • Nanostructures for single photon devices • Nanostructures for THz radiation • Nanostructures for solar cells • Microcavities and photonic crystals • Hybrid nanostructures with pre-defined properties

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

R11 Lasers for Satellite Ranging Systems, Space Geodesy, Space Communication and Global Navigation
Advanced picosecond lasers for satellite laser ranging • High power solid-state lasers for space junk monitoring • Atmospheric effects on laser ranging • Laser ranging retroreflector systems • Single-electron photodetectors • Lasers for space communication and cryptography systems • Time transfer via one-way laser ranging

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8TH INTERNATIONAL A. M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS

TOPICS

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

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

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

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

MONDAY, 1 JULY	
11.00-13.30	**ICLO 2024 - PLENARY SESSION** *PIEDMONTE ROOM - FLOOR 3, P.1*
14:15-16:45	**8TH INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS - PLENARY SESSION** *PIEDMONTE ROOM - FLOOR 3, P.73*
18.00-20.00	**WELCOME RECEPTION** *TOSKANA RESTAURANT - FLOOR 3*

TUESDAY, 2 JULY					
9.00-11.00		***SYB*** TISSUE OPTICS 1 ***PETROV-VODKIN 1*** *P. 75*	***SYC*** PHOTONICS AND NANO-BIOTECHNOLOGY 1 ***PETROV-VODKIN 2*** *P. 77*	***SYA*** ADVANCED LASER MEDICAL SYSTEMS & TECHNOLOGIES 1 ***PETROV-VODKIN 3*** *P. 73*	***R5*** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 1 ***DEYNEKA*** *P. 5*
11.00-11.30	COFFEE BREAK				
11.30-13.30		**SYB** TISSUE OPTICS 2 ***PETROV-VODKIN 1*** *P. 76*	***SYC*** PHOTONICS AND NA-NOBIOTECHNOLOGY 2 ***PETROV-VODKIN 2*** *P. 78*	***SYA*** ADVANCED LASER MEDICAL SYSTEMS & TECHNOLOGIES 2 ***PETROV-VODKIN 3*** *P. 74*	***R5*** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 2 ***DEYNEKA*** *P. 6*
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION** **R7, R8, SYA, SYB** ***NIKOLSKY + LEVINSON FOYER*** *P. 14, 14, 80, 80*	**SYB** FLUORESCENCE AND APPLICATION ***PETROV-VODKIN 1*** *P. 76*	***SYC*** PHOTONICS AND NA-NOBIOTECHNOLOGY 3 ***PETROV-VODKIN 2*** *P. 78*	***SYA*** ADVANCED LASER MEDICAL SYSTEMS & TECHNOLOGIES 3 ***PETROV-VODKIN 3*** *P. 75*	***R5*** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 3 ***DEYNEKA*** *P. 7*
17.00-17.30	COFFEE BREAK				
17.30-19.30	**POSTER SESSION** **R7, R8, SYA, SYB** ***NIKOLSKY + LEVINSON FOYER*** *P. 14, 14, 80, 80*				***R7*** FREE ELECTRON LASERS ***DEYNEKA*** *P. 9*

WEDNESDAY, 3 JULY					
9.00-11.00	**POSTER SESSION** **R2, R5, R6, R11, SYC** ***NIKOLSKY + LEVINSON FOYER*** *P. 36, 39, 41, 46, 88*	**SYB** OPTICAL CHARACTER-IZATION OF BLOOD CELLS AND FLOW 1 ***PETROV-VODKIN 1*** *P. 82*	***SYC*** PHOTONICS AND NA-NOBIOTECHNOLOGY 4 ***PETROV-VODKIN 2*** *P. 83*	***SYD*** PHOTODYNAMIC PRO-CESSES IN BIOLOGY AND MEDICINE 1 ***PETROV-VODKIN 3*** *P. 85*	***R1*** SOLID STATE LASERS 1 ***DEYNEKA*** *P. 21*
11.00-11.30	COFFEE BREAK				
11.30-13.30	**POSTER SESSION** **R2, R5, R6, R11, SYC** ***NIKOLSKY + LEVINSON FOYER*** *P. 36, 39, 41, 46, 88*	**SYB** OPTICAL CHARACTER-IZATION OF BLOOD CELLS AND FLOW 2 ***PETROV-VODKIN 1*** *P. 82*	***SYC*** PHOTONICS AND NA-NOBIOTECHNOLOGY 5 ***PETROV-VODKIN 2*** *P. 83*	***SYD*** PHOTODYNAMIC PRO-CESSES IN BIOLOGY AND MEDICINE 2 ***PETROV-VODKIN 3*** *P. 86*	***R1*** SOLID STATE LASERS 2 ***DEYNEKA*** *P. 21*
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION** **R1, R10, SYC** ***NIKOLSKY + LEVINSON FOYER*** *P. 32, 43, 88*	**SYB** PHOTOACOUSTIC ***PETROV-VODKIN 1*** *P. 83*	***SYC*** PHOTONICS AND NA-NOBIOTECHNOLOGY 6 ***PETROV-VODKIN 2*** *P. 85*	***SYD*** PHOTODYNAMIC PRO-CESSES IN BIOLOGY AND MEDICINE 3 ***PETROV-VODKIN 3*** *P. 87*	***R10*** NONLINEAR QUANTUM PHOTONICS 3 ***DEYNEKA*** *P. 30*
17.00-17.30	COFFEE BREAK				
17.30-19.30	**POSTER SESSION** **R1, R10, SYC** ***NIKOLSKY + LEVINSON FOYER*** *P. 32, 43, 88*	**POSTDEADLINE** ***PETROV-VODKIN 1+2+3*** *P. 30*			

MONDAY, 1 JULY

ICLO 2024 - PLENARY SESSION
PIEDMONTE ROOM - FLOOR 3, P.1

8TH INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS - PLENARY SESSION
PIEMONTE ROOM - FLOOR 3, P.73

WELCOME RECEPTION
TOSKANA RESTAURANT - FLOOR 3

TUESDAY, 2 JULY

R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID 1 ***STENBERG I*** *P. 1*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 1 ***STENBERG 2*** *P. 9*	***R10*** NONLINEAR QUANTUM PHOTONICS 1 ***RICHTER*** *P. 11*	***R4*** LASER BEAM CONTROL 1 ***PUDOVKIN*** *P. 3*	
COFFEE BREAK				
R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID 2 ***STENBERG I*** *P. 2*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 2 ***STENBERG 2*** *P. 9*	***R10*** NONLINEAR QUANTUM PHOTONICS 2 ***RICHTER*** *P. 12*	***R4*** LASER BEAM CONTROL 2 ***PUDOVKIN*** *P. 3*	
LUNCH BREAK				
R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID 3 ***STENBERG I*** *P. 2*	***R11*** LASERS FOR SATELLITE RANGING SYSTEMS, ... 1 ***STENBERG 2*** *P. 12*	***R6*** LASERS AND SYSTEMS FOR IMAGING, ... 1 ***RICHTER*** *P. 7*	***R4*** LASER BEAM CONTROL 3 ***PUDOVKIN*** *P. 4*	
COFFEE BREAK				
	R11 LASERS FOR SATELLITE RANGING SYSTEMS, ... 2 ***STENBERG 2*** *P. 13*	***R6*** LASERS AND SYSTEMS FOR IMAGING, ... 2 ***RICHTER*** *P. 8*	***R4*** LASER BEAM CONTROL 4 ***PUDOVKIN*** *P. 5*	

WEDNESDAY, 3 JULY

R3 SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS 1 ***STENBERG I*** *P. 22*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 3 ***STENBERG 2*** *P. 26*	***R4*** LASER BEAM CONTROL 5 ***RICHTER*** *P. 24*	***R9*** OPTICAL NANOMATERIALS 1 ***PUDOVKIN*** *P. 28*	
COFFEE BREAK				
R3 SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS 2 ***STENBERG I*** *P. 23*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 4 ***STENBERG 2*** *P. 26*	***R4*** LASER BEAM CONTROL 6 ***RICHTER*** *P. 25*	***R9*** OPTICAL NANOMATERIALS 2 ***PUDOVKIN*** *P. 29*	
LUNCH BREAK				
R3 SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS 3 ***STENBERG I*** *P. 24*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 5 ***STENBERG 2*** *P. 27*	***R4*** LASER BEAM CONTROL 7 ***RICHTER*** *P. 25*	***R9*** OPTICAL NANOMATERIALS 3 ***PUDOVKIN*** *P. 29*	***A1*** EXHIBITORS WORKSHOP ***PIEDMONTE*** ***P.103***
COFFEE BREAK				

THURSDAY, 4 JULY					
9.00-11.00	**POSTER SESSION R3, R4** ***NIKOLSKY + LEVINSON FOYER*** *P. 58, 62*	**SYB** TERAHERTZ ***PETROV-VODKIN 1*** *P. 91*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY 7 ***PETROV-VODKIN 2*** *P. 92*	***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 4 ***PETROV-VODKIN 3*** *P. 94*	***R1*** SOLID STATE LASERS 3 ***DEYNEKA*** *P. 47*
11.00-11.30	COFFEE BREAK				
11.30-13.30	**POSTER SESSION R3, R4** ***NIKOLSKY + LEVINSON FOYER*** *P. 58, 62*	**SYB** PHOTODYNAMIC AND PHOTOTHERMAL THERAPY ***PETROV-VODKIN 1*** *P. 91*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY 8 ***PETROV-VODKIN 2*** *P. 93*	***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 5 ***PETROV-VODKIN 3*** *P. 95*	***R1*** SOLID STATE LASERS 4 ***DEYNEKA*** *P. 48*
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION R9, SYD** ***NIKOLSKY + LEVINSON FOYER*** *P. 64, 97*	**SYB** LASER MICROSCOPY AND OPTICAL COHERENCE IMAGING ***PETROV-VODKIN 1*** *P. 92*		***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 6 ***PETROV-VODKIN 3*** *P. 95*	
17.00-17.30	COFFEE BREAK				
17.30-19.30	**POSTER SESSION R9, SYD** ***NIKOLSKY + LEVINSON FOYER*** *P. 64, 97*				

FRIDAY, 5 JULY					
9:00-11:00					
11.00-11.30	COFFEE BREAK				
13.30-15.00					

EXHIBITION "LASERS AND PHOTONICS"

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

A1. Exhibitors Workshop

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

The venue of the Conference ICLO 2024 is the Hotel "Moskovskie Vorota"

THURSDAY, 4 JULY				
R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID 4 ***STENBERG I*** *P. 49*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 6 ***STENBERG 2*** *P. 53*	***R5*** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 4 ***RICHTER*** *P. 51*	***R9*** OPTICAL NANOMATERIALS 4 ***PUDOVKIN*** *P. 56*	
COFFEE BREAK				
R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID 5 ***STENBERG I*** *P. 49*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 7 ***STENBERG 2*** *P. 54*	***R5*** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 5 ***RICHTER*** *P. 51*	***R9*** OPTICAL NANOMATERIALS 5 ***PUDOVKIN*** *P. 56*	
LUNCH BREAK				
R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID 6 ***STENBERG I*** *P. 50*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 8 ***STENBERG 2*** *P. 54*	***R5*** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 6 ***RICHTER*** *P. 52*	***A2*** OPEN MEETING TK296 ***PUDOVKIN***	
COFFEE BREAK				
	R8 NONLINEAR PHOTONICS: FUNDAMENTALS AND ... 9 ***STENBERG 2*** *P. 55*		***A2*** OPEN MEETING TK296 ***PUDOVKIN***	

FRIDAY, 5 JULY				
	SYB GENERAL ISSUES OF BIOPHOTONICS AND SIMULATION ***STENBERG 2*** *P. 99*			
COFFEE BREAK				
	SYB RAMAN SPECTROSCOPY ***STENBERG 2*** *P. 99*			

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

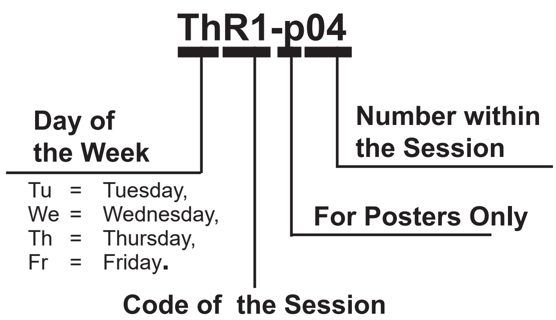
Official Language: Russian

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

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

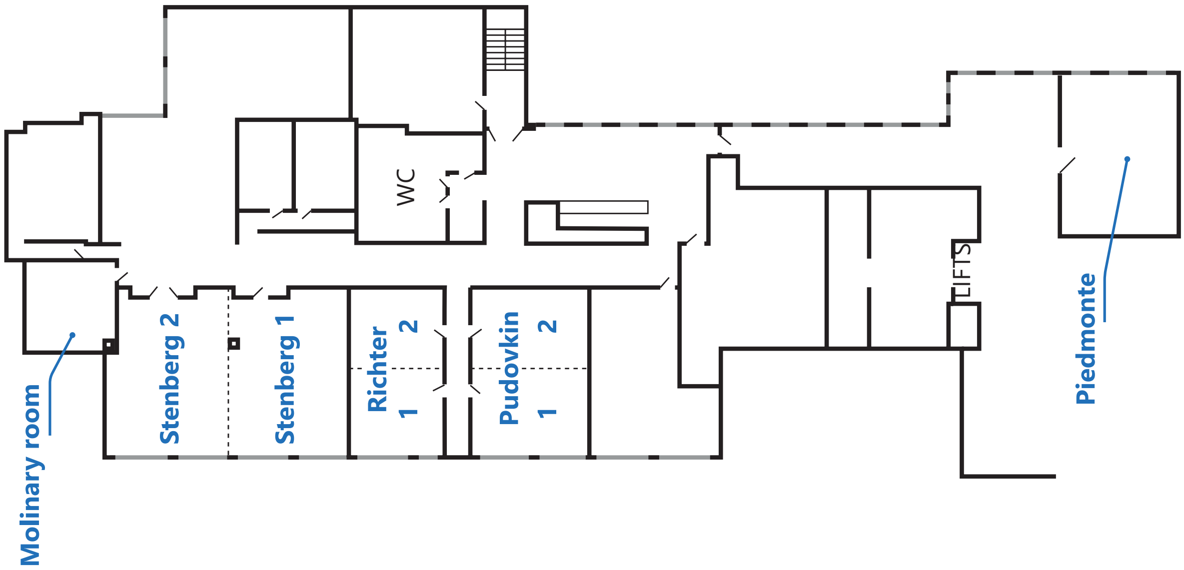
1. The first two letters of the code indicate the day of the week:
   Tu = Tuesday, **We** = Wednesday,
   Th = Thursday, **Fr** = Friday.
2. The next characters indicate code of the session.
   R = regular session, **W** = workshop, **SY** = Symposia
3. The number at the end of the code gives the position of the paper within the session (first, second, third, etc.).
4. Index «**p**» before the number indicates the poster session.

   For example, a session numbered **ThR1-p04** would indicate that this paper is to be presented at Thursday, at session R1, it is a poster paper and is the fourth paper presented during the session.

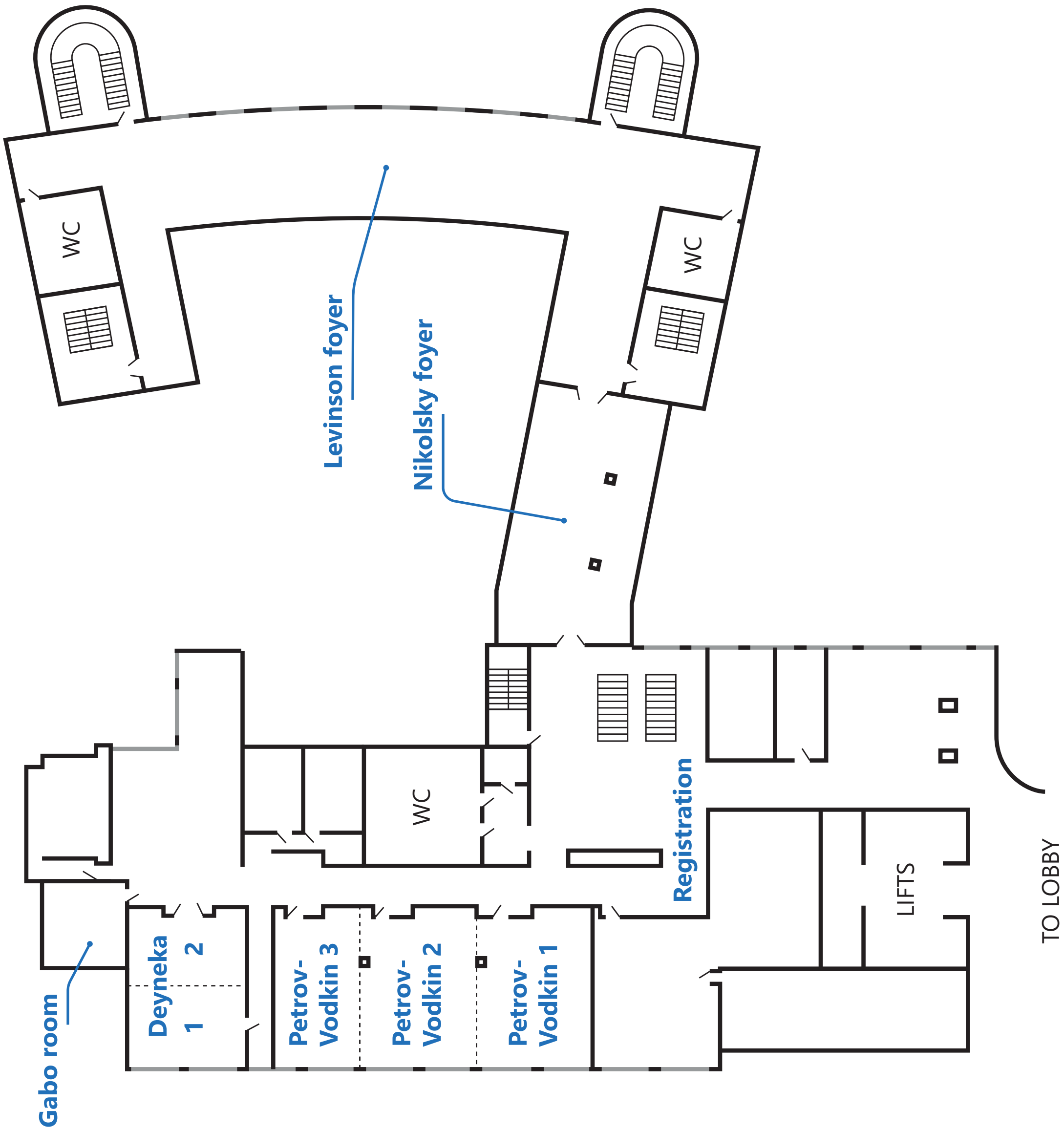


ICLO 2024 Venue:
Moskovskiye Vorota Hotel – St. Petersburg

THIRD FLOOR



SECOND FLOOR



21ST INTERNATIONAL CONFERENCE LASER OPTICS ICLO 2024

PL: PLENARY

Location: Piedmonte Room, Floor 3; Date: Monday, July 01, 2024

PL: PLENARY 1

Session Chair:

MoPL-01 11:15-12:00

Ultrafast magnetism - terra incognita beyond the classical approximations *(Plenary)*

A. Kimel; Radboud University, The Netherlands

Abstract is not available.

MoPL-02 12:00-12:45

Light as a factor in controlling plant growth and development *(Plenary)*

Yu.N. Kulchin; Institute of Automation and Control Processes FEB RAS, Russia

Abstract is not available

MoPL-03 12:45-13:30

Semiconductor colloidal quantum dots: benefits and challenges for optoelectronic applications *(Plenary)*

A.V. Rodina; Ioffe Institute, Russia

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

- Lunch Break -

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

Location: Stenberg 1 Room, Floor 3; Date: Tuesday, July 02, 2024

R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID 1

Session Chair:

TuR02-01 09:00-09:30

Recent progress in fiber lasers at NTO IRE-Polus and their novel applications *(Invited paper)*

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

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

TuR02-02 09:30-10:00

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

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

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

TuR02-03 10:00-10:15

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

S.S. Aleshkina[1], D.A. Davydov[1], V.V. Velmiskin[1], M.V. Yashkov[2], A.A. Umnikov[2], S.V. Alyshev[1], L.D. Iskhakova[1], M.M. Bubnov[1], D.S. Lipatov[2], M.E. Likhachev[1]; [1]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center; [2]Devyatykh Institute of Chemistry of High-Purity Substances RAS, Russia

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

TuR02-04 10:15-10:30

11dB SBS-gain suppressed $Al_2O_3/GeO_2/P_2O_5$/F-doped silica LMA optical fiber for high-power single-frequency radiation delivery

S.V. Tsvetkov[1], A.S. Lobanov[2], D.S. Lipatov[2], T.S. Zaushitsyna[1], L.D. Iskhakova[1], M.E. Likhachev[1]; [1]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center; [2]Institute of Chemistry of High Purity Substances RAS, Russia

Presented a new design of complexly-doped passive LMA optical fiber with conventional optical characteristics but extremely low stimulated Brillouin scattering gain coefficient of ~1pm/W.

TuR02-05 10:30-10:45

The zones of stable generation of dissipative solitons in fiber lasers depending on the cavity dispersion and the modulation depth of the saturable absorber

D.V. Khudyakov, A.A. Semirenchenkov; Prokhorov General Physics Institute RAS, Russia

The zones of stable pulsed generation of dissipative solitons in fiber lasers are determined depending on the group delay dispersion of the resonator and the modulation depth of the saturable absorber. It is concluded that pulse generation depends on the dynamics of the modulation depth changes of the saturable absorber during multiple passes of the pulse through the laser resonator.

TuR02-06 10:45-11:00

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

R. Shaidullin[1], V. Dolgov[2], I. Kuranov[3], N. Kovalenko[1], O. Ryabushkin[1]; [1]Fryazino Branch of Institute of Radio Engineering and Electronics RAS; [2]Moscow Institute of Physics and Technology (National Research University); [3]"NTO IRE-Polus", Russia

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

- Coffee Break -

Location: Stenberg 1 Room, Floor 3; Date: Tuesday, July 02, 2024

R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID 2

Session Chair:

TuR02-07 11:30-12:00

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

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

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

TuR02-08 12:00-12:30

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

Yu.M. Klimachev, A.A. Ionin, M.V. Ionin, I.O. Kinyaevskiy, A.Yu. Kozlov, A.M. Sagitova, D.V. Sinitsyn; Lebedev Physical Institute RAS, Russia

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

TuR02-09 12:30-13:00

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

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

The output power and spectral characteristics of radiation were studied during RF or MW gas-discharge excitation of planar IR-lasers depending on: the composition and pressure of the gas mixture, pump pulse parameters. In new experiments we studied a (CO2-Xe) laser with MW pumping and RF exited CO2 laser with an unstable resonator and additional optical elements located outside the laser.

TuR02-10 13:00-13:15

Yellow neon laser pumped by a pulsed inductive longitudinal discharge

A.M. Razhev[1], D.S. Churkin[1,2], R.A. Tkachenko[1,2]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State University, Russia

The experimental studies results of the energy, temporal and spatial lasing characteristics of Penning neon laser (λ = 585.3 nm) pumped by a pulsed inductive longitudinal discharge are presented. The maximum lasing energy of about 0.14 mJ was achieved. The average generation duration was 200 ns (FWHM) which corresponds to pulse power of 700 W.

TuR02-11 13:15-13:30

Resonance-enhanced multiphoton ionization of molecular oxygen at the 222 nm KrCl laser wavelength

E.V. Ionushaite, A.V. Shutov; Lebedev Physical Institute, Russia

We study the photo-ionization mechanism of molecular oxygen at the rare wavelength of 222 nm using a KrCl laser. It was found that the ionization mechanism is (2+1) REMPI process. Value of the (2+1) REMPI cross section was calculated.

- Lunch Break -

Location: Stenberg 1 Room, Floor 3; Date: Tuesday, July 02, 2024

R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID 3

Session Chair:

TuR02-13 15:30-16:00

High power solid state lasers with non-stationary gain media *(Invited paper)*

N.G. Zakharov, V.I. Lazarenko, E.S. Safronov, E.V. Saltykov, I.I. Karpov, M.V. Volkov, G.M. Mishenko; RFNC-VNIIEF, Russia

In this paper we present the results of numerical and experimental research pertaining to high power solid state lasers with various non-stationary gain media as Yb:YAG and Cr:ZnSe. Dependencies of output laser power and beam quality on pump power and gain medium velocity are given. Efficiencies of air-cooled and water-cooled heat sinks are discussed.

TuR02-14 16:00-16:15

New scheme of Faraday isolator with dV/dT distortions compensation

I.L. Snetkov; FRC A.V. Gaponov-Grekhov Institute of Applied Physics RAS; Lobachevsky State University of Nizhny Novgorod, Russia

A new scheme of a Faraday isolator with compensation of the contributions to thermally induced depolarization from the temperature dependence of the Verdet constant was proposed. The efficiency of using the proposed scheme and comparison with known schemes is analyzed analytically and numerically at two cases: a cryogenic isolator and an isolator on crystalline material cut in a critical orientation.

TuR02-15 16:15-16:30

Thermally induced distortions of radiation in multipass Faraday isolators

A.V. Starobor, O.V. Palashov; Federal Research Center A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia

We investigated thermally induced depolarization in multi-pass Faraday isolators schemes, that are inevitable for low Verdet constant media. It is shown theoretically and experimentally that it is possible to increase isolation ratio 1.6 times by choosing the optimal distance between beams in "linear" arrangement and there is no optimum for the arrangement of beams along a circle.

TuR02-16 16:30-16:45

High-energy single-crystal Fe:CdTe laser operating in the wavelength range of 5.3-6.0 μm

V.A. Antonov[1], K.N. Firsov[2], E.M. Gavrishchuk[3], V.B. Ikonnikov[3], I.G. Kononov[2], S.V. Kurashkin[3], S.V. Podlesnykh[2], D.V. Savin[3], N.V. Zhavoronkov[1]; [1]Res. Inst. of Material Science and Technology JSC RIMST; [2]Prokhorov General Physics Institute RAS; [3]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

The lasing characteristics of a Fe:CdTe single crystal prepared by a modified vertical gradient freeze method followed by high-temperature treatment were studied. The possibility of efficient pumping using Fe:ZnSe or deuterium fluoride laser was demonstrated. The broadband generation in the range of 5.3-6.0 μm with a maximum energy of 350 mJ at a pulse duration of 220 ns was obtained.

TuR02-17 16:45-17:00

Enhanced stability of SHG in PPLN incorporated in the Pierce oscillator circuit

K.V. Zotov[1], N.V. Tereshchenko[1], A.Yu. Ostapiv[1], G.Yu. Ivanov[1], V.P. Surovtseva[1], A.V. Konyashkin[2], O.A. Ryabushkin[2]; [1]Moscow Institute of Physics and Technology (National Research University), Russia; [2]Kotelnikov FIRE RAS, Russia

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

- Coffee Break -

R04: LASER BEAM CONTROL

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

R04: LASER BEAM CONTROL 1

Session Chair:

TuR04-01 09:00-09:30

Adaptive optical image correction system for the Large Solar Vacuum Telescope *(Invited paper)*

A.G. Borzilov, P.A. Konyaev, V.P.Lukin; V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia

The report presents an analysis of the results of processing experimental data obtained during the expedition of the LCAO IOA SB RAS in August 2023 at the LSVT of the Baikal Astrophysical Observatory of the Institute of Solar-Terrestrial Physics SB RAS.

TuR04-02 09:30-10:00

Axially symmetric Hermite-Gaussian beams for the space-earth quantum cryptography channel *(Invited paper)*

D.D. Reshetnikov[1], A.L. Sokolov[2], V.Yu. Venediktov[1], V.M. Petrov[1]; [1]Faculty of Physics, St. Petersburg State University, [2]JSC "Research-and-production corporation "Precision system and Instruments" (RPC PSI), Russia

The work provides a description of Hermite – Gaussian beams with an axially symmetric polarization structure, suitable for quantum space communication and cryptography systems. The possible creation and detection of such beams within the framework of a communication and cryptographic polarization protocols using the devices with a radial polarizer is discussed.

TuR04-03 10:00-10:15

Imaging of a natural star under the angular anisoplanatism effect

V.A. Bogachev[1], A.V. Nemtseva[1,2], F.A. Starikov[1,3]; [1]FSUE "RFNC-VNIIEF", [2]Lomonosov Moscow State Univ., [3]Sarov Physics and Technology Institute of the National Research Nuclear University MEPhI, Russia

The results of numerical simulation of light propagation from a natural star through the turbulent atmosphere to the ground-based telescope and obtaining star image using adaptive optical system are presented taking into account the effect of angular anisoplanatism.

TuR04-04 10:15-10:30

Wavefront correction with conformal and holographic optical elements

V.P.Korolkov[1], R.I.Kuts[1], D.A.Belousov[1], A.R.Sametov1, S.K.Golubtsov[1], A.I.Malyshev; [1]IA&E SB RAS, Russia

The results of the development of technologies for the manufacture of static conformal refractive and computer-generated holographic correctors of laser beam wavefronts are presented. The results of the practical application of the manufactured wavefront correctors are shown.

TuR04-05 10:30-11:00

An alternative wavefront sensing technique for free-space optical communication *(Invited paper)*

Huizhe Yang, Yonghui Liang, Jin Liu, Yukuan Zhou; College of Advanced Interdisciplinary Studies, National University of Defense Technology, China

Aiming at the problem caused by the point-ahead angle in free-space optical communication systems, this paper adopts an alternative wavefront sensing technique termed PPPP. The feasibility of PPPP is verified through both the numerical simulations and laboratory experiments. The results demonstrate that PPPP and the commonly-used Shack-Hartman wavefront-sensor achieve similar wavefront reconstruction accuracy.

- Coffee Break -

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

R04: LASER BEAM CONTROL 2

Session Chair:

TuR04-06 11:30-12:00

Problems of using laser guide stars *(Invited paper)*

L.A. Bolbasova, V.P. Lukin; V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia

The problems of using sodium laser guide star (LGS) in adaptive optics (AO) system of ground-based telescopes are considered. The research was carried out with the financial support of the Russian Science Foundation project No.23-42-00043.

TuR04-07 12:00-12:30

Generation of high-power terahertz vortex Bessel beams by diffractive optical elements at the NovoFEL and their application in plasmonics *(Invited paper)*

N.D. Osintseva[1], Yu.Yu. Choporova[1], V.V. Gerasimov[1,2], V.S. Pavelyev[3], O.E. Kameshkov[4], V.D. Kukotenko[1], M.S. Komlenok[5], B.A. Knyazev; [1]Budker Institute of Nuclear Physics SB RAS; [2]Novosibirsk State University; [3]Samara National Research University, Russia; [4]The Australian National University, Research School of Physics, Australia; [5]Prokhorov General Physics Institute RAS, Russia

The report is dedicated to the study and application of terahertz vortex Bessel beams formed by diffractive optical elements at the Novosibirsk Free Electron Laser. Generation of vortex surface plasmon polaritons for prospective multiplex wire communication lines was demonstrated.

TuR04-08 12:30-13:00

Hybridly polarized optical vortices *(Invited paper)*

S.S. Stafeev[1,2], V.V. Kotlyar[1,2]; [1]Department "Image Processing Systems Institute - Samara" of the Kurchatov Complex of Crystallography and Photonics of the National Research Center "Kurchatov Institute"; [2]Samara National Research University, Russia

In this work numerically using Richards-Wolf equation and experimentally using spatial light modulator we have investigated optical vortices with hybrid polarization. The polarization of these beams combines azimuthal polarization and circular polarization.

TuR04-09 13:00-13:30

Integrated vortex emitter design for mode signal multiplexing *(Invited paper)*

R.V. Kutluyarov, L.I. Bakirova, V.S. Lyubopytov; Ufa University of Science and Technology, Russia

The work describes an optical vortex emitter based on an integrated ring resonator, which also multiplexes vortices in one optical beam. An algorithm for numerical calculation of the structure dimensions is proposed. It is shown that simultaneous emission of two pairs of conjugate vortices at the same wavelength is possible with the designed structure.

- Lunch Break -

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

R04: LASER BEAM CONTROL 3

Session Chair:

TuR04-10 15:00-15:15

Microring optimization for the tunable vortex beam emitter

L.I. Bakirova, G.S. Voronkov, V.S. Lyubopytov, V.Kh. Bagmanov; Ufa University of Science and Technology, Russia

We present a novel method for optimizing a micro-ring resonator (MRR) for emitting vortex beams with orbital angular momentum of a variable order. The MRR consists of a ring waveguide with periodic holes, side-coupled to a bus waveguide.

TuR04-11 15:15-15:30

Modeling the propagation of Laguerre-Gaussian beams through a turbulent medium

D.D. Reshetnikov, T.K. Korol, E.V. Malyutina, V.M. Petrov; Faculty of Physics, St. Petersburg State University, Russia

In this work, the influence of atmospheric turbulence on Laguerre-Gaussian modes of various orders is investigated using phase masks for a spatial light modulator. The possibility of using optical vortices for atmospheric communication channels and cryptographic channels under conditions of changing atmospheric turbulence and the choice of an optimal set of modes for this are discussed.

TuR04-12 15:30-15:45

Modelling of a free-space optical communication link with vortices

D. Svirsky, I. Kazakov, S. Kontorov, A. Shipulin; ScolTech, Russia

Numerical simulations of the beams with optical angular momentum (OAM) propagating in a turbulent atmosphere is performed. A novel method is proposed for the numerical estimation of bit error rate utilizing optical vortices. Another important example is free space quantum cryptography. The application of the protocol for Quantum Key Distribution with OAM is considered.

TuR04-13 15:45-16:00

New aberration modes for the improvement of laser beam focusing in case of Kolmogorov phase distortion statistics

D.A. Yagnyatinskiy; LUCH JSC, Russia

For the laser beam focusing in case of Kolmogorov phase distortion statistics new “Karhunen-Loève-Lukosz” aberration modes with a property of minimizing the residual geometrical root-mean squared focal spot radius are proposed. Calculations indicate that sequential correction of these modes up to 7th order inclusive gives the improvement of focusing parameters in comparison with other known aberration modes.

TuR04-14 16:00-16:15

Mode decomposition algorithm for enhancing the phase measurement accuracy

D.S. Kharenko[1,2], M.D. Gervaziev[1,2], A.A. Revyakin[1,2], K.V. Serebrennikov[2], F. Mangini[3], M. Ferraro[4], S. Wabnitz[3], S.A. Babin[1,2]; [1]Institute of Automation and Electrometry SB RAS, Russia; [2]Department of Physics, Novosibirsk State University, Russia; [3]DIET, Sapienza University of Rome, Italy; [4]Department of Physics, University of Calabria, Italy

Holographic mode decomposition methods are extremely fruitful in revealing the physical mechanism of nonlinear effects, but also suffer from unresolved issues. In this work we improve the measurement accuracy of the relative modal phases, by adjusting the modal intensities.

TuR04-15 16:15-16:30

Simple method for spherical aberration correction in direct laser writing

V.S Tsarev, V.K. Mezentsev, A.G. Okhrimchuk; Prokhorov General Physics Institute RAS, Russia

The relation is established which shows the focusing depths with compensated spherical aberrations under the high aperture focusing through the surface in materials with different refractive indices and the same pre-compensation settings. The focusing objective possesses the correction ring calibrated for single specific material. The developed relation allows calculation of depth at which correct pre-compensation is applied for any material.

TuR04-16 16:30-16:45

Fiber acousto-optic vortex-involved interaction: photon-phonon spin and orbital momentum transfer and transformation

D. Vikulin, B. Sokolenko, N. Shostka, C. Alexeyev, M. Yavorsky; Vernadsky Crimean Federal University, Russia

The novel processes of spin and orbital angular momentum transfer and conversion during an interaction between topologically charged vortex photons and vortex phonons in a waveguiding medium are described.

TuR04-17 16:45-17:00

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

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

A programming library was developed, using Stratton-Chu diffraction integrals for calculating reflected fields. Focusing schemes with tunable number of beams and mirrors placement were studied, considering the influence of phase distortion and aberrations. The intensity above 3×10^26 W/cm2 was found theoretically attainable in a system of 12 beams of 50 PW each with about 90% of that value realistically achievable.

- Coffee Break -

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

R04: LASER BEAM CONTROL 4

Session Chair:

TuR04-18 17:30-17:45

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

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

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

TuR04-19 17:45-18:00

Controllable formation of giant nonlinearities in integrated optical travelling wave modulators

V.S. Gerasimenko[1,2], N.D. Gerasimenko[2], V.M. Petrov[1,3]; [1]Research and Educational Center for Photonics and Optoinformatics, ITMO University, [2]Quanttelecom, [3]Dept. of General Physics, St. Petersburg State University, Russia

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

TuR04-20 18:00-18:15

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

E.A. Efremova[1], I.R. Krylov[2], U.V. Prokhorova[2], E.V. Shalymov[3], V.I. Shoev[1,3], V.Yu. Venediktov[2,3], A.A. Zinchik[1]; [1]ITMO University; [2]St. Petersburg State University; [3]St. Petersburg Electrotechnical University "LETI", Russia

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

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

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

R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 1

Session Chair:

TuR05-01 09:00-09:30

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

N.E. Andreev[1,2], I.R. Umarov[1,2], V.S. Popov[1]; [1]Joint Institute of Hight Temperatures RAS; [2]Moscow Institute of Physics and Technology, Russia

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

TuR05-02 09:30-09:45

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

I.A. Aleksandrov[1,2], E.D. Akimkina[1], A.A. Andreev[1,2]; [1]St. Petersburg State University; [2]Ioffe Institute RAS, Russia

We investigate conditions for Breit-Wheeler pair production within the interaction of a circularly polarized ultra-intense laser pulse with gamma photons emitted by seed particles. In the initial state, we consider neutral xenon, the electrons of which get ionized. We examine the magnetic field effects and enhancement of the pair-production process due to the circular polarization of the laser field.

TuR05-03 09:45-10:00

Laser acceleration of charged particles from preplasma

M.A. Rakitina[1], A.V. Brantov[1,2], S.I. Glazyrin[2]; [1]Lebedev Physical Institute RAS; [2]Dukhov Research Institute of Automatics (VNIIA), Russia

A series of hydrodynamic calculations of target irradiation with a nanosecond laser pulse were carried out, describing the plasma density profiles that arise during target expansion, depending on the parameters of the laser prepulse/additional pulse. The results obtained make it possible to increase the efficiency of ion acceleration during the interaction of short laser pulses with a plasma target.

TuR05-04 10:00-10:30

Electron accelerator driven by 1TW femtosecond laser pulses: targetry, principles and prospects *(Invited paper)*

K.A. Ivanov[1,2], I.N. Tsymbalov[1,3], D.A. Gorlova[1,3], S.A. Shulyapov[1], I.P. Tsygvintsev[4], I.Yu. Vichev[4], Yu.V. Kochetkov[5], R.V. Volkov[1], A.B. Savel'ev[1,2]; [1]Physics Faculty, Lomonosov Moscow State University, [2]Lebedev Physical Institute RAS, [3]Institute for Nuclear Research RAS, [4]Keldysh Institute of Applied Mathematics RAS, [5]National Research Nuclear University MEPhI, Russia

Various methods and approaches of efficient bunched high energy particles accelerations are discussed with the use of few terawatt-class lasers interacting with tailored under-critical plasma.

TuR05-05 10:30-10:45

Numerical study of a collimated high charge electron beam generation on laser systems with terawatt peak power

D.A. Gorlova[1,2], I.N. Tsymbalov[1,2], K.A. Ivanov[1], E.M. Starodubtseva[1], A.B. Savel'ev[1]; [1]Faculty of Physics, Lomonosov Moscow State University, [2]Institute for Nuclear Research RAS, Russia

We had numerically studied electron acceleration in the interaction of a terawatt laser pulse with a target with density ~10% of critical. Based on PIC simulations, electron acceleration mechanism was found to be a combination of direct laser acceleration and laser wakefield acceleration. With the increase in pulse energy, a collimated electron beam with 1 nC charge can be obtained.

TuR05-06 10:45-11:00

Diagnostics of plasma channel parameters by optical plasma radiation in laser-plasma electron acceleration experiment

E.M. Starodubtseva[1], I.N. Tsymbalov[1,2], D.A. Gorlova[1,2], A.B. Savel'ev[1,3], K.A. Ivanov[1,3]; [1]Faculty of Physics, Lomonosov Moscow State University; [2]Institute for Nuclear Research RAS; [3]Lebedev Physical Institute RAS, Russia

A method for diagnostic plasma channel parameters by optical plasma radiation was developed. The electron density outside the plasma channel was obtained from the backward stimulated Raman scattering spectrum, and the refractive index inside the channel was obtained from the second harmonic radiation angle.

- Coffee Break -

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

R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 2

Session Chair:

TuR05-07 11:30-12:00

Relativistic self-trapping of power laser pulse and accompanying radiation-nuclear phenomena *(Invited paper)*

V.Yu. Bychenkov; Lebedev Physical Institute RAS; Dukhov Research Institute of Automatics (VNIIA), Russia

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

TuR05-08 12:00-12:15

High-brilliance synchrotron radiation in relativistic self-trapping regime

O.E. Vais[1,2], M.G. Lobok[1,2], V.Yu. Bychenkov[1,2]; [1]VNIIA; [2]LPI, Russia

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

TuR05-09 12:15-12:30

Bremsstrahlung gamma-ray source for prompt gamma-ray activation analysis based on the regime of relativistic self-trapping of light

M.G. Lobok[1,2], V.Yu. Bychenkov[1,2]; [1]VNIIA; [2]LPI, Russia

A numerical GEANT4 experiment on gamma-activation of thin plates made of natural gold and depleted uranium was carried out as a first-principles experiment. A comparison between bunch of monoenergetic collimated electrons with energy 15 MeV and a PIC (VSIM) simulated one from relativistic self-trapping electron source, which interacted with a bremsstrahlung converter preceding gamma-activation and nuclear-spectra analysis, was performed.

TuR05-10 12:30-13:00

Laser initiated strong THz pulses *(Invited paper)*

A.V. Brantov[1,2], M.G. Lobok[1,2], A.S. Kuratov[1,2], V.Yu. Bychenkov[1,2]; [1]Lebedev Physical Institute RAS; [2]Dukhov Research Institute of Automatics (VNIIA), Russia

The report presents the theory and modeling of the generation of powerful terahertz pulses as a result of the transition radiation of the most energetic electrons heated by a laser pulse. The influence of various effects on the shape of the half-cycle generated pulse is discussed. An increase in the efficiency of terahertz radiation using low-density targets has been demonstrated.

TuR05-11 13:00-13:15

Electron acceleration and THz emission during laser-cluster interaction

N.A. Kuzechkin[1], A.A. Angeluts[1,2], A.V. Balakin[2], P.M. Solyankin[1], A.P. Shkurinov[2]; [1]National Research Centre «Kurchatov Institute»; [2]Department of Physics, Lomonosov Moscow State University, Russia

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

TuR05-12 13:15-13:30

Efficient generation of low-frequency radiation at back-reflection of intense laser pulses from near-critical-density targets

A.V. Korzhimanov; Gaponov-Grekhov Institute of Applied Physics RAS; Lobachevsky University of Nizhny Novgorod, Russia

It is shown that when intense laser pulses are reflected from a near-critical density plasma, the Doppler shift leads to generation of intense radiation in both the high-frequency (ultraviolet and x-ray) and low-frequency (mid-infrared) ranges. The efficiency of energy conversion into the wavelength range above 3 μm can reach several percent, which allows to obtain relativistically intense mid-infrared pulses.

- Lunch Break -

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

R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 3

Session Chair:

TuR05-13 15:00-15:30

Coherent and incoherent scattering a counter-propagating laser pulse at a relativistic electron mirror *(Invited paper)*

V.V. Kulagin[1], V.N. Kornienko[2], V.A. Cherepenin[2], H. Suk[3]; [1]Sternberg State Astronomical Institute, Lomonosov Moscow State University; [2]Kotelnikov Institute of Radioengineering and Electronics RAS, Russia; [3]Department of Physics and Photon Science, Gwangju Institute of Science and Technology, South Korea

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

TuR05-14 15:30-15:45

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

I.N. Tsymbalov[1,2], D.A. Gorlova[1,2], K.A. Ivanov[1], A.B. Savel'ev[1]; [1]Faculty of Physics, M.V. Lomonosov Moscow State University, [2]Institute for Nuclear Research RAS, Russia

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

TuR05-15 15:45-16:00

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

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

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

TuR05-16 16:00-16:30

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

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

Success in developing of compact laser driven electron accelerators requires developing of compact undulators. This is possible only with plasma undulators. To understand effects of plasma on electron beam bunching, multidimensional particle-in-cell simulations in high-gamma relativistic reference frames are curried out. Beam bunching by low density plasma, undulator bunching, and their joint effect on radiation coherency are discussed.

TuR05-17 16:30-16:45

X-ray yield enhancement from microplasma produced by tandem high-frequency fiber lasers

A.A. Garmatina[1], E.I. Mareev[1], N.V. Minaev[1], N.M. Asharchuk[1], T.A. Semenov[1], V.V. Rovenko[1], Y.S. Krivonosov[1], I.G. Dyachkova[1], A.V. Buzmakov[1], D.A. Zolotov[1], V.M. Gordienko[1,2], V.E. Asadchikov[1]; [1]Kurchatov Complex Crystallography and Photonics, NRC “Kurchatov Institute”; [2]Faculty of Physics, Moscow State University, Russia

We created a laser-plasma X-ray source based on the femtosecond fiber laser with high yield ~2x10^9 phot/s/2π (3-12 keV), and with a source size diameter of approximately 10 microns. The X-ray yield and the source size were optimized by using artificial intelligence, the He flow and nanosecond pre-pulse.

TuR05-18 16:45-17:00

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

S.V. Zabotnov[1], D.V. Shuleiko[1], E.V. Kuzmin[1], P.P. Pakholchuk[1], L.D. Volkovoynova[2], A.A. Serdobintsev[2], P.K. Kashkarov[1]; [1]Lomonosov Moscow State University, [2]Saratov State University, Russia

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

- Coffee Break -

R06: LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY

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

R06: LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY 1

Session Chair:

TuR06-01 15:15-15:45

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

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

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

TuR06-02 15:45-16:00

Integrated Application of Laser Technologies of Sustainable development Energy

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

Sustainable development of cities in countries is largely determined by the global state of the environment. Integrated Application Laser Technologies is the one of sustainable development to increase energy needs for sustainable development of mankind.

TuR06-03 16:00-16:15

Towards all-fiber chalcogenide system for spectroscopic remote sensing in mid-IR

E.A. Romanova[1,2], N.D. Parshina[1], A.P. Velmuzhov[2], M.V. Sukhanov[2], T.V. Kotereva[2], V.S. Shiryaev[2]; [1]Institute of Physics, Saratov State University; [2]Institute of Chemistry of High Purity Substances RAS, Russia

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

TuR06-04 16:15-16:30

Increase the data acquisition rate of a ghost polarimetry system via deep learning

V.S. Shumigai, P.E. Moreva, V.S. Tuchin, A.M. Startseva, B.A. Nasedkin, A.N. Tcypkin; ITMO Univ., Russia

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

TuR06-05 16:30-16:45

Multifrequency Terahertz quartz-enhanced photoacoustic spectroscopy for gas recognition

A.V. Dubrov[1], S.V. Ivanov[1], Yu.V. Kistenev[2], M.D. Khomenko[1], D.R. Makashev[2], I.A. Ozheredov[1,3], A.O. Sazhin[1,3], A.P. Shkurinov[1,3]; [1]NRC Kurchatov Institute; [2]Laboratory of Biophotonics, National Research Tomsk State University; [3]Faculty of Physics, Lomonosov Moscow State University, Russia

Quartz-enhanced photoacoustic spectroscopy in terahertz frequency range is applied for gas detection. Data analysis is carried out using a physically-informed machine learning model. Direct numerical simulations are carried out for absorption on terahertz laser lines showing a good correspondence to the experiments. A clear dependence of the sensor signal on a target analyte is seen showing feasibility for gases recognition.

TuR06-06 16:45-17:00

Distributed strain sensor based on double-wavelength phi-OTDR

T.V. Gritsenko, R.I. Khan, K.I. Koshelev, E.M. Rubtsov, A.V. Sibirtsev, A.B. Pnev; Bauman Moscow State Technical University, Russia

We propose a new phase recovery approach in a phi-OTDR based on weak fiber Bragg gratings (wFBG), utilizing two matched wavelengths. The method and an experimental setup are described. The presented experimental strain measuring results demonstrate an error of less than 5 µm.

- Coffee Break -

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

R06: LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY 2

Session Chair:

TuR06-07 17:30-18:00

Super-resolution of microsphere-assisted imaging *(Invited paper)*

A.V. Maslov[1], A.A. Erykalin[1], V.N. Astratov[2]; [1]Department of Radiophysics, University of Nizhny Novgorod, Russia; [2]Department of Physics and Optical Science, University of North Carolina at Charlotte, USA

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

TuR06-08 18:00-18:15

Measuring anatomy of vascular structures: workflow for analysis of 3D optoacoustic angiographic data

A.Yu. Korobov[1,2], Z.V. Besedovskaia[1], E.A. Petrova[2], A.A. Kurnikov[1], A.M. Glyavina[1], I.N. Druzhkova[3], M.A. Sirotkina[3], S.V. Nemirova[3], A.G. Orlova[1], D.A. Gorin[2], D. Razansky[4], P.V. Subochev[1]; [1]Ultrasonic and Opto-Acoustic Diagnostics Laboratory, Institute of Applied Physics RAS, IAP RAS, [2]CNBR, Skolkovo Institute of Science and Technology, Skoltech, [3]Privolzhsky Research Medical University, Russia; [4]Department of Information Technology &Electrical Engineering, Institute for Biomedical Engineering, ETH Zurich, Switzerland

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

TuR06-09 18:15-18:30

6-wavelength VIS -SWIR laser with acousto-optic attenuation

M.O. Sharikova, A.S. Machikhin, A.I. Lyashenko; STC UI RAS, Russia

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

TuR06-11 18:45-19:00

Multilayer interference metamaterials for advancing THz-TDS technique

N.A. Nikolaev[1,2], A.A. Rybak[1,2], S.A. Kuznetsov[1,2,3]; [1]Institute of Automation and Electrometry SB RAS; [2]Novosibirsk State University; [3]Design and Technology Institute of Applied Microelectronics, Rzhanov Institute of Semiconductor Physics SB RAS, Russia

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

TuR06-12 19:00-19:15

Predicting vascular states: ML modeling of optoacoustic imaging data for detection changes in the vasculature

Z.V. Besedovskaia[1], A.Yu. Korobov[1,2], M.M. Trofimov[1], D.A. Ushakov[4], A. Kurnikov[2], A. Glyavina[2], V.V. Klinshov[5], S.V. Nemirova[3], A.G. Orlova[2], P.V. Subochev[2]; [1]CNBR, Skolkovo Institute of Science and Technology, Skoltech, [2]Ultrasonic and Opto-Acoustic Diagnostics Laboratory, Institute of Applied Physics RAS, [3]Privolzhsky Research Medical University, [4]Laboratory of the Main Geomagnetic Field and Petromagnetism, Institute of Physics of the Earth RAS, [5]Institute of Applied Physics RAS, Russia

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

R07: FREE ELECTRON LASERS

Location: Deyneka 1+2 Room, Floor 2; Date: Tuesday, July 02, 2024
R07: FREE ELECTRON LASERS 1
Session Chair:

TuR07-01 17:30-18:00

Experimental stations of the Novosibirsk free-electron laser facility and research on them *(Invited paper)*

V.V. Gerasimov[1], V.V. Kubarev[1], E.N. Chesnokov[2], A. Vodopianov[3], S.E. Peltek[4], V.M. Popik[1], S.L. Veber[5], B.A. Knyazev[1], A.K. Nikitin[6], P.A. Nikitin[6], I.Sh. Khasanov[6], R.Yu. Zhukavin[7], Yu.Yu. Choporova[1], V.S. Paveliev[8], A.I. Ivanov[9], I.V. Antonova[9], O.E. Kameshkov[10], N.D. Osintseva[1], V.D. Kukotenko[1], N.A. Bazdirev[10], V.S. Vanda[10], O.A. Shevchenko[1], Ya.V. Getmanov[1], Ya.I. Gorbachev[1], M.A. Scheglov[1], N.A. Vinokurov[1], G.N. Kulipanov[1]; [1]Budker Institute of Nuclear Physics SB RAS; [2]Voevodsky Institute of Chemical Kinetics and Combustion SB RAS; [3]Institute of Applied Physics; [4]Institute of Cytology and Genetics SB RAS; [5]International Tomography Center SB RAS; [6]Scientific and Technological Centre of Unique Instrumentation RAS; [7]Institute for Physics of Microstructures RAS; [8]Samara University; [9]Rzhanov Institute of Semiconductor Physics SB RAS; [10]Novosibirsk State University, Russia

The most significant research results achieved at the terahertz radiation of the Novosibirsk free-electron laser in recent years will be presented.

TuR07-02 18:00-18:15

High-temperature continuous terahertz laser discharge at NovoFEL: parameters and applications

V.V. Kubarev[1], O.A. Shevchenko[1], Ya.V. Gorbachev[1], A.V. Sidorov[2], A.V. Vodopyanov[2], A.P. Veselov[2]; [1]Budker Institute of Nuclear Physics; [2]Gaponov-Grekhov Institute of Applied Physics, Russia

A stable point-like thermodynamically-equilibrium plasma with density of 3×1E17 cm-3, and temperature of 4-4.5 eV was obtained in a continuous laser discharge at NovoFEL at an average power of 180 W. Such plasma is a bright source of VUV radiation, and when its temperature reaches 10-12 eV, it can be a bright source of EVUV radiation.

TuR07-03 18:15-18:30

Target design for high-pressure temperature matter using inelastic x-ray scattering at the HED Instrument at the European XFEL

D. Bespalov[1,2], K. Appel[1], E. Brambrink[1], D. Kraus[2], R. Redmer[2], U. Zastrau[1]; [1]High-Energy Density Science, European XFEL; [2]Institut für Physik, Universität Rostock, Germany

This work presents an optimized target design for high-resolution inelastic x-ray scattering at the HED instrument, European XFEL. Utilizing hydrodynamics simulations and preliminary tests, the laser-irradiated aluminum target exhibits enhanced capabilities for studying WDM under extreme conditions.

TuR07-04 18:30-18:45

Side-band modes in open optical resonators of pulse-periodic free electron lasers

V.V. Kubarev; Budker Institute of Nuclear Physics; Voevodsky Institute of Chemical Kinetics and Combustion, Russia

Using the examples of terahertz and far-infrared Novosibirsk free electron lasers, a new cavity type of side-band modes that arise for certain periodic cavity geometries when the pump and cavity axes do not coincide is described.

TuR07-05 18:45-19:15

Recent developments in the applications of X-ray Free Electron Lasers *Invited*

M. Chergui; Elettra Sincrotrone Trieste S.C.p.A., Italy; Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne (EPFL), Switzerland

X-ray Free Electron lasers (XFELs) have been a game changer in time-resolved X-ray spectroscopic studies of matter thanks to their ultrashort pulses, high photon flux/pulse and photon energy range. I will briefly present some of the most representative studies carried out on chemical, biological systems and solid materials.

I will then dwell on trends that aim at exploiting the high photon fluxes and coherent properties of the XFEL beams, in order to implement non-linear X-ray spectroscopies, akin to what happened in the 1960s, after the birth of the laser.1 Indeed, techniques such as multiphoton absorption, second-harmonic generation and four-wave mixing have been implemented, and in the case of Transient Grating core-level spectroscopy, now routinely used.

TuR07-06 19:15-19:45

Magnetic measurements, pole tuning, landmark measurements and shimming process of hybrid X-ray undulators *Invited*

B. Ketenoglu; Ankara University, Türkiye

TuR07-07 19:45-20:15

Status and future of the Novosibirsk free electron laser facility *Invited*

O.A. Shevchenko; Budker Inst. of Nuclear Physics SB RAS, Russia

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Location: Stenberg 2 Room, Floor 3; Date: Tuesday, July 02, 2024
R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 1
Session Chair:

TuR08-01 09:00-09:30

Machine learning control of complex nonlinear dynamics in fibre lasers *(Invited paper)*

S. Boscolo[1], J. Peng[2], X. Wu[2], Y. Zhang[2], C. Finot[3], H. Zeng[2]; [1]Aston Institute of Photonic Technologies, Aston University, United Kingdom; [2]State Key Laboratory of Precision Spectroscopy, East China Normal University, China; [3]Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-Universite' de Bourgogne, France

We review our recent work on the use of genetic algorithms to assist in the control and study of non-stationary nonlinear wave dynamics in ultrafast fibre lasers. These include repetitive patterns, such as breathing solitons and breather molecular complexes, and non-repetitive rare events.

TuR08-02 09:30-10:00

Beam self-cleaning and wave thermalization in multimode fibers *(Invited paper)*

F. Mangini[1], M. Ferraro[2], W.A. Gemechu[1], M.D. Gervaziev[3,4], D.S. Kharenko[3,4], S.A. Babin[3,4], S. Wabnitz[1]; [1]DIET, Sapienza University of Rome, Italy; [2]Department of Physics, University of Calabria, Italy; [3]Department of Physics, Novosibirsk State University, Russia; [4]Institute of Automation and Electrometry SBRAS, Russia

Spatial beam self-cleaning in multimode optical fibers may be described as a result of wave thermalization. Our mode decomposition experiments confirm the validity of this approach, but also point to open questions.

TuR08-03 10:00-10:15

Integrated microresonator as a nonlinear reflecting mirror in fiber laser cavity for optical frequency comb generation

A.A. Mkrtchyan[1], Z. Ali[1], M.S. Mischevsky[1], N. Dmitriev[2], A. Nasibulin[1], I. Bilenko[2], Yu.G. Gladush[1]; [1]Skolkovo Institute of Science and Technology, [2]Russian Quantum Center, Russia

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

TuR08-04 10:15-10:30

Dynamics of long period pulsations when intra-cavity loss change

A.V. Sudin[1], S.N. Ushakov[1,2], I.A. Volkov[1], K.N. Nishchev[1], M.Y. Vlasov[1,3]; [1]National Research Mordovia State Univ.; [2]Prokhorov General Physics Inst. RAS; [3]Joint-Stock Company “The Engineering Centre of Fiber Optics”, Russia

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

TuR08-05 10:30-10:45

He-Xe gas-discharge fiber laser

D.G. Komissarov[1], A.V. Gladyshev[1], S.M. Nefedov[2], A.F. Kosolapov[1], V.V. Velmiskin[1], A.P. Mineev[2], I.A. Bufetov[1]; [1]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center; [2]Prokhorov General Physics Institute RAS, Russia

Operation of a 2.03-μm He-Xe gas-discharge fiber laser based on a hollow-core fiber and pumped by a microwave radiation at 2.45 GHz is investigated. Optimal gas-mixture composition and pressure are identified. Opportunities for further development of gas-discharge fiber lasers are discussed.

TuR08-06 10:45-11:00

Stochastic narrowband generation in a random fiber Raman laser

O.A. Gorbunov, I.D. Vatnik, S.V. Smirnov, D.V. Churkin; Novosibirsk State University, Russia

Just above the generation threshold the spectrum of a random fiber laser consists of ultra-narrow localized modes, which evolve for time intervals of about 1 ms and decompose afterwards. We characterize its main features: lifetimes and power of these modes, their temporal and statistical properties and articulate the mechanism of modes’ decay as a nonlinear wave mixing process.

- Coffee Break -

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

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 2

Session Chair:

TuR08-07 11:30-11:45

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

D.R. Kharasov[1], E.A. Fomiryakov[1,2], D.M. Bengalskii[1], S.P. Nikitin[1], O.E. Nanii[1,2], V.N. Treshchikov[1]; [1]T8 Sensor LLC, [2]Lomonosov Moscow State University, Russia

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

TuR08-08 11:45-12:00

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

P.A. Danilov[1], I.D. Matayev[1,2], D.A. Pomazkin[1], P.Ya. Ilushin[1,3], S.I. Kudryashov[1]; [1]Lebedev Physical Institute; [2]Bauman Moscow State Technical University; [3]Lomonosov Moscow State University, Russia

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

TuR08-09 12:00-12:15

Optoacoustic effects on laser breakdown in a liquid

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

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

TuR08-10 12:15-12:30

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

S.M. Pershin[1], V.A. Orlovich[2], A.I. Vodchits[2], I.A. Khodasevich[2], M.Ya. Grishin[1]; [1]Prokhorov General Physics Institute RAS, Russia; [2]B.I. Stepanov Institute of Physics NASB, Belarus

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

TuR08-11 12:30-12:45

Stimulated Raman scattering of 240 fs laser pulses in PMMA

S.M. Pershin[1], M.Ya. Grishin[1], M.V. Ponarina[1], A.A. Ushakov[1], I.A. Khodasevich[2]; [1]Prokhorov General Physics Institute RAS, Russia; [2]B.I. Stepanov Institute of Physics NASB, Belarus

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

TuR08-12 12:45-13:00

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

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

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

TuR08-13 13:00-13:15

Emission induced by an energy transfer from electronic excitations in SiO_2 to N_2 molecules

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

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

TuR08-14 13:15-13:30

Shaping energy landscape of organic polariton condensates in double dye cavities

A.D. Putintsev[1], K.E. McGhee[2], D.A. Sannikov[1], A.V. Zasedatelev[1], J.D. Topfer[1], T. Jessewitsch[3], U. Scherf[3], D.G. Lidzey[2], P.G. Lagoudakis[1]; [1]Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, Russia; [2]Department of Physics and Astronomy, University of Sheffield, UK; [3]Macromolecular Chemistry Group and Institute for Polymer Technology, Bergische Universität Wuppertal, Germany

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

TuR08-15 13:30-14:00

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

A Redyuk; Novosibirsk State University, Russia

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

- Lunch Break -

R10: NONLINEAR QUANTUM PHOTONICS

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

R10: NONLINEAR QUANTUM PHOTONICS 1

Session Chair:

TuR10-01 09:00-09:30

Tuning quantum emission with frequency filtering and homodyning *(Invited paper)*

E. del Valle; Física Teórica de la Materia Condensada-IFIMAC, Universidad Autónoma de Madrid, Spain; Institute for Advanced Study, Technische Universität München, Germany

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

TuR10-02 09:30-10:00

Spectral filtering of non-classical light *(Invited paper)*

V.Yu. Shishkov; Moscow Institute of Physics and Technology, Russia

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

TuR10-03 10:00-10:15

Statistical properties of light produced by spontaneous Raman scattering

I.V. Panyukov[1,2], V.Yu. Shishkov[1,2,3], E.S. Andrianov[1,2,3]; [1]Dukhov Research Institute of Automatics (VNIIA); [2]Moscow Institute of Physics and Technology; [3]Institute for Theoretical and Applied Electromagnetics, Russia

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

TuR10-04 10:15-10:30

Effective programming of a photonic processor with complex interferometric structure

I.V. Kondratyev[1], K.N. Urusova[1], A.S. Argenchiev[1], S.S. Kuzmin[1], N.N. Skryabin[1], I.V. Dyakonov[1,2], S.S. Straupe[1,2], S.P. Kulik[1,3]; [1]Quantum Technology Centre, Lomonosov Moscow State University; [2]Russian Quantum Center; [3]Laboratory of quantum engineering of light, South Ural State University, Russia

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

TuR10-05 10:30-10:45

Dissipative phase transition in quadratically driven Kerr oscillator

V.Yu. Mylnikov[1], S.O. Potashin[1], M.S. Ukhtary[2,3], C.A. Downing[2], G.S. Sokolovskii[1]; [1]Ioffe Institute, Russia; [2]Department of Physics and Astronomy, University of Exeter, UK; [3]Research Center for Quantum Physics, National Research and Innovation Agency (BRIN), Indonesia

The nonequilibrium dissipative phase transition of the Kerr oscillator with two-photon drive and dissipation is studied. We investigate properties of the steady state and critical slowing down near the phase transition point.

TuR10-06 10:45-11:00

Photon antibunching as a tool for enhancement of nanosensors spatial resolution

A.B. Mikhalychev, S.Ya. Kilin; B.I. Stepanov Institute of Physics NASB, Belarus

We propose a method of spatial resolution enhancement in metrology (magnetometry, thermometry, etc.) with color center based nanosensors by using photon antibunching for single quantum emitters. Numerical simulations demonstrate efficiency of the approach. We perform quantitative estimation of the information increase due to exploitation of photon antibunching and find the conditions, under which application of the proposed method is reasonable.

- Coffee Break -

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

R10: NONLINEAR QUANTUM PHOTONICS 2

Session Chair:

TuR10-07 11:30-12:00

Multiphoton processes from single-photon emitters *(Invited paper)*

E. Zubizarreta Casalengua; Technical University of Munich, Germany

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

TuR10-08 12:00-12:30

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

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

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

TuR10-09 12:30-13:00

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

Juan Loredo; University of Vienna, Austria

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

TuR10-10 13:00-13:15

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

A.V. Taichenachev[1,2], V.I. Yudin[1,2,3], T. Zanon-Willette[4]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State Univ.; [3]Novosibirsk State Tech. Univ., Russia; [4]Sorbonne Univ., France

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

TuR10-11 13:15-13:30

Quantum ghost polarimetry with correlated photons

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

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

- Lunch Break -

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

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

R11: LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION AND GLOBAL NAVIGATION 1

Session Chair:

TuR11-00 14:30-15:00

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

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

Abstract is not available.

TuR11-01 15:00-15:30

Coherent laser systems for remote atmosphere sensing *(Invited paper)*

A.S. Boreysho[1,2], M.A. Konyaev[1,2]; [1]BSTU «VOENMEH» named after D.F. Ustinov; [2]Laser Systems Ltd., Russia

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

TuR11-02 15:30-16:00

Lasers for satellite and lunar ranging *(Invited paper)*

A.F. Kornev; «Lasers & Optical Systems» Co. Ltd., Russia

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

TuR11-03 16:00-16:15

Picosecond Nd:YAG laser for SLR in outdoor conditions

A.F. Kornev[1], V.V. Koval[1], Yu.V. Katsev[1], V.D. Nenadovich[2], A.L. Sokolov[2]; [1]«Lasers & Optical Systems» Co. Ltd., [2]JSC «RPC «PSI», Russia

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

TuR11-04 16:15-16:30

Confirmation of the characteristics of the GLONASS system by means of query and non-query measurements of new generation SLR stations

V.V. Pasynkov[1], V.F. Braginets[2], A.V. Chaporgin[3]; [1]JSC "RPC "PSI"; [2]Branch of JSC "RPC "PSI"; [3]Institute of Navigation, Russia

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

TuR11-05 16:30-16:45

Design and systems characteristics for free-space laser communication terminals

K.V. Alybin, D.A. Boyarov, V.N. Grigoriev, I.V. Kuzmin, S.V. Petushkov, D.A. Safaev, V.V. Murashkin, R.K. Lozov; JSC RPC "PSI", Moscow, Russia

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

TuR11-06 16:45-17:00

14.7Gbit/s visible light laser communication over 100m free-space transmition utilizing Huffman coding based probabilistic shaping

Yuning Zhou, Zengyi Xu, Zhilan Lu, Junwen Zhang, Chao Shen, Jianyang Shi, Ziwei Li, Nan Chi; Key Laboratory for Information Science of Electromagnetic Waves (MoE), Department of Communication Science and Engineering, Fudan University, China

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

- Coffee Break -

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

R11: LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, SPACE COMMUNICATION AND GLOBAL NAVIGATION 2

Session Chair:

TuR11-07 17:30-17:45

Free-space laser communication terminals

D.A. Boyarov[1,2], V.N. Grigoriev[1], I.V. Kuzmin[1], S.V. Petushkov[1], V.V. Murashkin[1], S.V. Polkanov[1], R.K. Lozov[1]; [1]SC Scientific and Production Corporation Precision Instrument Engineering Systems; [2]National Research University "Moscow Power Engineering Institute", Russia

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

TuR11-08 17:45-18:00

Experimental research of an on-board laser acceleration measurements for the gravitational field parameters estimation on cubesate nanosatelite

F.V. Fateev, S.S. Donchenko, R.A. Davlatov; FSUE Scientific Research Institute for Physical-Engineering and Radiotechnical Metrology (VNIIFTRI), Russia

The paper considers the possibility of constructing an accelerometer for a space mission for gravitational field parameters measurement based on an optical interferometer instead of a capacitive measuring system. The layout of the accelerometer sensing element and a bench for measuring its sensitivity are described.

TuR11-09 18:00-18:15

Features of the diffraction pattern formation of the laser radiation, reflected from the CCRs in automatic system for docking the space transport vehicle and orbital station

A.S. Akentev, U.M. Afanasenkov, A.L. Sokolov, S.N. Bazzaeva; JSC "RPC "PSI", Russia

The optical cube reflectors (CRs) of the automatic docking systems of the space transport vehicles (STV) and orbital stations (OSs) are observed. The influence of CRs edges chamfers and offset of three dihedral angles of the CRs on the energy distribution of the radiation reflected from the CRs for different distances between the STV and the OSs has been determined.

TuR11-10 18:15-18:30

Laser ranging based on two-photon absorption excited by the optical comb of a fiber femtosecond laser

W. Xia, P. Chen, H. Hao, D. Guo, M. Wang; School of Computer and Electronic Information/School of Artificial Intelligence, Nanjing Normal University, China

This paper proposes a laser ranging technique based on the autocorrelation method of two-photon absorption. Theoretical analysis shows that the optical autocorrelation method based on two-photon absorption can be used for absolute distance measurement. In the laser ranging system, the real-time absolute distance measurement is achieved by locking the position of the peak point of the two-photon absorption autocorrelation signal.

TuR11-11 18:30-18:45

The protocol of quantum key distribution on beams with space structured polarization

D.D. Reshetnikov[1], A.L. Sokolov[2], E.A. Vashukevich[1], V.M. Petrov[1], T.Yu. Golubeva[1]; [1]St. Petersburg State University, [2]National Research University 'Moscow Power Engineering Institute', Russia

The work proposes a protocol for quantum key distribution using Laguerre-Gaussian beams with space structured polarization invariant to rotation of the radial coordinate in a plane normal to the beam propagation axis.

TuR11-12 18:45-19:00

Object detection by a microjoule-pulse LiDAR through a 18-m water layer: docking & navigation

S.M. Pershin[1], M.Ya. Grishin[1], V.A. Zavozin[1], P.A. Titovets[2], M.O. Fedyuk[2]; [1]Prokhorov General Physics Institute RAS, [2]Moscow Technical University of Communications and Informatics, Russia

The LiDAR backscattering signal (3 ns, 532 nm, 2 μJ) was recorded for the first time through 18 m of water and 7 m of air. Reflectors placed on the target surface are found to multiply the backscattering signal. Underwater maneuvering of unmanned robots, docking and navigation in flooded areas using a LiDAR with eye-safe radiation level is discussed.

R07: FREE ELECTRON LASERS - POSTERS

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

TuR07-p01 15:00-18:30

Simulation of the evolution of an electron bunch in a vacuum laser photodiode

I.V. Danilova[1], P.V. Tomashevich[1], S.A. Smirnov[1], A.P. Broyko[2]; [1]NTC "SYNTEZ", AO NIIEFA, [2]Department of Micro- and Nanoelectronics, ETU "LETI", Russia

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

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS - POSTERS

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

TuR08-p01 15:00-18:30

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

K.N. Min'kov[1], D.D. Ruzhitskaya[1], P.O. Kapralov[1], O.V. Borovkova[1,2]; [1]Russian Quantum Center, Skolkovo; [2]Faculty of Physics, Lomonosov Moscow State University, Russia

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

TuR08-p02 15:00-18:30

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

K.V. Lvov[1], S.Yu. Stremoukhov[1,2]; [1]Lomonosov Moscow State University; [2]National Research Center "Kurchatov Institute", Russia

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

TuR08-p03 15:00-18:30

Random lasing in suspension of ZnO nanoparticles during a phase transition

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

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

TuR08-p04 15:00-18:30

Analytical approximation for light bullets in multi-core fibers

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

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

TuR08-p05 15:00-18:30

Optomechanics of nanoparticles in the hybrid anapole state

S.R. Rozental[1], N.S. Babich[2], D.A. Kislov[1]; [1]Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, [2]ITMO University, Russia

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

TuR08-p06 15:00-18:30

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

M.V. Korolkov[1], I.A. Khodasevich[1], A.S. Piotukh[1], A.S. Grabtchikov[1], E.V. Kolobkova[2], T.V. Nguyen[3], D.S. Mogilevtsev[1]; [1]B.I. Stepanov Institute of Physics NASB, Belarus; [2]ITMO University, Russia; [3]Institute of Material Sciences VAST, Vietnam

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

TuR08-p07 15:00-18:30

Efficient Cherenkov-type optical-to-terahertz conversion in a prism-coupled $LiTaO_3$ crystal

S.B. Bodrov[1,2], N.A. Abramovsky[1], M.V. Platonova[1], A.N. Stepanov[2], M.I. Bakunov[1]; [1]University of Nizhny Novgorod; [2]Institute of Applied Physics RAS, Russia

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

TuR08-p08 15:00-18:30

Vortex-generating light-induced phase converter in azobenzene polymer

I.A. Budagovsky[1], M.P. Smayev[1], A.S. Zolot'ko[1], A.Yu. Bobrovsky[2]; [1]Lebedev Physical Inst. RAS; [2]Lomonosov Moscow State Univ., Russia

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

TuR08-p09 15:00-18:30

Tunable broadband polariton lasing from perovskite nano crystals at room temperature

M.D. Kolker[1], D.A. Sannikov[1], A.D. Putintsev[1], I.. Krasionov[1], T. Cookson[1], A.P. Pushkarev[2], P.G. Lagoudakis[1]; [1]Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, [2]ITMO University, Russia

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

TuR08-p10 15:00-18:30

A comparison of the sensitivity of two temperature sensing devices, designed in fiber optics

G.E. Sandoval-Romero[1], F. Velazquez-Carreon[1,2], A. Perez-Alonzo[1,2], E.E. Garia-Unzueta[1]; [1]Instituto de Ciencias Aplicadas y Tecnología, Universidad Nacional Autónoma de México; [2]Programa de Maestría y Doctorado en Ingeniería, Universidad Nacional Autónoma de México, México

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

TuR08-p11 15:00-18:30

Plasma characterization in liquid jets through third harmonic reflection

S. Hilal, M.V. Melnik, A.O. Ismagilov, A.N. Tsypkin; ITMO University, Russia

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

TuR08-p12 15:00-18:30

Modification of amorphous $Ge_2Sb_2Te_5$ film by XZ femtosecond laser scanning

M.P. Smayev[1], I.A. Budagovsky[1], D.O. Kuzovkov[1,2,3], P.I. Lazarenko[2]; [1]Lebedev Physical Institute RAS; [2]National Research Univ. of Electronic Technology; [3]SPC Lasers and Equipment TM, Russia

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

TuR08-p13 15:00-18:30

Cherenkov self-synchronized ultrashort Raman solitons on the whispering gallery modes of silica microspheres

E. Anashkina[1,2], A.V. Yulin[3], A. Osipov[3]; [1]A.V. Gaponov-Grekhov Inst. of Applied Physics RAS, [2]Lobachevsky State Univ., [3]ITMO Univ., Russia

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

TuR08-p14 15:00-18:30

The trajectory of the propogation of oblique rays in optical fibers with a stepped profile of the reflective index

D.V. Ryakhovskii, A.A. Makovetskii, S.M. Popov, A.A. Zamyatin; Kotelnikov Institute of Radio Engineering and Electronics RAS, Russia

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

TuR08-p15 15:00-18:30

Highly transient Raman convertion in $SrMoO_4$ under ultrafast double-pulse pumping

Yu.A. Kochukov[1,2], D.P. Tereshchenko[1], S.N. Smetanin[1,2], A.G. Papashvili[1], K.A. Gubina[2], V.V. Bulgakova[1], A.A. Ushakov[1], V.E. Shukshin[1], E.E. Dunaeva[1], I.S. Voronina[1], L.I. Ivleva[1]; [1]Prokhorov General Physics Institute RAS; [2]National University of Science and Technology MISIS, Russia

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

TuR08-p16 15:00-18:30

Metal capillaries: new prospects for application in Raman spectroscopy

V.V. Vitkin[1], A.P. Kouzov[2], E.E. Popov[1], N.N. Filippov[2], I.K. Chubchenko[3]; [1]ITMO University; [2]St. Petersburg State University; [3]Mendeleyev Institute for Metrology, Russia

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

TuR08-p17 15:00-18:30

Periodically poled waveguides in lithium niobate

A.R. Akhmatkhanov[1], E.S. Savelyev[1], A.V. Sosunov[2], A.R. Kornilicyn[2], V.S. Shur[1]; [1]Ural Federal University; [2]Perm State University, Russia

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

TuR08-p18 15:00-18:30

Hidden photon detection

K.S. Gochelashvili[1], V.N.Goryachev[2], G.N. Gol'tsman[3], V.N. Evdokimov[2], S.V. Erin[2], A.V. Semenov[3], A.A. Sysoliatin[1]; [1]Prokhorov General Physics Institute RAS; [2]NRC «Kurchatov institute» - IHEP; [3]Moscow Pedagogical State University, Russia

The report discusses a proposal to search for hidden photons (dark matter candidate) using an experimental setup "ERA" installation. The source of the creation of hidden photons is a powerful source of laser radiation. The search for hidden photons is the first option of the research program in the experiment to test the predictions of the Standard Model.

TuR08-p19 15:00-18:30

Fe:ZnSe laser generation at room temperature

N.G. Zacharov, V.I. Lazarenko, A.S. Safronov, G.N. Nomakonov, E.V. Saltykov, A.V. Pravdynuk, A.A. Lobanova, K.A. Tulyakov; Russian Federal Nuclear Center, Sarov, Russia

We report working at room temperature system based on Fe:ZnSe and ZGP crystals in mid-IR and far-IR spectral range. The emission light of the ZGP was used as a pump source for Fe:ZnSe laser, which generates pulses at λ = 4.45 μm. The laser operates in the pulse-periodic pump regime with a repetition rate up to 50 Hz.

TuR08-p20 15:00-18:30

Continuous signal processing using windowed Nonlinear Fourier Transform

I.S. Chekhovskoy[1], E.V. Sedov[2], G.A. Patrin[1], O.V. Shtyrina[1]; [1]Novosibirsk State University, Russia; [2]Aston Institute of Photonic Technologies, Aston University, UK

We present a new way to handle signal processing in fiber-optic networks. It combines chromatic dispersion compensation (CDC) with sliding window techniques to make processing signals more precise and effective. The Nonlinear Fourier Transform (NFT) is a key tool used here to manage chromatic dispersion and the Kerr effect, which are crucial for transmitting signals over long distances.

TuR08-p21 15:00-18:30

Researching the features of second harmonic generation in GaP nanowires

A.S. Funtikova[1,2], A.M. Mozharov[1,2], V.V. Fedorov[1,2], I.S. Mukhin[1,2], V.A. Sharov[2,3]; [1]Peter the Great St. Petersburg Polytechnic University, [2]Alferov University, Russia; [3]Ioffe Institute, Russia

Work is devoted to researching the process of second harmonic generation in GaP NWs depending on the orientation of the radiation source in order to achieve optimal direction of the second harmonic. Data were obtained on the relationship between the irradiation wavelength and the geometric parameters of NWs, which can be used to create integrated systems with optical activation.

TuR08-p22 15:00-18:30

Multi-frequency laser spectroscopy of sub-Doppler resonances in miniature vapour cells

I.S. Mesenzova[1], S.M. Ignatovich[1], D.V. Brazhnikov[1,2], M.N. Skvortsov[1], N.L. Kvashnin[1]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State University, Russia

A new method of atomic spectroscopy was developed. The key feature is that the new method uses dual-frequency laser beams with a special field geometry: linearly polarized counter beams with a mutual angle between the polarizations equal to 90 degrees, which, due to the CPT effect, form a resonance with the opposite sign of the saturated absorption resonances.

TuR08-p23 15:00-18:30

Erbium random laser for extended telecom range

S.M. Popov[1], A.A. Rybaltovskii[2], D.V. Ryakhovskii[1], Yu.K. Chamorovskii[1], D.S. Lipatov[3]; [1]Kotelnikov Institute of Radio Engineering and Electronics RAS; [2]Prokhorov General Physics Institute RAS; [3]Devyatykh Institute of Chemistry of High-Purity Substances RAS, Russia

We report on a new «random» fiber laser which operates on 1588 nm (long-wavelength telecom range (1570+ nm or «L-band») in the continuous-wave mode with a slope efficiency of 16% under pumping at a wavelength of 975 nm. The laser's cavity is FBG-array which formed by UV-inscription in the photosensitive erbium doped optical fiber (OF) during the OF's drawing process.

TuR08-p24 15:00-18:30

Interference effects of coherent population trapping resonances detected by the Ramsey method in gas cells with alkali atoms and a buffer gas

G.V. Voloshin, A.N. Litvinov, K.A. Barantsev, A.S. Kuraptsev; Peter the Great St. Petersburg Polytechnic University, Russia

In this work, a semiclassical theory of pulsed excitation of coherent population trapping resonances is constructed, taking into account the magnetic structure of the levels of excited atoms. As a result, the possibility of interference of different pulsed excitation channels is shown, observed as a nonmonotonic dependence of the resonance amplitude on the magnetic field and ellipticity of laser radiation.

TuR08-p25 15:00-18:30

Second harmonic generation with two noncollinear passage walk-off compensation

S. Grechin, E. Shashkov; Prokhorov General Physics Institute RAS, Russia

The results of experimental investigations for the walk-off compensation second harmonic generation with non-collinear propagation on direct and reverse passage in a single crystal are presented.

TuR08-p26 15:00-18:30

Fiber femtosecond frequency comb for measuring the dispersion of optical elements

Y.G. Isaeva[1,2], N.A. Koliada[1,3], A.A. Filonov[1], V.S. Pivtsov[1,2], S.V. Chepurov[1]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State Technical University; [3]Institute of Automation and Electrometry SB RAS, Russia

A new approach to measuring the dispersion parameter using a three-wave single-arm interferometer and a femtosecond fiber frequency comb stabilized to a Yb+ single-ion optical frequency standard are presented. In addition, the second-order group velocity dispersion was taken into account for the first time. This approach can be applied to any optical fibers and bulk optical elements.

TuR08-p27 15:00-18:30

Self-action of structured light beams in amorphous azobenzene-containing polymer

I.A. Budagovsky[1], M.P. Smayev[1], A.I. Baranov[1,2], A.A. Kuznetsov[1], A.S. Zolot'ko[1], A.Yu. Bobrovsky[3]; [1]Lebedev Physical Inst. RAS; [2]National Research Univ. of Electronic Technology; [3]Lomonosov Moscow State Univ., Russia

The action of the light beams of various structure and their transformation in a thin layer of the polymethacrylate azobenzene-containing polymer is studied. Depending on the beam structure, it is possible to induce negative or positive anisotropy in an initially amorphous sample, as well as to create a complex spatial distribution of optical axes, similar to that of vortex converters.

TuR08-p28 15:00-18:30

Monitoring optical fiber parameters using stimulated Brillouin scattering

D.P. Andreev[1], O.D. Nesterov[2], E.I. Andreeva[2]; [1]Peter the Great St. Petersburg Polytechnic University; [2]St. Petersburg State University of Telecommunications prof. M.A. Bonch-Bruevich, Russia

The effect of the stimulated Brillouin scattering (SBS) in the optical fibers was experimentally studied. It has been shown that this effect can be used to monitor parameters and early diagnosis of changes in the state of optical fiber. This control method is suitable for DWDM systems.

TuR08-p29 15:00-18:30

New fast exponential splitting schemes for nonlinear Fourier transform

S.B. Medvedev[1,2], D.I. Kachulin[1,3], I.S. Chekhovskoy[1], I.A. Vaseva[1,2], M.P. Fedoruk[1,2]; [1]Novosibirsk State University, [2]Institute of Computational Technologies SB RAS, [3]Skolkovo Institute of Science and Technology, Russia

The nonlinear Fourier transform (NFT) is an approach that allows to analyze the structure of a signal governed by the nonlinear Schrodinger equation. We present an approach that allows to find all variants of symmetric exponential splitting schemes suitable for the fast NFT (FNFT) algorithms. We obtained schemes which showed good numerical results comparing with other fast 4th order schemes.

TuR08-p30 15:00-18:30

Lyapunov exponents approach to creating ring fiber cavity regime charts

V.A. Razukov, L.A. Melnikov, P.V. Kuptsov; Yuri Gagarin State Technical University of Saratov, Russia

Lyapunov exponents method is used to unambiguously determine the dynamical state of the ring fiber cavity systems. Two-dimensional charts are then created to provide visual representation of the areas in given phase space, which clearly demonstrate how a certain nonlinear effect or instability in the cavity depends on its physical parameters. Mode prediction probability using the obtained charts is discussed.

TuR08-p32 15:00-18:30

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

K.V. Zotov[1], N.V. Tereshchenko[1], A.Yu. Ostapiv[1], G.Yu. Ivanov[1], O.A. Ryabushkin[2]; [1]Moscow Institute of Physics and Technology (National Research University); [2]Kotelnikov FIRE RAS, Russia

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

TuR08-p34 15:00-18:30

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

A.E. Bonert[1], A.N. Goncharov[1,2,3], D.N. Kapusta[1,2], O.N. Prudnikov[1,2], A.V. Taichenachev[1,2], S.N. Bagayev[1,2]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State University; [3]Novosibirsk State Technical University, Russia

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

TuR08-p35 15:00-18:30

Two-photon absorption in $Na_2Mo_2O_7$ crystal excited by picosecond pulses at 523 nm

D.S. Chunaev[1], S.B. Kravtsov[1], V.E. Shukshin[1], V.D. Grigorieva[2], V.N. Shlegel[2], P.G. Zverev[1]; [1]Prokhorov General Physics Inst. RAS, Russia; [2]Nikolaev Inst. Inorganic Chemistry SB RAS, Russia

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

TuR08-p36 15:00-18:30

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

M.S. Savelyev[1,2], P.N. Vasilevsky[1,3], A.Yu. Tolbin[4], A.Yu. Gerasimenko[1,5], S.V. Selishchev[1]; [1]MIET, [2]IRM, Sechenov University, [3]INME RAS, [4]IFAW FRC PCP MC RAS, [5]IBTI, Sechenov University, Russia

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

TuR08-p37 15:00-18:30

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

D.A. Dvoretskiy[1], I.O. Orekhov[1], S.G. Sazonkin[1], U.S. Lazdovskaia[1], N.M. Bogomolov[1], V.A. Davydov[1,2], V.E. Karasik[1], L.K. Denisov[1]; [1]Bauman Moscow State Technical University, [2]L.F. Vereshchagin Institute for High Pressure Physics, Russia

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

TuR08-p38 15:00-18:30

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

K.A. Barantsev, A.N. Litvinov; Peter the Great St. Petersburg Polytechnic University, Russia

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

TuR08-p39 15:00-18:30

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

D.S. Krysenko[1,3], O.N. Prudnikov[1], A.V. Taichenachev[1,2], V.I. Yudin[1,2,3], S.V. Chepurov[1], S.N. Bagaev[1]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State University; [3]Novosibirsk Technical University, Russia

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

TuR08-p40 15:00-18:30

Laser induced damage threshold of $ZnGeP_2$ and generation of IR radiation when exposed to pulsed laser radiation with a wavelength of ~2.1 µm

N.N. Yudin, A.I. Gribenyukov, V.V. Dyomin, M.M. Zinovev, S.N. Podzyvalov, V.S. Kuznetsov, E.S. Slyunko, A.B. Lysenko, A.Yu. Kalsin, H. Baalbaki, A.Sh. Gabdrakhmanov; National Research Tomsk State University, Russia

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

TuR08-p41 15:00-18:30

Stimulated Raman scattering in sodium dimolybdate crystal

D.S. Chunaev[1], S.B. Kravtsov[1], V.E. Shukshin[1], V.D. Grigorieva[2], V.N. Shlegel[2], P.G. Zverev[1]; [1]Prokhorov General Physics Inst. RAS, [2]Nikolaev Inst. of Inorganic Chemistry SB RAS, Russia

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

TuR08-p42 15:00-18:30

PCM for driving active THz modulators: frequency and polarization sensitivity

M.R. Konnikova[1,2,3], A.K. Tretyakov[3], A.R. Shevchenko[4], A.M. Mumlyakov[4], M.I. Krasil`nikov[4], Yu.V. Kistenev[3], A.P. Shkurinov[1,2,3]; [1]Faculty of Physics, Lomonosov Moscow State University; [2]National Research Center "Kurchatov Institute"; [3]Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University; [4]Institute of Nanotechnology of Microelectronics RAS, Russia

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

TuR08-p43 15:00-18:30

Influence of cascaded processes on frequency doubling process

V.A. Trofimov[1], D.M. Kharitonov[2], M.V. Fedotov[2]; [1]South China University of Technology, Guangzhou, China; [2]Lomonosov Moscow State University, Russia

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

TuR08-p44 15:00-18:30

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

E.A. Tereshchenkov; VNIIA; MIPT; ITAE, Russia

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

TuR08-p45 15:00-18:30

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

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

A method of depositing plasmonic particles on synthetic opal matrices was used for increasing the efficiency of laser-induced breakdown spectroscopy. It is shown that the maximum amplification corresponds to a plasmon resonance localized between silver particles. The optimal conditions for increasing the signal intensity were experimentally determined, and numerical modeling was carried out, consistent with the obtained data.

TuR08-p46 15:00-18:30

The nonlinear optical properties of the water clusters with oxygen molecule

V.A. Orlovich[1], I.A. Khodasevich[1], S.M. Pershin[2], G.A. Pitsevich[3]; [1]B.I. Stepanov Institute of Physics NASB, Belarus; [2]Prokhorov General Physics Institute RAS, Russia; [3]Department of Physical Optics and Applied Informatics, Belarusian State University, Belarus

Amazing growing the elements of polarizability tenzor and the first hyperpolarizability tenzor of the water clusters after oxygen molecule capture was predicted by ab initio quantum – chemical calculations. This phenomenon may be the reason of the new spectral component near 3000 cm-1 appearance on the water-air interface found by picosecond stimulated Raman scattering at 532 nm excitation.

TuR08-p47 15:00-18:30

Laser cooling and trapping of 87Rb atoms in pure-optical two-frequency light trap

R.Ya. Ilenkov[1], O.N. Prudnikov[1], A.V. Taichenachev[1,2], V.I. Yudin[1,2]; [1]Institute of Laser Physics SB RAS, [2]Novosibirsk State University, Russia

The laser cooling and trapping of 87Rb atoms in pure-optical two frequency trap is studied in details. The atoms can be simultaneously cooled and trapped by bichromatic laser field that opens up possibility to realize principally new type of pure optical trap.

TuR08-p48 15:00-18:30

Mechanism of Rabi-excitation of discrete modes outside the spectral line of a superradiant laser

E.R. Kocharovskaya[1], Vl.V. Kocharovsky[2]; [1]Nonlinear Dynamics and Optics Division, Institute of Applied Physics RAS; [2]Plasma Physics and High-Power Electronics Division, Institute of Applied Physics RAS, Russia

In a low-Q combined cavity, there is superradiant lasing of a strongly-asymmetric powerful polariton mode accompanied by excitation of several symmetric weak polariton or electromagnetic modes. The former is resonant to the laser spectral line, and the letters are outside it. Such a lasing takes place due to a self-consistent asymmetric grating of population inversion that provides undamped Rabi oscillations.

TuR08-p49 15:00-18:30

Study of nonlinear refractive index of barium chalcogenides

E.Y. Erushin[1,2,3], N.Yu. Kostyukova[1,2,3], A.A. Boyko[1,3], G.S. Shevyrdyaeva[4], D.V. Badikov[4]; Russia

For the first time, the nonlinear optical characteristics of BaGa4S7, BaGa4Se7, BaGa2GeS6 BaGa2GeSe6, and Ba2Ga8GeS16 crystals were measured at 1.053 μm in nanosecond regime. Two-photon absorption in tested plates was observed only in BaGa2GeSe6 crystal. The obtained values of nonlinear refraction fit well with the theoretical dispersion function.

TuR08-p50 15:00-18:30

Molecular single crystals for narrowband terahertz generation

A.S. Sinko[1,2,3], N.N. Kozlova[1], V.L. Manomenova[1], A.P. Shkurinov[1,2,3]; [1]NRC Kurchatov Institute; [2]Faculty of Physics, Lomonosov Moscow State University; [3]Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University, Russia

Narrowband coherent terahertz radiation sources based on alkali metal acid phthalate and on sucrose molecular single crystals are presented. The unique resonant spectral features of the transmission at terahertz frequencies make it possible to achieve the duration of generated terahertz pulses over 400 ps at a temperature <10K with several narrowband generation lines in the 0.2-3.6 THz spectral range.

TuR08-p51 15:00-18:30

Room temperature, cascadable, all-optical polariton universal gates

D.A. Sannikov[1], A.V. Baranikov[1], A.D. Putintsev[1], M. Misko[1], A.V. Zasedatelev[1], U. Scherf[2], P.G. Lagoudakis[1]; [1]Hybrid Photonics Laboratory, Skolkovo Inst. of Science and Technology, Russia; [2]Macromolecular Chemistry Group and Inst. for Polymer Technology, Germany

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

TuR08-p52 15:00-18:30

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

E.V. Grigorieva[1], S.A. Kaschenko[2]; [1]Belarus State Economic University, Belarus; [2]Yaroslavl State University, Russia

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

TuR08-p53 15:00-18:30

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

P.N. Vasilevsky[1,2], M.S. Savelyev[1,2], A.Yu. Gerasimenko[1]; [1]National Research University of Electronic Technology, [2]Institute of Nanotechnology of Microelectronics RAS, Russia

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

TuR08-p54 15:00-18:30

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

S.M. Popov[1], O.V. Butov[2], A.A. Rybaltovskii[3], D.V. Ryakhovskii[1], A.O. Kolosovskii[1], V.V. Voloshin[1], I.L. Vorob'ev[1], D.S. Lipatov[4], A.A. Fotiadi[5], Yu.K. Chamorovskii[1]; [1]Kotelnikov Inst. of Radio Engineering and Electronics RAS (Fryazino Branch); [2]Kotelnikov Inst. of Radio Engineering and Electronics RAS (Moscow Branch); [3]Prokhorov General Physics Inst. RAS; [4]Devyatykh Inst. of Chemistry of High-Purity Substances RAS; [5]Ulyanovsk State Univ., Russia

The report concerned high efficient single frequency «random» fiber laser with cavity based on erbium doped optical fiber (OF) with an array of fiber Bragg gratings (FBG) inscribed during OF's drawing process. Lasing with a maximum efficiency of 33% and linewidth of about 550 Hz was obtained at wavelengths of 1548 nm with pumping at a wavelength of 975 nm.

TuR08-p55 15:00-18:30

Photodynamic processes in prospective downconversion luminophores $NaLa(MoO_4)_2:Yb^{3+}$

A.S. Nizamutdinov[1], A.V. Astrakhantseva[1], K.S. Tsoi[1], S.V. Kuznetsov[2], K.A. Subbotin[2]; [1]Kazan (Volga Region) Federal University, [2]Prokhorov General Physics Institute RAS, Russia

Luminescence characteristics of prospective downconversion material NaLa(MoO4)2:Yb were investigated by means of selective laser spectroscopy. The luminescence quantum yield for Yb3+ ions was measured as 123%. Photodynamic processes and energy transfer mechanisms responsible for efficient energy transfer are discussed.

TuR08-p56 15:00-18:30

Ultrashort pulse laser based Raman DTS for mid-range FUT high spatial resolution measurements

A.O. Chernutsky, T.V. Gritsenko, A.A. Zhirnov, I.O. Orekhov, S.G. Sazonkin, R.I. Khan, D.A. Dvoretskiy, A.B. Pnev; Bauman Moscow State Technical University, Russia

We report on a study of distributed fiber-optic temperature sensor based on Raman scattering, in which an ultrashort-pulse fiber laser is used. Together with the short pulse duration and pulse repetition rate decimation scheme using an acousto-optical modulator, we were able to achieve experimentally 0.3 m spatial resolution over more than 8 km long fiber-under-test.

TuR08-p57 15:00-18:30

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

N.S. Tatarinova[1,2], A.V. Masalov[1,3], A.E. Shitikov[1], I.A. Bilenko[1,4], V.E. Lobanov[1], D.A. Chermoshentsev[1,2,5]; [1]Russian Quantum Center, [2]Moscow Inst. of Physics and Technology, [3]Lebedev Physical Institute RAS, [4]Faculty of Physics, Lomonosov Moscow State Univ., [5]Skolkovo Inst. of Science and Technology, Russia

The numerical and analytical analyses were conducted to determine the optimal parameters of a bichromatically pumped microring resonator system, focusing on the generation process of squeezed light states.

TuR08-p58 15:00-18:30

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

S. Kudryashov, P. Danilov, N. Smirnov, E. Kuzmin, A. Rupasov, G. Krasin, M. Kovalev, A. Gorevoy; Lebedev Physics Institute RAS, Russia

Inscription of embedded photoluminescent microbits, as carriers of archival memory, inside bulk natural diamond, LiF and CaF2 crystals was performed in sub-filamentation regime by 525 nm, 0.2 ps laser pulses focused by 0.65 NA micro-objective as a function of pulse energy, exposure and inter-layer separation. This research was funded by the Russian Science Foundation (project no. 21-79-30063); https://rscf.ru/en/project/21-79-30063/.

TuR08-p59 15:00-18:30

Measurement of dispersion characteristics and quality factors of optical microresonators

D.V. Morozov[1,2], A.K. Vorobyev[1,2], N.Yu. Dmitriev[1,2], D.A. Chermoshentsev[1,2], I.A. Bilenko[1,2,3]; [1]Russian Quantum Center, [2]Moscow Institute of Physics and Technology (National Research University), [3]Moscow State University, Faculty of Physics, Russia

We perform an experimental measurement of dispersion characteristics and quality factors of optical integrated silicon nitride ring microresonators with different geometries. Our study reveals that a microresonator dispersion charactericstics may be predefined at fabrication stage by geometry optimization.

TuR08-p61 15:00-18:30

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

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

The work demonstrates a novel method for increasing Laser-induced breakdown spectroscopy signal intensity when analyzing the elemental composition of nano and submicron particles contained in a suspension. The method is based on the displacement of particles by a solidification front during the process of directed freezing of a liquid.

TuR08-p62 15:00-18:30

Parallel beam pumped picosecond Raman laser on water with a preamplifier

S.M. Pershin, M.Ya. Grishin, P.A. Chizhov, V.N. Lednev, A.A. Ushakov; Prokhorov General Physics Institute RAS, Russia

Stimulated Raman scattering (SRS) in water was achieved when excited by a picosecond pulsed Nd:YLF laser (527 nm) parallel beam. A set of sample cuvettes of different lengths was used. The SRS was achieved when the pump optical path in water reached a certain value. Such experimental setup can be considered as a SRS laser with a parallel-beam-pumped preamplifier.

TuR08-p63 15:00-18:30

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

D.T. Batov[1], V.S. Voropaev[1], R. Jafari[2], S. Akturk[2], R. Trebino[3], V.A. Lazarev[1], M.K. Tarabrin[1]; [1]Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical University, Moscow, Russia; [2]Swamp Optics LLC, Atlanta, USA; [3]School of Physics, Georgia Institute of Technology, Atlanta, USA

Time-dependent polarization measurements of ultrashort pulses at 1.9 µm from a tulium-doped fiber laser system tuned with polarization controllers are demonstrated using the GRENOUILLE device and the TURTLE method.

TuR08-p64 15:00-18:30

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

S. Grechin[1], E. Shashkov[1], I. Epatko[1], A. Sadovskiy[2]; [1]Prokhorov General Physics Institute RAS; [2]NTO IRE-Polus, Russia

The results of experimental investigations of SHG with two laser crossed beams in biaxial crystal LBO are presented. It is shown for the first time that in biaxial crystals at different wavelengths there are directions in which joint scalar and vector phase matching takes place.

TuR08-p65 15:00-18:30

Spectral and energy characteristics of picosecond SRS in heavy water

I.A. Khodasevich[1], L.E. Batay[1], C.M. Pershin[2], A.I. Vodchits[1], M.Ya. Grishin[2], G.A. Pitsevich[3], V.A. Orlovich[1]; [1]B.I. Stepanov Inst. of Physics NASB, Belarus; [2]Prokhorov General Physics Inst. RAS, Russia; [3]Department of Physical Optics and Applied Informatics, Belarussian State Univ., Belarus

The forward and backward stimulated Raman scattering in heavy water was studied when excited by picosecond pulses (60 ps) at the 532 nm. Generation the five Stokes and the four anti-Stokes components was obtained in the spectral ranges of 566 – 723 nm and 427 - 474 nm respectively. The maximum energy efficiency of SRS conversion reached 5%.

TuR08-p66 15:00-18:30

New method for finding the temporal soliton at three waves interaction

V.A. Trofimov[1], D.M. Kharitonov[2], M.V. Fedotov[2]; [1]South China University of Technology, Guangzhou, China; [2]Lomonosov Moscow State University, Russia

New approach of obtaining the temporal soliton or soliton-like temporal structure at three waves interaction is proposed and demonstrated. It consists of two parts. In the first one, we construct the unchanged solution in long pulse duration approximation. In the second one, the condition of this solution stability to second order dispersion influence is derived.

TuR08-p68 15:00-18:30

Picosecond SRS in water excited by Bessel beams

V.A. Orlovich[1], S.M. Pershin[2], A.I. Vodchits[1], I.A. Khodasevich[1], M.Ya. Grishin[2]; [1]B.I. Stepanov Institute of Physics NASB, Belarus; [2]Prokhorov General Physics Institute RAS, Russia

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

TuR08-p69 15:00-18:30

Temperature noncritical frequency conversion in $ZnGeP_2$ crystal

S. Grechin[1], I. Murav'ev[2]; [1]Prokhorov General Physics Institute RAS; [2]Bauman MSTU, Russia

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

TuR08-p70 15:00-18:30

Delay measurement in fiber optic devices using a tunable delay line

O.V. Kolmogorov, S.S. Donchenko, D.V. Prokhorov, B.R. Alekperova; FSUE "VNIIFTRI", Russia

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

TuR08-p71 15:00-18:30

Transmission bistability of high-intensity THz radiation propagation in a nonlinear $LiNbO_3$ Fabry-Perot interferometer

A.O. Nabilkova[1], E.N. Oparin[1], M.V. Melnik[1], A.P. Fokin[3], A.S. Sedov[3], A.N. Tsypkin[1], S.A. Kozlov[2]; [1]Laboratory of Quantum Processes and Measurements, ITMO University; [2]Laboratory of Femtosecond Optics and Femtotechnologies, ITMO University; [3]Institute of Applied Physics RAS, Russia

This study examines the bistability characteristics of a "mirrorless" Fabry-Perot interferometer by combination of analytical modeling and experimental investigation. The research reveals that the use of a nonlinear LiNbO3 crystal as the medium leads to noticeable optical hysteresis under input intensities of up to 3.5x10^9 W/cm2 at a frequency of 0.25 THz.

TuR08-p72 15:00-18:30

Glass modification by backside irradiation using nano-second laser pulses

H. Saleh, Y.A. Konin, A.A. Petrov; Institute of Laser Technologies, ITMO University, Russia

The fiber fuse effect was successfully initiated in various bulk glass materials using backside irradiation with a nanosecond pulsed laser, employing different metallic foils as absorbers. The study reveals unique resultant structures within the glass, which vary depending on the initiation conditions and laser parameters used.

R01: SOLID STATE LASERS

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

R01: SOLID STATE LASERS 1

Session Chair:

WeR01-01 09:00-09:30

Near and mid infrared channeled waveguide lasers in rare-earth ion-doped fluoride crystals *(Invited paper)*

A. Sennaroglu[1,2], Y. Morova[1,2], B. Ayevi[1], M. Tonelli[3], B. Morova[4], H. Jahangiri[2], I. Baylam[2], A.D. Lieto[3], G. Cittadino[3], E. Damiano[3]; [1]Laser Research Laboratory, Departments of Physics and Electrical-Electronics Engineering, Koç University, Türkiye; [2]Koç University Surface Science and Technology Center (KUYTAM), Türkiye; [3]MEGAMATERIALS s.r.l and Dipartimento di Fisica dell'Università di Pisa, Italy; [4]Department of Physics, Koç University, Türkiye

Femtosecond laser written waveguide lasers operating in the near and mid infrared region at 1318 nm and 2700-2800 nm were investigated by using Nd3+:BaY2F8 and Er3+:YiLF4 crystals.

WeR01-02 09:30-09:45

Self-sweeping fiber laser for application in BOTDA system

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

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

WeR01-03 09:45-10:00

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

B.N. Nyushkov[1,2], I.I. Korel[1], S.V. Smirnov[2]; [1]Novosibirsk State Technical University, Russia; [2]Novosibirsk State University, Russia

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

WeR01-04 10:00-10:15

Hard excitation mode in optomechanical systems

A.A. Zyablovsky[1,2], E.S. Andrianov[1,2]; [1]Dukhov Research Institute of Automatics (VNIIA); [2]Institute Theoretical and Applied Electrodynamics RAS, Russia

We predict an existence of hard excitation mode in an optomechanical system of two optical modes interacting with each other via a phonon mode. We demonstrate that the hard excitation mode arises due to an additional phase condition for nonzero solutions. We propose a concept of highly sensitive sensor based on the optomechanical system operating in the hard excitation mode.

WeR01-05 10:15-10:30

Coherent combination of 4 laser channels amplified in a single Yb:YAG crystal

I.I. Kuznetsov[1], S.A. Chizhov[1], O.V. Palashov[1], P.A. Smolin[1,2], N.I. Karpov[1]; [1]Nonlinear Dynamics and Optics Department, A.V. Gaponov-Grekhov Institute of Applied Physics RAS; [2]Volga State University of Water Transport, Russia

The scheme for amplification of 4 beams in a single-rod Yb:YAG amplifier and their coherent combining using a tiled aperture scheme is proposed and demonstrated experimentally. Gain coefficient of 10 in each channel with >60% power in the central interference maximum, and phase stabilization with <3% standard deviation were successfully achieved. This approach will allow scaling average and peak power.

WeR01-06 10:30-10:45

Optimization of single-frequency continuous wave self-sweeping fiber laser based on separated gain and absorption dynamic gratings

E.K. Kashirina, I.A. Lobach, S.I. Kablukov; Institute of Automation and Electrometry SB RAS, Russia

We report on optimization of a single-frequency self-sweeping fiber laser with continuous-wave (CW) intensity dynamics operating near telecommunication L-band wavelength of 1607 nm with sweeping range of 2.45 nm. The laser output power was increased to 4 mW and frequency step was reduced to 10.3 MHz. The developed single-frequency self-sweeping fiber source can be use for optical frequency domain reflectometry.

WeR01-07 10:45-11:00

Russian development and production of lasers: hybrid, solid-state and fiber laser systems

D.V. Sachenko; JSC "NordLase", Russia

NordLaser LLC is a leading company in the field of laser systems development, manufacturing, and service provision. This presentation highlights the competencies of the company, focusing on its expertise in developing, producing, and servicing lasers and laser technology.

- Coffee Break -

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

R01: SOLID STATE LASERS 2

Session Chair:

WeR01-08 11:30-12:00

Development of ultrafast lasers for high-repetition-rate VUV source generation *(Invited paper)*

Zhigang Zhao; Shandong University, China

Abstract is not available.

WeR01-09 12:00-12:15

Raman dissipative soliton parameters near 1.7 microns depending on external cavity dispersion

V.M. Volosi[1,2], D.S. Kharenko[1,2], N.A. Koliada[1,3]; [1]Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; [2]Novosibirsk State University, Novosibirsk, Russia; [3]Institute of Laser Physics SB RAS, Novosibirsk, Russia

In this paper, we have studied a Raman dissipative solitons oscillator at a wavelength near 1.7 microns with external cavity pumping from an erbium doped mode-locked laser. It was numerically simulated in various configurations to investigate the effects of dispersion management on the pulse characteristics and modes of operation.

WeR01-10 12:15-12:30

PM Tm-doped fiber laser harmonically mode-locked using single-walled carbon nanotubes

V.A. Belova[1], E.S. Ivashkina[1], S.I. Mizgirev[1], D.T. Batov[1], V.S. Voropaev[1], A.A. Mkrtchyan[2], Yu.G. Gladush[2], D.V. Krasnikov[2], A.G. Nasibulin[2], V.A. Lazarev[1], M.K. Tarabrin[1]; [1]Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical University, [2]Center for Photonic Science and Engineering, Skolkovo Institute of Science and Technology, Russia

A polarization maintaining thulium-doped fiber laser mode-locked by single-walled carbon nanotubes has been developed. The fundamental pulse repetition frequency of the laser is 84 MHz. Harmonic mode-locking is observed with a maximum pulse repetition frequency of 504 MHz. Following pulse parameters are achieved: pulse duration of 440 fs, center wavelength of 1912 nm, maximum average power of 600 mW.

WeR01-11 12:30-12:45

Cr:Forsterite oscillator synchronously pumped by an ytterbium ultrafast laser

V.M. Alibaeva, A.V. Pushkin, F.V. Potemkin; Lomonosov Moscow State Univ., Russia

With output radiation of the synchronously pumped Cr:Forsterite laser difference frequency generation at a wavelength near 6 μm at a high repetition rate is realized. The energy and spectral parameters of pulses in various generation regimes are characterized. Such a seeding source is promising for development powerful CPA systems in mid-IR range based on iron doped chalcogenide crystals.

WeR01-12 12:45-13:00

Features of high-order soliton molecule amplification in an Er-doped fiber amplifier

I.O. Orekhov[1], A. Ismaeel[1,2], S.G. Sazonkin[1], D.A. Dvoretskiy[1], A.A. Krylov[3], L.K. Denisov[1], V.E. Karasik[1]; [1]Bauman Moscow State Technical University; [2]Moscow Institute of Physics and Technology; [3]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia

We report on the generation high-order soliton molecule and its amplification in single-cascade amplifier based on erbium-doped fiber. The amplification of 15 pulses regime with 432 fs pulses duration and 46 mW average power in 1m long erbium-doped fiber amplifier led to the generation of 20 pulses regime with 449 fs pulses duration and 102 mW average power.

WeR01-13 13:00-13:15

Hybrid amplification of highly-chirped pulses around 1.3 micron in an all-fiber configuration

E.A. Evmenova[1], D.S. Kharenko[1,2], A.M. Khegai[3], K.E. Riumkin[3], F.V. Afanasiev[4]; [1]Inst. of Automation and Electrometry SB RAS; [2]Novosibirsk State Univ.; [3]Prokhorov General Physics Inst. RAS; [4]G.G. Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

We report the amplification of highly-chirped dissipative solitons around 1.3 μm in an all fiber configuration by two methods: Stimulated Raman Scattering in a standard passive fiber and using active centers in a Bi-doped fiber pumped by CW radiation. The former provides spectrally uniform amplification resulting in good quality of compressed pulse, and the latter provides a 16-fold net gain.

WeR01-14 13:15-13:30

Self-started tunable femtosecond Cr^{2+}:ZnSe laser from 2.15 to 2.4 μm

E.A. Kozlova[1], A.A. Mkrtchyan[2], D.A. Nazarov[1], M.K. Tarabrin[1], Yu.G. Gladush[2]; [1]Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical University; [2]Center for Photonic Science and Engineering, Skolkovo Institute of Science and Technology, Russia

This study presents the development of a tunable femtosecond laser on a Cr2+:ZnSe crystal with a Lyot filter in the mid-infrared region. The system provides continuous wavelength tunability in the range of 2.15-2.4 μm with with a maximum spectrum width of 96.5 nm at a wavelength of 2.2 μm.

- Lunch Break -

R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

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

R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS 1

Session Chair:

WeR03-01 09:00-09:30

A quantum dot laser with a single asymmetric barrier layer: A novel design for high temperature-stability *(Invited paper)*

C. Hammack, L.V. Asryan; Virginia Polytechnic Institute and State University, USA

A semiconductor quantum dot laser with a single asymmetric barrier layer is studied. The use of a barrier layer is shown to considerably enhance the laser temperature stability – the characteristic temperature is well above that of the reference quantum dot laser that does not have a barrier layer.

WeR03-02 09:30-09:45

High-power superluminescent diodes based on chirped InGaAs/GaAs quantum well-dots

N.Yu. Gordeev[1], A.S. Payusov[1], G.O. Kornyshov[1], Yu.M. Shernyakov[1], A.A. Beckman[1], Yu.A. Salii[1], S.A. Mintairov[1], N.A. Kalyuzhnyy[1], M.V. Maximov[2]; [1]Ioffe Institute, Russia; [2]Alferov University, Russia

We have designed and investigated superluminescent diodes with the active regions based on 5 and 7 layers of chirped InGaAs quantum well-dots. The devices have shown spectra as broad as 120 nm and output cw optical power as high as 34 mW.

WeR03-03 09:45-10:00

Experimental reservoir computing based on a laser subject to optoelectronic feedback

G.O. Danilenko, E.A. Viktorov, A.V. Kovalev; ITMO University, Russia

We experimentally study a reservoir computing system based on a DFB laser diode with positive optoelectronic feedback. The system is operated in the vicinity of the Hopf bifurcation with N = 25 nodes, and 40 MHz input symbol rate. We evaluate memory capacity of the system and a chaotic time series prediction error.

WeR03-04 10:00-10:15

Dynamics of lasing switching between the ground and excited-state in a quantum-dot microdisk

A.M. Nadtochiy[1], A.A. Karaborchev[1], N.A. Fominykh[1], I.S. Makhov[1], K.A. Ivanov[1], Yu.A. Guseva[2], M.M. Kulagina[2], S.A. Blokhin[2,1], N.V. Kryzhanovskaya[1], A.E. Zhukov[1]; [1]International Laboratory of Quantum Optoelectronics, HSE University, [2]Ioffe Institute, Russia

A quantum-dot microdisk was optically pumped by a mixture of continuous-wave excitation and sub-ps pulses of various powers. Depending on the level of the pulsed excitation, the ground-state lasing intensity can be either enhanced (for weak pulses) or fully quenched (for strong pulses). In the latter case, the excited-state lasing is ignited for a short time.

WeR03-06 10:30-11:00

Single-mode MBE-grown 1550 nm wafer-fused VCSELs for high-speed PAM4 data transmission *(Invited paper)*

S.C. Tian[1,2], G.A. Sapunov[1], S.A. Blokhin[3], I.N. Kovach[4], L.Ya. Karachinsky[4], I.I. Novikov[4], A.V. Babichev[4], K.O. Voropaev[3], A.Yu. Egorov[4], D. Bimberg[1,2]; [1]Bimberg Chinese-German Center for Green Photonics, CIOMP CAS, Changchun, China; [2]Technical University of Berlin, Germany; [3]Ioffe Institute, Russia; [4]ITMO University, Russia

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

- Coffee Break -

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

R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS 2

Session Chair:

WeR03-07 11:30-12:00

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

A.Andreev; A-Modelling Solutions Ltd, Guildford, U.K. and Tyndall National Institute, Ireland

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

WeR03-08 12:00-12:15

High-power QCL for 8 μm spectral range

V.V. Dudelev[1], E.D. Cherotchenko[1], I.I. Vrubel[1], D.A. Mikhailov[1], D.V. Chistyakov[1], V.Yu. Mylnikov[1], S.N. Losev[1], E.A. Kognovitskaya[1], A.V. Babichev[1], A.V. Lyutetskiy[1], S.O. Slipchenko[1], N.A. Pikhtin[1], A.V.Abramov[1], A.G. Gladyshev[2], K.A. Podgaetskiy[3], A.Yu. Andreev[3], I.V. Yarotskaya[3], M.A. Ladugin[3], A.A. Marmalyuk[3], L.Ya. Karachinsky[2,4], I.I. Novikov[2,4], A.Yu. Egorov[2,5], G.S. Sokolovskii[1]; [1]Ioffe Institute, [2]Connector Optics LLC, [3]M.F. Stelmakh POLYUS Research and Development Institute, [4]ITMO University, [5]Alferov St. Petersburg National Research Academic University, Russia

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

WeR03-09 12:15-12:30

Four-wave mixing in a laser diode gain media due to resonant backreflection from the microresonator

D.M. Sokol[1,2], N.Yu. Dmitriev[1], D.A. Chermoshentsev[1,2,3], A.V. Masalov[1,4], V.E. Lobanov[1], I.A. Bilenko[1,5], A.E. Shitikov[1]; [1]Russian Quantum Center, [2]Moscow Inst. of Physics and Technology, [3]Skolkovo Inst. of Science and Technology, [4]Lebedev Physical Inst., [5]Faculty of Physics, Lomonosov Moscow State Univ., Russia

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

WeR03-10 12:30-12:45

Plasmonic photoconductive antennas based on Bi(2-x) SbxSeyTe(3-y) topological insulators

P.M. Kovaleva[1], K.A. Kuznetsov[1,2], P.I. Kuznetsov[2], D.V. Lavrukhin[3,4], R.R. Galiev[3], D.S. Ponomarev[3,5], G.Kh. Kitaeva[1]; [1]Lomonosov Moscow State University, [2]Kotelnikov IRE RAS, [3]Institute of Ultra High Frequency Semiconductor Electronics RAS, [4]Prokhorov General Physics Institute RAS, [5]Moscow Institute of Physics and Technology, Russia

The study presents the first experimental observation of enhanced THz radiation in plasmonic photoconductive antenna (PCA) based on Bi2-xSbxSeyTe3-y topological insulator (TI). The optimized plasmonic grating geometry maximizes optical light transmission, stimulating efficient surface plasmon-polariton (SPP) excitations along the TI/grating interface. The plasmonic TI-based PCA showed a ~9-fold enhancement in emitted THz power.

WeR03-11 12:45-13:00

Terahertz high-resolution microscopy based on rutile solid immersion lens

V.A. Zhelnov[1], N.V. Chernomyrdin[1], A.A. Gavdush[1], I.E. Spector[1], V.N. Kurlov[2], M. Skorobogatiy[3], K.I. Zaytsev[1]; [1]Prokhorov General Physics Institute RAS; [2]Osipyan Institute of Solid State Physics RAS, Russia; [3]Department of Engineering Physics Polytechnique Montreal, Quebec, Canada

Solid immersion microscopy is a promising microscopy approach which allows to overcome Abbe diffraction limit. Spatial resolution of this approach is limited by refractive index of immersion lens. In our work we use rutile as a material of solid immersion lens and demonstrate that our microscope provide the highest resolution in the range of 0.06-0.11 λ.

WeR03-12 13:00-13:30

THz and Multi THz Lasers Based on Heterostructure with HgCdTe/CdHgTe with Quasirelativistic Dispersion Laws *(Invited paper)*

S.V Morozov

We show that in the long-wavelength part of mid-IR Hg(Cd)Te/CdHgTe QWs offer the quasi-relativistic carrier dispersion law that suppresses the Auger recombination, enabling stimulated emission (SE) up to 31 μm, and laser generation up to 24 μm in the temperature range from 10 to 80 K.

- Lunch Break -

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

R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS 3

Session Chair:

WeR03-13 15:00-15:30

Use of plasma sources in the epitaxy of III-V compounds *(Invited paper)*

P. Bulkin; LPICM CNRS Ecole Polytechnique IP Paris, Palaiseau, France

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

WeR03-14 15:30-15:45

Wavelength switching in low-dimensional structures at high current densities

A.A. Beckman[1], G.O. Kornyshov[1], A.S. Payusov[1], Yu.M. Shernyakov[1], N.Yu. Gordeev[1], M.V. Maximov[2]; [1]Ioffe Institute; [2]Alferov University, Russia

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

WeR03-15 15:45-16:00

Switching from invisibility to coherent emission by phase-change materials

S. Lepeshov[1], A. Vyshnevyy[2], A. Krasnok[3]; [1]Technical University of Denmark (DTU), Denmark; [2]Moscow Institute of Physics and Technology (MIPT), Russia; [3]Florida International University, USA

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

WeR03-16 16:00-16:30

Scientific journals rating: a game with no rules *(Invited Lecture)*

N.L. Istomina[1], O.L. Levchenko[2]; [1]Department of physics RAS, [2]Inst. of Solid State Physics RAS, Russia

The scientific journal industry has many similarities with the sports industry. Competition in scientific periodicals is characterized by a very strong interweaving of sports, politics, business and ideology. Is the increase in the rating of one of the opponents equal to the decrease in the rating of the other? What period of competition is rated?

R04: LASER BEAM CONTROL

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

R04: LASER BEAM CONTROL 5

Session Chair:

WeR04-22 09:00-09:30

Frequency analysis of a auto-tuning system for multistage laser complex *(Invited paper)*

A.V. Kirsanov, I.V. Kuz'min, I.B. Mukhin, V.V. Chernov; A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia

One of problems of multistage power lasers are radiation deviations from a given direction during its transmission between cascades. An automatic radiation direction correction system based on piezoelectric actuators with feedback via a four-section photodiode has been assembled. It is shown that the auto-tuning complex works reliably at low frequencies of disturbances and performs worse at high frequencies.

WeR04-24 10:00-10:30

Lasers with cavities coupled by a Bragg grating *(Invited paper)*

A.P. Pogoda[1], V.M. Petrov[2], N.L. Istomina[3], A.S. Boreysho[1]; [1]Baltic State Technical University "VOENMEH", [2]St. Petersburg State University, [3]Moscow State University of Geodesy and Cartography, Russia

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

WeR04-25 10:30-11:00

Nonlinear multiplexing of optical second harmonic in high-dimensional nonlinear photonic crystals *(Invited paper)*

A.M. Vyunishev[1,2], V.G. Arkhipkin[1,2]; [1]Kirensky Institute of Physics, FRC KSC SB RAS; [2]Siberian Federal University, Russia

The results of second harmonic generation (SHG) in one-(1D), two-(2D) and three-dimensional (3D) nonlinear photonic crystals (NPCs) are presented. The theory of second harmonic generation of femtosecond laser pulses in high-dimensional periodic nonlinear photonic crystals is developed. High-dimensional NPCs are shown to be promising for nonlinear multiplexing and discrete angular spectrum formation.

- Coffee Break -

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

R04: LASER BEAM CONTROL 6

Session Chair:

WeR04-26 11:30-12:00

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

V.M. Petrov[1], D.V. Masygin[2], A.A. Sevryugin[2], E.V. Shalymov[2], D.V. Venediktov[2], V.Yu. Venediktov[1,2]; [1]Faculty of Physics, St. Petersburg State University, [2]Department of Laser Measurement and Navigation Systems, St. Petersburg Electrotechnical University "LETI", Russia

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

WeR04-27 12:00-12:30

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

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

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

WeR04-28 12:30-13:00

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

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

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

WeR04-29 13:00-13:30

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

A.V. Venediktova[1,2], I.M. Kislyakov[2], P.V. Ivanov[1], A.Yu. Vlasov[1]; [1]St. Petersburg State University, Russia; [2]Shanghai Institute of Optics and Fine Mechanics, CAS, China

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

- Lunch Break -

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

R04: LASER BEAM CONTROL 7

Session Chair:

WeR04-30 15:00-15:30

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

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

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

WeR04-31 15:30-15:45

Reconfigurable optical traps based on acousto-optic spatial filters

K.B. Yushkov[1], D.V. Obydennov[1,2], V.Ya. Molchanov[1]; [1]Univ. MISIS; [2]Lomonosov Moscow State Univ., Russia

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

WeR04-32 15:45-16:00

Switching platform for writing/erasing laser-induced periodic surface structures (LIPSS) on GST

V.B. Glukhenkaya[1], M.P. Smayev[2], G.N. Pestow[1,3], M.A. Saurov[3], P.I. Lazarenko[1]; [1]National Research University of Electronic Technology; [2]Lebedev Physical Institute RAS; [3]Scientific-Manufacturing Complex "Technological Centre", Russia

A switching platform which provides writing/erasing of extended two-phase periodic laser-induced surface structures on the GST has been developed: writing is carried out by fs laser pulses, and erasing - by electric current ones. The obtained results demonstrated possibility of using a thin-film resistive heater to create elements of non-volatile integrated optical and optoelectronic devices, for example, tunable diffraction gratings.

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Location: Stenberg 2 Room, Floor 3; Date: Wednesday, July 03, 2024

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 3

Session Chair:

WeR08-16 09:00-09:30

Stability analysis of platicons in optical microresonators *(Invited paper)*

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

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

WeR08-17 09:30-09:45

Tapered fiber reinforcement for stable coupling with WGM microresonator

K.N. Min'kov[1], D.D. Ruzhitskaya[1], K.E. Lakhmanskiy[1], O.V. Borovkova[1,2]; [1]Russian Quantum Center, Skolkovo; [2]Faculty of Physics, Lomonosov Moscow State University, Russia

A method of the tapered fiber reinforcement for the stable coupling with whispering gallery mode microresonator is developed. It is revealed that the slight curvature of tapered fiber results in its stronger fixation and prevents the sticking of the fiber and microresonator. An excitation of WGMs by reinforced curved tapered fiber with curvature radius about ~15 mm is demonstrated.

WeR08-18 09:45-10:00

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

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

Micro Ring Resonator was considered to be a nonlinear element for a Neural Network accelerator. Its thermal nonlinearity was tested with a neural network model on the MNIST dataset, showing an accuracy rate of 99.17%. The power and time delay of each operation were estimated to be 0,2 mW and 0,3 ms (60 nJ per operation).

WeR08-19 10:00-10:15

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

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

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

WeR08-20 10:15-10:30

Dual -laser self-injection locking microcomb regime switching

A.E. Shitikov[1], N.S. Tatarinova[1,2], A.N. Danilin[1,3], N.Yu. Dmitriev[1], D.M. Sokol[1,2], A.K. Vorobyev[1,2], V.E. Lobanov[1], A.V. Masalov[1], I.A. Bilenko[1,3], D.A. Chermoshentsev[1]; [1]Russian Quantum Center, [2]Moscow Institute of Physics and Technology, [3]Faculty of Physics, Lomonosov Moscow State University, Russia

The research demonstrates the generation of soliton microcombs and perfect soliton crystals using a bichromatical pump by self-injection-locked laser diodes. We unveil intense cross-talk between laser diodes through the microring, providing the possibility of deterministic switching of generated soliton states by manipulating the detuning of one of the lasers.

WeR08-21 10:30-10:45

Estimation of a time dependent frequency shift of whispering gallery modes due to the pump induced heating

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

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

WeR08-22 10:45-11:00

Solitons in SNAP microresonator with various shape

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

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

- Coffee Break -

Location: Stenberg 2 Room, Floor 3; Date: Wednesday, July 03, 2024

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 4

Session Chair:

WeR08-23 11:30-12:00

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

B. A. Malomed; Tel Aviv University, Israel

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

WeR08-24 12:00-12:30

Lightwave breathers *(Invited paper)*

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

Abstract is not available.

WeR08-25 12:30-12:45

Toroidal and cruciform vector laser solitons and their transformations

N.A. Veretenov, S.V. Fedorov, N.N. Rosanov; Ioffe Institute, Russia

We predict a new type of 3D optical dissipative vector solitons in a homogeneous isotropic medium with laser amplification and saturable absorption. Both circular polarization components have the toroidal intensity distribution and a unit topological charge. Soliton properties and polarization structure depend on the angle between toroidal circular components.

WeR08-26 12:45-13:00

Nonlinear components of energy, momentum and angular momentum of Gaussian beams in self-focusing in isotropic gyrotropic media

P.S. Ryzhikov, V.A. Makarov; Lomonosov Moscow State University, Russia

The magnitudes of contributions of the related to local and nonlocal parts of nonlinear optical response of the medium terms of the expressions for the electromagnetic energy density, momentum density, angular momentum density and the corresponding flux densities in self-focusing of elliptically polarized light beam in nonabsorbing isotropic gyrotropic medium is determined.

WeR08-27 13:00-13:15

Polarization singularities in the laser beam self-focusing in liquid crystals isotropic phase near the phase transition temperature

G.M. Shishkov, K.S. Grigoriev, V.A. Makarov; Lomonosov Moscow State University, Russia

We consider the appearance and behavior of polarization singularity lines in the process of self-focusing of an elliptically polarized Gaussian beam in an isotropic phase of cholesteric and nematic liquid crystals at a temperature close to the temperature of transition to mesophase. Values of radiation and medium parameters leading to nucleation of polarization singularities and their unusual behavior are given.

WeR08-28 13:15-13:30

Laser-induced damage of barium sulfides nonlinear crystals at 1053 nm

N.Yu. Kostyukova[1,2,3], E.Yu. Erushin[1,2,3], A.A. Boyko[1,2], E.V. Baranova[3], G.S. Shevyrdyaeva[4], D.V. Badikov[4]; [1]Novosibirsk State University, [2]Institute of Laser Physics SB RAS, [3]Novosibirsk State Technical University, [4]Kuban State University, Russia

This paper is devoted to the investigation of LIDT of the barium sulfides nonlinear crystals (BaGa4S7, BaGa2GeS6, and Ba2Ga8GeS16). All of these crystals demonstrate a high damage threshold of 6.5 - 7 J/cm2. Possessing such high LIDT in combination with a transmittance range the barium sulfides nonlinear crystals can become a promising material for high-energy frequency down-conversion in mid-IR range.

WeR08-29 13:30-14:00

Nonlinearity managed vector solitons *(Invited paper)*

F.Kh. Abdullaev[1], J. Yuldashev[1], M. Ogren[2]; [1]Phys. Tech. Inst., Uzbekistan; [2]Orebro Univ., Sweden

The evolution of vector solitons under nonlinearity management is studied. The averaged over strong and rapid modulations in time of the inter-species interactions vector Gross-Pitaevskii equation (GPE) is derived. The existence and stability of the managed vector solitons is investigated.

- Lunch Break -

Location: Stenberg 2 Room, Floor 3; Date: Wednesday, July 03, 2024

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 5

Session Chair:

WeR08-30 15:00-15:30

Periodic and quasiperiodic arrays of coupled exciton-polariton condensates *(Invited paper)*

S.Yu. Alyatkin[1], H. Sigurðsson[2], Y.V. Kartashov[3], K.A. Sitnik[1], I.S. Gnusov[1], J.D. Töpfer[1], P.G. Lagoudakis[1]; [1]Hybrid Photonics Laboratory, Skolkovo Institute of Science and Technology, Russia; [2]Science Institute, University of Iceland, Iceland; [3]Institute of Spectroscopy RAS, Russia

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

WeR08-31 15:30-15:45

Frequency control of oscillating vortex cluster spontaneously arising in the trapped polariton condensate

K.A. Sitnik, I. Gnusov, M. Misko, H. Sigurdsson, J.D. Topfer, S. Alyatkin, P.G. Lagoudakis; Skolkovo Inst. of Science and Technology, Russia

We demonstrate that optically trapped polariton condensate occupying two energy levels forms vortex cluster with periodically oscillating topological charges with a frequency around 5 GHz. This frequency is precisely controlled in the range of 300 MHz by scanning the ellipticity of the optically induced trapping potential. The presented results are qualitatively supported by the particle in the box-based theoretical model.

WeR08-32 15:45-16:00

New mode of a steady-state superradiant lasing

Vl.V. Kocharovsky[1], E.R. Kocharovskaya[2]; [1]Plasma Physics and High-Power Electronics Division, Institute of Applied Physics RAS, Russia; [2]Nonlinear Dynamics and Optics Division, Institute of Applied Physics RAS, Russia

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

WeR08-34 16:00-16:15

PECVD-fabricated microresonators for nonlinear photonics

N.Yu. Dmitriev[1], A.M. Mumlyakov[2], M.V. Shibalov[2], I.V. Trofimov[2], I.A. Filippov[2], A.A. Anikanov[2], M.A. Tarkhov[2], I.A. Bilenko[1,3]; [1]Russian Quantum Center, [2]Institute of Nanotechnology of Microelectronics RAS, [3]Faculty of Physics, Lomonosov Moscow State University, Russia

We demonstrate characteristics of high-Q ring silicon nitride microresonators fabricated with novel PECVD process. Proposed process allows to fabricate silicon nitride waveguides with thickness over 1 um. Studied 1um-thick silicon nitride ring microresontors features anomalous GVD and loaded Q factor over 1 million.

WeR08-35 16:15-16:30

High-Q crystalline germanium microresonators for Mid-IR

T.S. Tebeneva[1], A.E. Shitikov[1], K.N. Min'kov[1], V.E. Lobanov[1], I.A. Bilenko[1,2]; [1]Russian Quantum Center; [2]Faculty of Physics, Lomonosov Moscow State University, Russia

We report on the whispering gallery modes microresonators fabrication from crystalline germanium. The resulting Q-factor exceeding 10^7 is the highest ever recorded for Ge microresonators measured at the 2.68 μm pump wavelength. Self-injection locking of a laser diode to germanium microresonator, which is one of the ways to stabilize the laser frequency is achieved.

WeR08-36 16:30-16:45

Laser beam structure influence on optical and structural modification of phase-change materials

M.P. Smayev[1], P.A. Smirnov[1,2], I.A. Budagovsky[1], M.E. Fedyanina[2], V.B. Glukhenkaya[2], A.V. Romashkin[2], P.I. Lazarenko[2], S.A. Kozyukhin[3]; [1]Lebedev Physical Institute RAS; [2]National Research Univ. of Electronic Technology; [3]Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia

We studied a transition of amorphous Ge2Sb2Te5 thin films into the crystalline state under the action of structured cw laser beams. Light beams with an annular intensity profile are significantly more efficient for Ge2Sb2Te5 crystallization compared to the fundamental Hermite-Gaussian HG00 mode due to a more uniform temperature distribution inside the irradiated region.

WeR08-37 16:45-17:15

Kerr squeezed solitons for metrology *(Invited paper)*

Gerd Leuchs[1], Nikolay A. Kalinin[1,2], Arseny A. Sorokin[3], Thomas Dirmeier[1,2], Elena A. Anashkina[3,4], Alexey V. Andrianov[3], Joel F. Corney[5], Luis L. Sánchez-Soto[1,6]; [1]Max Planck Institute for the Science of Light, Erlangen, Germany; [2]Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; [3]Institute of Applied Physics, RAS, Nizhny Novgorod, Russia; [4]Advanced School of General and Applied Physics, Lobachevsky State University of Nizhny Novgorod, Russia; [5]School of Mathematics and Physics, University of Queensland, Brisbane, QLD[4072], Australia; [6]Departamento de Óptica, Facultad de Física, Universidad Complutense, Madrid[28040], Spain

A particularly robust source of squeezed quantum light is provided by the optical Kerr effect in a fibre. Using soliton pulses, the nonlinear interaction is effectively increased. The development of Kerr squeezing towards sensing applications advanced with the demonstration of interferometric phase sensitivity enhancement, N. Kalinin et al., Nanophotonics 12, 2945 (2023). We report on the status of the project.

- Coffee Break -

R09: OPTICAL NANOMATERIALS

Location: Pudovkin 1+2 Room, Floor 3; Date: Wednesday, July 03, 2024

R09: OPTICAL NANOMATERIALS 1

Session Chair:

WeR09-01 09:00-09:30

Energy transfer processes involving colloidal perovskite nanocrystals *(Invited paper)*

H. Mattoussi; Florida State University, Department of Chemistry and Biochemistry, USA

We exploit the ionic nature of CsPbBr3 QDs to achieve controlled coupling to sulfo-Cyanine dyes. We combine steady-state and time-resolved photoluminescence experiments to measure highly efficient energy transfer interactions, manifesting in pronounced losses in QD emission along with shortening of the lifetime. We will detail our synthetic approach and compare our findings to available theories on energy transfer process

WeR09-02 09:30-10:00

Exciton dynamics in semiconductor nanocrystals *(Invited paper)*

Prajit Kumar Singha, Gourab Rana, Priya Bhandari Anindya Datta; Department of Chemistry, Indian Institute of Technology Bombay, India

Ultrafast pump probe spectroscopy as well as Single Particle Microscopy have been used to decipher the ultrafast dynamics in water soluble cadmium chalcogenide and organic soluble perovskite nanocrystals. A unified picture of exciton dynamics in these systems have been thus developed.

WeR09-03 10:00-10:30

Light-matter interactions at nanoscale leading to chemical change *(Invited paper)*

P.P. Pillai; Department of Chemistry, Indian Institute of Science Education and Research (IISER) Pune, India

A photoexcited nanoparticle (NP) can initiate a series of relaxation pathways via radiative and non-radiative processes, resulting in unique outcomes. The non-radiative relaxation processes are mainly responsible for bringing-out chemical transformations. Specifically, both hot charge-carriers and heat dissipated from a photoexcited NP can be used for breaking and making of chemical bonds, which will be the focus of the presentation.

WeR09-04 10:30-11:00

Spin dependent ultrafast charge carrier dynamics of metal halide perovskite quantum dots and nanoclusters *(Invited paper)*

J.Z. Zhang; University of California Santa Cruz, USA

We use ultrafast laser spectroscopy with controlled polarization of pump and probe beams to interrogate spin-dependent dynamics of charge carriers in pristine and doped metal halide perovskite QDs and magic sized clusters (MSCs) and found a strong dependence on particle size and surface properties. Additionally, dopants and chemical composition the perovskites also affect the spin lifetime of charge carriers.

- Coffee Break -

Location: Pudovkin 1+2 Room, Floor 3; Date: Wednesday, July 03, 2024

R09: OPTICAL NANOMATERIALS 2

Session Chair:

WeR09-05 11:30-12:00

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

G.E. Cirlin[1], R.R. Reznik[1,2,3], V.O. Gridchin[1,2,3]; [1]St. Petersburg State University; [2]Alferov University; [3]Institute for Analytical Instrumentation RAS, Russia

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

WeR09-06 12:00-12:30

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

R.R. Reznik[1], K.P. Kotlyar[1,2,3], A.I. Khrebtov[1,2], I.V. Ilkiv[1,2,3], V.O. Gridchin[1,2,3], R. Radhakrishnan[4], N. Akopian[4], D. Barettin[5], G.E. Cirlin[1,2,3]; [1]Faculty of Physics, St. Petersburg State University; [2]Department of Epitaxial Nanotechnologies, Alferov University; [3]Department of Nanotechnology Methods and Instruments, Institute for Analytical Instrumentation RAS, Russia; [4]DTU Electro, Technical University of Denmark, Denmark; [5]Department of Electronic Engineering, Università degli Studi Niccolò Cusano - Telematica, Italy

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

WeR09-07 12:30-13:00

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

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

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

WeR09-08 13:00-13:30

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

Aimiao Qin; Guilin University of Technology, China

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

- Lunch Break -

Location: Pudovkin 1+2 Room, Floor 3; Date: Wednesday, July 03, 2024

R09: OPTICAL NANOMATERIALS 3

Session Chair:

WeR09-09 15:00-15:30

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

V.V. Gerasimov[1,2], V.D. Kukotenko[1], A.I. Ivanov[3,4], I.V. Antonova[3,4], I.Sh. Khasanov[5]; [1]Budker Institute of Nuclear Physics SB RAS; [2]Novosibirsk State University; [3]Rzhanov Institute of Semiconductor Physics SB RAS; [4]Novosibirsk State Technical University; [5]Scientific and Technological Centre of Unique Instrumentation RAS, Russia

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

WeR09-10 15:30-16:00

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

Guanying Chen; Harbin Institute of Technology, China

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

WeR09-11 16:00-16:15

Wide bangap nanostructured β-Ga_2O_3 -GaN for UV applications

L.A. Mochalov[1], M.A. Kudryashov[1], I.O. Prokhorov[1], Yu.P. Kudryashova[1], S.V. Telegin[1], E.U. Rafailov[2], A.N. Baranov[3], A.V. Knyazev[1]; [1]Lobachevsky University, Russia; [2]Aston University, United Kingdom; [3]University of Montpellier, France

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

WeR09-12 16:15-16:45

Understanding materials at the atomic scale through ab-initio simulations *(Invited paper)*

N. Seriani; The Abdus Salam ICTP, Italy

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

WeR09-13 16:45-17:15

Ultrafast carrier dynamics of nanomaterials to manipulate light harvesting *(Invited paper)*

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

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

- Coffee Break -

R10: NONLINEAR QUANTUM PHOTONICS

Location: Deyneka 1+2 Room, Floor 2; Date: Wednesday, July 03, 2024
R10: NONLINEAR QUANTUM PHOTONICS 3
Session Chair:

WeR10-12 15:00-15:30

Fundamental theory of Fano resonance in cavity QED systems *(Invited paper)*

Makoto Yamaguchi; Tokai Univ., Japan

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

WeR10-13 15:30-15:45

Benchmarking of 8-qudit quantum processor based on optical transition in 171Yb$^+$ ions

I. Zalivako[1,2], A. Borisenko[1,2], I. Semerikov[1,2], A. Korolkov[1,2], P. Sidorov[1,2], K. Galstyan[1,2], N. Semenin[1,2], V. Smirnov[1,2], M. Aksenov[1], A. Nikolayeva[1], E. Kiktenko[1], A. Fedorov[1], K. Khabarova[1,2], N. Kolachevsky[1,2]; [1]Russian Quantum Center; [2]Lebedev Physical Institute RAS, Russia

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

WeR10-14 15:45-16:00

Generation of polarization-entangled photon pairs from a single lithium niobate waveguide with a single poling period

Xinyue Zhang, Wei Fang, Limin Tong; College of Optical Science and Engineering, Zhejiang University, China

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

WeR10-15 16:00-16:15

Measurement of covariance of analog detector readings in the field of spontaneous parametric down-conversion

T.I. Novikova[1], K.A. Kuznetsov[1], I.V. Korolev[1], I.V. Pentin[2], G.Kh. Kitaeva[1]; [1]Lomonosov Moscow State University, [2]SCONTEL, Russia

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

WeR10-16 16:15-16:30

Stimulated emission in a complex background

D.V. Grosman, E.O. Lazarev, G.K. Sizykh, D.V. Karlovets; ITMO University, Russia

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

PD: POSTDEADLINE

Location: Petrov-Vodkin 1+2+3 Room, Floor 2; Date: Wednesday, July 03, 2024
PD: POSTDEADLINE 1
Session Chair:

WePD-01 17:30-17:40

An enhanced modeling approach for quantum cascade structures and superlattices

D.A. Barykin[1,2,3], N.A. Kostromin[1,2,3], A.S. Dashkov[1,3], L.I. Goray[1,3,4,5]; [1]Alferov University, [2]St. Petersburg Politechnic University, [3]St. Petersburg Electrotechnical University, [4]Institute for Analytical Instrumentation, [5]University associated with IA EAEC, Russia

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

WePD-02 17:40-17:50

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

A.V. Ivanenko[1], A.E. Bednyakova[1], S.V. Smirnov[1], B.N. Nyushkov[2]; [1]Novosibirsk State University, [2]Novosibirsk State Technical University, Russia

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

WePD-03 17:50-18:00

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

V.M. Gololobov, E.A. Milikov, P.S. Anisimov, V.V. Zemlyakov, J. Gao; Russian Research Institute, Huawei Technologies Co. Ltd, Russia

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

WePD-04 18:00-18:10

Terahertz emission in a Co/IrMn heterostructure with exchange bias

E.D. Lebedeva[1], P.Yu. Avdeev[1], A.V. Gorbatova[1], I.Yu. Pashenkin[2], M.V. Sapoznikov[2], A.M. Buryakov[1]; [1]MIREA - Russian Technological University, [2]Institute for Physics of Microstructures RAS, Russia

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

WePD-05 18:10-18:20

Kilowatt-class multi-element first cladding fiber laser

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

The article presents the results on experimental elaboration of a fiber laser technology with multi-element first cladding (MFC) manufactured at RFNC – VNIITF. A mockup of ytterbium single-mode fiber laser of 1000 W maximum output power has been designed and implemented.

WePD-06 18:20-18:30

Quantum electrodynamics cascade arising at reflection of a multipetawatt laser pulse from a solid plasma target

M.A. Serebryakov, E.N. Nerush, I.Yu. Kostyukov; Federal Research Center A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia

Quantum electrodynamics (QED) cascade arising in a superposition of incident multipetawatt laser pulse and its reflection from a solid target were studied numerically and analytically.

WePD-07 18:30-18:40

Photoconvertible polymer labels for macrophages tracking

Zh.V. Kozyreva[1], P.A. Demina[2], A.Yu. Sapach[1], D.A. Terentyeva[1], G.B. Sukhorukov[1,3], O.A. Sindeeva[1]; [1]Skolkovo Institute of Science and Technology, Russia; [2]Saratov State University, Russia; [3]Queen Mary University of London, UK

Cell tracking is conventionally performed using fluorescent green proteins. As an alternative, photoconvertible microcapsules were proposed for macrophage labeling, as transfection is unacceptable for this cell type. The capsules' fluorescence intensity, photostability, photoconversion ability and mechanism were investigated. RAW 264.7 and bone marrow-derived macrophages were labeled with capsules, that demonstrated minimal cytotoxicity and negligible effects on cell mobility.

WePD-08 18:40-18:50

Application of deep neural network in wavefront detection based on intensity transmission

Zhang Haoran[1], Liang Yonghui[1,2], Liu Jin[1,2], Yang Huizhe[1,2]; [1]College of Advanced Interdisciplinary Studies, National University of Defense Technology, [2]Nanhu Laser Laboratory, National University of Defense Technology, China

The utilization of the Transport of Intensity Equation (TIE) to reconstruct the phase information at different propagation distances represents a novel wavefront sensing method. We propose a Deep Neural Network (DNN) model for TIE wavefront sensing. Simulation results indicate that, compared to traditional linear reconstruction methods, DNN significantly reduces the laser power requirements while effectively improving wavefront sensing accuracy.

WePD-09 18:50-19:00

Laser speckle contrast imaging for intraoperative blood flow monitoring during neurovascular surgery

D.D. Stavtsev[1,2], A.N. Konovalov[1,3], F.V. Grebenev[1,3], I.O. Kozlov[1], G.A. Piavchenko[1], E.V. Blinova[1], A.Yu Gerasimenko[1,2], D.V. Telyshev[1,2]; [1]Sechenov Univ., Russia; [2]MIET, Russia; [3]Burdenko Neurosurgical Center, Russia;

Laser speckle contrast imaging is promising for intraoperative real-time blood flow monitoring during neurovascular interventions. In this study, we showcased the utility of this technique in evaluating cerebral blood flow reactivity during asystole and cardiac resuscitation, as well as in assessing blood flow variations during simulated neurovascular procedures, including in comparison with ICG angiography.

WePD-10 19:00-19:10

Non-adiabatic polariton condensation in annular optical traps

I. Chestnov[1], E. Cherotchenko[2], A. Nalitov[3]; [1]ITMO Univ., [2]Ioffe Institute, [3]MIPT, Russia

We explore formation and dynamics of nonequilibrium bosonic exciton-polariton condensates in annular optical traps. Near the condensation threshold, we develop the two-mode model, accounting for counter-rotating quantized vortices and corresponding angular harmonics in the incoherent excitonic reservoir density. Identifying the range of validity for adiabatic reservoir elimination, we extend the analytic model beyond the adiabatic approximation.

R01: SOLID STATE LASERS - POSTERS

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

WeR01-p01 15:00-18:30

Development 515 nm Q-switched thin disk laser

A.B. Kozlov, N.P. Badalyan, E.V. Kuznetsov, M.M. Zemlyanov, A.V. Shestakov; RDI Polyus, Russia

This paper discusses the results of the development of SHG 515 nm Q-switched thin disk lasers in the Research and Development Institute Polyus of M.F. Stelmakh. The main constructive elements of the thin disk laser, abilities of SHG and the demands to its technical characteristics are considered too.

WeR01-p02 15:00-18:30

Spectral, lasing and mechanical strength characteristics of crystals Yb,Li:$ZnWO_4$

K.V. Kuleshova[1,2], K.A. Subbotin[1,2], P.A. Loiko[3], Yu.I. Zimina[1,2], A.I. Titov[1,2], Ya.S. Didenko[1,2], D.A. Lis[1], S.K. Pavlov[1,2], P. Camy[3], A. Braud[3], R.M. Solé[4], M. Aguiló[4], F. Díaz[4], W. Chen[5,6], X. Mateos[4], V. Petrov[5], G.Z. Elabedine[4], P.A. Volkov[7]; [1]Prokhorov General Physics Institute RAS; [2]Mendeleev University of Chemical Technology of Russia, Russia; [3]Centre de Recherche sur les Ions, les Matériaux et la Photonique, Université de Caen Normandie, France; [4]Universitat Rovira i Virgili, Física i Cristallografia de Materials Tarragona, Spain; [5]Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Germany; [6]Fujian Institute of Research on the Structure of Matter CAS, China; [7]NRC "Kurchatov Institute" - IREA Shared Knowledge Center, Russia

Spectral and mechanical strength properties of Yb3+,Li+:ZnWO4 crystals were investigated, diode-pumped ZnWO4 laser with an output power of 2,41 W was demonstrated.

WeR01-p03 15:00-18:30

Iodine optical frequency standard with hybrid frequency stabilization system on a high-finesse cavity

S.M. Ignatovich, I.S. Mesenzova, M.N. Skvortsov, N.L. Kvashnin, V.I. Vishnyakov; Institute of Laser Physics SB RAS, Russia

A method is presented to combine a molecular iodine absolute frequency reference with a high-finesse optical cavity to take advantage of the frequency stability properties of both systems at different timescales. Experimental results show cavity-limited instability 5·10^−15 at time scales of 1s and iodine instability below 10^−15 for observation times of 10^4 s.

WeR01-p04 15:00-18:30

Stimulated emission and amplification in NV^- centers of diamond with CW pumping

A.D. Savvin[1], V.P. Mitrokhin[1], A.E. Dormidinov[1], E.I. Lipatov[2,3], V.G. Vins[4]; [1]Dukhov Automatics Research Institute, Federal State Unitary Enterprise; [2]National Research Tomsk State University; [3]Institute of High Current Electronics SB RAS; [4]Velman Ltd., Russia

Up to 1 % amplification CW irradiation with wavelength 730 nm in diamond with NV- centers under CW laser diode pumping with a central wavelength near 640 nm has been achieved. The magnetic field influence on the stimulated emission gain in diamond with NV- centers has been demonstrated.

WeR01-p05 15:00-18:30

Incoherent source of laser radiation

S. Kobtsev; Division of Laser Physics and Innovative Technology, Novosibirsk State University, Russia

A possibility is considered of a pulsed incoherent source of laser radiation on the basis of a mode-locked fibre laser. Incoherent laser radiation may consist of noise-like pulses, chirped pulses or chirped noise-like pulses. Different ways of generation regime implementation with suitable pulses are discussed.

WeR01-p06 15:00-18:30

2 J 3 ns 50 Hz diode-pumped 1047 nm Nd:YLF laser

A.F. Kornev, A.M. Makarov, Yu.V. Katsev, V.V. Koval, R.V. Balmashnov; "Lasers & Optical Systems" Co. Ltd, Russia

We developed a diode-pumped 1047 nm Nd:YLF laser based on MOPA configuration which produces 2 J 3 ns pulses at 50 Hz with high beam quality. The laser has a compact design and demonstrates excellent long-term stability of the output pulse.

WeR01-p07 15:00-18:30

Resonator for diamond NV^- laser based on one-dimensional photonic crystal structures

V.V. Chashchin[1,2], E.I. Lipatov[1,2], S.V. Rabotkin[2]; [1]Tomsk State University; [2]Institute of High Current Electronics SB RAS, Russia

A model of multilayer reflective coatings for the wavelength of diamond laser generation has been created. The results of the creation of reflective structures at the end of diamond samples are presented, the transmission and photoluminescence spectra of the samples (before and after the application of mirrors) are presented.

WeR01-p08 15:00-18:30

Filters based on taped optical fibers 1.2 - 1.6 μm

A.V. Shirmankin, V.A. Kamynin, V.B. Tsvetkov; Prokhorov General Physics Institute RAS, Russia

This work presents the development and analysis of tunable spectral filters using tapered fibers. The filter was created by heating and pulling single mode optical fiber to form tapers. The optical signal propagating in the fiber within the 1.2 to 1.6 μm range was filtered by bending the taper.

WeR01-p09 15:00-18:30

Growth, spectroscopy and multi-site behavior of monoclinic Eu:$MgWO_4$ crystal

K.A. Subbotin[1,2], A. Baillard[3], A.I. Titov[1], D.A. Lis[1], Yu.I. Zimina[1,2], Ya.S. Didenko[1,2], G.Z. Elabedine[4], R.M. Solé[4], M. Aguiló[4], F. Díaz[4], P. Camy[3], X. Mateos[4], P.A. Loiko[3]; [1]Prokhorov General Physics Institute RAS; [2]Mendeleev University of Chemical Technology, Russia; [3]Centre de Recherche sur les Ions, les Matériaux et la Photonique Université de Caen Normandie, France; [4]Física i Cristallografia de Materials, Universitat Rovira i Virgili, Spain

Monoclinic Eu3+-doped MgWO4 crystal is grown from the flux using Na2WO4 as a solvent and its polarized emission properties in the visible are studied revealing a multi-site behavior of this promising laser material.

WeR01-p10 15:00-18:30

Influence of Fe^{2+} -co-doping on Cr^{2+} ion spectroscopic properties in Zn.7Mn.3Se and Zn.7Mg.3Se crystals at room-temperature

M.E. Doroshenko[1], K.A. Pierpoint[1], H. Jelinkova[2], A. Riha[2]; [1]Prokhorov General Physics Institute RAS, Russia; [2]Czech Technical University in Prague, Czech Republic

The influence of Fe2+ co-doping on the room-temperature spectroscopic properties of Cr2+ ions in Zn0.7Mn0.3Se and Zn0.7Mg0.3Se crystals is demonstrated. The absorption and fluorescence spectra maxima shift towards higher energies in the Cr-Fe co-doped samples, negatively affecting the nonradiative energy transfer process between Cr2+ and Fe2+ ions.

WeR01-p11 15:00-18:30

Growth, structure, thermal properties and spectroscopy of Tm^{3+}-doped $MgMoO_4$ laser crystal

A.I. Titov[1,2], K.A. Subbotin[1,2], Y.S. Didenko[1,2], D.A. Lis[2], Y.I. Zimina[1,2], G.Z. Elabedine[3], K. Eremeev[4], R.Maria Sol´e[4], M. Aguil´o[4], P.A. Volkov[5], P.A. Popov[6], E.V. Chernova[1], F. Díaz[3], P. Camy[4], P.A. Loiko[4], X. Mateos[3]; [1]Prokhorov General Physics Institute RAS, Russia; [2]Mendeleev University of Chemical Technology of Russia, Russia; [3]Universitat Rovira i Virgili (URV), Spain; [4]Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, France; [5]NRC "Kurchatov Institute" - IREA Shared Knowledge Center, Russia; [6]Petrovsky Bryansk State University, Russia

Tm3+-doped MgMoO4 crystal was grown by Czochralski. The actual Tm concentration in the crystal, the tensor of thermal expansion coefficients and thermal conductivity was determined. Spectroscopic studies were shown broad emission band extending beyond 2 μm (the 3F4 → 3H6 transition) and a long 3F4 excited-state lifetime that makes this crystal promising for broadly tunable and mode-locked lasers.

WeR01-p12 15:00-18:30

Development of a new crystalline scintillation single crystal based on silver and thallium halides

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

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

WeR01-p13 15:00-18:30

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

S.V. Gagarsky[1], S.G. Grechin[2], P.Y. Druzhinin[3], J.R. Istamgulova[1], V.A. Rusov[4], A.N. Sergeev[1]; [1]ITMO University, [2]Prokhorov General Physics Institute RAS, Russia; [3]Photon energy GmbH (Hitachi Group Company), Germany; [4]Vavilov State Optical Institute, Russia

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

WeR01-p14 15:00-18:30

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

D.A. Kuzin, A.V. Starobor, I.I. Kuznetsov, O.V. Palashov; Federal Research Center A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia

We developed Yb:YAG slab scalable laser amplifier and investigated numerically and experimentally the main problems limiting its average and peak power: overheating, surface breakdown and pump power scaling. We have shown that using composite gradient doped slab with compensation of beam area compression effect allows to use pump power to 1000W with maximum output energy of 50mJ with a M2<1.5.

WeR01-p15 15:00-18:30

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

A.D. Zverev[1], V.A. Kamynin[1], B.I. Denker[1], S.E. Sverchkov[1], V.V. Vel'miskin[2], Y.G. Gladush[3], D.V. Krasnikov[3], A.G. Nasibulin[3], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Institute RAS; [2]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center; [3]Skolkovo Institute of Science and Technology, Russia

The study demonstrates the generation of ultrashort pulses in an erbium-ytterbium codoped fiber laser with a short ring cavity. A fundamental repetition rate of 484.3 MHz was achieved, and harmonic mode locking was obtained with pulse repetition rates of 969 and 1453 MHz.

WeR01-p16 15:00-18:30

Investigation of solid solutions of Eu^{3+}-doped CaxNa(1-x)/2Gd(1-x)/2MoO_4 (x = 0 - 1) crystals

Y.S. Didenko[1,2], K.A. Subbotin[1,2], A.I. Titov[1], S.K. Pavlov[1,2], V.V. Voronov[1], L.D. Iskhakova[1], E.V. Chernova[1], P.A. Volkov[3], K.V. Kuleshova[1,2], Y.I. Zimina[1,2], D.A. Lis[1]; [1]Prokhorov General Physics Institute RAS; [2]Mendeleev University of Chemical Technology of Russia; [3]NRC "Kurchatov Institute" - IREA Shared Knowledge Center, Russia

The single crystals of the concentration series of CaMoO4 – Na0.5Gd0.5MoO4 scheelite-like solid solutions was grown and investigated. According to most of the properties studied, this solid solution shows some deviations from additivity.

WeR01-p17 15:00-18:30

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

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

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

WeR01-p18 15:00-18:30

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

V.A. Rusov[1], V.E. Yacobson[1], A.A. Mirzaeva[1], M.V. Nezhevyasov[1], S.B. Eron'ko[1], V.V. Koval[2], A.F. Kornev[2], V.D. Nenadovich[3]; [1]Vavilov State Optical Inst.; [2]«Lasers & Optical Systems» Co. Ltd.; [3]OJC «RPC «PSI», Russia

A technology for manufacturing Pockels cells on domestic high-resistance RTP crystals with a contrast of at least 1000:1 for Nd:YAG lasers has been developed. The use of manufactured Pockels cells in a picosecond Nd:YAG laser made it possible to obtain the following characteristics: a duration of 35 ps, and a maximum energy of 4.2 mJ.

WeR01-p19 15:00-18:30

Pleochroism of β-BBO crystals grown from $NaBaBO_3$, vanadium, and molybdenum-based melt solutions: visible and infrared spectral range

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

We present study on optical properties of β-BBO crystals grown from three distinct melt solutions: Na2O-NaF, NaBaBO3-V2O5, and BaMoO4-BaF2. Polarized VIS and FTIR spectra as well as with Raman scattering spectra were measured. The mean absorption coefficient for e-waves within the 1.5–2.0 μm range measured 0.03, 0.015, and 0.008 cm-1 for vanadium, sodium, and molybdenum based grown crystals.

WeR01-p20 15:00-18:30

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

O. Antipov[1,2], I. Eranov[1], A. Dobrynin[1,2], Yu. Getmanovskiy[1], V. Sharkov[1,2]; [1]Institute of Applied Physics RAS, [2]Nizhny Novgorod State University, Russia

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

WeR01-p21 15:00-18:30

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

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

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

WeR01-p22 15:00-18:30

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

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

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

WeR01-p23 15:00-18:30

Growth and polarized spectroscopy of stoichiometric $NaEu(WO_4)_2$ laser crystal

K.A. Subbotin[1,2], A. Baillard[3], A.I. Titov[1], S.K. Pavlov[1,2], E.V. Zharikov[1], P.Camy[3], X. Mateos[4], Pavel Loiko[3]; [1]Prokhorov General Physics Institute RAS; [2]Mendeleev University of Chemical Technology, Russia; [3]Centre de Recherche sur les Ions, les Matériaux et la Photonique, Université de Caen Normandie, France; [4]Física i Cristallografia de Materials, Universitat Rovira i Virgili, Spain

Stoichiometric tetragonal disordered NaEu(WO4)2 laser crystal is grown by the Czochralski method and its polarized spectroscopic properties are studied. The stimulated-emission cross-section for the deep-red 5D0 → 7F4 transition is 2.53×10-20 cm2 at ~702 nm for π-polarization.

WeR01-p24 15:00-18:30

Narrowband ultrashort pulses generation in different fiber schemes using a highly chirped Bragg grating

V.D. Efremov[1], D.S. Kharenko[1,2]; [1]Institute of Automation and Electrometry SB RAS, [2]Novosibirsk State University, Russia

A fiber laser was realized based on self-amplitude modulation of the effect of nonlinear polarization evolution and highly chirped Bragg grating. Generation of narrowband ultrashort pulses were investigated numerically and experimentally. As a result, a spectral width of about 0.1 nm was obtained.

WeR01-p25 15:00-18:30

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

V.Yu. Zhmykhov[1], D.A. Guryev[1], E.A. Dobretsova[1], V.S. Tsvetkov[1], Yu.N. Pyrkov[1], S.V. Kuznetsov[1], M.S. Nikova[2], D.S. Vakalov[2], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Institute RAS; [2]Scientific Laboratory Complex of Clean Rooms, North Caucasus Federal University, Russia

Temperature dependence of the lasing properties of 8.3(3) at.% Yb:YSAG ceramics with various composition (Y2.35Yb0.25Sc1.00Al4.4O12, Y1.95Yb0.25Sc1.00Al4.8O12 and Y2.25Yb0.25Sc0.38Al4.5O12) have been studied. Study was carried out in a temperature range from 50ºC to 125ºC. The best lasing performance has been achieved for the Y2.35Yb0.25Sc1.00Al4.4O12 ceramics, the maximum slope efficiency was 58% and the optical efficiency was 51%.

WeR01-p26 15:00-18:30

Study of the spectral and kinetic characteristics of the Er^{3+} ion in BaY.8Lu.2F_8 mixed crystals to assess the possibility of continuous laser oscillation at a wavelength of 2.7 µm

A.V. Astrakhantseva[1], A.A. Shavelev[1], A.S. Nizamutdinov[1], K.N. Boldyrev[2], A.G. Nikolaev[3], S.V. Kuznetsov[4], E.B. Dunina[5], A.A. Kornienko[5]; [1]Institute of Physics, Kazan Federal University; [2]Institute of Spectroscopy RAS; [3]Institute of Geology and Oil and Gas Technologies, Kazan Federal University; [4]Prokhorov General Physics Institute RAS, Russia; [5]Vitebsk State Technological University, Belarus

Here we present the spectral and kinetic characteristics of Er3+ ions in the heavily doped BaY1.8Lu0.2F8 mixed crystals and evaluate the possibility of continuous laser oscillation at a wavelength of 2.7 µm.

WeR01-p27 15:00-18:30

Growth, structure and spectroscopy of Yb^{3+}-doped $MgMoO_4$ crystal

Y.S. Didenko[1,2], K.A. Subbotin[1,2], A.I. Titov[1], L.D. Iskhakova[1], D.A. Lis[1], S.K. Pavlov[1,2], Y.I. Zimina[1,2], K.V. Kuleshova[1,2], R.M. Solé[3], M. Aguiló[3], F. Díaz[3], G.Z. Elabedine[3], X. Mateos[3], P. Camy[4], P. Loiko[4]; [1]Prokhorov General Physics Institute RAS; [2]Mendeleev University of Chemical Technology of Russia, Russia; [3]Universitat Rovira i Virgili, Física i Cristal·lografia de Materials, Spain; [4]Centre de Recherche sur les Ions, les Matériaux et la Photonique, UMR6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, France

Yb:MgMoO4 crystal is grown by the Czochralski method. The crystal structure, thermal expansion, vibronic properties, polarized room- and low-temperature spectroscopy are studied. Yb3+ ions in MgMoO4 exhibit intense and broad absorption at 978 nm, relatively broad and smooth emission bands above 1 µm and a long luminescence lifetime (0.63 ms). The research was supported by the Russian Scientific Fund (No 23-22-00416).

WeR01-p28 15:00-18:30

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

M.E. Doroshenko, L.I. Ivleva, A.G. Papashvili, I.S. Voronina, E.E. Dunaeva, K.A. Pierpoint; Prokhorov General Physics Institute RAS, Russia

Calcium orthovanadate crystals doped with cobalt ions via thermal diffusion and during Czochralski growth process are studied. The spectroscopic properties of M1 and M2 Co2+ optical centers are presented. Nonlinear transmission and efficient absorption cross-sections are measured for Co2+ M2 centers. A narrow fluorescence line at 1170 nm is attributed to trivalent Co ions.

WeR01-p29 15:00-18:30

Gain-switched single-frequency ytterbium fiber laser

A.V. Shirmankin[1], A.I. Trikshev[1], V.A. Kamynin[1], D.S. Lipatov[2], A.A. Rybaltovsky[1], V.B. Tsvetkov[1], M.V. Yashkov[2]; [1]Prokhorov General Physics Institute RAS; [2]G.G. Devyatykh Institute of Chemistry of High-Purity Substances RAS, Russia

We have investigated the generation characteristics of a distributed Bragg reflector (DBR) short cavity ytterbium fiber laser. Due to pulse pumping, the laser with an emission wavelength of 1066 nm was operated in gain switch mode with pulse durations ranging from 32 ns to 83 ns.

WeR01-p30 15:00-18:30

Dispersion properties of composite Erbium-Ytterbium doped optical fibers

V.V. Velmiskin, B.I. Denker, A.D. Zverev, V.A. Kamynin, S.E. Sverchkov, V.B. Tsvetkov; Prokhorov General Physics Institute RAS, Russia

The dispersion parameter of composite optical fiber doped with ytterbium-erbium complex has been experimentally investigated using Kelly sidebands analysis. The dispersion values in the spectral range of 1542-1564 nm were obtained. The maximum dispersion value was 308 ps2/km at the wavelength of 1542 nm.

WeR01-p31 15:00-18:30

Growth and physical properties of $MgWO_4$ crystal

S.K. Pavlov[1,2], K.A. Subbotin[1,2], A.I. Titov[1,2], Y.I. Zimina[1,2], P.A. Popov[3], P.A. Loiko[4], V.V. Voronov[1], D.A. Lis[1], Y.S. Didenko[1,2], K.V. Kuleshova[1,2]; [1]Prokhorov General Physics Institute RAS; [2]Mendeleev University of Chemical Technology of Russia; [3]Petrovsky Bryansk State University, Russia; [4]Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, France

MgWO4 single crystals were grown by top seed solution growth method. Their thermal conductivity, mechanical strength properties, as well as dispersion and thermal coefficients of the refraction indices were measured.

WeR01-p32 15:00-18:30

Temperature dynamics of laser generation spectra at NV centers in diamond.

A.V. Samolov[1], D.E. Genin[2], E.I. Lipatov[2], A.P. Eliseev[3], V.G. Vins[4]; [1]National Research Tomsk State University, [2]Institute of High-Current Electronics SB RAS, [3]V.S. Sobolev Institute of Geology and Mineralogy SB RAS, [4]Vellman Ltd, Russia

Currently, there is a problem of rapid degradation of equipment in outer space, where there is strong radiation. A promising solution to this problem is the creation of a diamond-based laser. The report presents the results of an experimental study of artificial diamond samples laser generation in the temperature range from 80K to 300K. Laser generation was obtained on NV-centers.

WeR01-p33 15:00-18:30

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

V.Yu. Zhmykhov[1], E.A. Dobretsova[1], V.S. Tsvetkov[1], A.A. Shvedchenko[1], S.V. Kuznetsov[1], Yu.N. Pyrkov[1], V.A. Tarala[2], D.S. Vakalov[2], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Institute RAS; [2]Scientific Laboratory Complex of Clean Room, North Caucasus Federal University, Russia

Spectral and kinetic characteristics of 8.3(3) at.% Yb:YSAG laser ceramics produced by sintering solid solution powders have been studied at different temperatures.

WeR01-p34 15:00-18:30

Laser driver for electron photoinjector

A.K. Poteomkin, M.A. Martyanov, E.I. Gacheva, I.V. Kuzmin, S.Yu. Mironov; Institute of Applied Physics RAS, Russia

Femtosecond laser system was designed and built in the Institute of Applied Physics RAS to illuminate the cathode of an electron photoinjector. It consists of Yb-fiber front-end followed by Yb:KGW solid state amplifiers and harmonics generation. The major feature of the system is the pulse shaping capability which is performed inside the fiber-front-end.

WeR01-p35 15:00-18:30

Numerical study of mid-infrared lasing in rare-earth -doped chalcogenide multicore fibers

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

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

WeR01-p36 15:00-18:30

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

D.M. Bengalskii[1], D.R. Kharasov[1], E.A. Fomiryakov[1,2], S.P. Nikitin[1,3], O.E. Nanii[1,2], V.N. Treshchikov[1]; [1]T8 LLC; [2]Lomonosov Moscow State University, Department of Physics; [3]Femtovision LLC, Russia

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

WeR01-p37 15:00-18:30

Spectroscopy investigation of highly doped $LiCaAlF_6:Ce^{3+}$ crystals

A.A. Shavelev[1], A.S. Nizamutdinov[1], A.A. Shakirov[1], I.D. Sidorov[1], S.L. Korableva[1], D.G. Zverev[1], A.A. Rodionov[1], E.V. Lukinova[2], V.V. Semashko[1,3]; [1]Kazan Federal University; [2]Belgorod State University; [3]Kazan Physical-Technical Institute, FRC Kazan Scientific Center RAS, Russia

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

WeR01-p38 15:00-18:30

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

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

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

WeR01-p39 15:00-18:30

Luminescence properties of $Er^{3+}:Y_2O_3$ laser ceramics

V.Yu. Zhmykhov[1], V.S. Tsvetkov[1], A.A. Shvetchenko[1], E.A. Dobretsova[1], Yu.N. Pyrkov[1], D.A. Permin[2], O.N. Postnikov[2], V.B. Tsvetkov[1]; [1]General Physics Institute RAS; [2]Institute of Chemistry of High-Purity Substances RAS, Russia

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

WeR01-p40 15:00-18:30

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

M.I. Skvortsov[1], K.V. Proskurina[1], E.V. Golikov[1], S.R. Abdullina[1], A.V. Dostovalov[1], D.S. Lipatov[2], A.S. Lobanov[2], A.A. Rybaltovsky[3], S.A. Babin[1]; [1]Institute of Automation and Electrometry SB RAS; [2]G.G. Devyatykh Institute of Chemistry of High-Purity Substances RAS; [3]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia

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

WeR01-p41 15:00-18:30

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

V.F. Lebedev[1], T.S. Misnikova[1], Ya.A. Ryvkina[1], D.E. Genin[2], A.V. Samolov[2], E.I. Lipatov[2], V.G. Vince[3], I.V. Klepikov[4], A.V. Koliadin[4], R.V. Isakov[5]; [1]St. Petersburg State University of Aerospace Instrumentation; [2]Tomsk State University; [3]LLC "VELMAN"; [4]LLC NPK Almaz; [5]LLC «New Diamond Technology», Russia

Direct observation of stimulated emission of NV^- centres in HPHT-diamonds are presented. The spectra and pulse durations of the SE were simultaneously recorded. It was found that the shapes of the spectra and the intensity of SE depend on the number of emitting centres and the position of the crystal relative to the focus of the pump beam.

WeR01-p42 15:00-18:30

Spectral-kinetic characteristics and sensitized luminescence of $LiY_xLu_{(1-x)}F_4$ mixed crystals with Tm^{3+} and Ho^{3+} ions

T.M. Minnebaev, A.S. Nizamutdinov, A.A. Shavelev, V.V Semashko; Institute of Physics, Kazan Federal University, Russia

We report about spectral and luminescence characteristics of the concentration series of $LiY_xLu_{1-x}F4$ crystals doped with Tm3+ and Ho3+ ions. The sensitized luminescence and polarization dependent spectral characteristics of crystals where some broadening of spectral lines is evidenced are presented and discussed. Measured data allowed us to estimate the Förster radius for the system of Tm3+-Ho3+ ions in $LiY_xLu_{1-x}F4$ crystals.

WeR01-p43 15:00-18:30

Spectral properties of Tb ions in SrF_2 crystal doped with Yb

A.V. Nekhoroshikh, P.G. Zverev, V.A. Konyushkin; Prokhorov General Physics Institute RAS, Russia

Absorption and luminescence properties of SrF2 crystal, co-doped with Tb and Yb ions, have been studied. It was found that the emission of Tb ions can be excited by diode laser at 955 nm. Emission intensity depends quadratically on the laser power, which proves the cooperative mechanism of Tb excitation.

WeR01-p44 15:00-18:30

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

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

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

WeR01-p45 15:00-18:30

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

M.V. Gavrish[1], P.K. Rozanov[1], E.A. Gavrish[2], A.A. Sergeev[1], A.P. Pogoda[1], A.S. Boreysho[1]; [1]D.F. Ustinov Baltic State Technical University "VOENMEH"; [2]The First Pavlov State Medical University of St. Petersburg, Russia

The research presents a multi-wavelength pulse generation mode in a Cr:LiSAF laser using optically coupled resonators. An intra-cavity Bragg grating facilitates wavelength control, achieving two non-commensurate wavelengths in free and passive Q-switch modes. Experimental results show a tunable range of 795 nm to 930 nm, minimal tuning step of 0.1 nm, and a 1.4 nm separation gap in Q-switch mode.

WeR01-p46 15:00-18:30

Optical centers of Yb^{3+} ion in $YScO_3$ crystal fiber

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

The spectral-kinetic properties of Yb3+ optical centers in YScO3 crystal fiber were studied using selective laser spectroscopy. Three distinct types of Yb3+ optical centers were identified. Here we discuss nature of Yb3+ optical centers formation.

WeR01-p47 15:00-18:30

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

V.V. Petrov[1,2,3], V.A. Petrov[1,2], G.V. Kuptsov[1,2], A.O. Kuptsova[1,3], V.V. Galutskiy[4], E.V. Stroganova[4]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State Technical University; [3]Novosibirsk State University; [4]Kuban State University, Russia

Yttrium-aluminum garnet crystals with a gradient distribution of Yb3+ ions (Yb:YAG) were grown using the Czochralski method with liquid recharge. The concentration of Yb3+ ions along the length of the crystal boule varied from 0 to 4 at.%. The subsequent studies showed the existence of a limiting gradient along the length of the crystals connected with formation of the impurities.

WeR01-p48 15:00-18:30

Numerical simulation of supercontinuum generation in all-fiber Er-doped master oscillator fiber amplifier

F. Yan[1], A. Ismaeel[1,2], I.O. Orekhov[1], S.G. Sazonkin[1], D.A. Dvoretskiy[1], A.A. Krylov[3], L.K. Denisov[1], V.E. Karasik[1]; [1]Bauman Moscow State Technical University; [2]Moscow Institute of Physics and Technology; [3]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia

Numerical study based on nonlinear Schrodinger equation was conducted to optimize the characteristics of all-fiber master oscillator fiber amplifier based on erbium-doped fiber laser. The generation of supercontinuum in high-nonlinearity fiber (HNLF) was achieved. The optimization of HNLF length, and the average power of amplified pulses led to 1155 nm spectral width at -20 dB.

R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID - POSTERS

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

WeR02-p01 10:00-13:30

Investigation of the effect of mirror shape distortions on the optical quality of radiation in unstable resonators

S.Yu. Strakhov, A.V. Savin, N.V. Sotnikova; Baltic State Technical University «Voenmeh», Russia

The paper considers the effect of mirror shape distortions on the optical quality of radiation in unstable resonators. The influence of the level and characteristic type of distortion on the M2 parameter, the Strehl number, and the radiation divergence angle is investigated.

WeR02-p02 10:00-13:30

Restoration of modal composition of radiation reflected from multimode fiber Bragg grating

F.R. Iakupov[1], F.V. Zakharov[1], R.I. Shaidullin[2], A.I. Baranov[3]; [1]Moscow Institute of Physics and Technology (National Research University); [2]Fryazino Branch of the Kotelnikov Institute of Radioengineering and Electronics RAS; [3]NTO-"IRE-Polus", Russia

An experimental and theoretical analysis of the reflection of laser radiation from the multimode fiber Bragg gratings has been carried out. Proposed theoretical model is based on the coupled mode theory, where a matrix approach for solving equations of the transverse radiation modes evolution was used.

WeR02-p03 10:00-13:30

Theoretical research of the spectral absorption line broadening in the development of K DPAL

A.V. Samsonov[1,2], V.M. Yamshchikov[1], G.N. Kachalin[1,2], A.A. Tarakanovsky[1], M.D. Naumov[1,2]; [1]RFNC - VNIIEF, [2]Branch of Lomonosov Moscow State Univ. in Sarov, Russia

Intermediate results of computational-theoretical studies of the parameters of a diode-pumped alkali vapor laser are presented. Calculation of the absorption spectral line profile for potassium at different parameters of the active medium was performed. At a temperature of 450 K and a buffer gas pressure of 3 atmospheres of the working medium, the absorption profile with FWHM=103.8 pm was calculated.

WeR02-p04 10:00-13:30

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

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

For the first time, a series of experiments has been conducted to study the scattering of radiation by laser plasma created by the impact of laser radiation with sub-petawatt values of power density on targets made of W, Al, S, Cu, and Ta. Scattering diagrams of laser plasma radiation have been obtained in two mutually perpendicular planes.

WeR02-p05 10:00-13:30

Manufacturing of optical fibers for the range of 4-27 μm based on silver halide single crystals

A.A. Yuzhakova, A.E. Lvov, D.D. Salimgareev, I.V. Yuzhakov, P.V. Pestereva, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia

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

WeR02-p06 10:00-13:30

Theoretical research of a potassium diode-pumped alkali laser

A.V. Samsonov[1,2], V.M. Yamshchikov[1], G.N. Kachalin[1,2], A.A. Tarakanovsky[1], D.A. Elkhimov[1,2]; [1]RFNC - VNIIEF, Russia; [2]Branch of Lomonosov Moscow State Univ. in Sarov, Russia

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

WeR02-p07 10:00-13:30

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

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

Impact of optical compressor on beam self-filtering before nonlinear pulse compression stage is analyzed numerically.

WeR02-p08 10:00-13:30

High power Q-switched and gain-switched fiber lasers

A.E. Alekseev, E.D. Maslova, A.A. Gagarin, S.V. Larin; IPG IRE-Polus, Russia

A compact all-fiber passively Q-switched and gain-switched Ytterbium-doped lasers are demonstrated. The basic laser architecture consists of two cavities encloses in fiber Bragg gratings. Several types of pulsed lasers were demonstrated: single-mode, few-mode, multimode with average output powers of 130W, 500W and 1kW. To optimize the laser performance, a special numerical model has been developed.

WeR02-p09 10:00-13:30

Obtaining stimulated emission on transitions from vibrationally excited levels of a KrF molecule at the high-power pulse discharge excitation

S.A. Yampolskaya, A.G. Yastremskii, Yu.N. Panchenko, A.V. Puchikin; Inst. of High Current Electronics SB RAS, Russia

The work theoretically and experimentally demonstrates the possibility of expanding the spectral range of tuning stimulated emission at the B–X transition of the KrF molecule due to radiation from upper vibrational levels.

WeR02-p10 10:00-13:30

A graded-index confined bismuth-doped fiber for cladding-pumped E+S -band high-power amplifiers

D.I. Oleinik[1], A.A. Umnikov[1], A.N. Abramov[1], D.F. Burmistrov[1], A.S. Vakhrushev[2], S.V. Alyshev[2], A.M. Khegai[2], E.G. Firstova[2], M.A. Melkumov[2], S.V. Firstov[2]; [1]G.G. Devyatykh Institute of Chemistry of High-Purity Substances RAS; [2]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia

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

WeR02-p11 10:00-13:30

Measurement of optical absorption coefficient of lithium-sodium molybdate crystals

D.Yu. Demushkin[1], D.A. Denisov[1], I.V. Grishchenko[2], N.A. Khohlov[3], A.V. Konyashkin[2], O.A. Ryabushkin[2]; [1]Moscow Institute of Physics and Technology; [2]Fryazino Branch of Kotelnikov Institute of Radioengineering and Electronics RAS; [3]Mendeleev University of Chemical Technology, Russia

We introduce the measurement results of the optical absorption coefficient of the nonlinear-optical crystal lithium-sodium molybdate LiNa5Mo9O30 (LNM). The absorption coefficient of LNM at 1070 nm wavelength was determined using piezoelectric resonance laser calorimetry.

WeR02-p12 10:00-13:30

Estimation of broadening the spectrum of laser radiation in the development of optical schemes of narrow-band fiber lasers

M.G. Slobozhanina, A.N. Slobozhanin; Federal State Unitary Enterprise «Russian Federal Nuclear Center - Zababakhin All-Russia Research Institute of Technical Physics», Russia

The paper presents a method for analytically assessing the change in the spectral linewidth of laser radiation during its amplification in high-power fiber amplifiers. The verification of the resulting expressions is given.

WeR02-p13 10:00-13:30

Temperature-induced distortions redistribution of the stacked-actuator deformable mirrors with various apertures under different cooling regimes

V.V. Toporovsky[1], P.M. Kuzmitsky[1,2], I.V. Galaktionov[1], A.V. Kudryashov[1,2]; [1]Sadovsky Institute of Geosphere Dynamics RAS; [2]Moscow Polytechnic University, Russia

The behavior of the stacked-actuator deformable mirrors under 10kW power was simulated with finite element method. Thermomechanical analysis of the wavefront correctors was performed in three main cases: without thermostabilization, cooling through actuators and with applying periphery thermostabilization. The simulation showed that the best cooling is achieved with heat dissipation along the periphery of the mirror substrate.

WeR02-p14 10:00-13:30

Calculation of a frequency of laser beam parameter changes in a turbulent medium

Yu. Grekova[1], F. Kanev[2], A. Rukosuev[3], I. Galaktionov[3,1]; [1]Tomsk Polytechnic University, [2]V.E. Zuev Institute of Atmospheric Optics SB RAS, [3]Sadovsky Institute of Geosphere Dynamics RAS, Russia

Results of a laboratory and numerical experiments are analysed and compared in the paper. In experiments a laser radiation propagated in a randomly inhomogeneous medium.

WeR02-p15 10:00-13:30

Linear errors of radiation guidance in the laser communication channel due to atmospheric inhomogeneities

S.Yu. Strakhov, A.V. Savin, N.V. Sotnikova; Baltic State Technical University «Voenmeh», Russia

The paper proposes a method for calculating linear errors and discusses the results of its evaluation for a real atmospheric route.

WeR02-p16 10:00-13:30

Compact TEA-CO_2 laser with pulse repetition rate up to 2.5 kHz

B.A. Kozlov[1], P.V. Tomashevich[2]; [1]Ryazan State Radio Engineering Univ.; [2]JSC "NIIEFA", Russia

The influence of the parameters of high-voltage pulses on the formation of stable volume discharges in the gap 34 cm3 in CO2–laser mixtures with a high content of carbon dioxide at pulse repetition frequencies up to 2.5 kHz has been studied. Laser pulses with an energy of 80–120 mJ with duration of 25–35 nanoseconds were obtained.

WeR02-p17 10:00-13:30

Deactivating coatings of the discharge channel walls and average radiation power of a nitrogen laser

B.A. Kozlov, Z.V. Shvets; Ryazan State Radio Engineering Univ., Russia

The influence of deactivating coatings of the discharge channel walls on average radiation power of a nitrogen laser pumped by a longitudinal discharge has been studied. Graphite, boric acid and chromium oxide have the most efficiency. Graphite, boric acid and chromium oxide provide an increase in the pulse repetition rate and average radiation power by 1.8–2 times.

WeR02-p18 10:00-13:30

Stimulated Brillouin scattering threshold increase in narrow-band fiber systems

K.G. Aksyonov, O.L.Techko, S.M.Kulikov; RFNC-VNIIEF, Sarov, Russia

This paper presents results of an experimental and numerical study of the thermal method of stimulated Brillouin scattering (SBS) threshold increasing in narrow-band fiber systems. Novel model for calculating the influence of temperature distribution along the fiber on SBS threshold is developed.

WeR02-p19 10:00-13:30

Study of spectral-temporal characteristics of optical radiation during sputtering of cadmium into gas medium under nanosecond electron beam irradiation

K. Samarkhanov[1,2], M. Khasenov[1], E. Batyrbekov[3], Yu. Gordienko[1], Yu. Ponkratov[1], Ye. Tulubayev[1], V. Bochkov[1]; [1]Institute of Atomic Energy of the National Nuclear Center of the Republic of Kazakhstan, IAE NNC RK; [2]Sarsen Amanzholov East Kazakhstan University; [3]National Nuclear Center of the Republic of Kazakhstan, NNC RK, Kazakhstan

The optical radiation in a gaseous medium was investigated by irradiating a cadmium foil with a 150 keV electron beam and a 5 ns pulse duration. The foil was positioned 30 mm from the cathode, heated to 550 K, within the irradiation chamber of a nanosecond electron accelerator.

WeR02-p20 10:00-13:30

Optically pumped Ar-He gas laser

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

We represent the results of experiments on studying an optically pumped Ar-He laser (OPRGL). Measurements of output power of generation with longitudinal and transverse circuits and the maximum value of generation power obtained to date are given.

WeR02-p21 10:00-13:30

Gradient method for piezoresonance laser calorimetry

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

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

WeR02-p22 10:00-13:30

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

M.V. Zagidullin[1], P.A. Mikheyev[1], A.D. Dvornicov[1,2], R.A. Kuramshin[1,2]; [1]Samara Branch of Lebedev Physical Institute; [2]Samara State Korolev University, Russia

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

WeR02-p23 10:00-13:30

Thermal lens measurement in LNM with Gerchberg-Saxton algorhitm

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

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

WeR02-p24 10:00-13:30

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

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

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

WeR02-p25 10:00-13:30

Simulation of the process of laser radiation on steel

Dias Sultanuly, Iuliia S. Ruzankina; St. Petersburg Electrotechnical University “LETI”, Russia

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

WeR02-p26 10:00-13:30

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

A. Saramud, Iu. Ruzankina; St. Petersburg Electrotechnical University “LETI”, Russia

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

WeR02-p27 10:00-13:30

Statistical characteristics of optical vortices in a beam with an initial phase set by Zernike polynomials and by a turbulent screen

Yu. Grekova[1], F. Kanev[2], N. Makenova[2,1], I. Veretekhin[2]; [1]Tomsk Polytechnic University, [2]V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia

With the use of numerical experiment methods we compare distributions of optical vortices in beams whose initial phase was formed by Zernike polynomials and beams with the phase set by a screen simulating atmospheric turbulence.

WeR02-p28 10:00-13:30

Analysis of the gradient method for laser calorimetry and analytical correction factors

K.V. Zotov[1], N.V. Tereshchenko[1], A.Yu. Ostapiv[1], O.A. Ryabushkin[2]; [1]Moscow Institute of Physics and Technology (National Research University), Russia; [2]Kotelnikov FIRE RAS, Russia

We obtained the expression for the derivative difference value used in the gradient method for the laser calorimetry (LC). It has been firstly reinterpreted in terms of average temperature regarding the piezolectric resonance laser calorimetry (PRLC). Corrections factors in the cases of LC and PRLC were estimated. For the LC it is useful for choosing the optimal temperature sensor position.

WeR02-p29 10:00-13:30

Lasing on optically pumped metastable krypton atoms at 893 nm

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

The results of an experiment on laser generation using metastable krypton atoms with optical pumping 893 nm are presented.

WeR02-p30 10:00-13:30

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

D. Sizmin[1], S. Koshechkin[1], A. Dobikov[1], N. Maltseva[1], G. Sannikov[1], E. Dmitrieva[1], M. Gavrilenko[1,2], V. Derkach[1]; [1]Russian Federal Nuclear Center - All-Russian Scientific Research Institute of Experimental Physics, Sarov, Russia; [2]Lomonosov Moscow State University, Moscow, Russia

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

WeR02-p31 10:00-13:30

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

I. Galaktionov[1], V. Toporovsky[1], A. Nikitin[1], A. Rukosuev[1], J. Sheldakova[1], A. Kudryashov[1,2]; [1]Sadovsky Institute of Geosphere Dynamics RAS; [2]Moscow Polytech, Russia

The semi-automatic system for laser beam alignment was developed and researched. The alignment system was used to make the laser beam follow the predetermined path through the optical scheme. The system allowed to control the pointing and positioning of the beam as well as tip-tilt and overall curvature of the wavefront

WeR02-p32 10:00-13:30

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

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

The results of the laser shock peening in water medium are presented. The estimation of chemical composition of surface was studied by LIBS-method. The diffusion of paints and migration of elements of the substrate was observed layer-by-layer for aluminum anв steel plates.

WeR02-p33 10:00-13:30

Radiation power distribution over the beam cross section in a nitrogen laser pumped by longitudinal discharge

Z.V. Shvets, B.A. Kozlov; Ryazan State Radio Engineering Univ., Russia

The influence of exciting pulses on the distribution of radiation in beam cross section nitrogen laser has been studied. The determining role in the formation of radiation with minimal power in the "halo" is played pulse repetition frequency and rise time of the voltage pulses.

WeR02-p34 10:00-13:30

Microwave pumped multi-frequency planar (CO_2 -Xe)-laser

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

In a planar gas-discharge (CO2-Xe)-laser with microwave pumping and diffusion cooling of the working gas in discharge channel size 2x25x250 mm, lasing was obtained simultaneously on xenon atoms and on carbon dioxide molecules. A pulsed output power of 60 W at a wavelength of λ=10.6 μm and a total of 0.7 W at λ=2.03 and 3.43 μm was achieved.

WeR02-p35 10:00-13:30

Method to estimate the frequency modulated emission of long pulses

I.V. Zhluktova[1], V.A. Kamynin[1], D.A. Korobko[2], A.A. Wolf[3], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Institute RAS; [2]S.P. Kapitsa Scientific Technological Research Institute, Ulyanovsk State University; [3]Institute of Automation and Electrometry SB RAS, Russia

This paper presents a method for direct real-time estimation of the frequency modulation (chirp) of a relatively long duration laser pulse based on the use of an array of Fiber Bragg Gratings (FBGs). As an example, a 180-ps pulse generated by a mode-locked ytterbium-doped fiber laser has been studied.

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

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

WeR05-p01 10:00-13:30

Generation of long-lived strong magnetic fields in laser targets with cylindrical micro-channels

A.A. Andreev[1,3], L.A. Litvinov[1], K.Yu. Platonov[2]; [1]St. Petersburg State University; [2]Peter the Great St. Petersburg Polytechnic University; [3]Ioffe Institute, Russia

Superstrong magnetic field generation by a circularly polarized intensive laser pulse in a target consisting of several touching cylindrical nanochannels is considered. The cylindrical shells collapse towards the cylinder axis leads to magnetic field increase and continues for a sub-picosecond time. As a result, a long-lived Giga-Gauss magnetic field is generated in the laser target volume.

WeR05-p02 10:00-13:30

Plasma-mirror -based laser pulse contrast enhancement system for multiterawatt laser facility

S.F. Kovaleva, N.A. Fedorov, D.O. Zamuraev, A.S. Tishenko, A.L. Shamraev, K.V. Safronov, V.A. Flegentov, A.V. Potapov; RFNC-VNIITF, Russia

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

WeR05-p03 10:00-13:30

Research of ultrashort laser processing Si and glass for microelectronics applications

D.M. Kataev[1], N.N. Evthikhiev[1,2], N.V. Grezev[1], M.A. Murzakov[1]; [1]LLC "IRE-POLUS" LTD; [2]National Research Nuclear University MEPhI, Russia

Research of the laser processing by femtosecond pulses of borosilicate glass and silicon substrate has been carried out. At pulse energies in the range up to 15 μJ, a weld is formed at the interface "glass-silicon substrate". Experiments were carried out on laser cutting glass to form a base cut. The work of perforating holes in the Si was completed.

WeR05-p04 10:00-13:30

Research of the interaction ultrashort pulses in the processes of laser welding dissimilar metal and glass joints

M.A. Murzakov[1], N.N. Evthikhiev[1,2], D.M. Kataev[1]; [1]"IRE-POLUS" LTD; [2]National Research Nuclear University MEPhI, Russia

Results of experiments on the formation of metal-glass welded joints under influence of 1-3 ps pulses are presented. When laser radiation interacts with metal and glass, mechanical bond is formed at the interface between dissimilar materials. It is shown that the formation welds occurs at pulse energies of 30 μJ.

WeR05-p05 10:00-13:30

Experimental observation of Weibel instability in the astrophysical and Fast Ignition relevant plasmas induced by ultrashort 250 TW laser pulse

R.S. Zemskov, S.E. Perevalov, A.V. Kotov, A.A. Murzanev, A.N. Stepanov, A.A. Soloviev, M.V. Starodubtsev; A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia

Weibel instability was observed experimentally in the plasma generated after irradiation a solid target with a 250 TW ultrashort laser pulse at the PEARL petawatt laser facility. A small-scale current-structed Weibel instability has been studied using various optical diagnostics. The influence of laser radiation intensity and an external magnetic field on generation of the Weibel instability has been investigated.

WeR05-p06 10:00-13:30

Numerical simulation of broadband chirped pulses amplification in Yb^{3+}:KGW using Maxwell-Bloch equations

I.V. Kuzmin, S.Yu. Mironov, E.R. Kocharovskaya; Federal Research Center Institute of Applied Physics RAS, Russia

The features of broadband chirped infrared laser pulses amplification by using a numerical solution of the Maxwell-Bloch equations for a four-level medium are considered in this work.

WeR05-p07 10:00-13:30

Theoretical model of the self-trapping of a laser pulse in a relativistic plasma

I.I. Metelskii[1,2], V.F. Kovalev[1,3], V.Yu. Bychenkov[1,2]; [1]The Federal State Unitary Enterprise Dukhov Automatics Research Institute (VNIIA); [2]Lebedev Physical Institute RAS; [3]Keldysh Institute of Applied Mathematics RAS, Russia

Using a model approach the previously discovered in numerical simulation regime of stable propagation of relativistically intense laser pulses in a plasma over distances much greater than the Rayleigh length was studied. Conditions for matching the laser spot size with the plasma density and laser pulse intensity, which correspond to the self-trapping of radiation for relativistic plasma nonlinearity, are obtained.

WeR05-p08 10:00-13:30

Development of multicolor parametric amplifier based on sub-ps ytterbium laser

K.A. Glushkov, I.B. Mukhin, E.A. Perevezentsev; Institute of Applied Physics RAS (IAP RAS), Russia

A universal multicolor converter of sub-ps pulses of ytterbium lasers in a few cycle femtosecond pulses with the ability to adjust the central wavelength in the range from 650 to 2500 nm has been created. The possibility of amplification of these pulses to the mJ energy level by OPCPA and FOPA methods has been studied.

WeR05-p09 10:00-13:30

Temporal transformation of noise-like pulse bunches in an Er-doped fiber laser

A.Yu. Fedorenko, A.O. Prudnikov, I.O. Orekhov, D.A. Dvoretskiy, S.G. Sazonkin, L.K. Denisov, V.E. Karasik; Bauman Moscow State Technical University, Russia

A fiber laser generating noise-like two-pulse bunches with duration of ~66 fs is presented. The transformation of these pulses into a multi-bound soliton regime with a duration of 142 fs is investigated.

WeR05-p10 10:00-13:30

Energy relaxation in a strongly excited electron subsystem of a Nickel film on a substrate

S.A. Romashevskiy[1], S.A. Evlashin[2], P.A. Tsygankov[3], S.I. Ashitkov[1]; [1]Joint Institute for High Temperatures RAS, [2]Center for Materials Technologies, Skolkovo Institute of Science and Technology, Russia; [3]Universidad Industrial de Santander, Bucaramanga, Colombia

Non-destructive and non-contact all-optical methods for characterization of thermal and mechanical properties of layered materials with nanoscale spatial and femtosecond/picosecond temporal resolutions are in ever-increasing demand. We report on an experimental study of energy relaxation in a strongly excited electron subsystem of a Nickel film on a substrate upon ultrafast irradiation using time-resolved reflectivity measurements with phase-sensitive signal detection.

WeR05-p11 10:00-13:30

Dependence of electron beam characteristics on laser pulse polarization

O.D. Sviridova[1,3], M.G. Lobok[1,2], V.Yu. Bychenkov[1,2]; [1]LPHI, [2]VNIIA, [3]Pirogov RNRMU, Russia

In this work we investigated the influence of the laser pulse polarization on an electron beam accelerated in the longitudinal wake field of the laser pulse.

WeR05-p12 10:00-13:30

Generation of second and third harmonics of XUV pulse by noble-gas atoms in the presence of intense infrared field

A.A. Romanov[1,2], A.A. Silaev[1,2], N.V. Vvedenskii[1,2], M.V. Frolov[2,3]; [1]Institute of Applied Physics RAS, [2]Nizhny Novgorod State University, [3]Voronezh State University, Russia

The generation of second and third harmonics of XUV pulse by noble-gas atoms in infrared pulse is studied by solving numerically time-dependent Kohn-Sham equations. We show that all electrons in outer shell of atoms contribute significantly to these harmonics. Generation of XUV harmonics can be used to measure nonlinear susceptibilities in XUV range and monitor the phase of XUV pulse.

WeR05-p13 10:00-13:30

Spectral "breathing" of extremely compressed mid-infrared wave packet in dispersive medium

A. Dormidonov, E. Zaloznaya; Dukhov Automatics Research Institute, Russia

Features of multioctave frequency broadening of Mid-IR single-cycle light bullet are investigated. The group velocity dispersion moves the generated high frequencies out of the light bullet's core that limits the short-wavelength cutoff of the supercontinuum. The periodic change of cosine and sine-mode during the propagation of the light bullet leads to the formation of a striped pattern of supercontinuum distribution.

WeR05-p14 10:00-13:30

The fs-laser inscription of fiber Bragg gratings based on spatial light modulator

A.V. Dostovalov[1], A.Y. Kokhanovskiy[2], A. Revjakin[1,3], Z.E. Munkueva[1,3], D.S. Kharenko[1,3], S.A. Babin[1,3]; [1]Institute of Automation and Electrometry SB RAS, [2]School of Physics and Engineering, ITMO University, [3]Novosibirsk State University, Russia

We introduce a flexible method utilizing femtosecond laser technology for writing FBGs inside fiber core. Using a spatial light modulator enables precise positioning of the focal point within the core. This method enables to create uniform, phase-shifted, apodized FBGs and allows to change of the grating pitch dimension from a single point to more complex shapes, showcasing 3D structuring.

WeR05-p15 10:00-13:30

Magnonic oscillations of cluster laser plasma

A.A. Andreev[1,3], L.A. Litvinov[1], K.Yu. Platonov[2]; [1]St. Petersburg State University; [2]Peter the Great St. Petersburg Polytechnic University; [3]Ioffe Institute, Russia

We explore the generation of super strong magnetic fields in cluster plasmas using circularly polarized, relativistically intense laser pulses. The resulting magnetic fields induce magnetic moments and magnon oscillations within clusters, with a characteristic terahertz frequency. Our focus is on the consequent dynamics and interactions of these magnetic moments, crucial for understanding terahertz radiation generation in cluster plasma environments.

WeR05-p16 10:00-13:30

Features of vibrational nonlinear response in THz Kerr effect

M.S. Guselnikov, S.A. Kozlov; ITMO University, Russia

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

WeR05-p17 10:00-13:30

Particle drift, diffusion, and acceleration in quasi-static fields generated by ultrashort relativistically intense laser pulse channeling in near-critical density targets

A.J. Castillo[1,2], S.G. Bochkarev[2,3], V.Yu. Bychenkov[2,3]; [1]Peoples' Friendship University of Russia (RUDN University); [2]Lebedev Physics Institute RAS; [3]The Federal State Unitary Enterprise Dukhov Automatics Research (VNIIA), Russia

The dynamics of charged particles in the self-generated quasistatic fields of channels produced by the interaction of an ultrashort relativistically intense laser pulse with near-critical density plasmas has been studied numerically. We identify distinctive mechanisms of drift, diffusion, and acceleration of electrons in quasi-static fields generated in the laser plasma channel produced by ultrashort intense laser pulses.

WeR05-p18 10:00-13:30

High-order harmonics generation by solid slabs in two-color infrared and ultraviolet field

A.A. Romanov[1,2], A.A. Silaev[1,2], N.V. Vvedenskii[1,2], M.V. Frolov[2,3]; [1]A.V. Gaponov-Grekhov Institute of Applied Physics, [2]Lobachevsky State University of Nizhny Novgorod, [3]Voronezh State University, Russia

High-order harmonic generation (HHG) by solid slab in infrared (IR) field with the addition of ultraviolet (UV) pulse is studied numerically using developed code. It is shown that dependence of harmonic yield near HHG cutoff on time delay between IR and UV pulses represents interference pattern with oscillation frequency equal to UV-pulse frequency and averaged shape coinciding with UV-pulse envelope.

WeR05-p19 10:00-13:30

2D laser-induced periodic surface structures formation on thin metal films by femtosecond laser radiation

K. Bronnikov[1], S. Gladkikh[1], S. Mikerin[1], V. Terentiev[1], V. Simonov[1], A. Kuchmizhak[2,3], A. Dostovalov[1]; [1]Institute of Automation and Electrometry SB RAS; [2]Institute of Automation and Control Processes FEB RAS; [3]Pacific Quantum Center, Far Eastern Federal University, Russia

Here we study formation of the 2D TLIPSS on metal thin films under the impact of femtosecond laser pulses in the double pass approach with orthogonal polarization states. A variety of 2D-TLIPSS with a period of ≈700 nm morphologies (regular and honeycomb) based on that approach was demonstrated. The sensing applications results of these 2D-TLIPSS will be presented.

WeR05-p20 10:00-13:30

Interferometric reconstruction of the complex amplitude (IRCA) of femtosecond pulses

A. Mukhamedyanov[1,2], K.A. Akmarov[2], K.A. Emelyanov[1,2], S.A. Babaev[2], S.P. Nikitin[2]; [1]MIPT Univ.; [2]FemtoVision LLC, Russia

A novel femtosecond diagnostic technique based on interferometric reconstruction of the complex amplitude (IRCA) is introduced. It employs same-scan acquisitions of the Michelson interferometer signal along with the fringe-resolved autocorrelation function. Fourier transform spectrometry is used to evaluate pulse spectrum. The pulse E-field is calculated basing on acquired ACF and spectrum. Such approach simplifies hardware, reduces mechanical dimensions and costs.

WeR05-p21 10:00-13:30

Generation of tunable ultraviolet pulses using gas ionization by chirped two-color pulses

A.A. Romanov[1,2], A.A. Silaev[1,2], A.V. Budin[2], N.V. Vvedenskii[1,2]; [1]A.V. Gaponov-Grekhov Institute of Applied Physics RAS, [2]Lobachevsky State University of Nizhny Novgorod, Russia

We propose a method for generating pulses of ultraviolet radiation with stable phase and tunable frequency. The method is based on gas ionization by two-color laser pulses with frequency chirp of opposite sign and variable time delay. Changing the time delay allows simple tuning of the generation frequency near the fourth harmonic of the fundamental field.

WeR05-p22 10:00-13:30

Shape and temperature fiber sensors based on fs -laser written reflectors in 7-core fiber and machine learning

Z.E. Munkueva[1,2], K.A. Bronnikov[1,3], D. Sakhno[3], A.Y. Kokhanovskiy[3], A.V. Dostovalov[1], S.A. Babin[1,2]; [1]Institute of Automation and Electrometry SB RAS, [2]Novosibirsk State University, [3]School of Physics and Engineering, ITMO University, Russia

We present the experimental results on development of 3D shape and temperature fiber sensors based on random and regular reflectors inscribed by femtosecond laser radiation in 7-core fiber. In the first case the 3D shape measurements accuracy of <5% was achieved, whereas in the second case temperature sensor utilizing a machine learning algorithm for a spectral analysis was demonstrated.

WeR05-p23 10:00-13:30

Femtosecond laser pulse for γ-rays scintillators response investigation

V.A. Simonova, A.D. Savvin, V.P. Mitrokhin, E.D. Zaloznaya, A.E. Dormidonov; Dukhov Automatics Research Institute (VNIIA), Russia

The determination of the characteristics of high-speed plastic scintillators without exposure to pulsed γ-rays has been demonstrated. The obtained data are shown to correspond with measurements carried out when exposed to a source of picosecond γ-rays, which confirms the possibility of using a femtosecond laser setup as a safe tool for studying the parameters of scintillation converters of γ-rays.

WeR05-p24 10:00-13:30

Features of isotropic dielectric media vibrational nonlinear response in THz Kerr effect

M.S. Guselnikov, S.A. Kozlov; ITMO University, Russia

It was recently discovered via Z-scan technique that some media possess giant nonlinear refractive index coefficient n2 in terahertz spectral range. This result was doubted, because n2 measured via terahertz Kerr effect is occurred orders of magnitude smaller. Here we theoretically showed that parameter measured in terahertz Kerr effect is not n2. Our calculations matched well with experimental results.

WeR05-p25 10:00-13:30

Characterization of solid hydrogen isotopes layer parameters in cryogenic target for inertial confinement fusion

E.Yu. Zarubina, M.A. Rogozhina, I.A. Chugrov; The Russian Federal Nuclear Center–All-Russian Scientific Research Institute of Experimental Physics (RFNC-VNIIEF), Russia

The program system for indirect-drive cryogenic target was developed which makes it possible to measure liquid fuel when filling the shell during the performance of the experiment on developing the technology for target creation, to perform the characterization of the solid cryogenic layer parameters, to evaluate characterization results robustness.

WeR05-p26 10:00-13:30

Measuring the parameters of relativistic electron beams accelerated from thin solid targets by femtosecond laser pulses of 100 TW power

V.A. Flegentov, K.V. Safronov, S.A. Gorokhov, S.F. Kovaleva, N.A. Fedorov, D.O. Zamuraev, A.L. Shamraev, A.S. Tischenko, A.V. Potapov; All-Russian Scientific Research Institute of Technical Physics, VNIITF, Russia

A series of experiments on the generation of relativistic electrons beams from thin solid targets was carried out using a femtosecond high-intensity laser system. Spectra, angular distributions and total charges of the relativistic electron bunches accelerated in the laser field and transmitted to the back side of the target were characterized.

R06: LASERS AND SYSTEMS FOR IMAGING, GREEN PHOTONICS AND SUSTAINABILITY - POSTERS

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

WeR06-p01 10:00-13:30

Filtering methods for reconstructed digital holograms

V.V. Sementin, A.P. Pogoda, A.S. Boreysho; Baltic State Technical University "VOENMEH", Russia

Results are demonstrated on the use of various filtering algorithms for reconstructed digital holograms using a digital holographic system based on a Michelson interferometer with the following source parameters: central laser wavelength 408 nm, laser with the possibility of thermal wavelength tuning. The possibilities of using window functions, layer masks and deep learning systems are shown.

WeR06-p02 10:00-13:30

Cryothermal setup for arctic fiber Bragg grating tilt sensors investigation

R.R. Kozii, T.V. Gritsenko, R.I. Khan, K.I. Koshelev, E.M. Rubtsov, A.V. Sibirtsev, A.B. Pnev; Bauman Moscow State Technical University, Russia

We propose a new cryothermal setup for testing and comparison fiber optic tilt sensors in extremely-low temperature conditions. The setup makes possible simulating the required temperature conditions, investigating fiber optic tilt sensors accuracy characteristics and tracing trends of the sensors operation when ambient temperature decreases to critical low values.

WeR06-p03 10:00-13:30

Simulation of super-Gaussian laser beam propagation over 1 km turbulent atmospheric path with account for pre-generated Kolmogorov phase screens

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

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

WeR06-p04 10:00-13:30

Development of models and methods for forecasting methane emissions

S.L. Verkhoshentseva[1], O.V. Nepomnuashy[1], A.S. Tsipotan[1]; [1]Siberian Federal University, Russia

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

WeR06-p05 10:00-13:30

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

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

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

WeR06-p06 10:00-13:30

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

L.A. Mochalov[1], M.A. Kudryashov[1], M.A. Vshivtsev[1], Yu.P. Kudryashova[1], S.S. Safronova[1], E.I. Terukov[2]; [1]Lobachevsky University; [2]Ioffe Institute, Russia

CdTe thin films were prepared by PECVD on silicon substrates at the substrate temperature 50 °C. The structural quality and morphology of the samples were studied by XRD and SEM, respectively. The optical band gap of the resulting CdTe films was also determined.

WeR06-p07 10:00-13:30

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

E.V. Parkevich, A.I. Khiryanova, T.F. Khiryanov, D.V. Tolbukhin, K.V. Shpakov; Lebedev Physical Institute RAS, Russia

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

WeR06-p08 10:00-13:30

Visible light communication system based on RGBW LEDs

D.S. Shiryaev, K.R. Razzhivina, A.A. Kundius, I.S. Polukhin, E.S. Kolodeznyi; ITMO University, Russia

RGBW Li-Fi communication system with data transfer rate up to 42 Mbit/s was designed.

WeR06-p09 10:00-13:30

Experimental tests of a wavemeter based on phi-OTDR with thermally stabilized weak FBGs

T.V. Gritsenko[1], R.I. Khan[1], K.I. Koshelev[1], K.V. Stepanov[1], O.V. Butov[1,2], A.I. Lopunov[1,2], A.B. Pnev[1], A.O. Chernutsky[1], A.A. Zhirnov[1]; [1]Bauman Moscow State Technical University; [2]Kotelnikov Institute of Radioengineering and Electronics RAS, Russia

We present experimental results of continuous wavelength measurements for narrow linewidth laser in C-band. Wavemeter uses multi-base Fizeau interferometers based on phi-OTDR on weak fiber Bragg gratings with thermal stabilization. Achieved accuracy of setup was about 100 fm with 1 kHz discretization frequency. Possible improvements can allow reaching about 10 fm accuracy with more than 10 kHz sampling frequency.

WeR06-p10 10:00-13:30

Application of fiber Bragg gratings for composite rocket engine housings monitoring

T.V. Gritsenko[1], N.V. Ilgovskaya[1], A.N. Baryshev[1], L.P. Tairova[1], O.V. Butov[1,2], A.I. Lopunov[1,2], D.A. Yagodnikov[1], A.B.Pnev[1]; [1]Bauman Moscow State Technical University; [2]Kotelnikov Institute of Radioengineering and Electronics RAS, Russia

We report on a fiber Bragg gratings application for composite rocket engine housings monitoring. A prototype rocket engine housing made of four organoplastic layers with fiber Bragg gratings embedded was produced and investigated. Results of the ring housing deformation simultaneous monitoring with fiber sensors and strain gauges with loading it up to 30 kN are demonstrated and compared.

WeR06-p11 10:00-13:30

Classification of acoustic influences using trace pattern recognition

I.A. Barantsov, K.I. Koshelev, R.O. Khan, N.V. Ilgovskaya, E.O. Garin, T.V. Gritsenko, A.B. Pnev; Bauman Moscow State Technical University, Russia

A new approach of classifying acoustic impacts with phi-OTDR is proposed. The first model is used to extract spatial features, the second one is used to extract temporal dependencies. Stacking was used as an ensemble technique as an effective solution to increase an accuracy. The predictions accuracy on the test sample for confirmed and false alarms were 97.18% and 97.43%.

WeR06-p12 10:00-13:30

Realizatiom of simple compressive sensing sceme for low light photography based on spatial phase light modulator

N.V. Sibirev[1], I.V. Shtrohm[1,2]; [1]St. Petersburg State University; [2]Institute for Analytical Instrumentation RAS, Russia

Compressive sensing method is a widely used algorithm for shooting/capturing fast-moving objects as well as for low light photography. This paper looks into how the compressive sensing algorithm can be applied in a spatial phase light modulator. It demonstrates that a significant reduction in exposure time without quality loss can be achieved.

WeR06-p13 10:00-13:30

A design of miniaturized three-dimensional wind LIDAR

Sheng Yicheng[1,2], Zhang Caishi[1,2], Cao Dingxiang[2], Zhao Deping[2], Chen Zhe[1,3]; [1]Department of Optoelectronic Engineering, Jinan University; [2]Zhuhai Emgo-Tech Co. ltd.; [3]JiHua Laboratory, Foshan, Guangdong, China

This paper describes a compact and eye-safe coherent LIDAR system developed for wind sensing applications. The system is based on an all-fiber and modular architecture configuration that reduces size, weight and power consumption. Operating at 1550nm and with a PRF of 10 kHz, the wind LIDAR is air cooled with overall dimensions of 360×180×208mm.

WeR06-p14 10:00-13:30

130-km-sensing-range single-ended high-sensitive distributed acoustic sensor based on phase-senstive OTDR assisted by remote optically pumped amplifier

A.S. Dudin[1,2], D.R. Kharasov[1], E.A. Fomiryakov[1,2], D.M. Bengalskii[1], O.E. Nanii[1,2], S.P. Nikitin[1], V.N. Treschikov[1]; [1]T8 Sensor LLC, [2]Lomonosov Moscow State University, Russia

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

WeR06-p15 10:00-13:30

Correction for non-leveling ground-based Doppler wind lidar

Zhang Caishi[1,2], Sheng Yicheng[1,2], Cao Dingxiang[2], Zhao Deping[2], Chen Zhe[1,3]; [1]Department of Optoelectronic Engineering, Jinan University; [2]Zhuhai Emgo-Tech Co. ltd.; [3]JiHua Laboratory, Foshan, Guangdong, China

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

WeR06-p16 10:00-13:30

Zernike-based hill-climbing algorithm for super-Gaussian and doughnut-like laser beam shaping by means of a phase-only spatial light modulator

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

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

R10: NONLINEAR QUANTUM PHOTONICS - POSTERS

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

WeR10-p01 15:00-18:30

Crystal growth and optical properties of TbM3 (BO) (M= Al, Ga) crystals

A.E. Kokh[1], A.Y. Jamous[2], M.I. Rakhmanova [3], K.A. Kokh[1], A.B. Kuznetsov[1]; [1] Sobolev Institute of Geology and Mineralogy SB RAS; [2] Tomsk State University; [3] Nikolaev Institute of Inorganic Chemistry SB RAS, Russia

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

WeR10-p02 15:00-18:30

Resonant scattering under two-photon excitation in a GaN crystal

L.E. Semenova[1], Y.Y. Maslova[2], M.A. Semenov[2]; [1]Prokhorov General Physics Institute RAS, [2]Lebedev Physical Institute RAS, Russia

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

WeR10-p03 15:00-18:30

Increasing BOTDA precision using correlation image processing methods

Yu.A. Konstantinov, F.L. Barkov, A.I. Krivosheev; Perm Federal Research Center UB RAS, Russia

We demonstrate improving the precision of correlation methods for Brillouin frequency shift extraction in distributed fiber optic sensors by applying the algorithms in 2D space. The use of several spectra at once to calculate correlation functions made it possible to increase the BOTDA precision. The developed approaches are effective when processing spectra with low frequency resolution.

WeR10-p04 15:00-18:30

H_3 diamond color centers for quantum magnetometry

E.I. Lipatov[1,2], O.I. Lyga[1], V.V. Chashchin[1,2], M.A. Shulepov[1,2], V.G. Vins[3], A.P. Yelisseyev[4]; [1]Tomsk State University; [2]Institute of High-Current Electronics SB RAS; [3]VELMAN LLC; [4]Sobolev Institute of Geology and Mineralogy SB RAS, Russia

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

WeR10-p05 15:00-18:30

Achieving subwavelength cavity using an amplifying medium

I.V. Doronin[1], A.A. Zyablovsky[1,2]; [1]FSUE VNIIA; [2]ITAE RAS, Russia

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

WeR10-p06 15:00-18:30

Center-of-mass tomography for multimode photon states

I.V. Dudinets[1,2], V.I. Man'ko[3], M.A. Man'ko[3]; [1]Russian Quantum Center, [2]Moscow Institute of Physics and Technology, [3]Lebedev Physical Institute RAS, Russia

There exists tomographic probability representations of quantum mechanics. In these representations the states of quantum systems are described by probability distributions. In our work we study the center-of-mass tomography of multimode electromagnetic field states. We present the concept of entangled probability distribution of random variables. Examples of entangled probability distribution are considered.

WeR10-p07 15:00-18:30

High effective LiB_3O_5 laser

N.G. Zacharov[1], A.S. Safronov[1], A.V. Savkin[1], V.I. Lazarenko[1], E.V. Saltykov[1], I.I. Karpov[1], A.A. Lobanova[1], L.A. Danilova[1,2]; [1]Russian Federal Nuclear Center; [2]Sarov branch of the Lomonosov Moscow State University, Russia

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

WeR10-p08 15:00-18:30

Modification of the JINR laser driver to generate relativistic electron beams with orbital angular momentum status report

A.S. Dyatlov; ITMO University, Russia

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

WeR10-p09 15:00-18:30

Optical system for gravimeter based on cold atoms

G.V. Osipenko, M.S. Aleynikov; FSUE "VNIIFTRI", Russia

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

WeR10-p10 15:00-18:30

Two-temperature distribution in task of laser cooling in fields with a polarisation gradient of atoms

A.A. Kirpichnikova, R.Ya. Il'enkov, O.N. Prudnikov; Institute of Laser Physics SB RAS, Russia

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

WeR10-p11 15:00-18:30

Research on EIT in ground state of NV centers in diamond in transverse magnetic field

S.M. Drofa[1,2,3], S.V. Bolshedvorskii[1,2,3], V.V. Soshenko[1,2], E. Primak[1,2,3], P. Vilyuzhanina[1,2,5], A.N. Smolyaninov[2], V.N. Sorokin[1,4], A.V. Akimov[1,4]; [1]Lebedev Physical Institute; [2]Spin Sensor Technologies; [3]Moscow Institute of Physics and Technology; [4]Russian Quantum Center; [5]National Research Nuclear University MEPhI, Russia

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

WeR10-p12 15:00-18:30

Thermo-optical effects impact on a compact high-Q Fabry-Perot cavity characteristics

K.Yu. Khabarova[1,2], D.S. Kryuchkov[1,2], N.O. Zhadnov[1,2], K.S. Kudeyarov[1,2], G.A. Vishnyakova[1,3], N.N. Kolachevsky[1,2]; [1]Russian Quantum Center; [2]Lebedev Physical Institute RAS; [3]Moscow Institute of Physics and Technology, Russia

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

WeR10-p13 15:00-18:30

Broadband OTDR device for quantum key distribution systems

K.D. Bondar[1], I.S. Sushchev[1,2], D.S. Bulavkin[2], K.E. Bugai[2,3], A.S. Sidelnikova[1,2], D.A. Dvoretskiy[2,3]; [1]Quantum Technology Centre and Faculty of Physics, Lomonosov Moscow State University; [2]SFB Laboratory, Ltd.; [3]Bauman Moscow State Technical University, Russia

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

WeR10-p14 15:00-18:30

Nonclassical phase-space dynamics of single-atom laser

S.V. Vlasenko, A.B. Mikhalychev, S.Ya. Kilin; B.I. Stepanov Institute of Physics NASB, Belarus

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

WeR10-p15 15:00-18:30

Integrated photonic platform for hybrid computing

A.S. Baburin; Dukhov Automatics Research Institute (VNIIA), Russia

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

WeR10-p16 15:00-18:30

Coexistence of discrete-variable phase-time coding QKD with intense classical signals over 60 km

A.V.Borisova[1], A.N.Klimov[2], I.V. Gritsenko[1]; [1]JSC InfoTeCS,; [2]Quantum Technology Centre, Lomonosov Moscow State University, Russia

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

WeR10-p17 15:00-18:30

Implementation of reinforcement learning algorithms for fiber mode-locked lasers

A. Kokhanovskiy[1,2], K. Serebrennikov[3], E. Kuprikov[3]; [1]School of Physics and Engineering, ITMO University; [2]Institute of Automation and Electrometry SB RAS; [3]Department of Physics, Novosibirsk State University, Russia

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

WeR10-p18 15:00-18:30

Raman scattering for gas detection

A.V. Shelaev, A.V. Baryshev; Federal State Unitary Enterprise Dukhov Automatics Research Institute (VNIIA), Russia

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

WeR10-p19 15:00-18:30

FROG technique for the entangled soliton pulses identification

Yu.A. Mazhirina[1], L.A. Melnikov[1], A.A. Sysolyatin[1], I.V. Zhluktova[1], A.D. Zverev[2], A.I. Konukhov[1,3]; [1]Yuri Gagarin State Technical University; [2]Prokhorov General Physics Institute RAS; [3]N.G. Chernyshevsky State University, Saratov, Russia

We propose to use the source of entangled optical pulse with large photon number, which can be produced via fission of the two-soliton breather in the optical fiber with periodically varying along the fiber dispersion for quantum communications and quantum sensing. For the detection of the scattered field we propose to use the frequency resolved gating technique.

WeR10-p20 15:00-18:30

On investigation dispersive readout technique for NV -center in diamond

E.A.Primak[1,2], M. Kozodaev[3], S.V. Bolshedvorskii[4], V.V. Soshenko[4], I.S. Cojocaru[2,4], P.G. Vilyuzhanina[2,3], S.M. Drofa[1,2], A. Chernyavskiy[1,2,4], V.N. Sorokin[4], A.N. Smolyaninov[5], A.V. Akimov[2,4]; [1]Moscow Institute of Physics and Technology (National Research University); [2]Russian Quantum Center; [3]National Research Nuclear University 'MEPhI'; [4]Lebedev Physical Institute RAS; [5]LLC Sensor Spin Technologies, Russia

Dispersive readout technique proposes a strong coupling of a high quality resonator with a quantum system in order to enhance readout fidelity. In this work we investigate the implementation of the dispersive readout to nitrogen vacancy centers in diamond in order to increase precision and diminish noise of the measurements in quantum sensors.

WeR10-p21 15:00-18:30

Second-harmonic generation in $LiNa_5Mo_9O_{30}$ crystalline sample

D.A. Denisov[1], D.Yu. Demushkin[1], I.V. Grishchenko[2], N.A. Khokhlov[3], E.S. Barkanova[3], A.P. Sadovskiy[3], A.V. Konyashkin[1,2], O.A. Ryabushkin[1,2]; [1]Moscow Institute of Physics and Technology; [2]Fryazino Branch of Kotelnikov Institute of Radioengineering and Electronics RAS; [3]D. Mendeleev University of Chemical Technology of Russia, Russia

Second-harmonic generation (SHG) of 1030 nm wavelength was performed in lithium-sodium molybdate crystalline sample. The dependences of both SHG power and conversion efficiency on pump power were measured.

WeR10-p22 15:00-18:30

Correlation-based technique for the BFS extraction

F.L. Barkov, A.I. Krivosheev, Yu.A. Konstantinov; Perm Federal Research Center UB RAS, Russia

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

WeR10-p23 15:00-18:30

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

R. Goncharov[1,2,3], A. D. Kiselev[4], V. Egorov[1,2,3]; [1]Quantum Information Laboratory, ITMO University, Saint Petersburg, Russia; [2]Leading Research Center "National Center for Quantum Internet", ITMO University, Saint Petersburg, Russia; [3]SMARTS-Quanttelecom LLC, Saint Petersburg, Russia; [4]Laboratory of Quantum Processes and Measurements, ITMO University, Saint Petersburg, Russia

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

WeR10-p24 15:00-18:30

Protection method against bright light attacks based on fiber fuse effect

K.E. Bugai[1,2], I.S. Sushchev[1], D.S. Bulavkin[1], R. Yu. Lokhmatov[1,2], D.A. Dvoretskiy[1,2]; [1]SFB Laboratory Ltd, [2]Bauman Moscow State Technical University, Russia

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

WeR10-p25 15:00-18:30

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

E.A. Tereshchenkov[1,2,3], E.S. Andrianov[1,2,3]; [1]Dukhov Research Institute of Automatics (VNIIA); [2]Moscow Institute of Physics and Technology; [3]Institute for Theoretical and Applied Electromagnetics, Russia

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

WeR10-p26 15:00-18:30

Frequency and intensity noise measurement of single-frequency lasers

K.A. Zagorulko[1], A.V. Kozlov[1,2], N.P. Khatyrev[1]; [1]Russian Metrological Institute of Technical Physics and Radio Engineering; [2]National Research Nuclear University MEPhI, Russia

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

WeR10-p27 15:00-18:30

The implementation of the MS-gate on an ion trap Ca_{40} quantum computer

N.V. Morozov[1,2], L.A. Akopian[1,3], N.A. Sterligov[1,3], A.N. Matveev[1], M.M. Borisov[1], O.Y. Lakhmanskaya[1], K.E. Lakhmanskiy[1,3]; [1]Russian Quantum Center; [2]National Research Nuclear University MEPhI; [3]Moscow Institute of Physics and Technology, Russia

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

WeR10-p29 15:00-18:30

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

D.M. Melkonian[1,2], K.S. Kravstov[1], S.P. Kulik[1]; [1]Quantum Technology Centre and Faculty of Physics, Lomonosov Moscow State University; [2]SFB Laboratory, Ltd., Russia

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

WeR10-p30 15:00-18:30

Quantum correlation in twin pulses generated by soliton fission

A.A. Sysoliatin[1,3], L.A. Melnikov[1], Ju.G. Konyukhova[2], A.I. Konyukhov[2]; [1] Saratov State Technical University; [2] Institute of Physics, Saratov State University; [3] Prokhorov General Physics Institute RAS, Russia

We study the quantum fluctuations of a pulse pair parameters created by second-order soliton fission in a dispersion oscillating fiber. The correlation function and squeezing ratio depend on the modulation period and modulation phase of the fiber dispersion. The squeezing ratio depends on the pulse propagation distance and can be enhanced using optimized dispersion parameters.

WeR10-p31 15:00-18:30

Relaxation processes in optical systems with ultra-strong coupling regime

T.T. Sergeev[1,2], A.A. Zyablovsky[1,3]; [1]Dukhov Research Inst. of Automatics (VNIIA); [2]Moscow Inst. of Physics and Technology; [3]Inst. for Theoretical and Applied Electromagnetics, Russia

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

WeR10-p32 15:00-18:30

Study of light diffraction on chirped two-layer inhomogeneous holographic diffraction structures PPM-LC

D.S. Rastrygin, V.O Dolgirev, S.N. Sharangovich; Tomsk State University of Control Systems and Radioelectronics, Russia

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

WeR10-p33 15:00-18:30

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

M.Yu. Basalaev[1,2,3], D.V. Kovalenko[1], A.V. Taichenachev[1,2], V.I. Yudin[1,2,3]; [1]Inst. of Laser Physics SB RAS, [2]Novosibirsk State Univ., [3]Novosibirsk State Tech. Univ., Russia

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

WeR10-p34 15:00-18:30

Microchip Paul trap for quantum computing with 171Yb$^+$ ions

N.O. Zhadnov[1,2], K.S. Kudeyarov[1,2], I.S. Gerasin[1,2,3], K.Yu. Khabarova[1,2], I.A. Semerikov[1,2], N.N. Kolachevsky[1,2]; [1]Lebedev Physical Institute RAS; [2]Russian Quantum Centre; [3]Moscow Institute of Physics and Technology, Russia

Using ion qubits allows to create one of the most productive quantum computers. The main way to scale such systems is to use planar ion traps. We will present the initial results of our work on the microchip-based ion quantum processor project and discuss the primary experimental challenges faced in the project, along with its future goals and plans.

WeR10-p35 15:00-18:30

Measurement of absolute frequencies of transitions in thulium atoms

A. Golovizin[1,2], D. Tregubov[1,2], M. Yaushev[1,2], D. Mishin[1,2], D. Provorchenko[1,2], N. Kolachevsky[1,2]; [1]Lebedev Physical Institute RAS; [2]International Center for Quantum Technologies, Skolkovo, Russia

We present results of measurement of absolute frequencies of cooling, pumping and clock transitions in neutral thulium atoms using femtosecond frequency comb. We performed spectroscopy of these transition in ensemble of ultracold thulium atoms in free space or optical lattice.

WeR10-p36 15:00-18:30

Interaction of the quantum electromagnetic field with solid-state nanostructures under nonlinearity

I.A. Tereshchenko[1,2], O.V. Tikhonova[1,2]; [1]Faculty of Physics, Lomonosov Moscow State University, [2]Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Russia

Dynamics of excitation induced in solid-state planar nanosystems by non-classical electromagnetic fields is investigated under the Kerr self-phase nonlinearity. New peculiarities of the quantum state evolution are found due to mutual interplay between the electron-photon coupling and the self-phase modulation. The possibility to control the excitation by changing the frequency detuning of the field and non-linearity degree is demonstrated.

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

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

WeR11-p01 10:00-13:30

Propagation of homogenized THz millimeter range beams in multi-layered media

G.S. Rogozhnikov[1], V.V. Kostromykina[1], I.N. Nikolaeva[1,2], A.G. Efremov[1,2]; [1]FSUE “Russian Federal Nuclear Center - VNIIEF”; [2]Sarov Branch of Lomonosov Moscow State University, Russia

Several problems concerning free space communication in anhydrous media by means of THz waves of millimeter range have been reviewed. Solutions for beam homogenizing and beam spatial quality preservation have been proposed.

WeR11-p02 10:00-13:30

Four-frequency Zeeman laser gyroscopes with a symmetrical cavity, a system for separating rotation signals from orthogonal polarizations and a perimeter control system

Yu.Yu. Broslavets[1,2], A.A. Fomichev[1,2], E.A. Polukeev[1,2], V.G. Semenov[1,2], D.S. Redichkina[1], A.R. Pokrovskaya[1]; [1]Moscow Institute of Physics and Technology (National Research University); [2]JSC “Lasex”, Russia

The work presents four-frequency Zeeman laser gyroscopes with a cavity in the form of an isohedral and regular tetrahedrons. Optical or mathematical and electronical methods were used to separate the beat signals of counter-propagating waves of orthogonal polarization. Perimeter control system uses the signal of co-directional waves’ beats. A significant suppression of the external magnetic fields influence was shown.

WeR11-p03 10:00-13:30

Investigating the feasibility of attacks on the local oscillator in continuous-variables quantum key distribution systems

P.A. Morozova, M.E. Gellert, B.A. Nasedkin; ITMO University, Russia

The study explores the susceptibility of the balanced detector quantum key distribution systems arising from the constraints in electronic components. It empirically establishes the correlation between average intensity values and applied radiation power, while pinpointing the saturation threshold and signal noise levels. The results contribute to recognizing potential blinding attacks and offer insights into defense strategies.

WeR11-p04 10:00-13:30

Physical factors causing zero drift and noise in a solid-state laser gyroscope based on YAG:Cr^{4+} at mode locking

Yu.Yu. Broslavets, A.A. Fomichev, E.A. Polukeev, V.G. Semenov, D.S. Redichkina, A.R. Pokrovskaya; Moscow Institute of Physics and Technology (National Research University), Russia

The work presents the results of creating a solid-state YAG:Cr4+ laser gyroscope working in mode locking. Perimeter control system uses an absorbing cell with acetylene. An electro-optical modulator is used to create a frequency dither; it creates a phase shift at the moment the pulse passes. The main factors influencing the gyroscope zero drift and noise are determined.

R01: SOLID STATE LASERS

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

R01: SOLID STATE LASERS 3

Session Chair:

ThR01-15 09:00-09:30

Mid IR fiber lasers based on rare earth ions doped chalcogenide glasses *(Invited paper)*

V.V. Koltashev[1], V.G. Plotnichenko[1], B.I. Denker[2], B.I. Galagan[2], S.E. Sverchkov[2], M.V. Sukhanov[3], A.P. Velmuzhov[3], M.P. Frolov[4]; [1]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center; [2]Prokhorov General Physics Institute RAS; [3]Devyatykh Institute of Chemistry of High-Purity Substances RAS; [4]Lebedev Physical Institute RAS, Russia

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

ThR01-16 09:30-09:45

Neodymium glass laser emitting at ~6 µm.

B.I. Denker[1], M.P. Frolov[2], B.I. Galagan[1], V.V. Koltashev[3], Yu.V. Korostelin[2], V.G. Plotnichenko[3], M.V. Sukhanov[4], S.E. Sverchkov[1], A.P. Velmuzhov[4]; [1]Prokhorov General Physics Institute RAS; [2]Lebedev Physical Institute RAS; [3]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center; [4]Devyatykh Institute of Chemistry of High-Purity Substances RAS, Russia

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

ThR01-17 09:45-10:00

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

O. Antipov[1,2], A. Dobrynin[1,2], Yu. Getmanovskiy[1], E. Karaksina[4], V. Shiryaev[4], M. Sukhanov[4], T. Kotereva[4]; [1]Institute of Applied Physics RAS, [2]Nizhny Novgorod State University, [3]Department of Material Sciences and Technologies, Nizhny Novgorod State Technical University, [4]Institute of Chemistry of High-Purity Substances RAS, Russia

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

ThR01-18 10:00-10:15

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

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

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

ThR01-19 10:15-10:30

Study of a new 2-µm laser crystal Tm^{3+}:$ZnWO_4$

Yu.I. Zimina[1,2], K.A. Subbotin[1,2], A.I. Titov[1,2], D.A. Lis[1], S.K. Pavlov[1,2], K.V. Kuleshova[1,2], Ya.S. Didenko[1,2], G.Z. Elabedine[3], P.A. Loiko[4], Z. Pan[5], A. Nadi[4], P. Camy[4], A. Braud[4], R.M. Solé[3], M. Aguiló[3], F. Díaz[3], W. Chen[5,6], X. Mateos[3], V. Petrov[5]; [1]Prokhorov General Physics Institute RAS; [2]Mendeleev University of Chemical Technology of Russia, Russia; [3]Física i Cristallografia de Materials, Universitat Rovira i Virgili, Spain; [4]Centre de Recherche sur les Ions, les Matériaux et la Photonique, Université de Caen Normandie, France; [5]Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Germany; [6]Fujian Institute of Research on the Structure of Matter CAS, China

Tm3+, Li+:ZnWO4 single-crystal was grown by the Czochralski (Cz) method. Dispersions and temperature coefficients of the refractive indices (RI), as well as the mechanical strength characteristics of the crystal were measured. Spectroscopic studies of the crystal were carried out. The first laser operation above 2 µm at this crystal was obtained.

ThR01-20 10:30-10:45

Holmium fiber laser generation switching using excited state absorption

S.A. Filatova[1], V.A. Kamynin[1], A.E. Fale[1,2], A.I. Fedoseev[2], A.R. Makeeva[1,3], O.E. Nanii[2], A.P. Smirnov[2], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Institute RAS; [2]Lomonosov Moscow State University; [3]Peoples Friendship University of Russia, Russia

We have demonstrated optical switching of generation in the Holmium-doped fiber laser. The generation switching from continuous-wave to pulsed regime was performed by external pulsed radiation with a wavelength of ≈1.6 µm due to excited state absorption from 5I7 level.

ThR01-21 10:45-11:00

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

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

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

- Coffee Break -

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

R01: SOLID STATE LASERS 4

Session Chair:

ThR01-22 11:30-11:45

Nd:YAG laser terminal level relaxation time direct evaluation and its considering at picosecond pulse amplification

V.B. Morozov, A.N. Olenin, D.V. Yakovlev; Physics Faculty of M.V.Lomonosov Moscow State University, Russia

Direct measurements of the terminal level relaxation time of Nd:YAG laser transition with 1064 nm wavelength were fulfilled based on the gain recovery diagnostics after picosecond saturating pulse passage. The relaxation time is estimated as ~70 ps. The result is important in view of developing effective longitudinally diode-pumped picosecond amplifiers operating under saturation conditions.

ThR01-23 11:45-12:00

Athermal design of Yb:YAG thick disk active element

M.R. Volkov[1], G.A. Kurnikov[1,2], I.I. Kuznetsov[1], I.B. Mukhin[1]; [1]Institute of Applied Physics RAS; [2]National Research Lobachevsky State University, Russia

A specially-shaped heat conducting plate provides efficient heat removal from the disk active element only in its pumped region. Thus, the radial heat flow is blocked and thermally-induced lensing is reduced. The method was implemented with thick-disk Yb:YAG active element and composite Yb:YAG/sapphire. Zero thermal lens active element was demonstrated in the experiment.

ThR01-24 12:00-12:15

Towards kilowatt average laser power compression by new type of chirped volume Bragg gratings

E.A. Perevezentsev, M.R. Volkov, A.I. Gorokhov, A.V. Starobor, I.B. Mukhin; Institute of Applied Physics RAS, Russia

A comprehensive study of the first fs-laser-inscribed fused silica chirped volume Bragg gratings is performed. The perspective of the new approach together with a good agreement between the calculated and measured parameters are demonstrated. According to estimations, gratings of this type can be used at a kilowatt average laser power.

ThR01-25 12:15-12:30

Laser generation on NV^- centers in diamonds: state of things and prospects

D.E. Genin[1,2], E.I. Lipatov[1,2], V.G. Vins[3], A.D. Savvin[4], A.V. Samolov[1], P.E. Komarova[1], V.F. Lebedev[5], T.S. Misnikova[5], Ya.A. Ryvkina[5]; [1]National Research Tomsk State University; [2]Institute of High Current Electronics; [3]Velman LLC; [4]Dukhov Automatics Research Institute (VNIIA); [5]St. Petersburg State University of Aerospace Instrumentation, Russia

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

ThR01-26 12:30-12:45

Divalent copper as the possible active center for solis-state NIR lasers

A.N. Romanov, E.V. Haula, A.A. Kapustin, V.N. Korchak; N.N. Semenov Federal Research Center for Chemical Physics RAS, Russia

Broadband Near-IR photoluminescence was observed in many oxide hosts, containing divalent copper impurity cations. These materials include corundum, several spinels and perovskite-type crystals. Divalent copper is octahedrally coordinated in all of these hosts and Jahr-Teller effect in 2E ground state significantly influences the spectral properties of obtained materials, resulting in broadband photoluminescence.

ThR01-27 12:45-13:00

Bismuth-doped heterogeneous multi-layered fibers for broadband optical amplifiers

S.V. Alyshev, A.S. Vakhrushev, M.A. Melkumov, S.V. Firstov; Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia

A concept of spatial separation of the different types of active centers in a heterogeneous bismuth-doped multi-layered fiber design is proposed. This approach can be efficiently used for gain broadening and equalization to achieve wideband amplification in O+E+S-band.

ThR01-28 13:00-13:15

Quantum yield of bismuth active centers luminescence in germanosilicate optical fibers

A.V. Elopov[1], M.V. Yashkov[2], A.N. Abramov[2], K.E. Riumkin[1], S.V. Firstov[1], M.A. Melkumov[1]; [1]Prokhorov General Physics Inst., Dianov Fiber Optics Research Center; [2]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

The quantum yield (QY) of luminescence of bismuth active centers associated with silica (BAC-Si) at 830 nm and 1400 nm was measured in bismuth-doped optical fibers. The branching ratio (BR) of radiative transitions at 830 nm and 1400 nm excited at 800 nm was defined. The influence of co-doping with boron on QY and BR is examined.

ThR01-29 13:15-13:30

Single and dual wavelength oscillation of Nd:YAG laser at 1318 - 1444 nm

P.G. Zverev[1,2], I.V. Smirnov[1,2], A.A. Sirotkin[1]; [1]Prokhorov General Physics Inst. RAS; [2]Moscow Power Engineering Inst., Russia

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

ThR01-30 13:30-14:00

Pulse instability suppression in Q-switched thin-disk lasers

(Invited paper)

S. Radmard; Tarbiat Modares University, Iran

Abstract is not available.

- Lunch Break -

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

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

R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID 4

Session Chair:

ThR02-18 09:00-09:30

Gas lasers on hollow-core fibers *(Invited paper)*

A.V. Gladyshev; Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia

Progress in the development of gas lasers that are based on hollow-core fibers is reviewed. Gas fiber lasers based on both population inversion and stimulated Raman scattering are considered. Recent demonstration of the first gas-discharge fiber laser is discussed.

ThR02-19 09:30-09:45

UV nitrogen laser pumped by a joint pulsed longitudinal electric and inductive discharge

A.M. Razhev[1], D.S. Churkin[1,2], R.A. Tkachenko[1,2], I.A. Trunov[1]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk National Research State University, Russia

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

ThR02-20 09:45-10:00

New approach of non-coherent power scaling of fiber sources for material processing

S. Larin, N. Broytman, I. Obronov, R. Vihrov; Industrial division, IRE-Polus, Russia

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

ThR02-21 10:00-10:15

Design of fiber laser based technological equipment for direct laser deposition

G.A. Turichin, E.V. Zemlyakov, K.D. Babkin; Inst. of Laser Welding Technology, St. Petersburg Marine Technical Univ., Russia

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

ThR02-22 10:15-10:30

Woofer-tweeter adaptive optical system for atmospheric turbulence mitigation

V.V. Toporovsky, I.V. Galaktionov, A.N. Nikitin, A.V. Kudryashov, V.V. Samarkin, A.L. Rukosuev; Sadovsky Institute of Geosphere Dynamics RAS, Russia

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

ThR02-23 10:30-10:45

Methods of parallel mode decomposition for investigating real-time mode dynamics

M.D. Gervaziev[1,2], A.A. Revyakin[1,2], A.G. Kuznetsov[1], N.N. Smolyaninov[1], M. Ferraro[3], F. Mangini[4], D.S. Kharenko[1,2], S. Wabnitz[4], S.A. Babin[1,2]; [1]Inst. of Automation and Electrometry SB RAS, Russia; [2]Novosibirsk State Univ., Russia; [3]University of Calabria, Italy; [4]Sapienza Univ. of Rome, Italy.

In this work we numerically compared digital hologram generation methods for the purpose of fiber mode decomposition. After that, the most accurate method was implemented in the experimental analysis of real-time intermodal dynamics in a Raman fiber laser.

ThR02-24 10:45-11:00

The method for the investigation of wavefront distortion in laser amplifiers

G.V. Kuptsov[1,2], A.O. Kuptsova[1,3], V.A. Petrov[1,2], V.V. Petrov[1,2,3]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State Technical University; [3]Novosibirsk State University, Russia

The method of laser scanning is proposed and developed for the investigation of radiation wavefront distortion in active elements of high-power laser amplifiers. Optical path difference profile is calculated from simultaneously investigated temperature and inverted population distributions in an active element. Optical path difference profiles introduced by pumped active elements of high-power laser amplifier are studied.

- Coffee Break -

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

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

Session Chair:

ThR02-25 11:30-12:00

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

I.B. Mukhin, K.A. Glushkov, E.A. Perevezentsev, A.A. Soloviev, A.A. Shaykin, V.N. Ginzburg, I.V. Kuzmin, M.A. Martyanov, S.E. Stukachev, S.Yu. Mironov, I.V. Yakovlev, E.A. Khazanov; Institute of Applied Physics RAS, Russia

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

ThR02-26 12:00-12:30

Adaptive optical correction of powerful laser beams *(Invited paper)*

A. Kudryashov; M.A.Sadovskii Institute of Geosphere Dynamics RAS, Russia

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

ThR02-27 12:30-13:00

New generation of broad-range femtosecond IR laser sources: the way to multispectral excitation of matter *(Invited paper)*

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

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

ThR02-28 13:00-13:15

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

E.K. Mikhailov[1], K.K. Bobkov[2], A.E. Levchenko[1], V.V. Velmiskin[1], D.V. Khudyakov[3], S.S. Aleshkina[1], T.S. Zaushitsyna[1], M.M. Bubnov[1], D.S. Lipatov[4], M.E. Likhachev[1]; [1]Prokhorov General Physics Institute RAS, Dianov Fiber Optics Research Center, Russia; [2]Optoelectronics Research Centre, University of Southampton, Southampton, UK; [3]Prokhorov General Physics Institute RAS; [4]G.G. Devyatykh Institute of Chemistry of High Purity Substances RAS, Russia

The Yb-doped fiber amplifier was optimized for operation in the spectral range near 1030 nm. Stimulated Raman scattering and four-wave mixing were the dominant limiting factors for power scaling. By determining a superior gain regime and taper configuration, we maximized the threshold of these nonlinear effects and achieved 1 MW peak power directly at the output of the fiber.

ThR02-29 13:15-13:30

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

A.I. Lobanov[1,2], A.A. Sirotkin[1], Y.L. Kalachev[1], S.A. Filatova[1], V.A. Kamynin[1], B.D. Ovcharenko[1], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Institute RAS; [2]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia

A hybrid fiber master oscillator solid-state power amplifier system with a Holmium fiber laser-based reference oscillator and a YSGG:Cr3+:Tm3+:Ho3+ crystal-based amplifier is demonstrated. The time dynamics of the amplification of the YSGG:Cr3+:Tm3+:Ho3+ crystal as a function of pump power and the central wavelength of the master oscillator were characterized.

- Lunch Break -

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

R02: HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID 6

Session Chair:

ThR02-30 15:00-15:30

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

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

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

ThR02-31 15:30-16:00

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

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

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

ThR02-32 16:00-16:30

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

L. Seleznev[1], G. Rizaev[1], M. Levus[1], D. Mokrousova[1], D. Pushkarev[1], D. Shipilo[1,2], N. Panov[1,2], I. Nikolaeva[1,2], O. Kosareva[1,2], A. Ionin[1]; [1]Lebedev Physical Institute RAS; [2]Faculty of Physics, Lomonosov Moscow State University, Russia

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

ThR02-33 16:30-16:45

Difference frequencies generation into the mid-IR range (5.5-9.5 μm) using femtosecond Ti:sapphire laser and a nonlinear $AgGaS_2$ crystal

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

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

ThR02-34 16:45-17:00

Frequency domain model for high power solid-state laser amplifiers

A.O. Kuptsova[1,2], G.V. Kuptsov[1,3], V.A. Petrov[1,3], V.V. Petrov[1,2,3]; [1]Institute of Laser Physics SB RAS; [2]Novosibirsk State University; [3]Novosibirsk State Technical University, Russia

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

- Coffee Break -

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

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

R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 4

Session Chair:

ThR05-19 09:00-09:30

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

N.N. Rosanov[1], M.V. Arkhipov[1], R.M. Arkhipov[1,2], A.V. Pakhomov[2]; [1]Ioffe Institute; [2]Phys. Dept., St. Petersburg State Univ., Russia

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

ThR05-20 09:30-09:45

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

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

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

ThR05-21 09:45-10:15

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

A.B. Fedotov[1,2], I.V. Savitsky[1], A.A. Voronin[1,2], E.A. Stepanov[1,2], A.A. Lanin[1,2]; [1]Lomonosov Moscow State University, [2]Russian Quantum Center, Skolkovo, Russia

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

ThR05-22 10:15-10:30

Optimization of noncollinear schemes of coherent beam combining

V.I. Trunov[1,2], S.N. Bagaev[1], S.A. Frolov[1], A.V. Kirpichnikov[1], S.V. Avtaeva[1], V.V. Petrov[1,2]; [1]Laboratory of Physics of Ultrashort Pulse Lasers, Institute of Laser Physics SB RAS, [2]Novosibirsk State University, Russia

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

ThR05-23 10:30-10:45

Coherent beam combining set-up prototype for XCELS project

K.F. Burdonov[1], A.A. Soloviev[1], I.B. Mukhin[1], A.E. Pestov[2], A.A. Shaykin[1], M.V. Starodubtsev[1], E.A. Khazanov[1]; [1]Institute of Applied Physics RAS; [2]Institute for Physics of Microstructures, Russia

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

ThR05-24 10:45-11:00

Spectral, spatial and temporal characteristics study of laser plasma radiation of sulfur and tungsten targets in the X-ray spectral range

A.T. Sahakyan, V.N. Puzyrev, A.A. Kologrivov, D.M. Bezverkhnyaya, T.T. Kondratenko, A.N. Starodub; Lebedev Physical Institute RAS, Russia

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

- Coffee Break -

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

R05: SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES 5

Session Chair:

ThR05-25 11:30-12:00

Control of plasma instabilites *(Invited paper)*

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

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

ThR05-26 12:00-12:15

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

S.I. Glazyrin[1,2]; [1]FSUE VNIIA, [2]Lebedev Physics Intitute RAS

The paper discusses the possibility to study the effect of radiation on hydrodynamical instabilities development on an interface, accelerated in a laser experiment. A multilayer target dynamics is considered. By changing initial parameters different regimes of radiation transport can be switched in experiments. The impact of the regimes on interface instability growth is studied numerically.

ThR05-27 12:15-12:30

Ultrafast electromagnetic instabilities causing periodic damage of metals and semiconductors

I.V. Oladyshkin, D.A. Fadeev; Institute of Applied Physics RAS, Russia

The ultrafast decay of an optical wave into counter-propagating surface plasmon-polaritons was studied analytically and numerically in direct 2D-modeling of Maxwell equations and electronic motion equations. The instability development was confirmed, which plays an important role in strongly inhomogeneous metal heating and surface structuring. Support: Ministry of Science and Higher Education of the Russian Federation (#075-15-2022-316), BASIS Foundation (#22-1-3-49-1).

ThR05-28 12:30-12:45

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

A.A. Andreev[1,2], K.Yu. Platonov[3], L.A. Litvinov[1]; [1]St. Petersburg State University; [2]Ioffe Institute; [3]St. Petersburg Technical University, Russia

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

ThR05-29 12:45-13:00

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

S.G. Bochkarev[1,2], D.A. Gozhev[1], O.E. Vais[1,2], M.G. Lobok[1,2], A.V. Brantov[1,2], V.Yu. Bychenkov[1,2]; [1]Lebedev Physics Institute RAS; [2]Center for Fundamental and Applied Research, Federal State Unitary Enterprise "NL Dukhov All-Russian Scientific Research Institute of Automation", Russia

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

ThR05-30 13:00-13:15

Energetic particles and X-rays generation under relativitically intense femtosecond irradiation of ethane clusters

I.M. Mordvintsev[1,2], K.A. Ivanov[1,2], T.A. Semenov[4], S.A. Shulyapov[1], A.V. Lazarev[3], A.A. Rupasov[2], A.A. Kologrivov[2], E.A. Bolkhovitinov[2], I.A. Zhvaniya[1], I.N. Tsymbalov[1], R.V. Volkov[1], V.M. Gordienko[1], A.B. Savel'ev[1,2]; [1]Physics Faculty, Lomonosov Moscow State University, [2]Lebedev Physical Institute RAS, [3]Faculty of Chemistry, Lomonosov Moscow State University, [4]National Research Centre "Kurchatov Institute", Russia

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

ThR05-31 13:15-13:30

Lattice dynamics of Si under intense laser impact

E.I. Mareev[1], N.N. Obydennov[2], F.V. Potemkin[2]; [1]Kurchatov Complex Crystallography and Photonics, NRC "Kurchatov Institute"; [2]Faculty of Physics, Moscow State University, Russia

Using time-resolved techniques we revealed the dynamics of Si lattice under impact of intense nanosecond and femtosecond laser pulse. The energy transfer from laser-induced plasma to the atomic subsystem occurs on a sub-ps timescale, generates a shock wave that leads to the cascade of phase transitions (Si-X → Si-VII → Si-VI → Si-XI → Si-XII → Si-III).

- Lunch Break -

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

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

Session Chair:

ThR05-32 15:00-15:15

LIPSS on titanium plate prepared by nanosecond pulses

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

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

ThR05-33 15:15-15:30

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

A.A. Silaev[1,2], A.A. Romanov[1,2], N.V. Vvedenskii[1,2]; [1]IAP RAS, Russia; [2]Nizhny Novgorod State Univ., Russia

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

ThR05-34 15:30-15:45

Laser-plasma accelerator for radiation hardness testing of microelectronic devices

K. Safronov, V.A. Flegentov, S.A. Gorokhov, N.N. Shamaeva, D.I Bashkin, A.S. Tischenko, D.O. Zamuraev, A.L. Shamraev, S.F. Kovaleva, N.A. Fedorov, S.M. Dubrovskikh, A.S. Pilipenko, A.S. Kustov, E.A. Shibakov, A.V. Potapov; Russian Federal Nuclear Center - Zababakhin All-Russian Research Institute of Technical Physics, Russia

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

ThR05-35 15:45-16:00

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

Yu.E. Geints, D.V. Apeksimov, P.A. Babushkin, A.D. Bulygin, A.M. Kabanov, V.K. Oshlakov, A.V. Petrov, E.E. Khoroshaeva, A.A. Zemlyanov; V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia

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

ThR05-36 16:00-16:15

Experimental study of ultrafast laser-induced phenomena in gold

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

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

ThR05-37 16:15-16:30

Femtosecond laser-induced periodic surface structures formation on optical fibers

K. Bronnikov[1], S. Gladkikh[1], V. Terentiev[1], V. Simonov[1], S. Mikerin[1], S. Babin[1], A. Kuchmizhak[2,3], A. Dostovalov[1]; [1]Institute of Automation and Electrometry SB RAS; [2]Institute of Automation and Control Processes FEB RAS; [3]Pacific Quantum Center, Far Eastern Federal University, Russia

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

ThR05-38 16:30-16:45

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

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

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

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

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

R08: NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS 6

Session Chair:

ThR08-38 09:00-09:30

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

A.R. Akhmatkhanov[1], M.A. Chuvakova[1], A.A. Esin[1], A.A. Boyko[2], B.I. Lisjikh[1], M.S. Kosobokov[1], V.S. Shur[1]; [1]Ural Federal Univ., Russia, [2]Novosibirsk State Univ, Russia

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

ThR08-39 09:30-09:45

Dispersion of effective nonlinearity for frequency conversion in biaxial crystals

E. Shevelkina[1], S.G. Grechin[2]; [1]NTO IRE-Polyus, [2]Prokhorov General Physics Institute RAS, Russia

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

ThR08-40 09:45-10:00

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

E.A. Migal[1], D.Z. Suleimanova[1], D.V. Badikov[2], F.V. Potemkin[1]; [1]Lomonosov Moscow State Univ.; [2]Kuban State University, Russia

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

ThR08-41 10:00-10:15

Dual-pumped integrated microring degenerate optical parametric oscillator

A.K. Vorobyev[1,2], N.A. Kapridov[1,2], T.R. Yunusov[1,2], A.E. Shitikov[1], D.A. Chermoshentsev[1], I.A. Bilenko[1,3]; [1]Russian Quantum Center; [2]Moscow Institute of Physics and Technology; [3]Faculty of Physics, Moscow State University, Russia

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

ThR08-42 10:15-10:30

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

A.G. Sakharova[1,2], A.E. Shitikov[1], N.Y. Dmitriev[1], D.A. Chermoshentsev[1,2], I.A. Bilenko[1,3]; [1]Russian Quantum Center, [2]Moscow Institute of Physics and Technology, [3]Lomonosov Moscow State University, Russia

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

ThR08-43 10:30-10:45

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

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

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

ThR08-44 10:45-11:00

SOA-based reservoir computing

A. Bednyakova[1], E. Manuylovich[2], D.A. Ivoilov[1], I.S. Terekhov[3], S.K. Turitsyn[2]; [1]Novosibirsk State University, Russia; [2]Aston Institute of Photonic Technologies, Aston University, UK; [3]School of Physics and Engineering, ITMO University, Russia

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

- Coffee Break -

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

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Session Chair:

ThR08-45 11:30-12:00

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

S.A. Kozlov, I.R. Artser, M.V. Melnik, A.N. Tsypkin; ITMO University, Russia

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

ThR08-46 12:00-12:30

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

Yiqi Zhang[1], Yaroslav V. Kartashov[2]; [1]Xi'an Jiaotong University, China; [2]Institute of Spectroscopy RAS, Russia

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

ThR08-47 12:30-13:00

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

S.K. Ivanov[1], Ya.V. Kartashov[2]; [1]University of Valencia, Institute of Materials Science (ICMUV), Spain; [2]Institute of Spectroscopy, Russia

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

ThR08-48 13:00-13:15

Nonlinear propagation of ultrashort pulses in nanophotonic halide perovskite waveguides

A.O. Mikhin[1], N. Glebov[1], M. Masharin[2], A.V. Yulin[1], S.V. Makarov[1], D.N. Krizhanovskii[3], A.K. Samusev[4], V. Kravtsov[1]; [1]ITMO University, Russia; [2]EPFL, Switzerland; [3]The University of Sheffield, United Kingdom; [4]Technische Universität Dortmund, Germany

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

ThR08-49 13:15-13:30

Polarization state evolution of extremely compressed femtosecond laser wave packets in fused silica

I.Y. Geints, O.G. Kosareva; Lomonosov Moscow State Univ., Russia

The evolution of radiation polarization parameters during the filamentation and formation of extremely compressed femtosecond wave packets in fused silica is studied numerically on the basis of the carrier-resolved unidirectional pulse propagation equation (UPPE). It is revealed that the polarization state of radiation tends to linear one in the core of the formed extreme wave packet.

ThR08-50 13:30-13:45

Beam self-cleaning and transition from nonlinear to geometric focusing during filamentation

D.V. Pushkarev[1], G.E. Rizaev[1], M.V. Levus[1,2], and L.V. Seleznev[1]; [1]Lebedev Physical Institute RAS, [2]Lomonosov Moscow State University, Russia

We propose an approach to distinguish filamentation regimes with nonlinear and geometric focusing predominance, basing on beam profiles after filamentation. At tight focusing, the beam self-cleaning is not observed. Transitional numerical aperture between the regimes scales as inverse square root of self-focusing critical power. When it is low enough, the nonlinear focusing dominates even at numerical apertures close to 1.

ThR08-51 13:45-14:00

Few-fs half-cycle pulse train with an ultra-high pulse repetition rate from nested quantum wells

R.M. Arkhipov[1,2], M.V. Arkhipov[1,2], A.V. Pakhomov[1], N.N. Rosanov[1,2]; [1]St. Petersburg State University; [2]Ioffe Institute, Russia

We propose a simple and compact structure, consisting of a pair of nested quantum wells, as a source of a train of half-cycle pulses of few-fs duration when driven by an external electric field. We demonstrate the possibility of the generation of ultrafast half-cycle pulse trains with ultra-high pulse repetition rates of tens of THz.

- Lunch Break -

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

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Session Chair:

ThR08-52 15:00-15:30

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

R.M. Arkhipov[1,2], M.V. Arkhipov[1,2], A.V. Pakhomov[1], O.O. Diachkova[1,2], N.N. Rosanov[1,2]; [1]St. Petersburg State University; [2]Ioffe Institute, Russia

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

ThR08-53 15:30-16:00

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

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

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

ThR08-54 16:00-16:15

Spectral, spatial and energy stabilization of filament supercontinuum Stokes wing by amplitude modulation

D.V. Pushkarev[1,2], N.A. Zhidovtsev[1], D.S. Uryupina[1], E.V. Mitina[1], R.V. Volkov[1], A.B. Savel'ev[1,2]; [1]Faculty of Physics, Lomonosov Moscow State University, [2]Lebedev Physical Institute RAS, Russia

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

ThR08-55 16:15-16:30

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

O.O. Diachkova[1,2], R.M. Arkhipov[1,2], M.V. Arkhipov[1,2], A.V. Pakhomov[1], N.N. Rosanov[1,2]; [1]St. Petersburg State University; [2]Ioffe Institute, Russia

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

ThR08-56 16:30-16:45

Ab-initio calculations of xenon-like atom nonlinear response on UV and IR femtosecond pulse

N.R. Vrublevskaya[1], D.E. Shipilo[1,2], I.A. Nikolaeva[1,2], N.A. Panov[1,2], O.G. Kosareva[1,2]; [1]Faculty of Physics, Lomonosov Moscow State University; [2]Lebedev Physical Institute RAS, Russia

Quantum-mechanical simulations of the nonlinear response of a one-dimensional quantum system with the energy structure close to that of the xenon atom to an ultraviolet femtosecond pulse reveal the dispersion of the cubic nonlinearity coefficient in the UV spectral range and its intensity dependence. This excludes the description of the response of bound electrons using constant value of Kerr coefficient.

ThR08-57 16:45-17:00

Investigation of refractive index change in KRS-5 sample volume under femtosecond Ti:Sa laser irradiation

A.A. Murzanev, A.V. Romashkin, Yu.A. Sergeev, A.N. Stepanov; Institute of Applied Physics, Russia

Methods for three-dimensional laser modification of the KRS-5 sample in the nonlinear two-photon absorption mode are developed. The Ti:Sa laser irradiation was focused into the sample volume. Y-shaped structures were obtained. Interferometry showed a change in the refractive index of about 2%. The two-photon absorption coefficient is estimated. A theoretical description of the modification process was constructed.

- Coffee Break -

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

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Session Chair:

ThR08-58 17:30-18:00

Stimulated terahertz emission from molecular crystals *(Invited paper)*

V.I. Kovalev[1], A.S. Sinko[2], A.P. Shkurinov[3]; [1]Lebedev Physical Institute RAS; [2]National Research Centre Kurchatov Institute; [3]Department of Physics, Lomonosov Moscow State University, Russia

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

ThR08-59 18:00-18:15

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

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

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

ThR08-60 18:15-18:30

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

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

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

ThR08-61 18:30-18:45

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

N.A. Nikolaev[1]; S.A. Bychkova[1]; S.L. Mikerin[1]; V.D. Antsygin[1]; A.S. Sinko[2,3]; A.P. Shkurinov[2,3]; [1]Institute of Automation and Electrometry SB RAS, [2]NRC "Kurchatov Institute", [3]Moscow State University, Russia

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

ThR08-62 18:45-19:00

Fiber laser driven terahertz generation in a $LiNbO_3$ layer sandwiched between Si prisms

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

We demonstrate experimentally that a 55 microns thick layer of LiNbO3 clamped between Si prisms works as a converter of femtosecond Er-fiber oscillator pulses to a single terahertz beam. The pulses of 2.15 nJ energy were converted to broadband terahertz radiation with the efficiency of 1.6×10^(-6). Using the converter in a THz-TDS setup provided a dynamic range of 55 dB. The work was supported by the Russian Science Foundation (22-19-00371).

ThR08-64 19:00-19:15

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

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

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

R09: OPTICAL NANOMATERIALS

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

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Session Chair:

ThR09-15 09:00-09:15

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

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

Interfacial abruptness in axial heterostructures within III-V nanowires (NWs) grown by the VLS method is affected by the reservoir effect in catalyst droplets. Here, we present a model which provides explicitly the interfacial profiles in double NW heterostructures based on group V interchange of any composition, and fit the data on Au-catalyzed InP/InAs/InP, self-catalyzed GaAs0.6P0.4/GaxAsxP1-x/GaAs0.6P0.4 and GaP/GaAsxP1-x/GaP NW heterostructures.

ThR09-16 09:15-09:30

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

E.D. Leshchenko[1], V.G. Dubrovskii[2]; [1]Submicron Heterostructures for Microelectronics, Research and Engineering Center RAS ; [2]St. Petersburg State University, Russia

We develop a growth model for ternary AxB1-xC nanomaterials and show that the vapor-solid distribution can be tuned from the equilibrium to kinetic shape by decreasing the total (A+B)/C flux ratio. We demonstrate the excellent fits of available data for AlSbAs epilayers, InSbAs, InAsP and GaAsP NWs grown under different total V/III flux ratios in vapor.

ThR09-17 09:30-09:45

Modeling the crystal phase switching in self-catalyzed GaAs nanowires

A.A. Koryakin[1], N.V. Guruleva[2]; [1]St. Petersburg State University; [2]Alferov St. Petersburg Academic University, Russia

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

ThR09-18 09:45-10:00

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

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

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

ThR09-19 10:00-10:15

Growth and properties of microstructures based on aluminum fluoride

A.M. Dautov[1], K.P. Kotlyar[1,2], T.H. Berezovskaya[2], A.M. Khafizova[3], T. Shugabaev[2], E. Lendyashova[2]; [1]Faculty of Physics, St. Petersburg State University; [2]Alferov University; [3]St. Petersburg State Electrotechnical University "LETI", Russia

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

ThR09-20 10:15-10:30

Formation of nanovoids grating in Zr/SiO_2/Si at scanning of tightly focused cw laser beam

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

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

ThR09-21 10:30-10:45

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

D.R. Dadadzhanov[1,2], N.S. Petrov[2], I.A. Gladskikh[2], T.A. Vartanyan[2], G. Markovich[1]; [1]Raymond and Beverly Sackler Faculty of Exact Sciences, School of Chemistry, Tel Aviv University, Israel; [2]International Research and Education Center for Physics of Nanostructures, ITMO University, Russia

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

ThR09-22 10:45-11:00

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

I.V. Shtrom[1,2], N.V. Sibirev[1], I.V. Ilkiv[1,2], I.P. Soshnikov[3], R.R. Reznik[1,4], G.E. Cirlin[1,2,4]; [1]St. Petersburg State University; [2]Institute for Analytical Instrumentation RAS; [3]Ioffe Institute; [4]Alferov Institute, Russia

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

- Coffee Break -

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

R09: OPTICAL NANOMATERIALS 5

Session Chair:

ThR09-23 11:30-12:00

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

A.L. Simões Gamboa[1], E.N. Bodunov[2], A.V. Fedorov[1]; [1]ITMO Univ., Russia; [2]Emperor Alexander I St. Petersburg State Transport Univ., Russia

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

ThR09-24 12:00-12:30

Nanoprobes for in vivo Imaging *(Invited paper)*

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

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

ThR09-25 12:30-12:45

Molecular detection using plasmonic nanostructures of particular geometry

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

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

ThR09-26 12:45-13:00

Optical nanoheaters with fluorescent thermometers on board

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

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

ThR09-27 13:00-13:15

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

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

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

ThR09-28 13:15-13:30

Laser synthesis of nanoparticles for photocatalitic applications

D.V. Dyubo[1], I.S. Kazantsev[1], G.I. Tselikov[2], I.V. Martynov[1], A.V. Syuy[1], A.V. Arsenin[1], V.S. Volkov[2]; [1]Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, Russia; [2]Emerging Technologies Research Center, XPANCEO, Internet City, Emmay Tower, Dubai, United Arab Emirates

Various nanostructures such as hybrid nanoparticles, core-shell particles, intercalated nanoparticles were synthesized by laser ablation and laser fragmentation methods. We have studied the optical and structural properties of the composites and demonstrated their potential application as a photocatalyst. The catalytic activity of Au/TiO2 nanocomposites was found to be 1.5 times higher than that of TiO2 under the same conditions.

ThR09-29 13:30-13:45

Quantum dots. Hydrophilization techniques for analytical applications

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

Quantum dots are semiconductor crystals with unique optical properties. Analytical applications are made possible due to the stability of the crystal, the ability to vary the fluorescence wavelength, and the capacity for non-radiative energy transfer. They are influenced by the composition, structure and coating of QDs.

R03: SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS - POSTERS

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

ThR03-p01 10:00-13:30

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

D.R. Il'enkova[1], D.D. Rybnikov[1], V.A. Zhelnov[1], A.I. Alekseeva[2], K.I. Zaytsev[1], N.V. Chernomyrdin[1]; [1]Prokhorov General Physics Institute RAS; [2]Research Institute of Human Morphology, Russia

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

ThR03-p02 10:00-13:30

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

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

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

ThR03-p03 10:00-13:30

Active region overheating in quantum cascade lasers

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

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

ThR03-p04 10:00-13:30

Pulsed cathodoluminescence kinetics of Fe:ZnSe ceramic

A.V. Spirina[1], A.S. Makarova[1], V.I. Solomonov[1], A.S. Korsakov[2], F.M. Kucherenko[2], V.S. Kostrov[2]; [1]Institute of Electrophysics UB RAS; [2]Ural Federal University named after the First President of Russia B.N. Yeltsin, Russia

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

ThR03-p05 10:00-13:30

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

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

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

ThR03-p06 10:00-13:30

Quantum-cascade laser with increased ring radius

E.S. Kolodeznyi[1], A.V. Babichev[1], N.Yu. Kharin[1,2], A.G. Gladyshev[1], G.V. Voznyuk[3], M.I. Mitrofanov[3], S.O. Slipchenko[3], A.V. Lyutetskii[3], V.P. Evtikhiev[3], L.Ya. Karachinsky[1], I.I. Novikov[1], V.Yu. Panevin[2], N.A. Pikhtin[3], A.Yu. Egorov[1]; [1]ITMO University, [2]Peter the Great St. Petersburg Polytechnic University, [3]Ioffe Institute, Russia

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

ThR03-p07 10:00-13:30

Dielectric spectroscopy of $Ge_2Sb_2Te_5$ and VO_2 upon temperature-induced phase transitions

A.A. Bogutskii[1], A.A. Gavdush[1], G.A. Komandin[1], D.S. Ponomarev[2], Qiwu Shi[3], K.I. Zaytsev[1]; [1]Prokhorov General Physics Institute RAS, [2]Institute of Ultra-High Frequency Semiconductor Electronics RAS, Russia; [3]College of Materials Science and Engineering, Sichuan University, China

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

ThR03-p08 10:00-13:30

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

D.S. Papylev[1], S.A. Blokhin[2], Y.N. Kovach[2,1], A.G. Gladyshev[1], I.I. Novikov[1], E.S.Kolodeznyi[1], A.V. Babichev[1], K.O. Voropaev[2], A.Yu. Egorov[1], and L.Ya. Karachinsky; [1]ITMO Univ., Saint Petersburg, Russia; [2]Ioffe Inst., Saint Petersburg, Russia

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

ThR03-p09 10:00-13:30

Pulsed laser annealing of sulfur hyperdoped silicon prepared by ion implantation

I.M. Podlesnykh[1,2], M.S. Kovalev[2], R.I. Batalov[3]; [1]Bauman Moscow State Technical Univ.; [2]Lebedev Physical Inst. RAS; [3]Kazan Physical Technical Inst. RAS, Russia

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

ThR03-p10 10:00-13:30

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

M.I. Mitrofanov[1,2], A.A. Beckman[1], E.S. Kolodeznyi[3], A.S. Payusov[1], G.V. Voznyuk[1], V.P. Evtikhiev[1]; [1]Ioffe Institute, [2]SHM R&E Center RAS, [3]ITMO University, Russia

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

ThR03-p11 10:00-13:30

Extreme events in dynamics of frequency-swept semiconductor lasers

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

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

ThR03-p12 10:00-13:30

Optimization of the energy barrier layer position in 1550 nm high-power laser diodes

A.A. Podoskin[1], D.A. Veselov[1], T.A. Bagaev[1], V.N. Svetogorov[1], I.V. Yarotskaya[1], V.V. Zolotarev[1], V.A. Kruchkov[1], I.V. Shushkanov[1], M.A. Ladugin[2], A.A. Marmalyuk[2], S.O. Slipchenko[1], N.A. Pikhtin[1]; [1]Ioffe Institute, [2]M.F. Stel'makh Polyus Research Institute, Russia

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

ThR03-p13 10:00-13:30

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

V.V. Dudelev[1], E.D. Cherotchenko[1], D.A. Mikhailov[1], D.V. Chistyakov[1], S.O. Slipchenko[1], A.V. Lyutetskiy[1], A.G. Gladyshev[2], A.V. Babichev[1], L.Ya. Karachinsky[2], I.I. Novikov[2], N.A. Pikhtin[1], A.Yu. Egorov[3], A.V. Kondrashov[4], A.A. Semenov[4], A.B. Ustinov[4], G.S. Sokolovskii[1]; [1]Ioffe Institute, [2]Connector Optics LLC, [3]Alferov St. Petersburg National Research Academic University, [4]St. Petersburg Electrotechnical University "LETI", Russia

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

ThR03-p14 10:00-13:30

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

P.Ya. Ilyushin[1,2,3], D.E. Shipilo[1,2], I.A. Nikolaeva[1,2,3], N.A. Panov[1,2], O.G. Kosareva[1,2,3]; [1]Faculty of Physics, Lomonosov Moscow State University; [2]Lebedev Physical Institute RAS; [3]Kharkevich Institute for Information Transmission Problems RAS, Russia

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

ThR03-p15 10:00-13:30

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

Ya.N. Kovach[1,2], S.A. Blokhin[1], M.A. Bobrov[1], A.A. Blokhin[1], N.A. Maleev[1], A.V. Babichev[2], I.I. Novikov[2], A.G. Gladyshev[2], L.Ya. Karachinsky[2], E.S. Kolodeznyi[2], K.O. Voropaev[1], A.Yu. Egorov[2], V. M. Ustinov[1]; [1]Ioffe Institute; [2]ITMO University, Russia

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

ThR03-p16 10:00-13:30

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

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

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

ThR03-p17 10:00-13:30

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

K.A. Podgaetskiy[1], A.V. Lobintsov[1], A.I. Danilov[1], M.A. Ladugin[1], A.A. Marmalyuk[1], V.V. Dudelev[2], D.A. Mikhailov[2], D.V. Chistyakov[2], A.V. Babichev[3], E.A. Kognovickaya[2], A.V. Lutetskiy[2], S.O. Slipchenko[2], N.A. Pikhtin[2], A.G. Gladyshev[4], I.I. Novikov[3], L.Y. Karachinsky[3], A.Y. Egorov[4], G.S. Sokolovskii[2]; [1]Stel'makh Research Institute Polyus; [2]Ioffe Institute; [3]ITMO University; [4]Connector Optics LLC, Russia

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

ThR03-p18 10:00-13:30

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

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

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

ThR03-p19 10:00-13:30

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

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

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

ThR03-p20 10:00-13:30

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

P.E. Kopytov[1], S.S. Rochas[1], E.S. Kolodeznyi[1], J.N. Kovach[1,2], K.O. Voropayev[2], I.I. Novikov[1], S.A. Blokhin[2]; [1]ITMO University; [2]Ioffe Institute, Russia

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

ThR03-p21 10:00-13:30

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

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

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

ThR03-p22 10:00-13:30

Interrogation of FBG using standard telecom DFB diode as a transceiver

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

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

ThR03-p23 10:00-13:30

Study of the capabilities of high-power UV and blue LEDs for pumping coumarin dyes laser

A.V. Aladov[1], A.E. Chernyakov[1], A.E. Ivanov[1,2], A.L. Zakgeim[1]; [1]Submicron Heterostructures for Microelectronics Research and Engineering Center RAS; [2]St. Petersburg Electrotechnical University LETI, Russia

High-power AlGaInN LEDs are of interest for pumping of dyes lasers. In this regard, comprehensive studies of the power and spectral characteristics of LEDs in short-pulse modes used to laser pump were carried out. The energy capabilities and spectral properties of LED excitation of coumarin dyes were revealed.

ThR03-p24 10:00-13:30

1550 nm few-mode laser diodes

Yu.K. Kirichenko(Bobretsova)[1], D.A. Veselov[1], A.Yu. Leshko[1], A.E. Rizaev[1], S.O. Sliphenko[1], N.A. Pikhtin[1], A.A. Marmalyuk[2], Yu.L. Ryaboshtan[2], M.A. Ladugin[2]; [1]Ioffe Institute; [2]Sigm Plus Company, Russia

The main characteristics of 1550 nm few-mode laser diodes with aperture width 20 µm were measured. There are two ranges of pump currents in which the characteristics of lasers behave differently: in the first range there is a scatter in the output characteristics of lasers due to few-mode operating mode; in the second range the laser operates predictably and stably.

ThR03-p25 10:00-13:30

Portable optoelectronic vibration sensor based on self-mixing effect in a laser diode

A.V. Rybaltovskii, G.O. Danilenko, I.S. Mamaev, A.V. Kovalev; ITMO University, Russia

We introduce a portable optoelectronic vibration sensor utilizing the self-mixing effect for remote vibration measurement. The device uses a laser diode as emitter and detector, providing non-contact detection of vibration parameters (VP) during equipment operation, without damage and without violating safety requirements. It accurately measures VPs from 50 to 4000 Hz with less than 10% error.

ThR03-p26 10:00-13:30

Compact high-power laser pulse sources with nanosecond (ns) and sub-ns durations for time-of-flight LiDAR systems

S.O. Slipchenko[1], A.A. Podoskin[1], I.V. Shushkanov[1], A.E. Rizaev[1], M.I. Kondratov[1], A.E. Grishin[1], K.V. Bakhvalov[1], Yu.K. Kirichenko[1], A.I. Zhelnin[1,2], T.A. Bagaev[1,2], M.A. Ladugin[2], A.A. Marmalyuk[2], N.A. Pikhtin[1]; [1]Ioffe Institute, [2]Stelmakh Research Institute Polyus, Russia

The report discusses the main experimental results related to the development of pulsed laser sources, enabling pulse durations in the ns and sub-ns ranges. A compact stack, comprising a semiconductor laser and current switch, is demonstrated, achieving a peak optical pulse power of 36W with a pulse duration of 3ns. Approaches for generating high-power sub-ns laser pulses are also studied.

ThR03-p27 10:00-13:30

Vortex Bessel beam generation from conically refracted laser diode radiation

S.H. Abdulrazak, V.Yu. Mylnikov, S.N. Losev, N.G. Deryagin, V.V. Dudelev, G.S. Sokolovskii; Ioffe Institute, Russia

We demonstrate generation of Bessel beam from conically refracted laser diode radiation. Conical refraction provides annular distribution of the beam at the axicon that is favorable for efficient Bessel beam generation.

ThR03-p28 10:00-13:30

Noise performance of 89X nm single-mode VCSELs

M.A. Bobrov[1], S.A. Blokhin[1], Ya.N. Kovach[1], A.A. Blokhin[1], N.A. Maleev[1], A.G. Kuzmenkov[1], Yu.M. Zadiranov[1], M.M. Kulagina[1], Yu.A. Guseva[1], A.P. Vasil'ev[2], M.N. Marchii[1], V.M. Ustinov[2]; [1]Ioffe Institute; [2]SHM R&E Center, Russia

The study of the noise characteristics of the 89X nm single-mode polarization-stable VCSELs based on InGaAs quantum wells is presented. When VCSEL emission is in resonance with the Cs D1 line, the relative intensity noise (RIN) is -110 dB/Hz at 10Hz and -140 dB/Hz at 10 kHz. The polarization-resolved RIN is slightly higher than RIN but exhibits similar frequency behavior.

ThR03-p29 10:00-13:30

Microscopic origins of the thermally stimulated wavelength chirp in quantum cascade lasers

E.D. Cherotchenko[1], I.I. Vrubel[1], A.V. Pavlov[2,3], A.S. Konanykhina[2,3], R.G. Polozkov[2,3], V.V. Dudelev[1], G.S. Sokolovskii[1]; [1]Ioffe Institute, [2]St. Petersburg Academic University, [3]Peter the Great St. Petersburg Polytechnic University, Russia

We study the QCL active region overheating by the analysis of the refractive index-temperature variation. We apply ab-initio methods and interpret the numerical results by the normal dispersion theory. The outcomes of the work create the reliable theoretical basis for the thermal management of QCL devices via the wavelength chirp measurement.

ThR03-p30 10:00-13:30

Semiconductor lasers in gain-switching mode for high power sub-ns optical pulses

I.V. Shushkanov, A.A. Podoskin, M.G. Zadorozhniy, A.A. Klimov, L.S. Vavilova, S.O. Slipchenko, N.A.Pikhtin; Ioffe Institute, Russia

Broad-area lasers with a 100 µm aperture based on heterostructures with double asymmetry and active regions at wavelengths of 850 nm using bulk 45 nm GaAs and at 970 nm using quantum wells were investigated. Output optical powers in the single first relaxation peak regime from 12 to 22 W were achieved with pulse durations from 100 to 150 ps.

ThR03-p31 10:00-13:30

Annealing temperature effect on the GaAs nanowire growth on the FIB-modified Si substrate

N.A. Shandyba, M.M. Eremenko, D.V. Kirichenko, N.E. Chernenko, S.V. Balakirev, M.S. Solodovnik; Laboratory of Epitaxial Technologies, Institute of Nanotechnologies, Electronics and Equipment Engineering, Southern Federal University, Russia

It is shown that an increase of the annealing temperature from 600 to 750 leads, on the one hand, to an increase of the nanowire density up to ~ 40 µm-2 at the maximum dose value. On the other hand, this leads to an increase in the proportion of vertically oriented nanowires up to 100%.

ThR03-p32 10:00-13:30

The dynamics of laser generation in single-mode semiconductor (1060 nm) emitters microbar under sub-ns pulse pumping

A.A. Podoskin, A.E. Kazakova, V.A. Strelets, Z.N. Sokolova, A.V. Lyutetskii, A.Yu. Leshko, V.A. Kruchkov, S.O. Slipchenko, N.A. Pikhtin; Ioffe Institute, Russia

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

ThR03-p33 10:00-13:30

Hybrid pulsed laser-thyristors output optical power-time characteristics

T.A. Bagaev[1], N.V. Gultikov[1], A.I. Zhelnin[1], M.A. Ladugin[1], A.A. Marmalyuk[1], Yu.V. Kurnyavko[1], V.V. Krichevsky[1], A.M. Morozyuk[1], V.P. Konyaev[1], V.A. Simakov[1], S.O. Slipchenko[2], A.A. Podoskin[2], N.A. Pikhtin[2]; [1]Stelmakh Research Institute Polyus, [2]Ioffe Institute, Russia

High-power hybrid semiconductor lasers–thyristors consisting of thyristor crystals soldered with a semiconductor laser with three emitting sections are studied. Experimental dependences of laser-thyristor output optical power on the charging capacity and pulse duration were obtained.

ThR03-p34 10:00-13:30

PbSe thin films for Mid-IR high-sensitive photodetectors

L.A. Mochalov[1], M.A. Kudryashov[2], I.O. Prokhorov[1], E.A. Slapovskaya[1], Yu.P. Kudryashova[1], S.V. Telegin[1], E.U. Rafailov[3], A.N. Baranov[4]; [1]Lobachevsky University; [2]Nizhny Novgorod State Technical University, Russia; [3]Aston University, United Kingdom; [4]University of Montpellier, France

In order to obtain the highly sensitive lead selenide layers, the novel PECVD approach was developed. The production and sensitization of the resulting films with iodine pentoxide was carried out in one vacuum cycle. The influence of annealing conditions on the surface morphology and photoelectric properties of the final films was studied.

ThR03-p35 10:00-13:30

UV emission of ZnO structures with whispering gallery modes synthesized by different methods

A.P. Tarasov; National Research Centre “Kurchatov Institute”, Russia

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

ThR03-p36 10:00-13:30

Cost-efficient fiber optic distributed acoustic sensor

A.T. Turov[1,2], F.L. Barkov[2], C.A. Lopez-Mercado[3,4], D. Claude[2], A.A. Fotiadi[5,6], M.A. Konovalova[1]; [1]Perm Nat. Res. Polytechnic Univ.; [2]Perm Fed. Res. Center UB RAS, Russia; [3]Scient. Res. and Advanced Studies Center of Ensenada, Mexico; [4]Univ. of Mons, Belgium; [5]S.P. Kapitsa Res. Inst. of Technology; [6]Ioffe Inst., Russia

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

ThR03-p37 10:00-13:30

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

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

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

ThR03-p38 10:00-13:30

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

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

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

ThR03-p39 10:00-13:30

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

N.Yu. Kharin[1,2], A.V. Babichev[1], E.S. Kolodeznyi[1], A.G. Gladyshev[1], S.O. Slipchenko[3], A.V. Lyutetskii[3], L.Ya. Karachinsky[1], I.I. Novikov[1], V.Yu. Panevin[2], N.A. Pikhtin[3], G.S. Sokolovskii[3], A.Yu. Egorov[1]; [1]ITMO University; [2]Peter the Great St. Petersburg Polytechnic University; [3]Ioffe Institute, Russia

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

ThR03-p40 10:00-13:30

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

N. Mgedle[1,2], O.S. Oluwafemi[1,2]; [1]Department of Chemical Sciences, University of Johannesburg, [2]Centre for Nanomaterials Science Research, University of Johannesburg, South Africa

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

ThR03-p41 10:00-13:30

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

V.N. Chizhevsky, M.V. Lakhmitski, S.Ya. Kilin; Institute of Physics NASB, Belarus

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

ThR03-p42 10:00-13:30

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

I.V. Oreshko[1,2], A.E. Kazakova[1], V.V. Zolotarev[1], I.V. Shushkanov[1], S.O. Slipchenko[1], N.A. Pihtin ; [1]Ioffe Institute; [2]St. Petersburg Electrotechnical University "LETI", Russia

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

ThR03-p43 10:00-13:30

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

M.E. Belokrylov[1], D.A. Kambur[1,2], Yu.A. Konstantinov[1], F.L. Barkov[1], D. Claude[1], S.Yu. Malyshev[2], A.T. Turov[1,2]; [1]1Perm Fed. Res. Center of the Ural Branch of the RAS, Russia; [2]Perm Nat. Res. Polytechnic Univ., Russia

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

ThR03-p44 10:00-13:30

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

E.S. Kolodeznyi[1], A.V. Babichev[1], A.G. Gladyshev[1], D.A. Mikhailov[2], V.V. Dudelev[2], S.O. Slipchenko[2], A.V. Lyutetskii[2], L.Ya. Karachinsky[1], I.I. Novikov[1], N.A. Pikhtin[2], G.S. Sokolovskii[2], A.Yu. Egorov[1]; [1]ITMO University; [2]Ioffe Institute, Russia

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

ThR03-p45 10:00-13:30

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

D.A. Guryev[1], V.A. Kamynin[1], P.I. Lazarenko[2], D.Y. Terekhov[2], S.A. Kozyukhin[3], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Institute RAS; [2]National Research University of Electronic Technology; [3]Kurnakov Institute of General and Inorganic Chemistry RAS, Russia

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

ThR03-p46 10:00-13:30

Optical parametric amplification of quantum cascade laser radiation in $ZnGeP_2$ crystal

O.B. Vyskubenko[1,2], S.G. Garanin[1], N.G. Zakharov[1,2], K.V. Kusakina[1,2,4], V.I. Lazarenko[1,2], A.V. Mukhin[1], G.S. Sokolovskii[3], K.A. Tulyakov[1,2,4]; [1]RFNC-VNIIEF; [2]Lobachevsky University; [3]Ioffe Institute; [4]Lomonosov Moscow State University, Russia

We demonstrate optical parametric amplification of a pulsed quantum cascade laser emitting near 4.6 µm in a nonlinear ZnGeP2 crystal. We report amplification of about 30 dB with output radiation peak power of 373 W.

ThR03-p47 10:00-13:30

Wavelength dependence of transparency current of InGaAs/GaAs quantum well-dot active medium

G.O. Kornyshov[1], A.S. Payusov[1], A.A. Beckman[1], Yu.M. Shernyakov[1], S.A. Mintairov[1], N.A. Kalyuzhnyy[1], N.Yu. Gordeev[1], M.V. Maximov[2]; [1]Ioffe Institute, [2]Alferov University, Russia

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

ThR03-p48 10:00-13:30

Advanced thin films of gallium selenide

L.A. Mochalov[1,2], M.A. Kudryashov[1,2], E.A. Slapovskaya[2], Yu.P. Kudryashova[1,2], S.V. Telegin[1], E.U. Rafailov[3], A.N. Baranov[4]; [1]Nizhny Novgorod State Technical University; [2]Lobachevsky University, Russia; [3]Aston University, United Kingdom; [4]University of Montpellier, France

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

ThR03-p49 10:00-13:30

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

M.A. Ladugin[1], A.A. Marmalyuk[1], A.Yu. Andreev[1], I.V. Yarotskaya[1], N.V. Gultikov[1], L.I. Shestak[2], V.A. Panarin[2]; [1]Sigm plus Co.; [2]NPP Inject Co., Russia

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

ThR03-p50 10:00-13:30

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

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

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

ThR03-p51 10:00-13:30

Defects for halide perovskite active media

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

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

ThR03-p52 10:00-13:30

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

V.N. Jmerik[1], D.N. Nechaev[1], V.I. Kozlovsky[2], Y.K. Skasyrsky[2], M.M. Zverev[2], N.A. Gamov[2]; [1]Ioffe Institute, [2]Lebedev Physical Institute RAS, Russia

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

ThR03-p53 10:00-13:30

Devising the ways to expand throughput of a directly modulated long-wavelength VCSEL

M.E. Belkin[1], K. Voropaev[2], D. Klyushnik[1], M.G. Vasiliev[3]; [1]MIREA - Russian Technological University, [2]PLC OKB-Planeta, [3]Institute of General and Inorganic Chemistry RAS, Russia

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

R04: LASER BEAM CONTROL - POSTERS

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

ThR04-p01 10:00-13:30

Spectral properties of borogermanate glass co-doped with $CsPbBr_3$ nanocrystals and Eu^{3+} ions

A. Babkina, A. Ratova, R. Kharisova, K. Zyryanova, N. Kuzmenko, N. Nikonorov; ITMO Univ., Russia

The spectral properties of borogermanate glass co-doped with CsPbBr3 perovskite nanocrystals and Eu3+ ions are investigated. Luminescence spectra contain several bands at 600, 615 and 700 nm corresponding to Eu3+ ions and one band in 510-535 nm regions dedicated to CsPbBr3 nanocrystals. Europium luminescence can be excited through perovskite crystals' bands.

ThR04-p02 10:00-13:30

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

A.A. Garkushin[1,2], V.V. Krishtop[1,2,3], I.L. Volkhin[2,3], D.A. Kustov[1,2], E.V. Nifontova[1,2], N.S. Milyukov[1,2]; [1]Perm National Research Polytechnic University; [2]Perm Scientific-Industrial Instrument Making Company; [3]Perm State National Research University, Russia

The paper proposes a power supply system with power transmission via optical fiber. Modelling is performed in the COMSOL Multiphysics software package using the finite element method. A digital model of a homogenizer for a photovoltaic converter is obtained. The homogeneity of the light spot in the model and experiment was 71.7% and 76.5%, respectively.

ThR04-p03 10:00-13:30

Optical multi-pass cell for TDLAS analysis of human breath

V.V. Vasinovich[1], A.D. Pivovarov[2], M.S. Khadjaev[3], A.S. Grishkanich[4], S.A. Davydov[5]; [1]Photonic Systems; [2]ITMO University, Russia; [3]Tashkent University of Information Technologies, Uzbekistan; [4]LLC Kobaklab, Russia; [5]Halitus GmbH, Germany

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

ThR04-p04 10:00-13:30

Metrological assurance of frequency-stabilized lasers

K.V. Chekirda, Z.V. Fomkina, N.A. Kononova, Yu.G. Zackharenko; Mendeleyev Institute for Metrology (VNIIM), Russia

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

ThR04-p05 10:00-13:30

New method of controlling the axis of laser radiation in Anderson differential cuvette in mobile refractometer

D.S. Provodin, M.A. Yakusheva, N.A. Riabogina, A.A. Goldberg, I.D. Kochetkov, V.V. Davydov; Peter the Great St. Petersburg Polytechnic University, Russia

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

ThR04-p06 10:00-13:30

Beam profiles and radiation coherence at the output of solid-state and dye lasers with an intra-cavity immersion diffuser

O.A. Burdukova[1,2], A.L. Koromyslov[1], V.A. Petukhov[1], Yu.V. Senatsky[1]; [1]Lebedev Physics Inst. RAS; [2]Sechenov Univ., Russia

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

ThR04-p07 10:00-13:30

Refractive phase masks for lensless laser beam shaping

D.A. Radnatarov[1], A.Yu. Kokhanovskiy[2], P.V. Kozmina[1], S.M. Kobtsev[1]; [1]Novosibirsk State University; [2]ITMO University, Russia

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

ThR04-p08 10:00-13:30

Application of piezoactuators to provide the required resolution of laser interferometers

E.A. Lavrov; Russian Research Institute of Physical, Technical and Radiotechnical Measurements (FSUE “VNIIFTRI”), Russia

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

ThR04-p09 10:00-13:30

Peculiarities of laser beam parameters control a during goniometric measurements of biological liquids refractive index

B.K. Reznikov[1], G.V. Stepanenkov[1], V.V. Davydov[2], N.Yu. Kolybelnikov[1], D.V. Oaserele[1], E.A. Logvinova[1]; [1]The Bonch-Bruevich St. Petersburg State University of Telecommunications; [2]Peter the Great St. Petersburg Polytechnical University, Russia

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

ThR04-p10 10:00-13:30

Using neural networks to reconstruct the wavefront of laser radiation based on the focal distribution of fluence near the waist

A.V. Kotov, A.A. Soloviev; Federal Research Center Institute of Applied Physics RAS, Russia

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

ThR04-p11 10:00-13:30

Laser switching of VO_2 attenuator in pulse-periodic mode

A.A. Antonov, I.M. Belousova, A.P. Zhevlakov, A.S. Narivonchik; Vavilov State Optical Inst., Russia

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

ThR04-p12 10:00-13:30

Constructing confocal Fabry-Perot cavity to stabilize multiple lasers for $40Ca^+$ optical qubit

S. Zarutskiy[1,2], A.O. Kadykov[1], L.A. Akopyan[1], A. Matveev[1], N.V. Morozov[1], K. Lakhmanskiy[1]; [1]Russian Quantum Center; [2]Moscow State Univ., Russia

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

ThR04-p13 10:00-13:30

Coherent beam combining of a multichannel fiber laser with an automatic alignment system

N.M. Rakcheev, S.V. Tyutin, V.S. Tsykin, M.I. Konovaltsov; Russian Federal Nuclear Center All-Russian Research Institute of Experimental Physics, Russia

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

ThR04-p14 10:00-13:30

Laser noise reduction with additional filtering resonator

A.P. Gordeev[1,2], Navjeet Kour[2,3], I.B. Bobrov[1,2], S.S. Straupe[1,2], S.P. Kulik[1,2]; [1]Faculty of Physics, Lomonosov Moscow State University, [2]Quantum Technology Center, Moscow State University, [3]Moscow Institute of Physics and Technology, Russia

Rydberg states in quantum computer based on neutral atoms are obtained by shining on the array of cold atoms with two lasers. Stability of the driving lasers and noise reduction are required for high fidelity of quantum gates. Theoretical analysis and experimental setup of PDH-locking scheme with additional filtering resonator will be presented.

ThR04-p15 10:00-13:30

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

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

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

ThR04-p16 10:00-13:30

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

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

The spectral properties of inorganic glasses with I-VII and II-VI nanocrystals and quantum dots are investigated. Nanosized copper halide and cadmium chalcogenide crystals stabilized fin glass matrix are shown to be a perspective material for nonlinear optical limiting.

R09: OPTICAL NANOMATERIALS - POSTERS

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

ThR09-p01 15:00-18:30

Production of hybrid materials in the MF_2 (M=Ba,Ca):Liq system by co-precipitation

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

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

ThR09-p02 15:00-18:30

Fast-slow light effects of chirped laser pulses in epsilon-near-zero nanorods based metamaterials

A.A. Dotsenko, V.B. Novikov, A.P. Leontiev, K.S. Napolskii, T.V. Murzina; Lomonosov Moscow State University, Russia

Experimental and numerical studies of fast and slow light effects under the propagation of chirped femtosecond laser pulses in epsilon-near-zero metamaterials based on the array of metal nanorods are carried out. We show that the chirp brings about additional control over the fast-slow light regimes.

ThR09-p03 15:00-18:30

Antireflection microstructures on ZnSe fabricated by wet-etching-assisted femtosecond laser ablation

A.A. Teslenko[1], T.G. Konstantinova[2], A.A. Bushunov[1], A.R. Ibragimov[2], I.A. Rodionov[2,3], M.K. Tarabrin[1]; [1]Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical University, [2]Functional Micro- and Nano- Systems, Bauman Moscow State Technical University, Russia

We report an increase of the ZnSe transmittance up to 98% in the mid- and far-IR using antireflection microstructures (ARMs) fabricated with femtosecond laser ablation assisted with wet chemical etching.

ThR09-p04 15:00-18:30

Optical crystals and ceramics based on the $AgCl_{0.25}Br_{0.75}$-TlI system as scintillator materials

P.V. Pestereva, I.V. Yuzhakov, D.D. Salimgareev, A.E. Lvov, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia

The work is devoted to the study of the phase diagram of the AgCl0.25¬Br0.75 – TlI system. Based on the results, homogeneous and heterogeneous regions were established where it is possible to grow single crystals and synthesize optical ceramics. Single crystals and ceramics of this system are intended for use as fibers and scintillators

ThR09-p05 15:00-18:30

Photoluminescence enhancement and Förster resonant energy transfer in a nanoporous alumina-silver nanoparticles hybrid structure

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

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

ThR09-p06 15:00-18:30

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

N.N. Rozhkova[1], V.V. Kononenko[2], A.V. Osipov[3], V.D. Samyshkin[3], A.S. Abramov[3], A.O. Kucherik[3]; [1]Karelian Research Centre RAS; [2]Natural Sciences Center of General Physics Institute, Prokhorov General Physics Institute RAS; [3]Department of Physics and Applied Mathematics, Vladimir State University Named after AG and NG Stoletovs, Russia

An experimental method was developed for synthesizing thin metallcarbon films consisting of linear carbon chains stabilized by gold nanoparticles. The uniqueness of this method lies in the simultaneous laser-induced decomposition of amorphous carbon and aqueous chloroauric acid, but it is more effective for forming thin films consisting of multiple linear chains.

ThR09-p07 15:00-18:30

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

E.A. Granizo[1], I.S. Kriukova[1,2], P.S. Samokhvalov[1,2], I.R. Nabiev[1,2,3]; [1]Laboratory of Nano-Bioengineering, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia; [2]Life Improvement by Future Technologies (LIFT) Center, Skolkovo, Russia; [3]Laboratoire de Recherche en Nanosciences (LRN-4682), Université de Reims Champagne-Ardenne, France

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

ThR09-p08 15:00-18:30

Direct aqueous synthesis of Mn-doped ZnInS/ZnS: the effect of the impurity on singlet oxygen generation and photo-thermal profiling

R. Maluleke[1,2], S.O. Oluwafemi[1,2]; [1]Department of Chemical Sciences, University of Johannesburg, [2]Centre for Nanomaterials Science Research, University of Johannesburg, South Africa

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

ThR09-p09 15:00-18:30

Upconversion responsivity of 4F9/2-4I15/2 transition of erbium in $NaYF_4$ matrix at high power pump

I. Asharchuk[1], N. Vovk[1], Yu. Bondareva[3], I. Filippov[1], A. Kravchenkov[1,2], M. Babaev[1,2], Y. Anufriev[1,2], M. Tarkhov[1,2]; [1]Institute of Nanotechnology of Microelectronics RAS, [2]National Research University "Moscow Power Engineering Institute", [3]Skolkovo Institute of Science and Technology, Russia

In this work is shown investigations the luminescence behavior of the erbium 4F9/2 - 4I15/2 transition in a NaYF4 crystalline matrix doped with Yb and Er ions, over a wide range of pump power with a wavelength of 980 nm.

ThR09-p10 15:00-18:30

Multiple optical switching of GST thin films for reflective display applications

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

The crystallization/amorphization processes of GST thin films under pulsed laser exposure were investigated. It was found that the optimal laser mode for GST crystallization and re-amorphization is 50 mW/10 µs and 106 mW/50 ns respectively. We demonstrate the 11-multiple write/ rewrite/ uniform-area of GST on the surface of large-size GST/ITO/Al/ substrate structure for reflective display applications.

ThR09-p11 15:00-18:30

Galleries of bound states in the continuum of dielectric objects: ring, split ring, cuboid

N. Solodovchenko[1], K. Samusev[1,2], M. Limonov[1,2]; [1]Department of Physics and Engineering, ITMO University; [2]Ioffe Institute, Russia

In our world, most phenomena are described by non-Hermitian physics, which gave us, for example, bound states in continuum (BIC) with a big quality factor. The main result of this work is the discovery of a new effect: cascades of BIC in various dielectric objects, such as a ring, a split ring and a cuboid.

ThR09-p12 15:00-18:30

Study of the effective optical characteristics of metal surfaces using terahertz surface plasmon interferometry

V.S. Vanda[1,2], V.V. Gerasimov[1,2], A.K. Nikitin[3]; [1]Budker Institute of Nuclear Physics SB RAS; [2]Novosibirsk State University; [3]Scientific and Technological Centre of Unique Instrumentation RAS, Russia

The theoretical and experimental studies of the effective optical constants of metal surfaces in the THz frequency range using dynamic plasmon interferometry will be presented. It was shown that the length of propagation of surface plasmon polaritons over conductors, as well as their optical constants, significantly depend on the surface metal roughness.

ThR09-p13 15:00-18:30

Lasing of polymer microspheres doped with $AgInS_2$ quantum dots and plasmonic nanoparticles

E.O. Soloveva[1], K. Kurassova[1], K.V. Bogdanov[1], A.A. Starovoytov[1], N.A. Toropov[2], N.N. Shevchenko[3], T.A. Vartanyan[1]; [1]ITMO University, Russia; [2]Univ. of Southampton, United Kingdom; [3]Inst. of Macromolecular Compounds, Russia

Whispering-gallery mode (WGM) microlasers were made of polystyrene microspheres in an aqueous solution of plasmonic nanoparticles and AgInS2 quantum dots. The emission spectra of doped microspheres exhibited narrow peaks corresponding to WGM. The presence of silver and gold nanoparticles reduces the emission intensity and, in the case of gold, simultaneously increases the microlaser quality factor.

ThR09-p14 15:00-18:30

Luminescent hybrid materials in the PbF_2:Znq2 system synthesized by co-precipitation method

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

Powder hybrid materials based on the organic phosphor bis(8-hydroxyquinoline) zinc (II) and the inorganic matrix of lead fluoride are considered. Hybrid materials were obtained by co-precipitation from aqueous-alcoholic solutions with ammonium fluoride under different conditions - different concentrations of organic and inorganic components, the order of mixing the reagents.

ThR09-p15 15:00-18:30

Coalescence of III-V and III -nitride nanowires

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

We study theoretically the nanowire coalescence process and present the structural diagrams separating the domains of partial or full coalescence depending on the presence or absence of a catalyst droplet at the NW tip and the epitaxy technique (either directional MBE method or vapor phase epitaxy).

ThR09-p16 15:00-18:30

Magnetic control of coherent tunneling in hybrid magnetic-dielectric integrated waveguides

O.V. Borovkova[1,2], A.A. Kolosova[1,3], V.I. Belotelov[1,2]; [1]Russian Quantum Center; [2]Lomonosov Moscow State University; [3]Moscow Institute of Physics and Technology, Russia

Magnetic control of the light routing and transfer in the integrated planar waveguide structure that combined both magnetic (iron garnet) and nonmagnetic (quartz) waveguides on the silicon dioxide chip based on the coherent tunneling by adiabatic passage (CTAP) is addressed. The effect is studied for two different directions of the external magnetic field.

ThR09-p17 15:00-18:30

Modeling approaches for the compositional control in ternary nanowires and heterostructures

E.D. Leshchenko[1], V.G. Dubrovskii[2]; [1]Submicron Heterostructures for Microelectronics, Research and Engineering Center RAS; [2]Faculty of Physics, St. Petersburg State University, Russia

The critical step in nanowire-based device design is the ability to control the nanowire composition. The shift of the research focus toward the investigation of more complex materials was accompanied by the development of a variety of models. Here we present recent progress in modeling strategies for the stationary compositions of ternary nanowires and the interfacial abruptness of the heterointerface.

ThR09-p18 15:00-18:30

Vibrational spectroscopy of Yb_2O_3, Nd_2O_3@Bi_2O_3 material

D.A. Artamonov, A.V. Tsibulnikova, I.G. Samusev, V.V. Bryukhanov; REC «Fundamental and Applied Photonics, Nanophotonics», Immanuel Kant Baltic Federal University, Russia

In this work, the synthesis of Yb2O3, Nd2O3@Bi2O3 was carried out and the vibrational spectroscopy of the obtained complex of different concentrations was investigated. Based on the results of vibrational spectroscopy, it was found that the Raman spectrum of the Nd2O3/Yb2O3 oxide mixture shows an increase in the intensity of vibrational bands after sintering at T=750C.

ThR09-p19 15:00-18:30

High-purity glasses for fiber optics

T.S. Letyagin[1], V.A. Solomatina[2], M.B. Grishechkin[1], A.D. Barkanov[2], I.Ch. Avetissov[1]; [1]The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology; [2]N.D. Zelinsky Institute of Organic Chemistry RAS, Russia

The properties of 0.2 ZnO – 0.8TeO2 glasses with different synthesis conditions were synthesized and studied. Er2O3, Yb2O3, Nd2O3 in the composition of 0.1% were used as dopants. High-purity tellurium oxide (5N) and high-purity zinc oxide (5N) are used as the main matrix material. The resulting glasses can be used for fiber optics or detectors of IR radiation.

ThR09-p20 15:00-18:30

Red-emissive carbon dots: machine learning for prediction and optimization of properties

V.S. Tuchin[1], E.A. Stepanidenko[1], A.A. Vedernikova[1], S.A. Cherevkov[1], E.V. Ushakova[1,2]; [1]International Research and Education Centre for Physics of Nanostructures, ITMO University, Russia; [2]Department of Materials Science and Engineering, and Centre for Functional Photonics (CFP), City University of Hong Kong, China

Development of nanotechnology opens a way to control the properties and performance of nanostructured materials at atomic scale. However, existed trial-and-error approach for synthesis of such materials is time-consuming, not effective considering cost of materials and manpower. Machine learning approaches may help to overcome this limitation. Here, we investigated the property-synthesis parameters relation via machine learning for red-emissive carbon dots.

ThR09-p21 15:00-18:30

High thermal tunability of optical transmission of Epsilon-Near-Zero metamaterials based on nanorods in liquid crystals

V.B. Novikov, A.K. Zagravskii, S.V. Sotnichuk, N.K. Davidenko, A.Yu. Bobrovsky, K.S. Napolskii, T.V. Murzina; Lomonosov Moscow State University, Russia

We revealed a salient thermal effect in the transmission of the epsilon-near-zero metamaterial consisting of an array of plasmonic nanorods in a dielectric template. The flavor of the structure is free-standing nanorod segments surrounded by liquid crystals possessing a strong thermal dependence of the permittivity. The observed resonant enhancement of the thermal sensitivity harnesses nonlocal optical response of the structure.

ThR09-p22 15:00-18:30

Study of light-emitting properties in a GaNPAs heterostructure on silicon

L.N. Dvoretckaia[1], A.M. Mozharov[1,2], A.S. Funtikova[1,2], V.V. Fedorov[1,2], I.S. Mukhin[1,2]; [1]Alferov University, [2]Peter the Great St. Petersburg Polytechnic University, Russia

The work demonstrates the results of a study on the creation of a matrix structure based on a p-i-n GaP/GaPNAs/GaP diode on Si.

ThR09-p23 15:00-18:30

2,5 μm photodetectors based on MBE grown InAlAs/InGaAs/InP metamorphic heterostructures

E.I. Vasilkova[1], E.V. Pirogov[1], K.Yu. Shubina[1], O.V. Barantsev[1], K.O. Voropaev[2], A.A. Vasil'ev[2], L.Ya. Karachinsky[1,3], I.I. Novikov[1,3], M.S. Sobolev[1]; [1]Alferov University, [2]JSC "OKB-Planeta", [3]ITMO University, Russia

This work reports on In0.83Ga0.17As/InP pin-photodiodes based on heterostructures with InAlAs metamorphic buffer layers grown by molecular beam epitaxy. The fabricated photodiodes are sensitive to 2,5 um light source as shown by the current-voltage characteristics. The measured photodiode dark current is ~ 300 nA under 10 mV reverse bias voltage.

ThR09-p24 15:00-18:30

Fabrication of nanostructures by femtosecond laser exposure of thin Au films with zero-order vortex beam retarder

V.A. Gulinyan, E.I. Ageev, D.A. Zuev; ITMO University, Russia

This study demonstrates nanostructures formation using single-shot femtosecond laser exposure on a thin gold film with zero-order vortex beam retarders. The research investigates the influence of the focused laser beam on the produced nanostructures and explores the dependencies of sizes and types on laser fluence. The proposed method simplifies fabrication and allows scaling up the production of arrays of nanostructures.

ThR09-p25 15:00-18:30

Optical properties of self assembled aligned single walled carbon nanotubes

A. Ismaeel[1,2], I.O. Orekhov[1], N.R. Arutyunyan[3], S.G. Sazonkin[1], D.A. Dvoretskiy[1], L.K. Denisov[1], V.E. Karasik[1], E.D. Obraztsova[2,3]; [1]Bauman Moscow State Technical University; [2]Moscow Institute of Physics and Technology; [3]Prokhrov General Physics Institute, Russia

The self – assembly method was used to prepare aligned single - walled carbon nanotubes for application as a saturable absorber in ultrashort pulses lasers. The nonlinear characteristics of the prepared aligned nanotubes film were compared to typical film with random nanotubes. The saturable absorber modulation depth was increased by 6% due to the alignment features.

ThR09-p26 15:00-13:30

A method for creating a metasurface based on titanium dioxide

V.D. Samyshkin[1], S.V. Kavokina[2,3], A.S. Abramov[1], A.V. Osipov[1], S.P. Essaka[1], N.A. Halimov[1], D.A. Bodunov[1], A.V. Kavokin[2,3]; [1]1D-Laboratory, Vladimir State University Named after AG and NG Stoletovs, Russia; [2]School of Science, Westlake University, Hangzhou, China; [3]Institute of Natural Science, Westlake University, Hangzhou, China

This article describes a method for creating a metasurface based on titanium dioxide, which can be used to design photosensitive elements capable of converting solar energy into electricity. The addition of metallic nanoparticles and long linear carbon chains changes the optical properties.

ThR09-p27 15:00-18:30

New materials for optical fibres based on oxochloride lead-tellurite glasses

A.M. Vasilenkova[1], D.A. Butenkov[1], K.I. Runina[1], A.A. Pynenkov[2], M.A. Uslamina[2], M.B. Grishechkin[1], O.B. Petrova[1]; [1]The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology; [2]Institute of High Technologies and New Materials, National Research Mordovia State University, Russia

Glasses in the PbCl2-TeO2 system were synthesized from high-purity starting materials. The glasses have record low absorption of hydroxyl groups, wide range of transparency and good crystallization stability. The materials are promising for drawing optical fibers.

ThR09-p28 15:00-18:30

Electromagnetic hot spots in dielectric cylindrical and ring resonators

K.A. Bronnikov, A.P. Chetverikova, N.S. Solodovchenko; ITMO University, Russia

The results of theoretical and experimental study of photonic resonances accompanied by the appearance of electromagnetic hot spots in subwavelength dielectric ring resonators and cylinder-ring dimers will be presented. The dependencies of these effects on geometrical and material parameters of the resonators will be discussed.

ThR09-p29 15:00-18:30

Aluminum metasurface as a booster for chemiluminescence sensors

D.R. Dadadzhanov, N.S. Petrov, A.V. Palekhova, T.A. Vartanyan; IR&EC PhysNano, ITMO University, Russia

Chemiluminescence, notwithstanding its relatively low yield, is an important transduction mechanism for chemical and biological sensors. To extend the applicability of chemiluminescence sensors in more demanding situations we explore the opportunity to enhance the chemiluminescence intensity via acceleration of radiation transitions which is known to be possible in the vicinity of a periodic array of nanoparticles possessing plasmon resonances.

ThR09-p30 15:00-18:30

Heavy glasses based on lead-gallate system for IR applications

O.B. Petrova, A.B. Terekhova, D.A. Butenkov, K.I. Runina; The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, Russia

Heavy lead-gallate glasses were synthesized in a wide range of compositions. Spectroscopic studies have shown that the system is promising for applications in the infrared spectral region. The glasses have good transmittance, low absorption of hydroxyl groups and are stable to crystallization.

ThR09-p31 15:00-18:30

Surface modification of gold nanoparticles with small molecules

Yu.A. Podkolodnaya, K.R. Kalishina, E.A. Zobnina, D.V. Tsyupka, E.A. Khudina, A.A. Bakal, A.M. Abramova; Chemical Institute, Saratov State University, Russia

Surface chemistry is frequently employed to surface functionalize nanoparticles. The surface modification option is influenced by the further use of nanoparticles. To obtain AuNPs with different functional groups, simultaneous modification of AuNPs with folic acid and polymer was carried out using hydrothermal synthesis.

ThR09-p32 15:00-18:30

Fe^{2+} doped transparent lithium aluminosilicate glass-ceramics with broadband absorption in the spectral range of 2 μm

K.S. Trukhanova[1], O.S. Dymshits[1,2], S.S. Zapalova[2], I.P. Alekseeva[2], K.V. Bogdanov[3], M.Ya. Tsenter[2], M.I. Tenevich[1], V.I. Popkov[1], A.A. Zhilin[4]; [1]Center of Nanoheterostructure Physics, Ioffe Institute, [2]Glass Department, S.I. Vavilov State Optical Institute, [3]International Research and Education Center for Physics of Nanostructures, ITMO University, [4]D.V. Efremov Institute of Electrophysical Apparatus, Russia

Transparent thermal-shock resistant glass-ceramics of the lithium aluminosilicate system nucleated by titania and doped with ferrous ions have been developed. There structure, thermal-mechanical and optical properties were studied. Their broadband absorption in the spectral region of 1.5–2.5 μm is due to Fe2+ ions in tetrahedral positions in ɣ-Al2O3 nanocrystals.

ThR09-p33 15:00-18:30

Reusable SERS platform based on Na^+ - Ag^+ ion-exchanged glass

Y.M. Sgibnev[1], A.V. Shelaev[1], A.V. Baryshev[1]; [1]Dukhov Automatics Research Institute

Na+-Ag+ ion exchange of sodium-aluminosilicate glass and subsequent heat treatment in air is shown to result in growth of silver nanoisland films only on the glass surface. Properties of silver films are determined by heat treatment parameters. The proposed method allows to grow and remove silver nanoisland film repeatedly several times, paving the way for developing reusable SERS-active substrates.

ThR09-p34 15:00-18:30

Spectroscopy of thulium ions in novel oxychloride lead-tellurite glasses

D.A. Butenkov[1], A.M. Vasilenkova[1], K. Veselský[2,3], P. Loiko[2], A. Braud[2], P. Camy[2], O.B. Petrova[1]; [1]Department of Chemistry and Technology of Crystals, Mendeleev University of Chemical Technology, Russia; [2]Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, France; [3]Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Czech Republic

Thulium-doped oxychloride lead-tellurite glasses were synthesized, and their spectroscopic properties were studied focusing on Tm3+ emissions at 2 - 3 μm. Tm3+ ions exhibit relatively long luminescence lifetimes of the 3H4 and 3F4 states owing to the low-phonon-energy behavior of the glass matrix.

ThR09-p35 15:00-18:30

Optical properties of modulated structures in chiral liquid crystals

P.V. Dolganov[1,2], K.D. Baklanova[1,2], V.K. Dolganov[1]; [1]Osipyan Institute of Solid State Physics RAS; [2]National Research University Higher School of Economics, Russia

Chiral liquid crystals form a number of modulated structures with unusual properties. Here we report experimental studies of the two-dimensional structure forming near the cholesteric-isotropic phase transition. Complex optical patterns with strong nontrivial dependence of the images on light polarization were found and investigated in transmission and reflection.

ThR09-p36 15:00-18:30

Multilayer mirrors based on rubidium for soft X-ray range

M.A. Yamschikova[1,2], V.M. Yamschikov[1]; [1]FSUE "RFNC-VNIIEF", [2]Lomonosov Moscow State University, Russia

This work examines multilayer X-ray mirrors of various compositions. Using a genetic algorithm, a search for optimal layer thicknesses is implemented for each mirror while maximizing reflectivity. Record theoretical reflectance limits of 78% at 13.5 nm and 83% at 17.04 nm are reported.

ThR09-p37 15:00-18:30

High-quality ultrathin metal films for plasmonics and optoelectronics

D.I. Yakubovsky[1], M.S. Mironov[1], D.V. Grudinin[1], I.S. Kazantsev[1], A.A. Vyshnevyy[1], G.A. Ermolaev[2], A.V. Arsenin[1,2], V.S. Volkov[2]; [1]Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, Russia; [2]Emerging Technologies Research Center, XPANCEO, Dubai Investment Park First, Dubai, United Arab Emirates

We propose a new method of making high-quality ultrathin gold films what optoelectronic properties are comparable to bulk gold. Excellent plasmonic response were confirmed by observing surface plasmon polaritons using scanning near-field optical microscopy and ellipsometry. The results pave the way for the use of ultrathin gold films in flexible and transparent nanophotonics and optoelectronic applications.

ThR09-p38 15:00-18:30

Photocatalytic activity of TiO_2/rGO/CdS nanocomposite

T.M. Serikov, N.H. Ibrayev, E.V. Seliverstova; Institute of Molecular Nanophotonics, Buketov Karaganda University, Kazakhstan

The results of a study of the effect of the concentration of CdS nanoparticles in the TiO2/rGO nanocomposite on its photocatalytic activity are presented. The introduction of CdS into TiO2/rGO leads to an increase in its photocatalytic activity due to the expansion of spectral sensitivity in the visible wavelength range and enhanced charge-transport parameters.

ThR09-p39 15:00-18:30

Optical study of Er^{3+} and Nd^{3+}/Yb^{3+}-doped CeO_2 and CeO_2 / CeF_3 nanoparticles

A.K. Ginkel[1], R.M. Rakhmatullin[1], O.A. Morozov[1,2], S.L. Korableva[1], V.V.Semashko[1,2], M.S. Pudovkin[1]; [1]Kazan Federal University, Institute of Physics, [2]Zavoisky Physical-Technical Institute, FRC Kazan Scientific Center RAS, Russia

Here, the facile dry synthesis of double-phase CeO2/ CeF3 nanoparticles doped with Er3+ or Nd3+/Yb3+ ions. The influence of the two-phase composition of nanoparticles on the luminescent properties of Er3+ and Nd3+/Yb3+ is also considered. The intensity of Er3+ increases by 3.5 times after fluorination. After the formation of two-phase Nd3+/Yb3+:-CeO2/CeF3 samples, emissions of both Nd3+ and Yb3+ are observed.

ThR09-p40 15:00-18:30

Photoluminescence enhancement of nanowires in IR-range induced by surface plasmon

T.M. Shugabaev[1,2], V.O. Gridchin[1,2,3], P. Bulkin[4], I.A. Melnichenko[2,5], A.A. Maksimova[2,6], K.P. Kotlyar[1,2,3], V.V. Lendyashova[1,2], K.V. Lickachev[7], N.V. Kryzhanovskaya[5], R.R. Reznik[1], G.E. Cirlin[1,2,3]; [1]St. Petersburg State Univ.; [2]Alferov Univ.; [3]Inst. for Analytical Instrumentation RAS; [4]LPICM CNRS, Ecole Polytechnique, IP Paris, France; [5]HSE Univ.; [6]St. Petersburg Electrotechnical Univ. "LETI"; [7]Ioffe Inst., Russia

Nanowires are promising solids for creating efficient optoelectronic and nanophotonic devices. Here, we study the optical properties of single InP/InAsP/InP nanowire transferred to Ag/SiOx plasmonic substrate. For the first time, photoluminescence enhancement for these nanowires due to exciton-plasmon interaction was demonstrated.

ThR09-p41 15:00-18:30

Photoluminescent aerogels with RGB emission

K.I. Runina[1], D.A. Korneev[2], I.Ch. Avetissov[1], N.V. Menshutina[3], A.E. Lebedev[3], E.N. Suslova[3], T.S. Vlasova[1,4], I.V. Taydakov[5]; [1]The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology; [2]The Department of Cybernetics of Chemical and Technological Process, D. Mendeleev University of Chemical Technology; [3]The Department of Chemical and Pharmaceutical Engineering, D. Mendeleev University of Chemical Technology; [4]Laboratory of Photoelectronic Systems, N.D. Zelinsky Institute of Organic Chemistry RAS; [5]S.I. Vavilov Department of Luminescence, Lebedev Physical Institute RAS, Russia

Three new luminescence aerogels based on silica matrix and -diketone complex with Eu(III) and 8-hydroxyquinoline complexes with Al(III) and Ca(II) have been synthesized and investigated. The obtained aerogels had PL maxima in the red, green, and blue regions of the visible range, respectively.

ThR09-p42 15:00-18:30

Vertical subwavelength grating coupler inspired by the moth's eye metasurface

I. Kazakov, A.V. Shipulin; ScolTech, Russia

We propose a new design principle for vertical grating couplers for integrated photonics. The principle is based on breaking the symmetry of the waveguide stripe using a moth's eye-inspired metamaterial. Our simulations of the grating coupler on a 220 nm SOI material platform show a coupling efficiency of 28% and unidirectionality of over 31 dB.

ThR09-p43 15:00-18:30

Polarization coupling in a bent otical waveguide based on thin film lithium niobate

D.N. Moskalev[1,2], E.D. Voblikov[1], V.V. Krishtop[1,2,3]; [1]Perm Scientific-Industrial Instrument Making Company; [2]Perm State University; [3]Perm National Research Polytechnic University, Russia

In the present paper the simulation of modes in waveguides based on thin film lithium niobate was performed. Further, the coupling coefficients depending on the waveguide angle were obtained. The results showed the maximal absolute value of the coupling coefficient was 0.013, which corresponds to direction of the waveguide at an angle of 50°.

ThR09-p44 15:00-18:30

Preparation and optical properties of transparent spinel-based glass-ceramics containing Fe(II) ions

O. Dymshits[1,2], V. Bukina[2], K. Eremeev[3], K. Trukhanova[1], S. Zapalova[2], I. Alekseeva.2, L. Basyrova[4], K. Bogdanov[5], A. Volokitina[2], M. Tsenter[2], P. Loiko[3], V. Popkov[1], A. Zhilin[6]; [1]Center of Nanoheterostructure Physics, Ioffe Institute, [2]Glass Department, S.I. Vavilov State Optical Institute, Russia; [3]Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), Université de Caen Normandie, France; [4]Université de Franche-Comté, CNRS, Institut FEMTO-ST, France; [5]International Research and Education Center for Physics of Nanostructures, ITMO University, Russia; [6]D.V. Efremov Institute of Electrophysical Apparatus, Russia

Transparent glass-ceramics of magnesium, lithium-gallium, lithium, and zinc aluminosilicate systems based on Fe2+-doped nanocrystals with spinel structure are developed by secondary heat-treatments of glasses melted in reducing conditions using TiO2 or a mixture of TiO2 and ZrO2 as nucleating agents. Their structure and optical properties are studied. The glass-ceramics are promising as saturable absorbers for lasers operating at ~2 µm.

ThR09-p45 15:00-18:30

Plasmon effect on energy transformation of electronic excitation in molecular systems

N.Kh. Ibrayev[1], E.V. Selievrstova[1], M.G. Kucherenko; [1]Buketov Karaganda University, Kazakhstan; [2]Orenburg State University, Russia

The influence of plasmon metal nanoparticles on intra- and intermolecular electronic processes in condensed matters has been studied. The transient absorption of plasmon nanoparticles as well as competitive effect of plasmonic enhancement of fluorescence and Förster energy transfer in the “chromophores/plasmon nanoparticles” system, and plasmonic effect on singlet-singlet and triplet-singlet energy transfer in the same donor-acceptor pair was considered.

ThR09-p46 15:00-18:30

Luminescence temperature sensing based on spectral characteristic of CeF_3 - TbF_3 - YF_3 nanoparticles

S.I. Kalinichenko, A.S. Nizamutdinov, M.S. Pudovkin; Kazan Federal University, Institute of Physics, Russia

Luminescence intensity ration Ce3+ and Tb3+ peaks was used as a temperature-dependent parameter (303-523K range). The LIR functions decay with the increase of temperature and depends on Tb3+ concentration. We suggest, that this is due to the competition of two processes: multiphonon non-radiate transition of Tb3+ from 5D3 to 5D4 and cross-relaxation between Tb3+ ions, which was considered less temperature-dependent.

ThR09-p47 15:00-18:30

Ultrafine precursor for laser sintering of Er:YAG-20Bi_2O_3-60B_2O_3-20BaO glass ceramics

A.D. Plekhovich, A.M. Kut'in, E.E. Rostokina, M.E. Komshina, K.V. Balueva, K.F. Shumovskaya; Devyatykh Institute of Chemistry of High Purity Substances RAS, Russia

A method has been developed for producing an amorphous ultrafine precursor with different ratios of Er:YAG and 20Bi2O3-60B2O3-20BaO. The method of selective laser sintering has been used to demonstrate the possibility of forming functional glass ceramics with a crystalline phase represented by yttrium aluminum garnet and yttrium/erbium borate.

ThR09-p48 15:00-18:30

Thin film GeTe and $Ge_2Sb_2Te_5$ for photonic applications

A.A. Burtsev, A.V. Kiselev, V.V. Ionin, A.A. Nevzorov, V.A. Mikhalevsky, N.N. Eliseev, A.A. Lotin; NRC «Kurchatov Institute», Russia

Thin film phase-change materials (PCM) such as germanium telluride are commonly utilized in photonic and optoelectronic devices. This study presents a reversible alteration in the optical properties of thin-film samples due to phase transitions under the influence of pulsed laser radiation using the pump-probe scheme.

ThR09-p49 15:00-18:30

A model of the process of forming the optimal fractional composition of powders during compaction

A.V. Kharkova, K.A. Frolov, D.A. Kochuev, R.V. Chkalov, D.G. Chkalova; Vladimir State University named after A. G. and N. G. Stoletov, Russia

A mathematical model for estimating the optimal fractional composition of the powder for compaction has been developing. The model has been testing on the data of fractional compositions of three mixtures. The laying of the powder mixture is modeling using the finite element method.

ThR09-p50 15:00-18:30

Photoluminescence enhancement of InGaN core-shell nanowires via wet chemical treatment

V.O. Gridchin[1,2,3], A.S. Kulagina[2], T. Shugabaev[1,2], A.I. Khrebtov[1], V.V. Lendyashova[1,2], I.S. Makhov[4], Yu.B. Samsonenko[2,3], R.R. Reznik[1,2,3], G.E. Cirlin[1,2,3]; [1]St. Petersburg State University; [2]Alferov University; [3]IAI RAS; [4]HSE University, Russia.

It has been revealed that removing the shell of spontaneously formed InGaN nanowires increases the amplitude and narrows their emission spectrum. It has been established that radiative recombination dominates in the nanowires. And the dependence of the integrated photoluminescence intensity on the pump power for nanowires after etching is superlinear in comparison with the initial ones.

ThR09-p51 15:00-18:30

Ultrathin GaN epitaxial layers for UV sensing

O.A. Sinitskaya[1], K.Yu. Shubina[1], A.M. Mizerov1, M.S. Sobolev[1], E.V. Nikitina[1,2]; [1]Nanoelectronics lab., Alferov University, [2]Ioffe Institute, Russia

Ultrathin GaN epitaxial layers are grown on Si(111) substrates by plasma assisted molecular beam epitaxy (PA MBE) and investigated. The UV photodetectors based on epilayers obtained are formed and their I-V and transient photoresponse on-off characteristics are studied. It is shown that GaN epitaxial layers with labyrinth-like morphology are prospective for fast-response UV detectors development.

ThR09-p52 15:00-18:30

Luminescent properties of the Er^{3+}/Yb^{3+} co-doped Bi_2O_3-GeO_2 glasses

K.S. Serkina, J.V. Zhegucheva, K.I. Runina, I.V. Stepanova; Mendeleev Univ. of Chemical Technology, Russia

Erbium and ytterbium co-doped bismuth-germanate glasses were synthesized and their luminescent characteristics have been investigated. It was shown that addition of these rare-earth oxides leads to an expansion of the luminescence spectral range of Bi2O3-GeO2 glasses (1100-1650 nm). Luminescence range broadening as well as luminescence enhancing was achieved by excitation energy transfer between Er3+, Yb3+ and bismuth active centers.

ThR09-p53 15:00-18:30

Femtosecond laser-induced optical anisotropy in thin chalcogenide vitreous semiconductor films

D.V. Shuleiko[1], E.V. Kuzmin[1], P.P. Pakholchuk[1], D.V. Pepelyaev[2], T.S. Kunkel[1,3], S.V. Zabotnov[1], P.K. Kashkarov[1]; [1]Faculty of Physics, Lomonosov Moscow State University; [2]Institute of Advanced Materials and Technologies, National Research University of Electronic Technology; [3]Moscow Institute of Physics and Technology, Russia

Femtosecond (515 nm, 300 fs) laser-induced periodic surface structures of various types were formed on As2Se3 vitreous semiconductor film. These structures have subwavelength (160±10 nm) or wavelength (480±10 nm) periods and form within the irradiated area independently or simultaneously, as a hierarchical structure. The formed structures demonstrate birefringence with the difference between the refractive indices up to 0.1.

ThR09-p54 15:00-18:30

Composite nanostructures for biomedical applications formed by femtosecond laser irradiation

D.T. Murashko[1], E.P. Otsupko[1], A.Yu. Gerasimenko[1,2]; [1]National Research Univ. of Electronic Technology; [2]I.M. Sechenov First Moscow State Medical Univ., Russia

Composite nanostructures were fabricated using carbon nanotubes, that were incorporated in bovine serum albumin matrix. Hardness and Young's modulus of the nanostructures with carbon nanotubes were 0.3 GPa and 5.9 GPa, respectively. The conductivity of the composite nanostructure were 33 µS. The possibility of transferring composite nanostructures to the skin surface has also been verified.

ThR09-p55 15:00-18:30

Dyakonov surface modes in an interfacial ring resonator

D.A. Chermoshentsev[1,2,3], I.I. Stepanov[1,3], O.V. Borovkova[1,4], A.V. Masalov[1], I.A. Bilenko[1,4], N.A. Gippius[2], S.A. Dyakov[2]; [1]Russian Quantum Center, [2]Skolkovo Institute of Science and Technology, [3]Moscow Institute of Physics and Technology, [4]Moscow State University, Russia

We predict the occurrence of Dyakonov surface modes in an anisotropic ring-shaped interface resonator. Our results indicate that for larger rings, the resonant conditions for these surface modes can be effectively described using the propagation constant of the Dyakonov surface waveguide mode in a straight interface waveguide. We examine the field structure of these modes.

ThR09-p56 15:00-18:30

Structural laser diagnostic for ordered substances, optical materials, and nanosystems

Ya.A. Fofanov, V.V. Manoilov; Institute for Analytical Instrumentation RAS, Russia

New prospects for laser polarization-optical diagnostics of structural features and fluctuations of ordered substances and functional materials are considered. Investigations of the polarization responses of optical materials and elements with a high degree of optical and structural homogeneity, magnetically ordered materials, perfect optical crystals, magnetic nanosystems (nanofluids) and other topical objects are described.

ThR09-p57 15:00-18:30

Void-free uniform gap filling between thick PECVD silicon nitride waveguides

A.M. Mumlyakov[1], N.Yu. Dmitriev[2], M.V. Shibalov[1], I.V. Trofimov[1], I.A. Filippov[1], A.A. Anikanov[1], I.A. Bilenko[2], M.A. Tarkhov[1,3]; [1]Institute of Nanotechnology of Microelectronics RAS, [2]Russian Quantum Center, [3]National Research University "Moscow Power Engineering Institute", Russia

In this research, we present a novel manufacturing technology for silicon nitride photonics, which is designed to address the issue of defects (voids) in areas where waveguides are closely situated.

ThR09-p58 15:00-18:30

Annealing of lead thin films on silicon

N.V. Sibirev[1], I.P. Soshnikov[2], I.V. Shtrom[3], I.V. Ilkiv[4]; [1]St. Petersburg State University; [2]Ioffe Institute; [3]IAI RAS; [4]Alferov University, Russia

III - arsenide nanowires are often grown via the vapor-liquid-crystal mechanism with foreign catalyst. Here we discuss the initial stage of nanowire growth with lead catalyst – annealing of thin film. The influence of thin film thickness, temperature, and time of annealing, was discussed.

ThR09-p59 15:00-18:30

Study of the oxygen defects influence on optoelectronic properties of single walled carbon nanotubes

M.I. Paukov[1], E.O. Chiglintsev[1], D.V. Krasnikov[2], G.A. Komandin[3], A.V. Gavdush[3], K.A. Brekhov[1,4], A.I. Chernov[1,5], A.G. Nasibulin[2], K.I. Zaitsev[3], A.V. Arsenin[1], V. Volkov[1], M.G. Burdanova[1,6]; [1]Center for Phot. and 2D Mat., Moscow Institute for Physics and Technology, [2]Center for Phot. Science and Engineering, Skoltech, [3]Prokhorov Institute of General Physycs RAS, [4]MIREA, [5]Russian Quantum Center, [6]Institute of Solid State Physics RAS, Russia

In this research we quantitatively study defect-induced changes of optoelectronic properties of single-walled cabon nanotubes. Based on the measurements, we suggest empirical laws of the parameters depending on the concentration of dopant. These results might be applicable for many potential applications, including sensors.

ThR09-p60 15:00-18:30

Pulse mode of optical exitating the MDMO-PPV polymer embadded in a porous silicon microcavity for detecting nitroaromatic compounds

O.K. Malyshev, I.L. Martynov, A.A. Chistyakov; National Research Nuclear University "MEPhI", Russia

This paper presents the results of a study of the time dependences of the fluorescence amplitude of the MDMO-PPV polymer under different optical excitation modes. Due to It's results, conclusions were drawn about the excitation parameters at which a further reduction of the average radiation intensity does not affect noticeably on the stability of the fluorescence of the polymer.

ThR09-p61 15:00-18:30

Enhanced chemiluminescence of luminol by silver and gold nanoparticles: investigating the role of particle size, shape, and concentration

A.V. Palekhova, D.V. Kononov, T.A. Vartanyan, D.R. Dadadzhanov; International Research and Education Center for Physics of Nanostructures, ITMO University, Russia

It was found that with the addition of a certain amount of metal nanoparticles, the intensity of luminol chemiluminescence increases, and this effect is observed at different pH levels. In addition, it was shown that the shape of metallic silver and gold nanoparticles in luminol solutions significantly affects the intensity of chemiluminescence.

ThR09-p62 15:00-18:30

Clarification of data on phase states in the Zn - Te - O system

O.N. Kuvaeva[1], S.A. Lukin[1], V.A. Solomatina[2], M.B. Grishechkin[1], A.D. Barkanov[2], I.Ch. Avetissov[1]; [1]The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology; [2]N.D. Zelinsky Institute of Organic Chemistry RAS, Russia

The cross section of the phase diagram of the Zn-Te-O system at a temperature of 823 K was clarified experimentally. During the work, the T-x cross section was studied within the chosen temperature and 6 monovariant equilibria were clarified. It has been demonstrated that the Zn2Te3O8 compound is shifted to the region of oxygen deficiency.

ThR09-p63 15:00-18:30

Enhancing the capabilities of generating THz vortices by utilizing advanced spiral zone plates based on carbon nanotubes

A.V. Radivon[1], G.M. Katyba[2,3], N.I. Raginov[4], A.V. Chernykh[5], A.S. Ezerskii[5], E.G. Tsiplakova[5], I.I. Rakov[4], M.I. Paukov[1], V.V. Starchenko[1], A.V. Arsenin[1], I.E. Spector[2], K.I. Zaytsev[2], D.V. Krasnikov[4], N.V. Petrov[5,6], A.G. Nasibulin[4], V.S. Volkov[1], M.G. Burdanova[1,2,3]; [1]Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, [2]Prokhorov General Physics Institute RAS, [3]Institute of Solid State Physics RAS, [4]Skolkovo Institute of Science and Technology, [5]ITMO University, Russia; [6]Qingdao Innovation and Development Center, Harbin Engineering University, China

Optical elements based on nanomaterials are increasingly found in the terahertz (THz) research. These materials offer compactness and unique properties such as flexibility and stretchability, which enable precise control of wave beams. In this work, we demonstrate an innovative approach to controlling the THz wavefront using spiral zone plates (SZPs) made of single-walled carbon nanotubes (SWCNTs).

ThR09-p64 15:00-18:30

Photoluminescence properties of YPO_4:Pr^{3+} nanoparticles in polystyrene nanocomposite films

B. Kahouadji[1], M. Lamine[1], O. Salim[1]; [1]Laboratory of Physical-Chemistry, University of Bejaia, Algeria

Inorganic-polymeric nanocomposites (NCs) have recently attracted tremendous attention from the scientific community. Owing to their reasonably low manufacturing costs, as well as the known physical and chemical properties of polymeric materials, they can be manipulated in different geometrical forms and with sufficiently large sizes.

ThR09-p65 15:00-18:30

Sodium modification effect on the Tm^{3+}-doped Bi_2O_3 - GeO_2 glasses NIR luminescence

K.S. Serkina, A.V. Korol, D.V. Volkova, K.I. Runina, I.V. Stepanova; The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology, Russia

Sodium-modified and thulium-doped bismuth-germanate oxide glasses were synthesized and their spectral-luminescent characteristics have been investigated. It was revealed that sodium modification and thulium doping improved the optical quality and luminescent characteristics of Bi2O3-GeO2 glasses.

ThR09-p66 15:00-18:30

Study of Terahertz transmission of metal halide optical materials

D.D. Salimgareev, A.E. Lvov, A.A. Yuzhakova, P.V. Pestereva, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia

A study was carried out of the AgCl0.25Br0.75 – TlCl0.74Br0.26 and AgCl0.25Br0.75 – TlBr0.46I0.54 systems optical materials' transmission in the infrared and terahertz regions. The data obtained will make it possible to produce a variety of optical products, including terahertz fiber optics for the creation of new generation equipment.

ThR09-p67 15:00-18:30

Optical free-standing waveguides with broadband prism couplers made by two-photon lithography

I.O. Batuev[1], A.N. Androsov[2], A.I. Maydikovskiy[1], D.O. Apostolov[1], T.V. Murzina[1]; [1]Lomonosov Moscow State University; [2]HSE University, Russia

We present a free-standing optical waveguide with prism adapters printed from polymer with two-photon laser lithography method. The diameter of the printed waveguides ranges from 0.5 to 2 micrometers and the length is 20 micrometers. We demonstrate experimentally obtained optical loss values ranging from 50% at wavelength 450 nm to 89% at 1300 nm, which are confirmed by numerical modeling.

ThR09-p68 15:00-18:30

Optical properties of silver halide single crystals and ceramics - promising materials for fiber optics

D.D. Salimgareev, A.E. Lvov, D.V. Shatunova, E.Y. Kabykina, P.V. Pestereva, L.V. Zhukova; Ural Federal University, Russia

A study of functional properties of single crystals and optical ceramics of the AgCl – AgBr0.7I0.3 system was carried out. The range of materials spectral transmission, the refractive index dispersion in a wide range of wavelengths, and the refractive index imaginary part have been determined. The results are the basis for modeling and manufacturing infrared fibers.

ThR09-p69 15:00-18:30

Laser formation of photocatalytically active TiO_2 coating

E.Y. Ponkratova[1], A.S. Shtumpf[1], A.M Kuzmichev[1], D.A. Rud'[2], E.I. Ageev[1], D.A. Sinev[2], D.A. Zuev[1]; [1]Faculty of Physics, ITMO University, [2]Institute of Laser Technologies, ITMO University, Russia

This work proposes the laser creation of TiO2 coatings with different anatase-rutile phase ratios on the surface of a titanium plate. Pulse repetition rate and scanning speed are used as variable laser parameters. It is shown that the structures are capable of accelerating the decomposition of the MB dye up to 6.3 times and can be used as efficient photocatalysts.

ThR09-p70 15:00-18:30

Temperature dependences of light emission and energy transfer in heterostructures with CdTe quantum wells of various thicknesses

N. Filosofov, A. Serov, V. Agekyan, I. Shtrom, S. Verbin; St. Petersburg State University, Russia

Understanding the mechanisms of excitation transfer is essential for optimizing the heterostructure design. We study CdTe/CdMgTe heterostructure with four quantum wells (QWs) of different thicknesses. Photoluminescence excitation (PLE) spectra reveal the coupling of QWs separated by thick barriers. The PLE spectra testify in favor of a resonant dipole-dipole interaction. The temperature behavior of QW photoluminescence depends on the excitation level.

ThR09-p71 15:00-18:30

Density functional theory study of In wetting layer formation during droplet epitaxy growth of InAs/AlGaAs quantum dots

D.D. Dukhan, S.V. Balakirev, M.S. Solodovnik; Southern Federal Univ., Russia

In this work we study effect where chemically active Al in substrate leads to increase in surface mobility of adatoms. Simulations showed that lack of As during wetting layer formation characteristic for droplet epitaxy growth allows In adatoms to form dimer rows that, as we hypothesize, shift their electron density towards Al weakening bonds of In adatoms with wetting layer.

ThR09-p72 15:00-18:30

Size-dependent properties of InAs quantum dots in Si

I. Ilkiv[1,2,3], V. Lendyashova[1,2], A. Khrebtov[1], V. Talalaev[4], B. Borodin[5], G. Cirlin[1,2,3]; [1]St. Petersburg State University; [2]Alferov University, Russia; [3]Institute for Analytical Instrumentation RAS, Russia; [4]Martin Luther University Halle-Wittenberg, Germany; [5]Ioffe Institute, Russia

The self-assembled InAs quantum dots (QDs) in silicon were fabricated by solid source molecular beam epitaxy on silicon using Volmer-Weber growth mode. The PL study revealed 1.6 µm emission from InAs quantum dots at 10K. As the InAs coverage decreased from 2 to 0.5 monolayers, the photoluminescence peak shifted from 1620 to 1580 nm and increased monotonously.

ThR09-p73 15:00-18:30

Laser synthesis of sp-carbon structures for nanophotonics

A.O. Kucherik[1], A.V. Osipov[1], V.D. Samyshkin[1], A.S. Abramov[1], N.A. Halimov[1], S.P. Essaka[1], D.S. Bodunov[1], A.V. Povolotskiy[2]; [1]1D-Laboratory, Vladimir State University named after A.G. and N.G. Stoletovs, [2]Institute of Chemistry, St. Petersburg State University, Russia

Here we study stable elongated carbon chains synthesized by the laser fragmentation technique in a colloidal solution. The mechanical stabilization of carbyne is achieved due to the electron bonding of carbon chains to gold nanoparticles. We demonstrated that high degree of alignment of the gold-terminated carbyne chains results in strongly anisotropic light absorption.

ThR09-p74 15:00-18:30

Lead-borogermanate glasses co-doped Sm^{3+}/Gd^{3+} luminescent thermometry materials

S.S. Zykova[1], K.S. Serkina[1], K.I. Runina[1], O.B. Petrova[1], K.A. Boldyrev[2]; [1]The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology; [2]Laboratory of Fourier-spectroscopy, Institute for Spectroscopy RAS, Russia

The luminescent properties of co-doped Sm3+/Gd3+ in the B2O3–GeO2–PbO glass system were investigated in the temperature range of 423-673K. Intensity of the Sm3+ band in the range of 525-540 nm (4F3/2→6H5/2) increased with increasing temperature. The fluorescence intensity ratio (FIR) changes between the thermosensitive band and the band is attributed to transition 5G5/2→6H7/2 was calculated and demonstrated.

layers of colloidal quantum dots under intense laser excitation

A.S. Kulagina[1,2], A.I. Khrebtov[2], A.S. Ruban[3], V.V. Danilov[3]; [1]St. Petersburg State University; [2]Alferov University; [3]Emperor Alexander I Saint-Petersburg State Transport University, Russia

The photoluminescence of nanostructures as InP/InAsP/InP nanowires, passivated by layers of colloidal quantum dots at increasing pump power, has been studied. A feature of the system is the existence of several luminescent centers connected through mechanisms of multi-stage non-radiative excitation transfer. It has been shown that the kinetics of decay of excited states depends on the nature of excitation.

ThR09-p76 15:00-18:30

Numerical calculation of arranged-microvoid volumetric reflective gratings in ZnSe

A.S. Gerasimenko, A.A. Bushunov, M.K. Tarabrin; Bauman Moscow State Technical University, Russia

In this work, we present the method of creating arranged-microvoid volumetric reflective gratings using femtosecond laser writing. These volumetric modifications are prospective to be used instead of reflective coatings in miniaturized lasers. The calculation results revealed the effectiveness of proposed modifications compared to conventional multilayer reflective coatings that are applied directly on the faces of an active medium crystal.

ThR09-p77 15:00-18:30

Site-controlled Ga(Al)As nanostructure arrays emitting at 740nm

N.E. Chernenko[1], I.S. Makhov[2], I.A. Melnichenko[2], S.V. Balakirev[1], D.V. Kirichenko[1], N.A. Shandyba[1], N.V. Kryzhanovskaya[2], M.S. Solodovnik[1]; [1]Laboratory of Epitaxial Technologies, Southern Federal University; [2]International Laboratory of Quantum Optoelectronics, National Research University Higher School of Economics, Russia

We presents the results of experimental studies of growth and optical properties of ordered Ga(Al)As nanostructures arrays on GaAs(001) substrates with regular arrays of holes. We have also shown that the emission wavelength (740 nm) of site-controlled Ga(Al)As nanostructures is practically independent of the patterned surface morphology, while the emission intensity is determined by the effective volume of nanostructures.

ThR09-p78 15:00-18:30

On investigation femtosecond laser writing of defects in hexagonal boron nitride

P.G. Vilyuzhanina[1,2], E.A. Primak[2,3], E.A. Stepanov[2,4], I. V. Savitsky[4], A. B. Fedotov[2,4], S.V. Bolshedvorskii[3], V.V. Soshenko[3], I.S. Cojocaru[2,3], A.M. Kozodaev[1], S.M. Drofa[3], A. Chernyavskiy[2], V.N. Sorokin[3], A.N. Smolyaninov[5], A.V. Akimov[2,3]; [1]National Research Nuclear University 'MEPhI'; [2]Russian Quantum Center; [3]Lebedev Physical Institute RAS; [4]Moscow State University; [5]LLC Sensor Spin Technologies, Russia

Color centers in h-BN have attracted a lot of attention due to their unique properties: optical detected magnetic resonance (ODMR) and single-photon emission (SPE) at room temperature. In this work, we present the results of our ongoing investigation on h-BN defects, including femtosecond laser writing for defect creation.

ThR09-p79 15:00-18:30

Optical properties of functionalized carbon dots and its application

N.Kh. Ibrayev[1], G.S. Amanzholova[1], T.N. Khamza[2], E.V. Seliverstova[1]; [1]Buketov Karaganda University, Kazakhstan; [2]Istanbul Technical University, Turkey

The influence of the composition of carbon dots (CDs) on the features of generation and deactivation of their electron-excited states. The influence of Ag nanoparticles (NPs) on absorption and luminescence of CDs films was studied. Synthesized CDs was considered as molecular oxygen activators. The influence of CDs on the photovoltaic properties of solar cells was studied.

ThR09-p80 15:00-18:30

Study of the evanescent field of terahertz surface plasmon polaritons on metal-dielectric layers

V.D. Kukotenko[1], V.V. Gerasimov[1,2], V. S. Vanda[1,2]; [1]Budker Institute of Nuclear Physics; [2]Novosibirsk State University, Russia

The results of a study of the influence of the technology of deposition of gold films with a dielectric coating of zinc sulfide, as well as the roughness of the substrate on the penetration depth of the field of surface plasmon polaritons, are presented. Which was measured using the "shielding" method at the Novosibirsk free electron laser.

lead-borate glasses

A.V. Bakaeva[1], D.A. Butenkov[1], K.I. Runina[1], A.V. Popov[2], O.B. Petrova[1]; [1]The Department of Chemistry and Technology of Crystals, D. Mendeleev University of Chemical Technology; [2]Prokhorov General Physics Institute RAS, Russia

The spectral-luminescent characteristics of oxochloride lead-borate glasses doped NdF3 are investigated. Two concentration series of these glasses were studied - for lead chloride (up to 40 mol%) and neodymium fluoride (up to 2 mol%).

ThR09-p82 15:00-18:30

Fabry-Pérot resonances in a dielectric ring

A.P. Chetverikova[1], N.S. Solodovechenko[1], K.B. Samusev[1,2], M.F. Limonov[1,2]; [1]School of Physics and Engineering, ITMO University; [2]Ioffe Institute, Russia

A study of the eigenmodes spectrum of a rectangular dielectric ring has been carried out. It is found that the low-frequency spectrum breaks up into separate groups of resonant modes. Linear dependences of the wavelength of resonances on the width and height of the resonator are revealed, representing are Fabry-Perot resonances. The numerical results obtained were confirmed by experiment.

ThR09-p83 15:00-18:30

Topological laser concept with tunable wavelength depending on cavity curvature

M.E. Bochkarev[1], N.S. Solodovechenko[1], K.B. Samusev[1,2], M.F. Limonov[1,2]; [1]ITMO University; [2]Ioffe Institute, Russia

We propose the concept of a laser with switchable resonant wavelength, which is based on the effect of CW-CCW modes splitting upon topological and curvature transformation from dielectric ring resonator to split resonator with narrow gap. By modulation of the gap size one can achieve any resonant wavelength in the range of one half-wavelength.

ThR09-p84 15:00-18:30

The effect of annealing and co-activation by Nd^{3+} ions on the temperature dependence of the spectral and kinetic characteristics of YF_3:Eu^{3+} nanoparticles

E.I. Oleynikova, M.S. Pudovkin, S.L. Korableva, O.A. Morozov; Institute of Physics, Kazan Federal University, Russia

The YF3:Eu nanoparticles demonstrated, that annealing in air at 400 °C for 4 hours increases the rise times by about 2 times and the luminescence decay times by about 1.2 times. Stronger temperature dependence of decay time was observed for samples without annealing. The addition of Nd leads to the increase of temperature sensitivity of spectral characteristics of YF3:Eu nanoparticles.

ThR09-p85 15:00-18:30

Novel oxochloride lead silicate glass doped with neodimium ions for NIR applications

A.M. Slastuhina[1], E.A. Bogoyavlenova[1], D.A. Butenkov[1], K.I. Runina[1], V.M. Korshunov[2], I.V. Taydakov[2], O.B. Petrova[1]; [1]The Department of Chemistry and Technology of Crystals, Mendeleev University of Chemical Technology; [2]Lebedev Physical Institute RAS, Russia

Nd-doped lead oxochloride silicate glasses were synthesized and their spectral characteristics were studied. The new synthesis technique made it possible to reduce losses due to lead chloride volatilization to two mass percent. Based on the combination of physical and chemical characteristics, these materials are promising for photonics and fiber optics applications.

ThR09-p86 15:00-18:30

Indirect evidence of the high antimony concentration during the growth in the shape of GaSb nanowires

N.V. Sibirev[1], I.V. Shtrom[1,2]; [1]St. Petersburg University, [2]IAI RAS, Russia

GaSb nanowires are often grown via the vapor-liquid-crystal mechanism, where a droplet plays a key role. In-situ observation of droplet composition during the growth is often difficult. This paper discusses the possibility of determining the composition of the drop on the basis of studying the shape of nanowire.

8TH INTERNATIONAL A. M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS

SYP: SYMPOSIUM PLENARY

Location: Piedmonte Room, Floor 3; Date: Monday, July 01, 2024

SYP: SYMPOSIUM PLENARY 1

Session Chair:

MoSYP-01 14:30-15:15

Advancing 7TM-protein structural studies: from XFELs to light-enabled cell control *(Plenary)*

V.I. Borshchevskiy; Moscow Institute of Physics and Technology, Russia

The talk will focus on modern methods of studying the structure of 7-alpha-helical transmembrane proteins and their practical applications. The speaker will discuss the use of synchrotrons and XFELs, along with advancements in single-molecule FRET spectroscopy.

MoSYP-02 15:15-16:00

Laser radiation, ultrasound and nanostructured particles work together to realise the theranostic approach *(Plenary)*

D. Gorin; Skolkovo Institute of Science and Technology, Russia

The application of photonic and acoustic tools can be used for visualization, navigation of multifunctional carriers and remote-controlled release of bioactive substances. These particles will combine the ability to deploy drugs in a controllable manner with physical triggering, multimodal detection, and visualization as well as sensing of important biological markers.

MoSYP-03 16:00-16:45

Multimodal spectro-imaging for human skin carcinoma in vivo optical biopsy *(Plenary)*

W. Blondel[1], V. Kupriyanov[1,2], S. Zaytsev[1], G. Khairallah[1,3], C. Perrin-Mozet[1], C. Fauvel[1], C. Daul[1], Y. Kistenev[2], M. Amouroux[1]; [1]Université de Lorraine, CNRS, CRAN UMR7039, France; [2]Tomsk State University, Russia; [3]Metz-Thionville Regional Hospital, Department of plastic, aesthetic and reconstructive surgery, France

Abstract is not available.

SYA: ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES

Location: Petrov-Vodkin 3 Room, Floor 2; Date: Tuesday, July 02, 2024

SYA: ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES 1

Session Chair:

TuSYA-01 09:00-09:30

High-power erbium -doped pulsed fiber laser for non-ablative fractional photo-rejuvenation *(Invited paper)*

M.Yu. Koptev[1], A.N. Morozov[2], K.V. Shatilova[2], S.V. Muravyev[1], A.E. Zapryalov[1], M.E. Likhachev[3], A.V. Kim[1]; [1]Institute of Applied Physics RAS; [2]Melsytech LLC; [3]Fiber Optics Research Center RAS, Russia

A high-power erbium laser system for fractional photorejuvenation was presented. The system generated rectangular pulses with a duration varying from 200 μs to 5 ms and pulse energy up to 130 mJ. The novelty of the system was the use of a powerful seed source in combination with a synchronously pumped amplifier made on a single-mode erbium-doped LMA fiber.

TuSYA-02 09:30-10:00

Optical visualizer of the venous wall with a high degree of contrast *(Invited paper)*

P.A. Ryabochkina, M.V. Gerasimov, A.D. Taratynova, K.V. Prosvirin; National Research Mordovia State University, Russia

A real-time optical visualization system of the venous bed is presented, created using near infrared (NIR) vein finder technology with spectral division of the light flux (visible and infrared), using a combination of video images and their processing algorithms.

TuSYA-03 10:00-10:30

Perspectives on a 3050 nm fiber laser mediated ablative fractional laser treatments in dermatology *(Invited paper)*

V. Arkhipova[1], A. Mimov[2], V. Smolyannikova[3], I. Larionov[1], D. Paithankar[4], I. Yaroslavsky[4], V. Andreeva[1], G. Altshuler[4]; [1]IRE Polus; [2]TORI Clinic; [3]Sechenov University, Russia; [4]IPG Medical, USA

We have evaluated a novel laser emitting at a wavelength of 3050 nm. We analysed its effect on skin ablation and regeneration. Our data show that this system has a strong tissue regenerative effect and a great potential for use in dermatology.

TuSYA-04 10:30-10:45

Infrared fibers based on AgCl - $AgBr_{0.7}I_{0.3}$ for medical and laser technologies

A.A. Yuzhakova, A.E. Lvov, D.D. Salimgareev, P.V. Pestereva, I.V. Yuzhakov, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia

For medical laser technologies, IR fibers based on single crystals of the AgCl – AgBr0.7I0.3 system have been developed. Using computer simulation, extrusion modes were determined and fibers with a diameter of 465 μm and a length of 1.4 m were obtained. They have a transmission range of 3.4–24.0 μm without absorption windows and low optical losses.

TuSYA-05 10:45-11:00

Are picosecond laser pulses applicable for microsurgery of zona pellucida of mammalian embryo?

D.S. Sitnikov[1], M.A. Filatov[2], M.V. Kubekina[2], Y.Y. Silaeva[3]; [1]JIHT RAS; [2]Center for Precision Genome Editing and Genetic Technologies for Biomedicine, IGB RAS; [3]Core Facility Centre, IGB RAS, Russia

Infrared picosecond laser pulses are used for microsurgery of mouse embryos at late stages of preimplantation development. The width of the cut made by a series of laser pulses at the zona pellucida of the mouse embryo is studied for different laser beam velocities and pulse energies.

- Coffee Break -

Location: Petrov-Vodkin 3 Room, Floor 2; Date: Tuesday, July 02, 2024

SYA: ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES 2

Session Chair:

TuSYA-06 11:30-12:00

Study of the possibility of using dielectric nanoparticles doped with rare earth ions for the treatment of tumors under non-contact exposure to near-IR laser radiation *(Invited paper)*

S.A. Khrushchalina[1], P.A. Ryabochkina[1], O.A. Kulikov[1], V.I. Shlyapkina[1], V.P. Ageev[1], N.Yu. Tabachkova[2], S.E. Kukarkina[1], E.E. Zimin[1]; [1]National Research Ogarev Mordovia State University; [2]National University of Science and Technology "MISIS", Russia

In this work, we investigated the possibilities of using Yb-containing particles (ZrO_2-30 mol.% Yb_2O_3) when excited by laser radiation with a wavelength of 980 nm for the treatment of subcutaneous tumors. Cytotoxicity studies of these particles and in-vivo experiments (on mice) were conducted.

TuSYA-07 12:00-12:30

Endovenous laser coagulation of large diameter varicose veins *(Invited paper)*

V.Yu. Bogachev[1,2], V.P. Minaev[3]; [1]The First Phlebological Center; [2]Pirogov Russian National Research Medical University; [3]IRE-Polus Ltd., Russia

The purpose of this report is to justify the selection of the optimal method of endovenous laser coagulation (EVLC) of varicose veins of large (more than 2 cm) diameter.

TuSYA-08 12:30-13:00

Laser perforation of bones. Photothermal effects and clinical applications *(Invited paper)*

I.A. Abushkin[1,2], A.E. Anchugova[2,3], A.V. Lappa[3], V.P. Minaev[4], V.M. Chudnovsky[5]; [1]Center for Medical Laser Technologies; [2]South Ural State Medical Univ.; [3]Chelyabinsk State Univ.; [4]NTO IRE-Polus; [5]Pacific Oceanological Inst., Russia

The study investigates the mechanism and clinical effectiveness of laser osteoperforation using radiation with wavelengths of 0.97 and 1.9 µm. The key points of the technology implementation were intermittent contact of the optical fiber with the bone at adequate radiation power. The clinical effectiveness of laser osteoperforation has been confirmed in the treatment of various bone pathologies.

TuSYA-09 13:00-13:15

Laser technologies in the osteomyelitis treatment

A.V. Lychagin[1], N.A. Nabatchikov[1,2], O.D. Podkosov[2]; [1]Sechenov First Moscow State Medical Univ.; [2]Botkin Hospital, Russia

Currently, the treatment of distal tibia osteomyelitis remains a hot topic for discussion. Traditional method involves radical segmental bone resection to the level of healthy tissue, which in turn leads to bone defect, which significantly increases treatment and rehabilitation time. But nowadays we have a new treatment method – laser osteoperforation.

TuSYA-10 13:15-13:30

Laser formation of biointegrated electronic components based on carbon nanotubes and graphene

A.Yu. Gerasimenko[1,2], A.V. Kuksin[1], E.A. Gerasimenko[1], A.S. Morozova[1], M.S. Savelyev[1,2]; [1]Institute of Biomedical Systems, National Research University of Electronic Technology, [2]Institute for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical University, Russia

Based on the revealed features of the interaction of laser radiation with carbon nanotubes and graphene, a new approach is proposed for the fabrication of silicon electronic devices and flexible wearable/implantable bioelectronics. Laser radiation stimulates the formation of graphene-nanotube contacts. That led to the development of novel flexible electrically conductive constructs for tissue recovery and electrostimulation of cell growth.

- Lunch Break -

Location: Petrov-Vodkin 3 Room, Floor 2; Date: Tuesday, July 02, 2024

SYA: ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES 3

Session Chair:

TuSYA-11 15:00-15:30

Thulium fiber laser: experimental study on biological tissue *(Invited paper)*

M.A. Ryabova[1], M.Y Ulupov[1], G.Y. Yukina[2], E.G. Sukhorukova[2], J.O. Rakhmonov[1]; [1]Department of Otorhinolaryngology with Clinic of Pavlov First St. Petersburg State Medical University; [2]Research Center of the Laboratory of Pathomorphology of Pavlov First St. Petersburg State Medical University, Russia

One of the important issues, to develop an optimal mode for minimally invasive outpatient turbinoplasty surgery. In this paper, we select the optimal mode at a wavelength of 1.94 µm on calf kidney tissue to achieve maximum coagulation without ablation of the superficial and interstitial layer. The optimal mode of exposure is concluded.

TuSYA-12 15:30-16:00

Surgery guidance with optical spectroscopy: advances in clinical translation *(Invited paper)*

E.A. Shirshin; Lomonosov Moscow State University, Russia

Optical spectroscopy has been multiply shown to be capable of assisting surgery guidance based on differences in the detected signal from tissue. However, the progress in clinical translation of optical intraoperational diagnostics is not that obvious. In this talk, we will discuss the state-of-art results in optical surgery guidance in urology with a focus on recently developed clinical systems.

TuSYA-13 16:00-16:30

Dual channel video platform for fluorescence diagnostics in augmented reality *(Invited paper)*

M.V. Loshchenov[1], A.M. Udeneev[1,2], N.A. Kalyagina[1,3]; [1]Department of Laser Micro-nano and Biotechnology, National Research Nuclear University MEPhI, [2]Federal State Budgetary «Federal Scientific and Clinical Center for Medical Rehabilitation and Balneology of the Federal Medical and Biological Agency», [3]Prokhorov General Physics Institute RAS, Russia

The topic of the presentation is a wide overview of the diagnostic videosystem combining excitation white light in the red region of visible spectrum and usual white light to give the physician ability observing the area of interest in full or semi-full colors so the diagnostic data appears right on top of the picture in natural colors.

TuSYA-14 16:30-16:45

Optical methods for new medical application: identification of disorders in blood circulation and structure of urethral tissues

E.B. Kiseleva[1], A.S. Kuyarov[2], L.A. Matveev[3], V.V. Dudenkova[1], V.V. Elagin[1], O.S. Streltsova[2]; [1]Research Institute of Experimental Oncology and Biomedical Technologies; [2]E.V. Shakhov Department of Urology; [3]Nonlinear Geophysical Processes Department, Institute of Applied Physics RAS, Russia

This study presents for the first time the combined use of several optical methods for in vivo examination of women with primary urethral pain syndrome (PUPS). Laser Doppler flowmetry (LDF) and transvaginal Doppler ultrasound (TVDUS) allow identifying disorders of blood circulation. Collagen fibrosis were revealed by cross-polarization optical coherence tomography (CP OCT) and then confirmed by nonlinear confocal microscopy.

TuSYA-15 16:45-17:00

Erbium laser for modification of dentin surface of the tooth

Y.S. Kozlova, S.N. Razumova, A.S. Brago; Russia

Indications for usage of Erbium family lasers in dentistry are increasing. The success of root canal treatment depends on removing bacterias and smear layer for better adhesion of sealer. Usage lasers in endodontical treatment enhancing success for the treatment in long-term follow up.

TuSYA-16 17:00-17:15

Promising approaches to optimize the efficiency of laser hydroacoustic processing of biological tissues

A.V. Belikov[1,2], R. Nasser[1], S.N. Smirnov[1]; [1]ITMO University; [2]Pavlov First St. Petersburg State Medical University, Russia

The results of experimental study of the fiber tip end shape influence on the size of the Yb,Er:Glass-laser-induced cavitation bubble and the value of the bubble collapse pressure, as well as theoretical study of the possibility of using 1.45 μm and 1.54 μm laser radiation to pre-heat the liquid before high-intensity laser pulse action, are presented.

- Coffee Break -

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY

Location: Petrov-Vodkin 1 Room, Floor 2; Date: Tuesday, July 02, 2024

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 1

Session Chair:

TuSYB-01 09:00-09:30

Wide-band diffuse reflectance spectroscopy with a self-calibrating fiber-optic probe *(Invited paper)*

I.V. Turchin, V.V. Perekatova, A.B. Kostyuk, A.G. Orlova, A.V. Khilov, E.A. Sergeeva, M.Yu. Kirillin; Federal Research Center A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia

A wide-band diffuse reflectance spectroscopy system with a fiber-optic contact probe with two source and two detection fibers has been created. Self-calibration approach made it possible to significantly reduce the influence of surface optical inhomogeneities of tissues and fluctuations of transient characteristics of the device on the obtained result, thus providing reliable data on tissue physiological characteristics.

TuSYB-02 09:30-10:00

Tissue exposure to laser pulses delivered by sapphire medical instruments: advantages for laser coagulation and ablation *(Invited paper)*

I.N. Dolganova[1], P.V. Aleksandrova[2], A.K. Zotov[1], A.A. Platonova[2], K.I. Zaytsev[2], V.N. Kurlov[1], D.G. Kochiev[2]; [1]Osipyan Institute of Solid State Physics RAS; [2]Prokhorov General Physics Institute RAS, Russia

We describe the advantages of sapphire shaped crystals for manufacturing of medical instruments, in particular, capillary needles for interstitial laser therapy. The application of them for tissue ablation and coagulation is discussed. The particular attention is paid to tissue exposure to short laser pulses delivered by these needles.

TuSYB-03 10:00-10:30

Theoretical and experimental study of the effect of laser heating on the optical characteristics of human skin *(Invited paper)*

A.V. Belikov[1,2], V.Yu. Chuchin[1,3], A.A. Masharskaya[1]; [1]ITMO University; [2]Pavlov First St. Petersburg State Medical University; [3]"NPP VOLO" LLC, Russia

For the first time in an in vivo experiment, the dependence of the reflectance spectrum of human skin when heated by laser radiation was measured. Theoretical interpretation of the experimental results is given, and it is shown that the change in reflectance observed in the experiment may be associated with the conversion of skin blood hemoglobin into methemoglobin.

TuSYB-04 10:30-10:45

Studies of the effects of hydrogen fluoride laser radiation on biological tissues

V.M. Fomin; JSC "NIIEFA", Russia

The effects were studied of HF-laser radiation on the eye cornea of primates, human skin - in vivo and on a human myocardial wall - in vitro. The obtained data the results of our previous works and the results of studies by other authors demonstrate the effectiveness and safety of the use of the HF lasers in surgery.

TuSYB-05 10:45-11:00

Study of the use of laser radiation with a wavelength of 450 nm to remove pigmented skin formations

S.A. Podurar[1], N.E. Gorbatova[1], A.V. Bryantsev[1], G.P. Kuzmin[2], A.A. Sirotkin[2], O.V. Tikhonevich[2], Yu.L. Kalachev[2], G.A. Varev[3]; [1]Research Institute of Emergency Pediatric Surgery and Traumatology, [2]Prokhorov General Physics Institute RAS, [3]Russian Engineering Club LLC, Russia

The optimal parameters of laser radiation for the removal and treatment of pigmented skin formations have been determined.

- Coffee Break -

Location: Petrov-Vodkin 1 Room, Floor 2; Date: Tuesday, July 02, 2024

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 2

Session Chair:

TuSYB-06 11:30-12:00

Determination of the spectral dispersion for the heart muscle - a Kramers-Kronig approach *(Invited paper)*

Luís M. Oliveira[1,2], Maria R. Pinheiro[2], Hélder P. Oliveira[2,3], Maria I. Carvalho[2,4], Valery V. Tuchin[5,6,7]; [1]Polytechnic of Porto, School of Engineering, Portugal; [2]Institute for Systems and Computer Engineering, Technology and Science (INESC TEC), Portugal; [3]Porto University, Faculty of Science, Portugal; [4]Porto University, Faculty of Engineering, Portugal; [5]Institute of Physics and Science Medical Center, Saratov State University, Russia; [6]Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University, Russia; [7]A. N. Bach Institute of Biophotonics, RC "Biotechnology of the Russian Academy of Sciences", Russia

The refractive index of the pigs heart was measured at wavelengths between 255 and 850 nm to calculate the dispersion. The total transmittance and total reflectance spectra of the pig heart were measured between 200 and 1000 nm to calculate the spectral absorption coefficient. Using Kramers-Kronig relations, the dispersion of the heart was matched to experimental refractive index values.

TuSYB-07 12:00-12:30

Optical monitoring of intradermal delivery of drug-loaded vaterite carriers *(Invited paper)*

Yu.I. Svenskaya, M.S. Saveleva, P.A. Demina, R.A. Verkhovskii, Yu.I. Surkov, R.A. Anisimov, I.A. Serebryakova, V.V. Tuchin; Saratov State University, Russia

Drug administration via skin appendages has gained great scientific interest, especially concerning delivery to specific targeted regions and the reduction of systemic toxicity. We propose a novel particulate system for the delivery of glucocorticoids into hair follicles aiming to treat inflammatory skin diseases. The system has been shown to be biodegradable and provide high intradermal concentration of the delivered drug.

TuSYB-08 12:30-13:00

Surgery guidance in orthopedics and dentistry *(Invited paper)*

G.S. Budylin[1], N.R. Rovnyagina[1], E.E. Nikonova[1], P.V. Dyakonov[1], V.A. Petrov[1], D.A. Davydov[1], A.Yu. Turkina[2], M.M. Lipina[3], A.V. Lychagin[3], P.S. Timashev[4], E.A. Shirshin[1,5]; [1]Laboratory of Clinical Biophotonics, Sechenov First Moscow State Medical University; [2]Therapeutic dentistry department, Sechenov First Moscow State Medical University; [3]Department of Trauma, Orthopedics and Disaster Surgery, Sechenov First Moscow State Medical University; [4]Institute for Regenerative Medicine, Sechenov First Moscow State Medical University; [5]Faculty of Physics, Lomonosov Moscow State University, Russia

The assessment of knee joint tissue condition during arthroscopy and the measurement of distance to the dental pulp when removing caries-infected dentin using a fiber-optic implementation of the diffuse reflectance spectroscopy method are investigated.

TuSYB-09 13:00-13:15

Study of liver parenchyma in obstructive jaundice using fluorescence and diffuse reflectance spectroscopy methods

K.Y. Kandurova[1], D.S. Sumin[1,2], A.V. Mamoshin[1,2], M.Yu. Kirillin[3], E.V. Potapova[1]; [1]Research & Development Center of Biomedical Photonics, Orel State University; [2]Orel Regional Clinical Hospital; [3]A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia

We report on the application of fluorescence and diffuse reflectance spectroscopy for in vivo measurements during biliary drainage. The results show high potential in developing new diagnostic and prognostic markers in liver state evaluation.

TuSYB-10 13:15-13:30

Measurement and simulation of mouse head optical properties at optical clearing

V.V. Tuchin[1], P.A. Dyachenko[1], D.K. Tuchina[1], Yu.A. Zhavoronkov[2,3], S.V. Ul'yanov[3], V.L. Kuzmin[2]; [1]Institute of Physics and Science Medical Center, Saratov State University, [2]Peter the Great St. Petersburg Polytechnic University, [3]St. Petersburg State University, Russia

Results of ex vivo measurements of NIR laser beams delivery through the mouse head at immersion optical clearing of the scalp are presented. Monte Carlo radiative transfer simulations performed for a four-layer mouse head model well fit experimental distributions.

- Lunch Break -

Location: Petrov-Vodkin 1 Room, Floor 2; Date: Tuesday, July 02, 2024

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 3

Session Chair:

TuSYB-11 15:00-15:30

Biophotonics in endocrinology: surgery guidance, optical biopsy and point-of-care testing *(Invited paper)*

E.A. Shirshin[1,2]; [1]Lomonosov Moscow State University, [2]The National Medical Research Center for Endocrinology, Russia

In this talk applications of biophotonics in endocrinology will be discussed, namely (1) parathyroid detection and viability assessment for surgery guidance, (2) tumor cells identification with spectrally-resolved confocal microscopy and fluorescence saturation microscopy, (3) body composition analysis with NIR spectroscopy.

TuSYB-12 15:30-16:00

Discovery of novel fluorophores in the human organism with quantitative structure-property relationship approach *(Invited paper)*

B.P. Yakimov[1,2], A.A. Rubekina[2], L.S. Urusova[3], E.A. Shirshin[2,3]; [1]Laboratory of Clinical Biophotonics, Sechenov First Moscow State Medical University; [2]Faculty of Physics, Lomonosov Moscow State University; [3]Endocrinology Research Center, Moscow, Russia

This study explores the application of AI-approach to identify new fluorophores in the human organism. Trained on the multiple representations of the chemical structure of molecules, the approach accurately restored optical properties for known fluorophores and identified new sources in the human body using available databases. The predictions of the presented approach were experimentally validated for fluorophores identified in tissues.

TuSYB-13 16:00-16:30

Time-resolved fluorescence spectroscopy in differential diagnosis of liver cancer in vivo *(Invited paper)*

E.V. Potapova[1], V.V. Shupletsov[1], V.V. Dremin[1,2], A.V. Mamoshin[1,3], A.V. Dunaev[1]; [1]Research & Development Center of Biomedical Photonics, Orel State University, Russia; [2]College of Engineering and Physical Sciences, Aston University, UK; [3]Orel Regional Clinical Hospital, Russia

This work reports a machine-learning-based approach to interpret time-resolved fluorescence spectroscopy data acquired during optical biopsy of the liver. The approach allowed to differentiate between liver parenchyma and tumor with sensitivity and specificity above 0.91 and 0.79, respectively, providing differential diagnosis of liver cancer (primary malignant tumor, metastases, or benign) with sensitivity and specificity of at least 0.80 and 0.95.

TuSYB-14 16:30-16:45

Development of dual-mode hyperspectral/fluorescence lifetime imaging system

V.V. Shupletsov, I.A. Goryunov, E.V. Potapova, V.V. Dremin; Research & Development Center of Biomedical Photonics, Orel State University, Russia

This paper presents a microscopic diagnostic system that combines hyperspectral and frequency domain fluorescence lifetime imaging to record the content of chromophores and high-speed changes in cell and tissue metabolism. The efficiency of the system was tested on liver tumor slices of a laboratory mouse.

TuSYB-15 16:45-17:00

Optical express biopsy of lymph nodes with time-resolved fluorescence macroimaging

A.M. Mozherov[1], A.A. Plekhanov[1], P.A. Kochetkova[3], D.S. Myalik[1,2], A.Yu. Vorontsov[2], B.P. Yakimov, A. Gayer, E.A. Shirshin[4], S.V. Gamayunov[2], V.I. Shcheslavskiy[1]; [1]Privolzhskiy Research Medical Univ.; [2]Nizhny Novgorod Regional Oncologic Hospital; [3]Lobachevsky State Univ.; [4]Lomonosov Moscow State Univ., Russia

We present a simple and fast approach to perform lymph nodes biopsy in a clinical setting using fluorescence time-resolved macroimaging. Histologic analysis is used as the reference standard. We demonstrate that the obtained data allow us to differentiate healthy and metastatic lymph nodes.

- Coffee Break -

SYC: PHOTONICS AND NANOBIOTECHNOLOGY

Location: Petrov-Vodkin 2 Room, Floor 2; Date: Tuesday, July 02, 2024

SYC: PHOTONICS AND NANOBIOTECHNOLOGY 1

Session Chair:

TuSYC-01 09:00-09:30

Confined surface-enhanced Raman scattering for bio-objects detection *(Invited paper)*

A.K. Sarychev[1], A.V. Ivanov[1], I.V. Bykov[1], K.E. Mochalovv[2], M.S. Shestopalova[2,3], V.A. Oleinikov[2,3]; [1]Institute of Theoretical and Applied Electrodynamics RAS, [2]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry RAS, [3]National Research Nuclear University MEPhI, Russia

Analytical theory and experimental results for surface enhanced Raman scattering of molecules confined in a spherical metal resonator is presented. The EM mechanism of the scattering enhancement is investigated. Raman scattering in silver-coated polystyrene spheres, which model bio-objects, is in agreement with our theory.

TuSYC-02 09:30-10:00

Determination of gold concentration in colloids by UV -vis spectroscopy: universality for various nanoparticles and clusters *(Invited paper)*

N.G. Khlebtsov; Institute of Biochemistry and Physiology of Plants and Microorganisms, Saratov Scientific Centre RAS (IBPPM RAS), Saratov State University, Russia

The UV-vis extinction method universality is demonstrated with six experimental and theoretical Au models: nanospheres, nanosphere clusters, nanorods, 2D nanotriangles and nanoplates, and 3D nanostars. In total, we fabricated 34 samples with different nanoparticle sizes, shapes, morphology, and Au concentrations. From simulated and experimental data we derived a universal relation between gold concentration and extinction [Au0](mM) = 0.44×A(400).

TuSYC-04 10:15-10:30

Plasmon-enhanced chemiluminescence of lucigenin due to interaction with colloidal gold nanoparticles

D.V. Kononov, A.V. Palehova, A.V. Kochakov, A.V. Afanasieva, T.A. Vartanyan, D.R. Dadadzhanov; ITMO University, Russia

Chemiluminescence enhancement of lucigenin in the vicinity of colloidal gold nanoparticles was studied. The chemiluminescence intensity was found to increase twice independent of the nanoparticle's concentration in the range of 10-4 to 10-8 M.

TuSYC-05 10:30-10:45

Development of biosensors based on surface plasmon resonance imaging technique

I.R. Rodin, I.N. Pavlov; National Research University "MPEI", Russia

The work is devoted to the development of a biosensor based on the phenomenon of surface plasmon resonance. In the process of the work, multiple measurements were carried out at the SPRi facility. The values sensitivity of the method and resolution limit were found to be comparable to the sensitivity and resolution of the frustrated total internal reflection method.

TuSYC-06 10:45-11:00

Lateral flow assay dynamics monitoring with real-time optical and magnetic registration: rapid and quantitative tumor marker detection

A.M. Skirda[1,2], V.A. Bragina[1], S.L. Znoyko[1], A.V. Orlov[1]; [1]Prokhorov General Physics Institute RAS; [2]Moscow Institute of Physics and Technology, Russia

This study presents an innovative biosensor for point-of-care molecular biomarker detection using lateral flow assay dynamics monitoring with real-time optical and magnetic registration. Spectral interferometry analyzes antibody kinetics targeting the tumor marker CYFRA21-1, leading to the development of rapid quantitative lateral flow tests. A novel tool is proposed for controlling label quantities, enhancing the robustness of real-time dynamics-based quantitative systems.

- Coffee Break -

Location: Petrov-Vodkin 2 Room, Floor 2; Date: Tuesday, July 02, 2024

SYC: PHOTONICS AND NANOBIOTECHNOLOGY 2

Session Chair:

TuSYC-07 11:30-12:00

Targeted PLGA nanoparticles as versatile platfrom for the delivery of oncotherapeutic compounds *(Invited paper)*

V.O. Shipunova[1,2], E.N. Komedchikova[1], A.V. Pushkarev[1], M.A. Yurchenko[1], D.A. Maedi[1], A.M. Skirda[1,3], M.P. Nikitin[1,2]; [1]Moscow Institute of Physics and Technology; [2]Sirius University of Science and Technology; [3]Prokhorov General Physics Institute RAS, Russia

In this study, we present the creation of targeted polymer nanoparticles, targosomes, which are loaded with paclitaxel for imaging and treatment of HER2-positive cancer. These synthesized nanoparticles were employed for targeted delivery to tumors and tumor growth reduction in vivo.

TuSYC-08 12:00-12:30

Genetically engineered nanocapsules with fluorescent and magnetic markers for cell tracking and targeted drug delivery *(Invited paper)*

A.N. Gabashvili[1], D.D. Namestnikova[2], I.L. Gubskiy[2], S.S. Vodopyanov[3], M.V. Efremova[4], P.I. Makarevich[5], V.A. Sarkisova[6], P.I. Nikitin[1]; [1]Prokhorov General Physics Inst. RAS; [2]Department of Neurology, Neurosurgery and Medical Genetics, Russia; [3]Department of Microbiology & Immunology, Albert Einstein College of Medicine, New York City, United States; [4]Department of Applied Physics and Science Education, Eindhoven Univ. of Technology, Netherlands; [5]Faculty of Medicine, Lomonosov Moscow State Univ.; [6]Cell Proliferation Laboratory, Engelhardt Inst. of Molecular Biology RAS, Russia

Currently, various functionalized nanocarrier systems are extensively studied for biomedical diagnostics and targeted drug delivery. Joining the approaches of genetic and chemical engineering novel carriers have been produced based on encapsulins, which are capsid-like protein structures, consisting of a shell and various payload inside. A range of potential applications of encapsulins have been developed.

TuSYC-09 12:30-12:45

Glutathione-loaded magnetic nanoparticles as a aprotective theranostic carrier in oncology

V.V. Barinova[1,3], D.A. Tarasova[1,3], V.S. Fedorov[1,2,4], L.Y. Yakovleva[1], N.M. Yudintseva[1,2], D.E. Bobkov[1,2], B.P. Nikolaev[1,2], M.A. Shevtsov[1,2]; [1]Institute of Cytology RAS; [2]Almazov National Medical Research Centre; [3]St. Petersburg State Institute of Technology (Technical University); [4]Department of Inorganic Chemistry and Biophysics, St. Petersburg State University of Veterinary Medicine, Russia

Gluthatione-conjugated magnetic nanoparticles were proposed as a protective drug carrier in theranostics. During the course of work, a stable conjugate was synthesized and had its physico-chemical and antioxidant poperties investigated.

TuSYC-10 12:45-13:00

Laser synthesis of iron-based nanoparticles in gaseous media and magnetic field by nanosecond pulses

D.A. Kochuev[1], A.S. Chernikov[1], M.A. Dzus[1], U.E. Kurilova[1,2,3], A.A. Voznesenskaya[1], A.F. Galkin[1], D.V. Abramov[1], A.V. Kazak[1,4], A.Yu. Gerasimenko[2,3], K.S. Khorkov[1]; [1]Vladimir State University; [2]National Research University of Electronic Technology MIET; [3]I.M. Sechenov First Moscow State Medical University; [4]Moscow Polytechnic University, Russia

The paper presents the results of the ablative synthesis of iron nanoparticles in an argon medium under the action of nanosecond laser pulses. Nanoparticles were collected and deposited using a magnetic field.

TuSYC-11 13:00-13:15

Imaging photoplethysmography to study blood supply in patients with systemic lupus erythematosus and systemic scleroderma

N.P. Podolyan[1], A.V. Belaventseva[1], A.V. Sakovskaia[1,2], O.V. Mamontov[1,3,4], R.V. Romashko[1], A.A. Kamshilin[1]; [1]Laboratory-24, Institute of Automation and Control Processes FEB RAS, [2]Institute of Therapy and Instrumental Diagnostics, Pacific State Medical University, [3]Department of Circulation Physiology, Almazov National Medical Research Centre, [4]Pavlov First St. Petersburg State Medical University, Russia

The parameters of facial blood supply were studied in patients with systemic lupus erythematosus and systemic scleroderma using a non-contact imaging photoplethysmography method synchronized with an electrocardiogram. Statistically significant differences in the amplitude and time of arrival of the pulse wave to different areas of the face were revealed in sick patients compared with the control group.

- Lunch Break -

Location: Petrov-Vodkin 2 Room, Floor 2; Date: Tuesday, July 02, 2024

SYC: PHOTONICS AND NANOBIOTECHNOLOGY 3

Session Chair:

TuSYC-12 15:00-15:30

Nanoparticles in optical bioanalytical techniques: finding efficient labels and formats of application *(Invited paper)*

A.V. Zherdev, B.B. Dzantiev; A.N. Bach Institute of Biochemistry, Research Centre of Biotechnology RAS, Russia

The use of nanoparticles as carriers and labels in optical bioanalytical systems will be discussed. Comparison of nanoparticles differing in composition, size and shape, content of immobilized bioreceptors (antibodies, aptamers) will be presented; criteria for reaching minimal limits of detection will be formulated. The effectiveness of the selected preparations in agglutination and lateral flow test systems will be demonstrated. The study was supported by the RSF grant 23-46-10011.

TuSYC-13 15:30-16:00

Low-dimensional magnetic structures as sensing nanoprobes for advanced bioapplications *(Invited paper)*

A.V. Orlov; Prokhorov General Physics Institute RAS, Russia

This research explores the potential of one- and two-dimensional magnetic nanomaterials in bioanalytical applications. Here, innovative methods are presented for advanced sensing, including ultrafast biomarker detection, electronic and optical quantification of anisotropic magnetic nanostructures, and simultaneous determination of various materials in a single sample. These methods hold the promise of faster targeting, advanced diagnostics, and new optical and magnetic bioimaging.

TuSYC-14 16:00-16:15

Ensemble methods for analyzing Raman spectra of macromolecular complexes with a small amount of additives

O.A. Mayorova, M.S. Saveleva, D.N. Bratashov, E.S. Prikhozhdenko; Science Medical Center, Saratov State University, Russia

Combining Raman spectroscopy and machine learning is a great way to study the chemical structure of macromolecules and their complexes. Random forest and gradient boosting approaches were implemented in solving regression and classification problems in analysis of WPI:HA Raman spectra with low HA amount. Feature importance obtained could highlight the Raman bands that differ the most among the samples.

TuSYC-15 16:15-16:30

Strategies for miRNA delivery to stimulate liver regeneration: nanocarriers and metabolic imaging

S. Rodimova[1], D. Kozlov[1,2], D. Krylov[1,2], A. Mozherov[1], V. Elagin[1], L. Mikhailova[3], M. Zyuzin[3], D. Kuznetsova[1]; [1]Privolzhsky Research Medical University; [2]National Research Lobachevsky State University; [3]ITMO University, Russia

We present a new strategy to develop a controlled method to stimulate liver regeneration. The method is based on the use of nanocarriers with microRNAs. Nanoparticle-based complexes represent a tool not only for therapy, but also for visualizing the distribution of the therapeutic agent.

SYA: ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES - POSTERS

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

TuSYA-p01 15:00-18:30

IR spectroscopy for hematology

L.V. Plotnikova[1], A.D. Garifullin[1,2], A.Y. Kuvshinov[2], S.V. Voloshin[2,3,4], R.V. Butyaev[1], A.D. Kartashova[1], A.M. Polyanichko[1,5]; [1]St. Petersburg State University, [2]Russian Research Institute of Hematology and Transfusiology, [3]Kirov Military Medical Academy, [4]Mechnikov Northwestern State Medical University, [5]Institute of Cytology RAS, Russia

Currently, there is an increase in the number of oncohematological diseases. Simple and reliable screening methods are required for their effective diagnosis. One of the promising and rapidly developing approaches is IR spectroscopy of various samples of biomaterials.

TuSYA-p02 15:00-18:30

Fiber pyrometer based on AgCl.25Br.75-AgI fiber for measuring temperature in hard-to-reach places

A.E. Lvov, A.A. Yuzhakova, D.D. Salimgareev, P.V. Pestereva, A.S. Korsakov, L.V. Zhukova; Ural Federal University, Russia

The work is devoted to the manufacture of a fiber pyrometer based on AgCl0.25Br0.75 – AgI fibers and using it to measure the temperature of objects in the range of 36-50 °C.

TuSYA-p03 15:00-18:30

Studying thermal effects of infrared femtosecond laser pulses applied for laser assisted hatching procedure on mouse embryos

D.S. Sitnikov[1], M.A. Filatov[2], M.V. Kubekina[2], Y.Y. Silaeva[3]; [1]JIHT RAS; [2]Center for Precision Genome Editing and Genetic Technologies for Biomedicine, IGB RAS; [3]Core Facility Centre, IGB RAS, Russia

Infrared femtosecond laser pulses are used for microsurgery of zona pellucida of mouse embryos at late stages of preimplantation development. Safety of the procedure is studied through embryo viability and heat shock proteins (HSP) gene expression assessment methods. Expression levels of the genes encoding HSPs were shown to increase slightly compared to the negative control group.

TuSYA-p04 15:00-18:30

Histophysiological study of the skin after exposure to holmium laser radiation

V.V. Astashov[1], P.V. Novokreshchenov[1], M.S. Kopyeva[1,2], S.A. Filatova[2], V.I. Kozlov[1], V.A. Duvanskiy[1]; [1]Peoples' Friendship University of Russia, RUDN University; [2]Prokhorov General Physics Institute RAS, Russia

A histophysiological investigation of the experimental animals skin was performed on day 3 after exposure to holmium-doped fiber laser continuous-wave radiation at different power intensities. Using histologic and functional research methods, changes characteristic of the exudative stage of aseptic inflammation were revealed, the severity of which depended on the radiation dose.

TuSYA-p05 15:00-18:30

Raman spectroscopy as a tool for helicobacter pylori diagnostics

E.E. Popov, A.V. Polishchuk, A.V. Kovalev, V.V. Vitkin; ITMO University, Russia

Raman spectroscopy was studied as a diagnostic tool for detecting Helicobacter pylori infection. We suggested a new methodology to account the changes in the spectrum of Raman scattering caused by pressure variations, which enabled us to measure the 13CO2 fraction with a relative error 2.1%. The results showed a positive correlation with a blood test for H. pylori antibodies.

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY - POSTERS

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

TuSYB-p01 15:00-18:30

The effect of optical clearing agents on the results obtained with the digital nailfold capillaroscopy

P.A. Moldon, A.E. Lugovtsov, P.B. Ermolinskiy, Y.I Gurfinkel, A.V. Priezzhev; Lomonosov Moscow State University, Russia

In this work the influence of optical clearing agents (OCA) on the blood flow in nailfold capillaries was studied. It was shown that parameters obtained by nailfold capillaroscopy technique depend on OCAs used for visualization of capillaries.

TuSYB-p02 15:00-18:30

Two approaches to estimate the depth of light penetration into biotissues

A.P. Tarasov[1,2], D.A. Rogatkin[1]; [1]Moscow Regional Research and Clinical Institute (MONIKI); [2]National Research Centre "Kurchatov Institute", Russia

The work compares two approaches to evaluate the depth, based, respectively, on the exponential decay, and on the estimation of a volume, where 95% of absorbed light is accumulated. It is shown that the approach, which uses the conventional exponential decay, underestimates the penetration depth in more than 2 times.

TuSYB-p03 15:00-18:30

In vivo study of vascularization and oxygenation of tumor xenografts

A.M. Glyavina[1,2], K.G. Akhmedzhanova[1,2], A.A. Kurnikov[1], Yu.A. Khochenkova[1,3], D.A. Khochenkov[1,3], I.V. Turchin[1], P.V. Subochev[1], A.G. Orlova[1]; [1]Inst. of Applied Physics RAS; [2]Lobachevsky State Univ. of Nizhny Novgorod; [3]N.N. Blokhin National Medical Research Center of Oncology, Russia

A combination of OA and DOS methods has been proposed to assess the vascular structure and oxygenation level of renal (SN-12C) and colon (Colo320, HCT116) cancer models. Differences in the structure of the vascular bed are shown; high vascularity was found for Colo320 and SN-12C. Colo320 showed increased hemoglobin and decreased oxygen saturation compared to SN-12C and HCT116.

TuSYB-p04 15:00-18:30

Validation and comparative analysis of off-axis digital holographic microscopy and SLIM for biological applications

I.V. Semenova[1], A.V. Belashov[1], A.A. Zhikhoreva[1], M.V. Belashov[2], P.S. Butorin[1]; [1]Ioffe Inst.; [2]ITMO Univ., Russia

The paper presents analysis of the performance of two quantitative phase imaging methods implemented on the model object of polystyrene beads dissolved in water. Phase images obtained using two realizations of SLIM technique and off-axis digital holographic microscopy were compared with the expected phase shift image from spherical transparent phase objects.

TuSYB-p05 15:00-18:30

Fast Spectroscopic Technique of Optical Biopsy of Intracranial Tumors

I.D. Romanishkin[1], T.A. Savelieva[1,2], A. Ospanov[2], S.V. Shugai[3], S.A. Goryajnov[3], G.V. Pavlova[3,4], I.N. Pronin[3], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Institute RAS, [2]National Research Nuclear University MEPhI, [3]N.N. Burdenko National Medical Research Center of Neurosurgery, [4]Institute of Higher Nervous Activity and Neurophysiology RAS, Russia

The possibility of differentiation of glial and meningeal tumors on the basis of the proposed method of optical-spectral analysis was shown. For non-fluorescing tumors, the most significant indicators were the intensity of elastic light scattering, carotenoid content, and the change in lipid/protein ratio.

TuSYB-p06 15:00-18:30

Advanced optoacoustic imaging capabilities using piezopolymer detectors: increased sensitivity, wide reception bandwidth, high numerical aperture

A.A. Kurnikov[1], A.G. Sanin[1], G.P. Volkov[1], A.G. Orlova[1], A.V. Kovalchuk[1], D. Razansky[2], P.V. Subochev[1]; [1]Inst. of Applied Physics RAS, Russia; [2]ETH Zurich, Switzerland

Optoacoustic (OA) angiography is a non-invasive imaging technique that involves probing tissue with laser pulses and recording ultrasound signals. This study focuses on analyzing the sensitivity, reception bandwidth, and numerical aperture of piezoelectric transducers used for ultrasound detection. Through numerical simulations and experiments, the effectiveness of piezopolymer detectors in providing detailed OA visualization of complex vascular networks has been demonstrated.

TuSYB-p07 15:00-18:30

Monte Carlo modeling of the red blood cell aggregation in photoplethysmography

D.G. Lapitan, A.P. Tarasov; Moscow Regional Research and Clinical Institute ("MONIKI"), Russia

The effect of red blood cell (RBC) aggregation on the photoplethysmography (PPG) signal at a wavelength of 810 nm was investigated using the Monte Carlo method. It was found that the main contribution to the formation of the PPG signal is made by scattering variations due to changes in the rouleaux size (84% versus 16% absorption, respectively).

TuSYB-p08 15:00-18:30

OCT monitoring of scattering kinetics in tissue phantoms at optical clearing with depth resolution

I.A. Serebryakova[1,2], Y.I. Surkov[1,2], E.A. Genina[1,2], V.V. Tuchin[1,2,3]; [1]Optics and Biophotonics Department, Saratov State University; [2]Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University; [3]Laboratory of Laser Diagnostics of Technical and Living Systems, Institute of Precision Mechanics and Control RAS, Russia

A method for reconstructing and monitoring the scattering coefficient with a depth resolution of homogeneous samples with optical clearing of the sample has been developed and tested on a gelatin phantom. The proposed method makes it possible to track changes in the scattering coefficient at different depths.

TuSYB-p09 15:00-18:30

Channel shape inside sapphire capillary needles and its impact on transmitted laser beam

I.A. Shikunova, D.O. Strukov, Yu.N. Zubareva, I.N. Dolganova, V.N. Kurlov; Osipyan Institute of Solid State Physics RAS, Russia

In sapphire needle capillaries, we analyze the form of the internal channel and the needle tip and their influence on the shape of the outcoming beam. We propose some methods of alteration of the capillary shape via growth conditions that contribute to obtaining the required geometry.

TuSYB-p10 15:00-18:30

Development of optical modules to existing laboratory devices for biomarker detection in vivo

M.A. Makhortov[1], O.V. Grishin[1], S.A. Perkov[2], O.I. Gusliakova[1,3], D.N. Bratashov[1], E.S. Prikhozhdenko[1]; [1]Science Medical Center, Saratov State University; [2]Photonics Center, Skolkovo Institute of Science and Technology; [3]Vladimir Zelman Center for Neurobiology and Brain Rehabilitation, Skolkovo Institute of Science and Technology, Russia

Usually, existing laboratory devices for conducting in vitro studies require modification to carry out in vivo measurements. We have developed the fiber probe connected to Raman spectrometer Renishaw inVia and the external optical circuit for in vivo photoacoustics cytometer which allows measuring photoacoustics signal of biological fluids either in laboratory tubes, or in vivo in laboratory animals.

TuSYB-p11 15:00-18:30

129Xe nuclear spin laser hyperpolarizer

V.M. Vodovozov, R.F. Kurunov, A.V. Pavlenko, V.M. Baev, M.V. Kuleshov, V.A. Chumichev, V.V. Eremkin, A.A. Baturina; JSC "NIIEFA", Russia

The experimental model of the 129Xe laser hyperpolarizer for MRI diagnostics of human organs inaccessible for examination by classical proton tomography is presented. Spin Exchange Optical Pumping (SEOP) is used to develop the hyperpolarized state of 129Xe. A polarization level of 40% has been achieved with a gas capacity of ~1,2 l/hour.

TuSYB-p12 15:00-18:30

Mathematical simulation of uniform heating of biological tissues by laser radiation

K.V. Sovin[1,2], N.V. Kovalenko[1,2], V.S. Anpilov[1,2], V.P. Surovtseva[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, Russia

The description of thermal damage to biological tissues is based on the Arrhenius formalism. Measurements of Arrhenius parameters are conducted under the assumption of homogeneously degraded samples. We simulated the degradation processes under conditions of heating with air, water and optical radiation. Optical heating demonstrated high accuracy in the retrieving degradation kinetics parameters at different sample thicknesses and degradation times.

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY

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

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 4

Session Chair:

WeSYB-16 09:00-09:30

Microcirculatory-tissue systems of the human body as an object of study in space research *(Invited paper)*

A.V. Dunaev; Orel State University, Russia

This paper presents the results of the study of changes in microcirculatory-tissue systems under spaceflight and isolation experiment conditions. For the first time, a technique has been developed for measuring microcirculatory-tissue systems in the limbs of cosmonauts during the period of acute adaptation to microgravity conditions and readaptation after the completion of a spaceflight.

WeSYB-17 09:30-10:00

The problem of data reproducibility in laser diffractometry of erythrocytes *(Invited paper)*

S.Yu. Nikitin; Physics Faculty of Lomonosov Moscow State University, Russia

Two algorithms for measuring the red blood cell mean radius and red blood cell distribution width (RDW) are proposed, based on the analysis of the diffraction pattern that occurs when a laser beam is scattered on a blood smear.

WeSYB-18 10:00-10:30

Experimental comparison of imaging photoplethysmography and laser speckle contrast imaging for blood flow assessment *(Invited paper)*

A.A. Kamshilin; Institute of Automation and Control Processes FEB RAS, Russia

In this work, responses of cortical vessels to administration of a metabolic agent were measured in rats using contactless imaging photoplethysmography and laser speckle contrast imaging systems providing full-field of view visualization of blood flow. It was found that blood-flow changes detected by two systems are significantly different due to different nature of light interaction with tissues underlying these methods.

WeSYB-19 10:30-10:45

Optically measured blood microcirculation parameters and their correlation with endothelium function in healthy volunteers and patients suffering from cardiovascular diseases

A.V. Priezzhev, P.B. Ermolinskiy, Yu.I. Gurfinkel, E. Sovetnikov, A.E. Lugovtsov; Lomonosov Moscow State University, Russia

The objective of this work was to examine and compare the microcirculation in healthy volunteers and two groups of patients suffering from cardiovascular diseases, specifically coronary heart disease (CHD) and atrial fibrillation (AF).

WeSYB-20 10:45-11:00

Imaging of microcirculation enhanced with optical clearing agents and evaluation of their effect on blood microrheology

A.E. Lugovtsov[1], P.B. Ermolinskiy[1], P.A. Moldon[1], D.A. Umerenkov[1], Yu.I. Gurfinkel[1], P.A. Timoshina[2], Pengcheng Li[3], A.V. Priezzhev[1]; [1]Lomonosov Moscow State University, Russia; [2]Saratov State University, Russia; [3]Huazhong University of Science and Technology, China

The efficiency of 15 optical clearing agents (OCAs) that are widely used for enhancement of imaging of tissues was investigated. We show a significant impact on elevating the transparency and improving the visualization of the nail bed capillaries. A significant effect of OCAs on microrheological parameters of blood was shown.

- Coffee Break -

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

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 5

Session Chair:

WeSYB-21 11:30-12:00

Optical measurements in vitro and in vivo of erythrocyte aggregation parameters in patients with different pathologies *(Invited paper)*

P.B. Ermolinskiy[1], M.K. Maksimov[1], D.A. Umerenkov[1], Yu.I. Gurfinkel[2], L.I. Dychuk[2], A.E. Lugovtsov[1], A.V. Priezzhev[1]; [1]Department of Physics, Lomonosov Moscow State University; [2]Medical Research and Education Center, Lomonosov Moscow State University, Russia

Blood microrheological parameters are essential for understanding blood microcirculation. In this study, we applied different laser-optical techniques to measure aggregation parameters in blood samples from healthy donors and patients suffering from cardiovascular diseases. We identified significant differences in aggregation parameters between groups, demonstrating the effectiveness of these methods for assessing erythrocyte aggregation both in vivo and in vitro.

WeSYB-22 12:00-12:15

Cerebral blood flow dynamics in rats with blood loss

N.V. Golubova[1,2], I.A. Ryzhkov[2], K.N. Lapin[2], V.N. Prizemin[1], A.V. Dunaev[1], V.V. Dremin[1], E.V. Potapova[1]; [1]Research & Development Center of Biomedical Photonics, Orel State University, [2]Federal Research and Clinical Center of Intensive Care Medicine and Rehabilitology, Russia

This paper presents the results of investigating the blood flow dynamics using the laser speckle contrast imaging method in rats with blood loss and without it. The results indicate that under such conditions, there was no significant decrease in speckle perfusion values.

WeSYB-23 12:15-12:30

Intraoperative assessment of blood flow during esophageal resection using fluorescence diagnostics and diffuse scattering spectroscopy

A.A. Krivetskaya[1,2], D.M. Kustov[1], V.V. Levkin[3], S.V. Osminin[3], S.S. Kharnas[3], E.V. Eventeva[3], F.P. Vetshev[3], R.N. Komarov[3], A.S. Gorbunov[3], K.G. Linkov[1], T.A. Savelieva[1,2], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Institute RAS; [2]Institute of Engineering Physics for Biomedicine, National Research Nuclear University MEPhI; [3]Department of Faculty Surgery No.1, I.M. Sechenov First Moscow State Medical University, Russia

The assessment of tissue blood supply during surgery can reduce the risk of postoperative complications. This work proposes the use of fluorescence diagnostics and diffuse scattering spectroscopy for the accomplishment of the desired aim.

WeSYB-24 12:30-12:45

Wearable multimodal analyzers in the microcirculatory-tissue systems monitoring during different sleep stages

Y.I. Loktionova[1], E.V. Zharkikh[1], D.F. Kleeva[2], V.S. Yanushin[1], V.V. Sidorov[3], A.I. Krupatkin[4], A.V. Dunaev[1]; [1]Research & Development Center of Biomedical Photonics, Orel State University; [2]National Research University Higher School of Economics; [3]SPE "LAZMA" Ltd.; [4]Priorov Central Research Institute of Traumatology and Orthopedics, Russia

This paper presents the first results of the study of changes in microcirculatory-tissue systems functioning during different sleep stages. Wearable multimodal devices were used to monitoring the microcirculatory-tissue systems during night sleep simultaneously with electroencephalography to separate the sleep stages.

WeSYB-25 12:45-13:00

Wearable multimodal laser analyzers in assessing of microcirculatory disorders in the long COVID syndrome

E.V. Zharkikh[1], Y.I. Loktionova[1], V.E. Parshakova[1], A.A. Fedorovich[1,2], A.V. Dunaev[1]; [1]Research & Development Center of Biomedical Photonics, Orel State University; [2]National Medical Research Center for Therapy and Preventive Medicine of the Ministry of Healthcare of the Russian Federation, Russia

The paper presents the results of the study of the effect of long COVID on the functional state of microcirculatory-tissue systems of the human body using wearable multimodal laser analyzers.

- Lunch Break -

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

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 6

Session Chair:

WeSYB-26 15:00-15:30

Revolutionizing vascular diagnostics: the role of wideband ultrasound detectors in optoacoustic visualization technologies *(Invited paper)*

P.V. Subochev; Institute of Applied Physics RAS, Russia

This presentation explores the transformative impact of wideband ultrasound detectors in optoacoustic angiography, combining optical imaging's molecular specificity with ultrasound's depth. We'll discuss advancements in piezopolymer detector design and the potential of these detectors in enhancing image quality, resolution, and real-time diagnostic capabilities in biomedical optoacoustic imaging.

WeSYB-27 15:30-16:00

Photoacoustic technologies for visualizing tumors and searching for foreign objects in the blood stream *(Invited paper)*

D.N. Bratashov, N.A. Shushunova, M.A. Makhortov, E.S. Prikhozhdenko; Saratov State University, Russia

Development of tumors at different stages in an animal model with engrafted tumors and study the number of circulating tumor cells produced by the tumors was investigated.The in vivo photoacoustic flow cytometry setup was developed for second task. It can work with the blood flow in a large vessel of an animal or the human body.

WeSYB-28 16:00-16:30

In vivo applications of raster-scan optoacoustic angiography *(Invited paper)*

A.G. Orlova[1], K.G. Akhmedzhanova[1,2], A.A. Kurnikov[1], A.M. Glyavina[1,2], D.A. Khochenkov[1,3], Yu.A. Khochenkova[1,3], A.V. Maslennikova[1,2,4], S.V. Nemirova[1,4], I.V. Turchin[1], P.V. Subochev[1]; [1]A.V. Gaponov-Grekhov Institute of Applied Physics RAS; [2]N.I. Lobachevsky State University of Nizhny Novgorod; [3]N.N. Blokhin National Medical Research Center of Oncology; [4]Privolzhsky Research Medical University, Russia

Vascular network of human and animal tissues was studied using raster-scan system with 532 nm laser source and wideband PVDF detector. Experimental tumors of different origin were compared. Changes in vascularity of tumors after radiation therapy were demonstrated. For patients with post-thrombotic syndrome changes in blood volume, vessel diameter and tortuosity were revealed.

WeSYB-29 16:30-16:45

A reduction in the required laser energy for optical resolution photoacoustic microscopy using PVDF-TrFe piezopolymer ultrasonic detectors

D.A. Voitovich, A.A. Kurnikov, A.G. Orlova, P.V. Subochev; Institute of Applied Physics RAS, Russia

Optical resolution photoacoustic microscopy (OR-PAM) is a high-resolution in-vivo imaging that based on the photoacoustic effect. This study introduces OR-PAM setup incorporating a PVDF-TrFe film in the ultrasonic detector. By employing this film, the sensitivity of the piezoelectric detector is enhanced. Additionally, it allows for a reduction in the required laser radiation energy for safety reasons.

SYC: PHOTONICS AND NANOBIOTECHNOLOGY

Location: Petrov-Vodkin 2 Room, Floor 2; Date: Wednesday, July 03, 2024

SYC: PHOTONICS AND NANOBIOTECHNOLOGY 4

Session Chair:

WeSYC-17 09:00-09:30

Multispectral fluorescence lifetime imaging microscopy of endogenous fluorophores at a single excitation wavelength *(Invited paper)*

B. Yakimov[1,2], A. Komarova[3], E. Nikonova[1], A. Mozherov[3], L. Shimolina[3], M. Shirmanova[3], W. Becker[4], E. Shirshin[1,2], V. Shcheslavskiy[3,4]; [1]Sechenov First Moscow State Medical University, Russia; [2]Lomonosov Moscow State University, Russia; [3]Privolzhsky Research Medical University, Russia; [4]Becker&Hickl GmbH, Germany

We present experiments on multi-wavelength fluorescence lifetime imaging microscopy of NAD(P)H and flavins at a single wavelength of 750 нм. We show the advantages and limitations of using single photon counting spectral detectors for metabolic imaging of cells and tumor spheroids.

WeSYC-18 09:30-10:00

Time-resolved fluorescence microscopy of QDs in investigations of endolysosome acidification *(Invited paper)*

E.S. Kornilova[1,2,3], I.K. Litvinov[1], A.V. Salova[1], T.N. Belyaeva[1]; [1]Institute of Cytology RAS; [2]Peter the Great St. Petersburg Polytechnic Univ.; [3]St. Petersburg State Univ., Russia

Endolysosome acidification was assessed by time-resolved fluorescence microscopy (FLIM) using quantum dots targeted by EGF (EGF-QDs). It has been shown that the interpretation of the results of changes in the QD lifetime using the proton pump inhibitor BafA1 depends on the method of its administration. Also, some additional factors in endolysosomes can affect lifetime of QDs besides pH.

WeSYC-19 10:00-10:15

Targeted magnetic nanoparticles for cancer diagnosis and treatment

O.A. Kolesnikova[1], E.N. Komedchikova[1], M.A. Yurchenko[1], D.A. Maedi[1], A.M. Skirda[1,3], V.O. Shipunova[1,2]; [1]Moscow Institute of Physics and Technology, [2]Sirius University of Science and Technology, [3]Prokhorov General Physics Institute RAS, Russia

Over the past few years, nanomaterials have garnered considerable attention, in particular, targeted nanoformulations due to their high specificity of delivery to molecular targets and reduced systemic toxicity for the organism. Here we report the study of the cellular delivery of targeted fluorescent magnetic nanoparticles to human epidermal growth factor receptor 2, clinically significant oncomarker.

WeSYC-20 10:15-10:30

Ir(III) complexes - sensors for hypoxia detection

I.S. Kritchenkov[1,2], M. Samandar[1], N.A. Zharskaia[1], S.A. Silonov[1,3], E.E. Galenko[1], D.O. Karpitskaya[1], S.P. Tunik[1]; [1]Institute of Chemistry, St Petersburg State University, [2]Faculty of Science, Peoples' Friendship University of Russia (RUDN University), [3]Institute of Cytology RAS, Russia

In this work, two new Ir(III) complexes were synthesized. All complexes exhibit efficient phosphorescence with pronounced sensitivity to the presence of oxygen. For the most promising complex the phosphorescence lifetime imaging experiments were conducted, revealing that this sensor markedly changes the phosphorescence lifetime values in cells from 1.8 to 4.1 μs upon transition from normoxia to simulated hypoxia.

WeSYC-21 10:30-10:45

Monitoring cellular uptake of gold nanoparticles by stationary absorption spectroscopy

A.V. Kochakov[1], A.A. Mitusova[2], D.R. Dadadzhanov[1], D.V. Kononov[1], N.S. Petrov[1]; [1]ITMO University, [2]Pavlov First Saint Petersburg State Medical University, Russia

Gold plasmonic nanoparticles were synthesized by the reduction of chloroauric acid (HAuCl4) followed by surface modification using a biocompatible polymer (PEG). Nanoparticles were introduced into tumor cells of leukemia and melanoma lines. Verification of endocytosis of nanoparticles by cancer cells is approved by stationary absorbance spectroscopy.

WeSYC-22 10:45-11:00

Green and red emissive N, O-doped chiral carbon dots functionalized with L-cysteine

A.A. Vedernikova[1], S.A. Shipilovskikh[2], E.V. Ushakova[1]; [1]International Research and Education Center for Physics of Nanostructures, ITMO University, [2]School of Physics and Engineering, ITMO University, Russia

Chiral carbon dots (CDs) are promising nanoparticles for sensing and bioimaging. Herein, the green and red emissive chiral CDs are fabricated via surface modification treatment of achiral CDs at room temperature. The treated CDs demonstrate an intense chiral signal in the region of 200–300 nm with dissymmetry factor up to 2.3×10 4.

- Coffee Break -

Location: Petrov-Vodkin 2 Room, Floor 2; Date: Wednesday, July 03, 2024

SYC: PHOTONICS AND NANOBIOTECHNOLOGY 5

Session Chair:

WeSYC-23 11:30-12:00

Design and interactions of luminescent nanoparticles in analytical systems *(Invited paper)*

I.Y. Goryacheva, D.D. Drozd, P.D. Strokin, D.A. Kornilov, Y.A. Podkolodnaya, O.A. Goryacheva; Saratov State University, Russia

Luminescent nanoparticles and nanoclusters represent a promising tool for imaging and bioanalysis. The sophisticated design of nanoparticles allows them to be used as active and passive labels to detect the presence of various components. The potential of nanoparticles to alter the optical signal in response to the presence of analytes and their analytical applications are discussed.

WeSYC-24 12:00-12:30

Upconversion nanoparticles for diagnosis and targeted treatment of cancer *(Invited paper)*

N.Yu. Shilyagina[1], E.L. Guryev[1], D.K. Bausheva[1], L.V. Krylova[1], A.B. Volovecki y[2], V.A. Vodeneev[1], I.V. Balalaeva[1], S.M. Deyev[3] and A.V. Zvyagin[1,2,3]; [1]Lobachevsky State Univ. of Nizhny Novgorod, [2]The Institute of Molecular Medicine, I.M. Sechenov First Moscow State Medical Univ., [3]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry RAS, Russia

Theranostics is one of the fastest growing areas in cancer therapy. We have created a new type of theranostic complexes based on up-conversion nanoparticles and the recombinant targeted toxin DARPin-LoPE. We demonstrated selective binding of the complexes to cells, demonstrated the ability to intravitally visualize the biodistribution and accumulation of complexes in tumors, and demonstrated specific toxicity to tumor cells.

WeSYC-25 12:30-13:00

Metabolic and oxygen measurements in tumors in vivo using fluorescence and phosphorescence lifetime imaging *(Invited paper)*

M.V. Shirmanova[1], A.D. Komarova[1], A.M. Mozherov[1], A.A. Plekhanov[1], M.A. Sirotkina[1], L.E. Shimolina[1], M. Lukina[1], L.N. Bochkarev[2], V.I. Shcheslavskiy[1]; [1]Privolzhsky Research Medical University; [2]Razuvaev Institute of Organometallic Chemistry RAS, Russia

Glycolysis and hypoxia are the critical features of solid tumors, however the relationships between oxygenation and the metabolic state of tumor cells are not entirely clear. We present the results of in vivo fluorescence and phosphorescence lifetime imaging to probe metabolic state and oxygen level in tumor models upon natural growth and anti-cancer therapy.

WeSYC-26 13:00-13:15

Effect of administration route on biodistribution of PLGA nanoparticles

E.N. Komedchikova[1], O.A. Kolesnikova[1], E.N. Mochalova[1,2], A.S. Drozdov[1], J.A. Malkerov[3], V.R. Cherkasov[1], V.O. Shipunova[1,2]; [1]Moscow Institute of Physics and Technology; [2]Sirius University of Science and Technology; [3]Prokhorov General Physics Institute RAS, Russia

In this study, we compared the biodistribution of PLGA nanoparticles 4h after intravenous or intraperitoneal injections – two commonly used administration routes.

WeSYC-27 13:15-13:30

Multifunctional hybrid nanoparticles as vectors for regulating the expression of target genes

P.I. Nikitin[1], A.M. Skirda[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]Moscow Inst. of Physics and Technology, Russia

Multifunctional hybrid nanoparticles have been developed for gene therapy and addresses the need for carriers of minimal cytotoxicity. The obtained nanoparticles exhibit optical and superparamagnetic properties, biomolecule binding, form stable complexes with therapeutic nucleic acids, and can serve as carriers for gene regulation. They demonstrate high efficiency in targeted siRNA delivery and offer biocompatibility and potential for controlled intracellular applications.

- Lunch Break -

Location: Petrov-Vodkin 2 Room, Floor 2; Date: Wednesday, July 03, 2024

SYC: PHOTONICS AND NANOBIOTECHNOLOGY 6

Session Chair:

WeSYC-28 15:00-15:30

Rigidochromic porphyrazine dyes: smart molecules for sensing and cancer treatment *(Invited paper)*

I.V. Balalaeva[1], N.N. Peskova[1], L.N. Shestakova[1], N.Yu. Shilyagina[1], V.I. Plekhanov[2], S.A. Lermontova[3], L.G. Klapshina[3]; [1]Lobachevsky State Univ. of Nizhny Novgorod, [2]Gaponov-Grekhov Inst. of Applied Physics RAS, [3]Razuvaev Inst. of Organometallic Chemistry RAS, Russia

Tetracyanotetra(aryl)porphyrazines are a unique group of dyes combining properties of molecular rotors and photodynamic agents. The fluorescence lifetime and quantum yield of these compounds are highly dependent on local viscosity, so they can be used as sensors of intracellular viscosity. The rigidochromic behaviour of the compounds provides a tool to quantify cell damage in real time during photodynamic cancer treatment.

WeSYC-29 15:30-16:00

Polymer optic fiber photoluminescent probe for cortisol continuous monitoring with metal-enhanced displacement fluoroimmunoassay *(Invited paper)*

P.A. Kusov, Yu.V. Kotelevtsev, V.P. Drachev; Skolkovo Institute of Science and Technology, Russia

The application and optimization of the surface-specific fluoroimmunoassay for real-time cortisol monitoring to novel substrate and setup – polymer optic fiber probe functionalized by gold nanoparticles and immobilized antibodies was achieved by our group. Free cortisol and fluorescently labelled carrier protein conjugated with cortisol hapten compete in binding with limited sites of surface-immobilized antibodies.

WeSYC-31 16:00-16:15

Detection and analysis of protein compounds based on Raman scattering and machine learning

E.Y. Ponkratova[1], A.S. Shtumpf[1], L.I. Fatkhutdinova[1], G.I. Bikbaeva[2], A.Y. Kokhanovskiy[1], A.A. Bogdanov[1], A.A. Manshina[2], D.A. Zuev[1]; [1]Faculty of Physics, ITMO Univ.; [2]Institute of Chemistry, St. Petersburg State Univ., Russia

Proteins are integral to cellular function within the human body. However, conventional techniques such as immunoassay and chromatography may not always provide accurate results in detecting biological compounds. This study proposes the utilization of Raman spectroscopy for the identification of individual amino acids and protein compounds, followed by machine learning-based quantitative and qualitative analysis of the acquired data.

WeSYC-32 16:15-16:30

Logic-gate-controlled density of antibody binding sites on sensing surface for immunoassays with improved analytical performance

N.A. Belyakov[1,2], D.O. Novichikhin[1], B.G. Gorshkov[1]; [1]Prokhorov General Physics Institute RAS; [2]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia

This study tackles the analytical performance balance in biosensing systems. Introducing a universal approach, we propose a surface with a logic gate molecularly controlled density of antibody binding sites. Experimental demonstration with spectral interferometry on glass sensor chips with adjustable biosensitive element density showed the ability to detect antibiotic chloramphenicol. This innovative method provides controlled analytical characteristics for developing biosensors.

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE

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

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 1

Session Chair:

WeSYD-01 09:00-09:40

Targeted photodynamic therapy treatment on colorectal tumour spheroids *(Keynote presentation)*

H. Abrahamse, N.W.N. Simelane; Laser Research Centre, Faculty of Health Sciences, University of Johannesburg, South Africa

Despite conventional therapeutic approaches, mortality from colorectal cancer (CRC) remains high, which is a major concern worldwide. Multifunctional bio nanoconjugates (MBNC) show promise as more effective targeted photosensitizer delivery systems in photodynamic therapy of colorectal cancer. Our findings highlight the synthesis and characterization of a MBNC for targeted PS delivery to irradicate colorectal cancer cells.

WeSYD-02 09:40-10:00

Photosensitization of singlet molecular oxygen by bacterial C_{40} carotenoids

A.A. Krasnovsky Jr.[1], A.S. Benditkis[1], A.A. Ashikhmin[2], A.A. Moskalenko[2]; [1]A.N. Bach Institute of Biochemistry, Federal Research Center of Biotechnology RAS; [2]Pushchino Scientific Center for Biological Research RAS, Institute of Basic Biological Problems RAS, Russia

Time-resolved measurement of photosensitized luminescence of singlet oxygen (SO) has been applied to studies of SO generation and quenching by C40 carotenoids (phytoene, zeta-carotene, neurosporene, lycopene, rhodopin and spirilloxanthin) having (5-13) conjugated double bonds (CDB) in their molecules. It was found that these carotenoids combine the property of strong SO quenching with an abilitiy of SO generation upon photoexcitation.

WeSYD-03 10:00-10:15

Sub-nanosecond excited state relaxation in FAD bound with bacterial diaphorase

I.A. Gorbunova, D.A. Volkov, D.V. Yashkov, M.E. Sasin, O.S. Vasyutinskii; Ioffe Institute, Russia

We present the results of analysis of polarized fluorescence decay in FAD bound with enzyme diaphorase. The analysis revealed isotropic and anisotropic fluorescence depolarization processes related with sub-nanosecond relaxation in FAD excited states. The significant differences in excited state dynamics in free FAD and FAD-diaphorase complexes was found.

WeSYD-04 10:15-10:30

$AlPcS_4Cl$ is effective against Squamous cell carcinomas

A. Crous; Laser Research Centre, University of Johannesburg, South Africa

Squamous cell carcinomas, or SCCs, are frequently occurring cancers. SCCs are caused by both non-squamous and squamous epithelial tissues. This study investigated the impact of gold nanoparticles (AuNPs)-based AlPcS4Cl - nanoPDT on melanoma, oesophageal, lung, and cervical cancers. The findings show that therapeutic chemical is more extensively absorbed and localised in cancer cells.

WeSYD-05 10:30-11:00

Spectroscopic intraoperative diagnostics of tumors during photodynamic therapy *(Invited paper)*

K.T. Efendiev[1,2], P.M. Alekseeva[1], A.A. Shiryaev[3], T.N. Pisareva[3], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Institute RAS; [2]National Research Nuclear University "MEPhI"; [3]Sechenov First Moscow State Medical University, Russia

Methods of intraoperative diagnostics of tumors in the process of photodynamic therapy have been developed, which include the use of a single light source for fluorescence diagnostics and photodynamic therapy. The obtained results demonstrate the possibility of tumor phototheranostics with simultaneous monitoring of photosensitizer photobleaching, blood oxygen level and the state of the vascular system of irradiated tumor tissues.

- Coffee Break -

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

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 2

Session Chair:

WeSYD-06 11:30-11:45

Synthesis of core-shell ternary quantum dots - porphyrin conjugates and its photodynamic therapy application

O.S Oluwafemi; Department of Chemical Sciences (formely Applied Chemistry), University of Johannesburg; Centre for Nanomaterials Science Research, University of Johannesburg, South Africa

In this presentation, a large-scale aqueous synthesis of ternary quantum dots (QDs) and its conjugation to porphyrin as an efficient way to overcome photosensitizer shortcomings will be discussed. The singlet oxygen generation of this highly aqueous soluble novel conjugate and its cell viability against different cancer cell lines, which shows its potential for PDT applications, will be discussed.

WeSYD-07 11:45-12:15

Impacts of quantum dots in photodynamic processes *(Invited paper)*

A.O. Orlova; ITMO University, Russia

Luminescent quantum dots (QDs) and their composites are currently being widely studied as generators of reactive oxygen species (ROS). Binary and ternary QDs with different chemical compositions have been shown to be efficient energy or charge donors in QD-based composites. A method to enhance the energy or charge transfer efficiency because of photoinduced modification of the QD surface is proposed.

WeSYD-08 12:15-12:45

Cannabidiol enhances photodynamic therapy effects on breast cancer cells *(Invited paper)*

B.P. George, D.R. Mokoena, H. Abrahamse; Laser Research Centre, Faculty of Health Sciences, University of Johannesburg, South Africa

Cannabidiol (CBD) is a derivative of Cannabis sativa with several therapeutic applications. In this study, hypericin photosensitizer was adsorbed on gold nanoparticles. CBD was utilized to treat MCF-7 breast cancer cells, followed by in vitro photodynamic combination therapy. This study proposes that the CBD and PDT combination is effective in killing breast cancer cells in vitro by inducing apoptosis.

WeSYD-09 12:45-13:15

Effect of microenvironment on photophysical properties of Radachlorin photosensitizer *(Invited paper)*

I.V. Semenova, A.V. Belashov, A.A. Zhikhoreva; Ioffe Institute, Russia

The paper presents an analysis of the dependence of major photophysical properties of Radachlorin photosensitizer on such microenvironment properties as acidity, viscosity and polarity, as well as on the presence of albumin molecules. Experiments were performed in solutions and in living cells of five established lines.

WeSYD-10 13:15-13:45

Mechanisms of the photodynamic effect with polycationic photosensitizers on the foci of bacterial and oncological diseases *(Invited paper)*

G.A. Meerovich[1,2], E.V. Akhlyustina[2], E.A. Makarova[3], E.A. Kogan[4], S.Sh. Karshieva[5,6], I.D. Romanishkin[1], I.G. Tiganova[7], Yu.M. Romanova[7], Zhi-Long Chen[8], V.B. Loschenov[1,2], I.V. Reshetov[4]; [1]Prokhorov General Physics Institute RAS; [2]National Research Nuclear University MEPhI; [3]Organic Intermediates and Dyes Institute; [4]I.M. Sechenov First Moscow State Medical University; [5]National University of Science and Technology MISIS; [6]N.N. Blokhin National Medical Research Center of Oncology; [7]Gamaleya National Research Centre for Epidemiology and Microbiology, Russia; [8]Huadong Hospital, Fudan University, China

This work presents the results of studies of the features, mechanisms and effectiveness of the photodynamic effect of PS based on polycationic derivatives of long-wave phthalocyanines and synthetic bacteriochlorin on bacteria, bacterial biofilms, tumor cells and experimental animal tumor model.

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

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 3

Session Chair:

WeSYD-11 15:00-15:30

Intraoperative fluorescent imaging of peripheral pulmonary nodules *(Invited paper)*

A. Akopov, G. Papayan, D. Fedotova, A. Gerasin; Pavlov First St. Petersburg State Medical Univ., Russia

This presentation is devoted to the discussion of various aspects of the intraoperative fluorescent imaging of lung cancer. The current situation based on the use of indocyanine green, the issues of using new targeted drugs are examined, as well as the possibility of increasing the depth of probing and combining with related treatment methods.

WeSYD-12 15:30-16:00

Robot-assisted photodynamic therapy *(Invited paper)*

T.G. Grishacheva[1], A.S. Vasiliev[2], A.V. Grabovskiy[3], S.A. Nikitin[3], V.V. Kharlamov[3], N.N. Potrahov[4], A.D. Obornev[5], N.N. Petrishchev[1]; [1]Laser Medicine Center, Pavlov First St. Petersburg State Medical University; [2]LLC Renomed; [3]LLC Medical Robotics; [4]Department of Electronic Instruments and Devices, St. Petersburg Electrotechnical University «LETI»; [5]Department of Thoracic Surgery, St. Petersburg State Research Institute of Phthisiopulmonology, Russia

Medical robot assisted fluorescence diagnostics (FD) and photodynamic therapy (PDT) of malignant lesions of external localizations, as well as intraoperative PDT is presented. This technique provides accuracy and uniformity of laser radiation distribution on the object and safety of treatment protocol.

WeSYD-13 16:00-16:15

Clinical and immunologic results of photodynamic therapy for HPV -associated cervical diseases

M.S. Afanasiev[1], A.D. Dushkin[2], T.G. Grishacheva[3], O. Svitich[4], P. Kukina[4], A. Avagyan[4], E. Biryukova[1], A. Khangeldie[5], A. Karaulov[1]; [1]Sechenov University, Clinical Immunology and Allergology; [2]Moscow City Oncology Hospital No62; [3]Pavlov First State Medical University; [4]Mechnikov Research Institute of Vaccines and Sera, Russia; [5]NJSC "Astana Medical University", Kazakhstan

Chlorine E6 photodynamic therapy (PDT) was used to treat 183 patients with HPV-related cervical diseases. The main of this study was to characterize the local immune response during treatment with PDT in patients with persistent HPV infection, LSIL, HSIL and cervical cancer. PDT is able to stimulate antiviral innate immune response, being important to treatment effectiveness.

WeSYD-14 16:15-16:45

Metabolic stress of tumor microenvironment during photothermal therapy: activation of an immune antitumor response *(Invited paper)*

A.V. Ryabova[1,2], D.V. Pominova[1,2], I.V. Markova[2], I.D. Romanishkin[1], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Institute RAS, [2]National Research Nuclear University MEPHI, Russia

The work presents a study of intracellular temperature and metabolic stress during photothermal therapy, affecting the triggered cell death processes of different types. The obtained data will make it possible to optimize the laser exposure parameters for photothermal therapy, increasing the thermosensitivity of cancer and immune cells triggering the process of immunogenic cell death.

WeSYD-15 16:45-17:00

The dynamic changes in the membranes microviscosity of cancer cells during PDT with photoditazine

L.E. Shimolina[1], A.E. Khlynova[1], A.M. Mozherov[1], M.K. Kuimova[2], M.V. Shirmanova[1]; [1]Institute of Experimental Oncology and Biomedical Technologies, Privolzhsky Research Medical University, Russia; [2]Department of Chemistry, Imperial College London, United Kingdom

The aim was to analyze the viscosity changes in tumor cell membranes after PDT. The microviscosity of the tumor cell membranes was assessed by molecular rotor BODIPY2 with FLIM microscopy. It was found that PDT causes changes in membrane microviscosity. These results improve the understanding of the biophysiological mechanisms of PDT and may be useful to monitoring its effectiveness.

- Coffee Break -

SYC: PHOTONICS AND NANOBIOTECHNOLOGY - POSTERS

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

WeSYC-p01 10:00-13:30

On-chip multisensor array based on phosphorylated graphene for the alcohols selective detection

V.S. Gabrelian[1], N.S. Struchkov[2], M.A. Solomatin[3], S.D. Saveliev[1,3], S.A. Ryzhkov[1,3], P.D. Cherviakova[1], A.S. Varezhnikov[3], S.I. Pavlov[1], D.A. Kirilenko[1], V.V. Sysoev[3], M.K. Rabchinskii[1]; [1]Ioffe Institute, [2]National Research University of Electronic Technology, [3]Yuri Gagarin State Technical University of Saratov, Russia

Herein, we consider the fabrication and gas-sensing properties of On-chip multisensor arrays based on a phosphorylated graphene (Gr-P) film with a gradually changed thickness. Selective detection of the alcohols, from methanol to butanol, mixed with air to match permissible exposure OSHA limits is demonstrated for the chip operating at room temperature.

WeSYC-p02 10:00-13:30

Dynamic of the absorption spectra of biological active substances of Tagetes flowers extract in visible wavelength region

E.S. Zemlyakova[1,2], A.V. Tsibulnikova[1], V.A. Slezkhin[1,2], I.G. Samusev[1], V.V. Bryukhanov[1], D.A. Artamonov[1]; [1]Immanuel Kant Baltic Federal University, [2]Kaliningrad State Technical University, Russia

In this work, spectral studies of marigold flower extract have been carried out. The extraction was prepared by maceration method. The triglycerides of fatty acids were used as an extractant. The resulting extract was diluted and the absorption spectra were measured. Absorption spectra show bands in the blue wavelength range, what is caused by the presence of the carotenoids.

WeSYC-p03 10:00-13:30

Enhancement of magnetic dipole emission in the presence of a spherical particle

A.D. Utyushev[1], R. Gaponenko[1], S. Sun[2,3], A.A. Shcherbakov[1], A. Moroz[4], I. L. Rasskazov[5]; [1]School of Physics and Engineering, ITMO University, Russia; [2]Microsystem and Terahertz Research Center, China Academy of Engineering Physics, China; [3]Institute of Electronic Engineering, China Academy of Engineering Physics, China; [4]Wave-scattering.com; [5]SunDensity Inc., Rochester, USA

We discover regimes for promoting fluorescence of magnetic light by four orders of magnitude due to magnetic dipole (MD) transitions of trivalent rare-earth ions Eu3+ located inside or near dielectric homogeneous spheres.

WeSYC-p04 10:00-13:30

Study of the temperature stability of the parameters of a fiber-optic resonator with preservation of polarization

K.A. Ovchinnikov[1,2], D.G. Gilev[1], V.V. Krishtop[1,2]; [1]Perm Scientific-industrial Instrument Making Company; [2]Perm National Research Polytechnic University, Russia

The temperature dependences of FSR, FWHM, Finesse, Q-factor and the output power of a fiber-optic resonator assembled on an optical polarization maintaining Panda-type fiber in the temperature range of -30...+50 °C were obtained. The studied resonator demonstrated stability of parameters within 10% for a given temperature range. Such resonator can be useful as a sensitive element of resonator fiber-optic gyroscopes.

WeSYC-p05 10:00-13:30

Laser-pumping attack on QKD sources

M. Fadeev[1,2], A.A. Ponosova[1], R. Shakhovoy[3,4,5], V. Makarov[1,5,6]; [1]Russian Quantum Center, Skolkovo; [2]ITMO University; [3]QRate, Skolkovo; [4]NTI Center for Quantum Communications, National University of Science and Technology MISIS; [5]Moscow Technical University of Communications and Informatics, Russia; [6]University of Science and Technology of China, China

We demonstrate a new type of attack on QKD systems based on laser pumping of a photon source. It includes injection of cw laser emission into a source at a wavelength that shorter than the system operating one. Particularly, we show that laser emission at 1310 nm induces increase in power at 1550 nm, changes in pulse energy and width.

WeSYC-p06 10:00-13:30

Particle characterization by analyzing light scattering signals with a machine learning approach

W. Schaefer[1], V. Dulin[2], S. Abdurakipov[2]; [1]ai-quanton GmbH, Germany; [2]Kutateladze Institute of Thermophysics, SB RAS, Novosibirsk State University, Russia

We present a new instrument in combination with a machine learning approach to achieve a more cost-effective measurement instrument for particle characterization based on the established measurement technique known as the Time-Shift-Time-of-Flight technique. We propose a machine learning model capable of using only a single signal to determine the same information about particles, traditionally obtained from the classical measurement device.

WeSYC-p07 10:00-13:30

Nanocomposite coatings to improve the hemocompatibility of medical devices

K.D. Popovich[1,2], S.V. Selishchev[1], A.Yu. Gerasimenko[1,2], E.A. Gerasimenko[1]; [1]Inst. of Biomedical Systems, National Research Univ. of Electronic Technology, MIET, [2]Inst. for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical Univ., Russia

This paper presents a method for the formation of nanocomposite hemocompatible coatings based on carbon nanotubes in a collagen polymer matrix using laser radiation. A microfluidic system was developed as a tool for in vitro testing of the coatings under dynamic flow conditions. Optical profilometry and Raman spectroscopy were used to evaluate the stability and hemocompatibility of the fabricated coatings.

WeSYC-p08 10:00-13:30

Low-coherence interferometry biosensors: real-time molecular detection with glass sensor chips

D.O. Novichikhin[1], M.N. Zaikina[1], Z.G. Zaitseva[1,2], N.A. Belyakov[1,2]; [1]Prokhorov General Physics Institute RAS; [2]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia

Compact biosensor devices have been developed based on low-coherence interferometry. These devices are characterized by high energy efficiency and offer ultrasensitive real-time registration of changes in the thickness of biomolecular complexes on widely available disposable sensor chips.

WeSYC-p09 10:00-13:30

Biocompatible pH sensors based on the Re(I) luminophores containing oligo(ethylene glycol) groups

K.S. Kisel[1], N.A. Zharskaia[1], S.A. Silonov[1,2], J.R. Shakirova[1]; [1]St. Petersburg State University, [2]Institute of Cytology RAS, Russia

Herein we present the synthesis of the rhenium(I) systems containing the diimine ligands with pH-sensitive carboxyl functions, as well as the auxiliary phosphine ligands containing oligo(ethylene glycol) (OEG) groups which impart biocompatibility and solubility in the physiological media to the target compounds. The obtained hydrophilic emitters display sensitivity of emission quantum yield and lifetime to the variations in media acidity.

WeSYC-p10 10:00-13:30

Investigation of NV center ensemble in dense carbon-13 diamond for quantum sensing

V.V. Soshenko[1,2], O.R. Rubinas[3,4], I.S. Cojocaru[1,2,5], S.V. Bolshedvorskii[1,2], P.G. Vilyuzhanina[5,6], E.A. Primak[5,7], S.M. Drofa[5,7], A.M. Kozodaev[5,6], V.G. Vins[8], V.N. Sorokin[1,2], A.N. Smolyaninov[2], A.V. Akimov[1,2,5]; [1]Sensor Spin Technologies; [2]Lebedev Physical Institute RAS, Russia; [3]IMOMEC, Belgium; [4]IMO, Hasselt University, Belgium; [5]Russian Quantum Center; [6]NRNU "MEPhI"; [7]Moscow Institute of Physics and Technology; [8]LLC Velman, Russia

Current work is devoted to investigation of Nitrogen-vacancy centers in diamond, doped by carbon-13 isotope (~30%). ODMR spectrum of such a diamond was analyzed with possible determination of magnetic field vector from the spectrum. A novel method to extract carbon isotope concentration in diamond was developed.

WeSYC-p11 10:00-13:30

Temperature stabilized microfluidic chip for plasmonic fiber biosensor

L.I. Fatkhutdinova, D.O. Gagarinova, A.F. Cherednikova, A. Kokhanovskiy, M.V. Zyuzin; School of Physics and Engineering, ITMO University, Russia

We developed a plasmonic fiber biosensor with microfluidic chip with thermostabilization. The biosensor includes a tilted fiber Bragg grating covered in gold to generate surface plasmon resonance. Temperature stability is ensured using a Peltier cell with an active PID-controller. Specific proteins are immobilized to the fiber's surface to selectively detect biomarkers in biofluids, based on changes in refractive index.

WeSYC-p12 10:00-13:30

Laser synthesis of cobalt-based nanoparticles in gaseous media and magnetic field

M.A. Dzus, A.S. Chernikov, A.V. Kharkova, D.A. Kochuev, E.S. Oparin, D.V. Abramov, A.F. Galkin, K.S.Khorkov; Vladimir State University, Russia

This paper presents the results of laser ablation of cobalt targets in a magnetic field in argon and air. The experimental setup, processing parameters are described and the results of scanning electron microscopy are presented, which allow us to estimate the size and shape of particles.

WeSYC-p13 10:00-13:30

Laser formation of a carbon conductive network for a gesture recognition system

A.S. Morozova[1], N.A. Nikitina[1], D.I. Ryabkin[1,2], V.V. Suchkova[1], A.V. Kuksin[1], E.S. Pyankov[1], L.P. Ichkitidze[1,2], E.A. Gerasimenko[1], S.V. Selishchev[1], A.Yu. Gerasimenko[1,2]; [1]National Research Univ. of Electronic Technology, [2]I.M. Sechenov First Moscow State Medical Univ., Russia

The study introduces a method to create conductive network of multi-walled carbon nanotubes in a silicone elastomer for strain-sensitive sensors. Laser radiation improves sensor characteristics, reducing initial resistance by 6 times than non-irradiated sensors. This enhancement enables a touch gesture recognition system with 94% accuracy. Data is processed through a developed electronic unit.

WeSYC-p14 10:00-13:30

Interferometric studies of nanoparticle conjugates for ultrasensitive detection of zearalenone in food

J.A. Malkerov[1,2], A.S. Rakitina[1,2], G.M. Sorokin[3], A.I. Nikitin[4], A.G. Burenin[1], A.M. Skirda1,5, S.L. Znoyko1; [1]Prokhorov General Physics Institute RAS, [2]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), [3]Chuvash State University, [4]Volga branch of MADI, Russia, [5]Moscow Institute of Physics and Technology

Zearalenone (ZEA) is a mycotoxin affecting human and animal health. The research explores various magnetic nanoparticle types, employing low coherence interferometry to study antibody kinetics. Monoclonal antibodies against ZEA are characterized, selected and immobilized on magnetic nanoparticles. A rapid, ultrasensitive lateral flow assay for on-site ZEA detection in food is developed, showcasing determination in real contaminated samples.

WeSYC-p15 15:00-18:30

Modeling of the quantum dynamics of nitrogen-vacancy centers in the spectrum for quantum sensors

V.V. Soshenko[1,2], L.S. Cojocaru[1,2,3], A.M. Kozodaev[3,4], S.V. Bolshedvorskii[1,2], V.N. Sorokin[1,2], A.N. Smolyaninov[2], A.V. Akimov[1,2,3,5]; [1]Lebedev Physical Institute RAS; [2]Sensor Spin Technologies; [3]Russian Quantum Center; [4]National Research Nuclear University MEPhI; [5]National University of Science and Technology MISIS, Russia

The system on the basis of which a quantum sensor can be built, must have a long coherence time, be technologically advanced in manufacturing, and have the ability to prepare and read states efficiently. The nitrogen-vacancy coloring center (NV center) in diamond possesses all these properties. In addition, NV center-based sensors can operate at room temperature.

WeSYC-p16 15:00-18:30

Influenza A virus detection via Ag@c-Si SERS and machine learning.

K. Prigoda[1], A. Ermina[1], A. Tabarov[2], V. Levitskii[3], O. Andreeva[2], A. Gazizulin[2], V. Bolshakov[1], S. Pavlov[1], A. Zheltukhina[4], D. Danilenko[4], Yu. Zharova[1], V. Vitkin[2]; [1]Ioffe Institute; [2]ITMO University; [3]RnD Center TFTE; [4]Smorodintsev Research Institute of Influenza, Russia

This study demonstrates the synthesis of SERS substrates with Ag@c-Si dendritic structures for the detection of the influenza A virus using machine learning. Spectra from the pure buffer medium and the buffer medium with influenza A virus were obtained. Subsequently, machine learning classification (PCA and SVM) was performed, resulting in a classification accuracy of 76.6 ± 4.2% for the spectra.

WeSYC-p17 15:00-18:30

Secure laser source for QKD systems

M. Fadeev[1,2], A.A. Ponosova[1], A. Huang[3], R. Shakhovoy[4,5,6], V. Makarov[1,5,7]; [1]Russian Quantum Center, Skolkovo; [2]ITMO University, Russia; [3]National University of Defense Technology, China; [4]QRate, Skolkovo; [5]NTI Center for Quantum Communications, National University of Science and Technology MISIS; [6]Moscow Technical University of Communications and Informatics, Russia; [7]University of Science and Technology of China, China

In practical quantum key distribution systems, single photon sources take laser-seeding attacks. Typically, some amount of isolation is recommended as the countermeasure against these attacks. Here, we demonstrate a new approach of QKD system protection against laser seeding based on internally seeded photon source scheme, resilient to external perturbations.

WeSYC-p19 15:00-18:30

Separation of probe beam dichroism and birefringence in polarization-modulation pump-probe spectroscopy

D.A. Volkov, M.E. Sasin, I.A. Gorbunova, O.S. Vasutinskii; Ioffe Institute, Russia

For the first time we experimentally separated probe beam dichroism and birefringence in stimulated Raman scattering by using polarization-modulation pump-probe spectroscopy. This method can be used for compound analysis of mixtures and biological systems.

WeSYC-p20 15:00-18:30

Surface-enhanced Raman scattering of electrospun non-woven fibers: synthesis of silver nanoparticles and their effect on the properties of SERS materials

V. Bakal, A.M. Kartashova, P.A. Demina, I.O. Kozhevnikov, E.S. Prikhozhdenko; Science Medical Center, Saratov State University, Russia

In this study, electrospun non-wovens were used as the templates for SERS sensors. The functionalization of sensor surface was performed by either in situ synthesis of AgNP or using of pre-synthesized AgNP. Then, SERS substrates were modified with glucose oxidase enzyme to provide the sensitivity and specificity for glucose detection. Machine learning approaches was implemented in spectra analysis.

WeSYC-p21 15:00-18:30

Silver nanoparticles for therapy HER2-positive breast cancers

T.V. Rozhnikova[1], A.M. Skirda[1,3], A.O. Antonova[1], V.O. Shipunova[1,2]; [1]Moscow Institute of Physics and Technology, [2]Sirius University of Science and Technology, [3]Prokhorov General Physics Institute RAS, Russia

The research is derected toward the development of HER2-targeted silver nanoparticles for breast cancer treatment.

WeSYC-p22 15:00-18:30

Evaluating carbon dots as trace element detection systems

L.I. Fatkhutdinova[1], H. Barhum[2], E.N. Gerasimova[1], D.S. Kolchanov[2], I.I. Vazhenin[1], P. Ginzburg[2], M.V. Zyuzin[1]; [1]School of Physics and Engineering, ITMO University, Russia; [2]Department of Physical Electronics, Tel Aviv University, Israel

Trace elements like Fe2+, Fe3+, and Co2+ are vital for body function. Fe2+, Fe3+ distribute oxygen, Co2+ aids metabolism and nervous system function. Health monitoring requires detecting these ions. Carbon dots (CDs) with stable fluorescence and water solubility can detect them. This study explored CDs' optical properties and their sensitivity to Fe2+, Fe3+, Co2+, aiding selective detection in medical diagnostics.

WeSYC-p23 15:00-18:30

Fluorescently controlled investigation of super-enhancers with CRISPR interference and CRISPR prime editing systems

N.N. Orlova[1], M.G. Gladkova[1,2], G.A. Ashniev[1], A.V. Orlov[1]; [1]Prokhorov General Physics Institute RAS; [2]Faculty of Bioengineering and Bioinformatics, Lomonosov Moscow State University, Russia

In the evolving landscape of genomic research, our study delves into the intricate exploration of super-enhancers, pivotal and controversial elements exerting profound influence over gene expression. Utilizing CRISPR interference and CRISPR prime editing systems, our work yields promising results and opens avenues for future research to refine and expand these approaches across diverse cell types.

WeSYC-p24 15:00-18:30

Method for measuring pairwise affinity of substantially non-complementary oligonucleotides

V.I. Arkhipova[1], E.S. Korenkov[2], M.Sh. Makhmuryan[1], M.A. Gubaidullina[1], Y.P. Chebotareva[1], E.N. Mochalova[1,2], D.O. Novichikhin[3], M.P. Nikitin[1,2]; [1]Nanobiomedicine Division, Sirius University of Science and Technology; [2]Moscow Institute of Physics and Technology; [3]Prokhorov General Physics Institute RAS, Russia

Strand commutation based on low-affinity interactions of non-complementary nucleic acids is a unique tool for data processing through DNA. Here we demonstrate a method for measuring pairwise oligonucleotide affinity, which allows us to create accurate predictive resources. We used a range of optical techniques, including UV- and fluorescence spectroscopy, to determine the binding constant in DNA duplex of non-complementary strands.

WeSYC-p25 15:00-18:30

Biocompatible composite material for the regeneration of large tissue defects

U.E. Kurilova[1,2], E.A. Gerasimenko[2], I.A. Suetina[3], M.V. Mezentseva[3], L.I. Russu[3], G.Yu. Galechyan[4], A.Yu. Gerasimenko[2,4]; [1]World-Class Research Center "Digital Biodesign and Personalized Healthcare", I.M. Sechenov First Moscow State Medical University, [2]Inst. of Biomedical Systems, National Research Univ. of Electronic Technology, [3]Inst. of Virology, National Research Center for Epidemiology and Microbiology Named after the Honorary Academician N.F. Gamaleya, [4]Inst. for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical Univ., Russia

This paper presents a technology for formation of biocompatible material for bone defect regeneration based on carbon nanotubes and biopolymers. Studies of the structure of the formed samples indicate the presence of the necessary characteristics. Biocompatibility studies have shown the applicability of the developed material for the regeneration of large tissue defects.

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY

Location: Petrov-Vodkin 1 Room, Floor 2; Date: Thursday, July 04, 2024

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 7

Session Chair:

ThSYB-30 09:00-09:30

Terahertz-wave scattering in turbid biological tissues *(Invited paper)*

K.I. Zaytsev[1], A.S. Kucheryavenko[2], N.V. Chernomyrdin[1], D.R. Il'enkova[1], I.N. Dolganova[2], V.V. Tuchin[3,4,5]; [1]Prokhorov General Physics Institute RAS; [2]Osipyan Institute of Solid State Physics RAS; [3]Institute of Physics and Science Medical Center, Saratov State University; [4]Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University; [5]Institute of Precision Mechanics and Control, FRC "Saratov Scientific Centre RAS", Russia

In our research, we combine the terahertz (THz) pulsed spectroscopy, superresolution THz solid immersion microscopy with methods of the Lorentz-Mie scattering theory and radiation transfer theory to shine the light on the THz-wave – turbid tissue interactions.

ThSYB-31 09:30-10:00

Terahertz spectroscopy of blood plasma for cancer diagnosis *(Invited paper)*

O. Cherkasova[1,2], N. Nikolaev[1,3]; [1]Laboratory of Terahertz Photonics, Institute of Automation and Electrometry SB RAS; [2]Department of Data Acquisition and Processing Systems, Novosibirsk State Technical University; [3]Laboratory of Laser Biophysics, Institute of Laser Physics SB RAS, Russia

Cancer is one of the major diseases that seriously affect human health. The early cancer diagnosis has of great significance and can be achieved by analyzing blood plasma. In the report, we will consider ways to increase the sensitivity of THz pulsed spectroscopy to cancer diagnosis.

ThSYB-32 10:00-10:30

Terahertz spectroscopy and machine learning for medical and ecological applications *(Invited paper)*

Yu. Kistenev, V.V. Prishepa, V. Skiba, V. Nikolaev, G. Rasponin, D. Makashev, A.K. Tretyakov, A. Borisov; LMIML Laboratory, Tomsk State University, Russia

The aim of the report is to demonstrate the usefulness of machine learning methods applications in qualitative and quantitative analysis of spectral data on examples of medical diagnostics and the atmosphere state monitoring. The work was conducted with the financial support of the Ministry of Science and Higher Education of Russia (Agreement No. 075-15-2024-557 dated 04/25/2024)

ThSYB-33 10:30-10:45

Terahertz-wave scattering in tissues: tissue-mimicking scattering phantom

A.S. Kucheryavenko[1], I.N. Dolganova[1], N.V. Chernomyrdin[2], A.A. Gavdush[2], V.M. Masalov[1], V.S. Nozdrin[2], V.V. Tuchin[3,4,5], K.I. Zaytsev[2]; [1]Institute of Solid State Physics RAS; [2]Prokhorov General Physics Institute RAS; [3]Institute of Physics and Science Medical Center, Saratov State University; [4]Laboratory of Laser Molecular Imaging and Machine Learning, Tomsk State University; [5]Institute of Precision Mechanics and Control, FRC "Saratov Scientific Centre RAS", Russia

Heterogeneity of biological tissues at the terahertz-wavelength scale can result in the non-Rayleigh scattering and doubts the applicability of effective medium theory for such tissues. For this reason, a tissue mimicking scattering phantom is developed, and the effective optical properties of the proposed phantom are still determined by EMT over wide ranges of scatterers' diameters and volume fractions.

Location: Petrov-Vodkin 1 Room, Floor 2; Date: Thursday, July 04, 2024

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 8

Session Chair:

ThSYB-34 11:30-12:00

Antibacterial photodynamic therapy. Role of endogenous Zn -coproporphyrin in the sterilization of M. tuberculosis *(Invited paper)*

A. Savitsky[1], M.O. Shleeva[1], I.A. Linge[2], A.S. Apt[2], A.S. Kaprelyants[1]; [1]Federal Research Centre of Biotechnology RAS, [2]Central Tuberculosis Research Institute, Russia

In the live and dormant forms of M. tuberculosis, the synthesis Zn-porphyrines significantly increased in the presence of 5-aminolevulinic acid and viability of dormant Mtb reduced by more than 99.99% under illumination with 565 nm as well accumulation of active Mtb cells in lung macrophages cells give the same results.These findings create a perspective for the treatment multidrug-resistant tuberculosis.

ThSYB-35 12:00-12:30

Combined photodynamic/photothermal cancer therapy accompanied by optical clearing *(Invited paper)*

E.A. Genina[1,2], A.B. Bucharskaya[3], V.D. Genin[1,2], N.A. Navolokin[3], D.A. Mudrak[3], G.N. Maslyakova[3], B.N. Khlebtsov[4], N.G. Khlebtsov[4], V.V. Tuchin[1,2,5]; [1]Saratov State University, [2]Tomsk State University, [3]Saratov State Medical University named after V. I. Razumovsky, [4]Institute of Biochemistry and Physiology of Plants and Microorganisms RAS; [5]Institute of Precision Mechanics and Control RAS, Russia

Combined technology of photodynamic therapy and laser plasmon photothermal therapy accompanied by optical clearing was developed for rats with tumor. Temperature monitoring and spectral measurements were made. Morphological studies were performed with standard and immunohistochemical methods. We observed pronounced necrotic changes in the tumor tissue. 21 days after the therapy, the tumor growth inhibition index by tumor mass was 77.4%.

ThSYB-36 12:30-13:00

Controlled photosensitizer-free singlet oxygen release for biomedical applications *(Invited paper)*

I.N. Makovik[1], A.V. Dunaev[1], E.U. Rafailov[2], V.V. Dremin[1,2]; [1]Orel State University, Russia; [2]Aston University, UK

Although various studies reporting the initiation of apoptosis or optimization of mitochondrial respiration by laser illumination and generation of singlet oxygen in various types of cells and tissues have been published, there is still a huge gap in knowledge and an essential need to identify the exact mechanism by which laser irradiation leads to these effects.

ThSYB-37 13:00-13:15

Laser-induced singlet oxygen stimuates bioenergetics of insulin-producing cells

L.V. Eratova, I.N. Makovik, A.Y. Vinokurov, V.V. Dremin; Research & Development Center of Biomedical Photonics, Orel State University, Russia

The paper presents the results of the study of the effect of singlet oxygen induced by 1267 nm laser exposure without the use of photosensitizers on the bioenergetics of rat insulinoma RINm5F. Differences in changes of analysed parameters of the investigated cells after laser treatment were revealed in comparison with the control group that were not exposed to laser.

ThSYB-38 13:15-13:30

Plasmonic agents for bioimaging and photothermal therapy with red and NIR lasers

E.V. Solovyeva, V.O. Svinko, A.I. Demenshin, A.N. Smirnov; St. Petersburg State University, Russia

This work is addressed to the development of hybrid systems which are considered as new means of imaging and therapy of malignant neoplasms. We represent here the study of a wide range of combinations of morphologically different gold nanoparticles and various molecular probes (fluorophores or Raman reporters).

- Lunch Break -

Location: Petrov-Vodkin 1 Room, Floor 2; Date: Thursday, July 04, 2024

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 9

Session Chair:

ThSYB-39 15:00-15:30

Optical coherence elastography with osmotically-induced strains for assessing degradation of cartilage samples *(Invited paper)*

Y.M. Alexandrovskaya[1,2], A.A. Sovetsky[2], E.M. Kasianenko[2,3], A.L. Matveyev[2], D.A. Atyakshin[4], O.I. Patsap[4], M.A. Ignatiuk[4], A.V. Volodkin[4], V.Y. Zaitsev[2]; [1]A.V. Gaponov-Grekhov Institute of Applied Physics RAS, Russia; [2]Terra Quantum AG, Switzerland; [3]National Research Center Kurchatov Institute, Russia; [4]Scientific and Educational Resource Center "Molecular Morphology", RUDN University, Russia

A new variant of Optical Coherence Elastography is presented, in which osmotically-induced strains are used instead of such auxiliary stimuli as compression or elastic-wave excitation. The method efficiency is demonstrated to differentiate cartilage samples with various stages of proteoglycan-component degradation. The method also looks promising for utilization with other tissue types, e.g., for express assessment of biopsy-needle samples.

ThSYB-40 15:30-16:00

New mechanisms in stem cells differentiation and tissue regeneration discovered by optical imaging *(Invited paper)*

E. Zagaynova[1,2], A. Meleshina[1], D. Kuznetsova[1], S. Rodimova[1], A. Kashirina[1], P. Ermakova[1], V. Zagainov[1,3], V. Shcheslavskiy[1]; [1]Institute of Biomedical Technologies, Privolzhskiy Medical Research University; [2]Lopukhin FRCC PCM; [3]Nizhny Novgorod Regional Clinical Oncological Dispensary, Russia; [4]Becker&Hickl GmbH, Germany

Using FLIM and multiphoton fluorescence microscopy we have made investigation of metabolic status in mesenchymal stem cell during adipogenic, osteogenic and chondrogenic differentiation, metabolic activity and intracellular pH in iPSC differentiating in dermal, epidermal, neuronal directions, in 3D neurospheres from iPSCs, in neural spheroids with Down syndrome, metabolic changes in living islets of Langerhans, and during liver regeneration.

ThSYB-41 16:00-16:30

Adapting laser microscopy to life sciences *(Invited paper)*

H. Schneckenburger; Aalen University, Germany

Transmission, scattering and fluorescence microscopy are adapted to various requirements of life sciences, e.g. angular resolution, 3D resolution and limitation of light exposure to a non-phototoxic level. Applications include scattering microscopy, Light Sheet Fluorescence Microscopy (LSFM), Structured Illumination Microscopy (SIM) in combination with TIRFM, Axial Tomography and laser-assisted micromanipulation.

ThSYB-42 16:30-16:45

OCT-based feature analysis of brain tissue ex vivo: rat gliomas 101.8, C_6 and human gliomas of different grades

P.V. Aleksandrova[1], K.I. Zaytsev[1], P.V. Nikitin[2], A.I. Alekseeva[3], P.A. Karalkin[4], I.V. Reshetov[4], I.N. Dolganova[5]; [1]Prokhorov General Physics Institute RAS, Russia; [2]University of Houston, USA; [3]Avtsyn Research Institute of Human Morphology of Federal State Budgetary Scientific Institution "Petrovsky National Research Centre of Surgery", Russia; [4]Institute for Cluster Oncology, Sechenov University, Russia; [5]Osipyan Institute of Solid State Physics RAS, Russia

Optical coherence tomography (OCT) is fast-noninvasive and label-free method for imaging the internal structure of biological tissues. In our research we applied commercial system OCT1300Y to study the ability of OCT for the intraoperative diagnosis of brain gliomas. We analyze ex vivo human gliomas of different grades and Wistar rat glioma models - glioma C6 and glioma 101.8.

SYC: PHOTONICS AND NANOBIOTECHNOLOGY

Location: Petrov-Vodkin 2 Room, Floor 2; Date: Thursday, July 04, 2024

SYC: PHOTONICS AND NANOBIOTECHNOLOGY 7

Session Chair:

ThSYC-34 09:15-09:45

Laser engineering of microbial systems: a new tool for microbiology *(Invited paper)*

N.V. Minaev[1], V.S. Zhigarkov[1], V.S. Cheptsov[1,2], V.I. Yusupov[1]; [1]Institute of Photon Technologies of Kurchatov Complex Crystallography and Photonics, NRC “Kurchatov Institute”; [2]Soil Science Faculty, Lomonosov Moscow State University, Russia

We present laser engineering of microbial systems (LIMS) technology - a new promising tool which allows significant progress towards solving the ambitious task of microbiology associated with expanding the base of cultivable microorganisms. The technology is based on laser-induced forward transfer (LIFT) of microscale gel droplets with living microorganisms from various natural environments while preserving their natural microenvironment.

ThSYC-36 09:45-10:00

Wettability control on glass surface by laser-induced nanostructures for nanoparticles self-assembly

Chunyu Li, M.A. Gremilov, E.I. Ageev, D.A. Zuev; ITMO Univ., Russia

To control the self-organized assembly of nanoparticles on substrate, which are distributed in solution, the LIPSS technology is used for the wettability controllable template fabrication. The template with adjustable period and morphology of nanostructures will help organize the alignment of nanoparticles. And these will provide an important step for development of metasurfaces.

ThSYC-37 10:00-10:15

Water transportation across membrane aquaporin channels by monomer H_2O

S.M. Pershin[1], Eu.V. Stepanov[1], D.G. Artemova[1], B.G. Katsnelson[2]; [1]Prokhorov General Physics Institute RAS, Russia; [2]University of Haifa, Israel

P. Agre (Nobel Prize, 2003) said that water transportation across membrane aquaporin channel by monomer H2O occurs with intensity around 3E9 monomer/s. It's still unknown till now where this monomer amount may storage? We have observed that water-air interface layer consists of a two water fraction: it has high/low meniscus height when capillary touch the surface/bulk water.

ThSYC-38 10:15-10:30

Sapphire THz waveguides for sensing and endoscopy applications

G.M. Katyba[1], S.P. Lebedev[2], A.S. Kucheryavenko[1], I.N. Dolganova[1], A.V. Kaledin[1], A.K. Zotov[1], M.G. Burdanova[1,3], K.I. Zaytsev[2], V.N. Kurlov[1]; [1]Institute of Solid State Physics RAS; [2]Prokhorov General Physics Institute RAS; [3]Moscow Institute of Physics and Technology, Russia

THz technologies developments into practice are limited by the absence of commercially available THz endoscopic systems. Previously, the transmission properties of waveguides, fibers and even fiber bundles based on shaped sapphire were studied. Sapphire hollow-core waveguides are suitable for efficient radiation transmission with minimal losses and for applications in endoscopy of hard-to-access objects and high-resolution imaging.

ThSYC-39 10:30-10:45

Laser functionalization of carbon nanotubes with LaB_6 particles

A.V. Kuksin[1], A.Yu. Gerasimenko[1,2]; [1]National Research University of Electronic Technology MIET; [2]Institute for Bionic Technologies and Engineering, I.M. Sechenov First Moscow State Medical University, Russia

This work experimentally investigates the effect of functionalization of carbon nanotubes array with LaB6 nanoparticles on the electrophysical properties. Resulting hybrid nanomaterial was based on a vertical nanotubes array functionalized with LaB6 nanoparticles. Nanotubes were structured by pulsed laser irradiation with an energy density of 0.15 J/cm2. The functionalized hybrid nanomaterial had a maximum field emission current of 55 µA.

ThSYC-40 10:45-11:00

Modeling of tubular aggregates of the chlorosome antenna complexes

R.Y. Pishchalnikov[1], V.A. Kurkov[1,2], D.D. Chesalin[1]; [1]Prokhorov General Physics Institute RAS; [2]Moscow Institute of Physics and Technology (National Research University), Russia

Green sulfur bacteria that live in low-light environment are characterized by the specific light-harvesting complexes, chlorosomes. The structural unit of the chlorosome is a tube consisting of pigments packed in a special way. We performed the simulation of linear optical response and calculated the distribution of excitation for each exciton state considering tubular aggregates of different lengths.

- Coffee Break -

Location: Petrov-Vodkin 2 Room, Floor 2; Date: Thursday, July 04, 2024

SYC: PHOTONICS AND NANOBIOTECHNOLOGY 8

Session Chair:

ThSYC-41 11:30-12:00

Fluorescence polarization immunoassay for detection of pesticides in food products *(Invited paper)*

S.A. Eremin[1,2], M.K. Kolokolova[2]; [1]A.N. Bach Institute of Biochemistry, Research Centre of Biotechnology RAS, [2]Faculty of Chemistry, Lomonosov Moscow State University, Russia

Fluorescence Polarization Immunoassay (FPIA) is immunochemical method based on the application of antibodies as recognition element and fluorophore as label for detection by measurement of fluorescence polarization. FPIA is simple method for organic compounds monitoring. Developments of FPIA for detection of pesticides 2,4-Dichlorophenoxyacetic acid and Glyphosate in food stuffs will be presented. The study was supported by RSF grant №24-43-00196.

ThSYC-42 12:00-12:15

Optical-magnetic characterization of IgG and nanoparticles for rapid biosensor development: detection of cardiac markers and mycotoxins

J.A. Malkerov[1,2], S.L. Znoyko[1], V.A. Bragina[1], B.G. Gorshkov[1]; [1]Prokhorov General Physics Institute RAS; [2]National Research Nuclear University MEPhI, Russia

This study introduces a novel method for characterizing IgG and nanoparticles in biosensor development. Using label-free low-coherence interferometry and magnetic lateral flow immunoassay, it enables kinetic studies, IgG sorption density quantification, and functional nanoparticle characterization. Demonstrating efficacy in sensitive assays for mycotoxins and cardiovascular biomarkers underscores its potential. Promising results in analytical characteristics highlight versatility for rapid biosensor advancement.

ThSYC-43 12:15-12:30

Chlorophyll fluorescence parameters of maize plants grown under linearly polarized light

Yu.N. Kulchin[1], S.O. Kozhanov[1], A.S. Kholin[1], E.P. Subbotin[1], K.V. Kovalevsky[2], N.I. Subbotina[1], A.S. Gomolsky[2]; [1]Institute of Automation and Control Processes, Far Eastern Branch RAS; [2]Advanced Engineering School "Institute of Biotechnologies, Bioengineering and Food Systems", Far Eastern Federal University, Russia

Chlorophyll fluorescence parameters are presented for three varieties of maize plants grown under polarized light. It is shown that there was no stress in groups grown under polarized radiation. The maize plants of Ranyya lakomka and Zolotoy Batam varieties grown under polarized treatment demonstrated greater values of photosynthesis parameters than plants grown under non-polarized treatment.

ThSYC-44 12:30-12:45

Estimation of the contribution of all-trans and cis-isomers to carotenoid absorption

V.A. Kurkov[1,2], D.D. Chesalin[1], U.A. Shkirina[1,3], R.Y. Pishchalnikov[1]; [1]Prokhorov General Physics Institute RAS, [2]Moscow Institute of Physics and Technology (National Research University), [3]Department of Mechanics and Mathematics, Moscow State University, Russia

We propose an original approach to determine the concentration of cis-isomers of carotenoids in solvents by performing the fitting of experimental data with the help of differential evolution. The total contribution of cis-isomers to the resulting optical response was modelled by a Gaussian curve, whereas the spectrum of the all-trans isomer was calculated within the framework of semi-classical theory.

ThSYC-45 12:45-13:00

Photophoresis-assisted transport administration of a micron-sized capsule: theoretical simulation

Yu.E. Geints, E.K. Panina; V.E. Zuev Institute of Atmospheric Optics SB RAS, Russia

We present the numerical model of photophoresis of a microcapsule illuminated by an intense laser pulse.

ThSYC-46 13:00-13:15

Limiting factors affecting the precision and stability of a quantum gyroscope based on NV centers in diamond and strategies to overcome them

I. Cojocaru[1,2,3], V.V. Soshenko[1,2], A.M. Kozodaev[2], S.V. Bolshedvorskii[1,2], O.R. Rubinas[1,2,3], V.N. Sorokin[1,2], A.N. Smolyaninov[2], A.V. Akimov[1,2,3]; [1]Lebedev Institute RAS; [2]LLC Sensor Spin Technologies; [3]Russian Quantum Center, Skolkovo Innovation Center, Russia (The work was supported by Rosatom in the framework of the Russian Roadmap for Quantum computing (Contract No. [868]1.3-15/15-2021 dated October[5, 2021]))

Nitrogen-vacancy (NV) centers nuclear spins show great potential as candidates for an innovative gyroscope. The precision and stability of this system depend on various parameters at each stage of the measurement protocol, including temperature fluctuations and the magnetic field of the environment. We characterize the influence of some of these parameters and propose protocols that could surpass these limitations.

- Lunch Break -

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE

Location: Petrov-Vodkin 3 Room, Floor 2; Date: Thursday, July 04, 2024

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 4

Session Chair:

ThSYD-16 09:00-09:30

Picosecond anisotropic relaxation in biomolecules studied by polarization-modulation pump-and-probe spectroscopy *(Invited paper)*

O.S. Vasyutinskii; Ioffe Institute, Russia

Transient monitoring and Stimulated Raman Scattering attract much attention as effective methods for investigation of the dynamics of biologically relevant molecules in solutions and living cells. The lecture presents the results of experimental and theoretical studies of ultrafast relaxation and energy transfer in biologically relevant molecules using a novel polarization-modulation pump-and-probe femtosecond spectroscopy developed recently by the authors.

ThSYD-17 09:30-10:00

Microscopy techniques for the enhancement of localized photodynamical processes *(Invited paper)*

Meisam Sadeghpour Karimi, Lishin Thottathi, Gabriele Ferrini; Università Cattolica del Sacro Cuore, Italy

We report on progress regarding light localization, light collection, and scanning capabilities of microscope objectives aided by single dielectric microspheres. Selective enhancement of photodynamic and thermo-mechanical processes at surfaces will be discussed.

ThSYD-18 10:00-10:15

Method of deep joint formation at laser welding of biological tissues

D.I. Ryabkin[1,2], V.V. Suchkova[1,2], E.A. Gerasimenko[1], A.Yu. Gerasimenko[1,2]; [1]Institute of Biomedical Systems, National Research Univ. of Electronic Technology, [2]Institute of Bionic Technology and Engineering, Sechenov First Moscow State Medical Univ., Russia

A new method of weld irradiation in the process of laser soldering of biological tissues is proposed. The method will allow transporting laser radiation to the area of weld formation with fewer losses, which allows minimizing the formation of temperature necrosis of the tissue. Modelling has shown the possibility of forming deeper welds compared to stationary irradiation methods.

ThSYD-19 10:15-10:45

Spectral properties of crystalline aluminum phthalocyanine nanoparticles and the possibility of their use in biophotonics *(Invited paper)*

V.I. Makarov[1,2], D.V. Pominova[1,2], A.V. Ryabova[1,2], I.D. Romanishkin[1], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Institute RAS; [2]National Research Nuclear University MEPhI, Russia

The use of AlPc nanoparticles as photosensitizers makes it possible to significantly increase the selectivity of the procedure. Using time-resolved laser spectroscopy, analysis of multispectral fluorescence microimages, microstructural and X-ray diffraction methods, we studied the occurrence of optical effects manifested in the interaction of crystalline AlPc NPs with the microenvironment and laser radiation.

ThSYD-20 10:45-11:00

Feasibility of photodynamic effect assessment by means of microcirculation optical monitoring during laser activation

A.S. Machikhin[1], A.V. Guryleva[1], T.G. Grishacheva[2], N.N. Petrishchev[2]; [1]Acousto-Optic Spectroscopy Lab. STC UI RAS; [2]Department of Pathophysiology. Pavlov University, Russia

Conventional non-invasive in vivo methods for studying photodynamic therapy mechanisms do not implement monitoring directly during photoactivation. Our study was aimed at evaluating the feasibility of such monitoring using videocapillaroscopy and photoplethysmography. We proposed an approach, designed its hardware and software, and approved it when studying the response of skin microcirculation in rats under various modes of laser activation.

- Coffee Break -

Location: Petrov-Vodkin 3 Room, Floor 2; Date: Thursday, July 04, 2024

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 5

Session Chair:

ThSYD-21 11:30-11:45

Methylene blue-mediated photodynamic therapy and tissue oxygen saturation control of postoperative mammary gland scars

D.M. Kustov[1], P.M. Alekseeva[1], A.S. Moskalev[1], L.Yu. Loschenova[2], A.V. Voitova[2], P.V. Pimanchev[3], A.A. Shiryaev[3], V.B. Loschenov[1,4]; [1]Prokhorov General Physics Institute RAS; [2]Biospec LTD; [3]I.M. Sechenov First Moscow State Medical University; [4]National Research Nuclear University MEPhI, Russia

Wounds are major health care problem. Photodynamic therapy (PDT) is a non-invasive procedure, can be applied to stimulate healing of skin wounds resulting from mammary gland surgery. The development of approaches to treatment of postoperative scars with PDT and simultaneous tissue oxygen saturation control will reduce the time of tissue healing and decrease the incidence of postoperative scars inflammation.

ThSYD-22 11:45-12:15

Method for rapid intraoperative analysis of the optical properties of multilayered walls of hollow organs *(Invited paper)*

T.A. Savelieva[1,2], A.A. Krivetskaya[1,2], V.V. Levkin[3], D.M. Kustov[1], A.S. Gorbunov[3], A.A. Shiryaev[3], S.S. Harnas[3], K.G. Linkov[1], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Institute RAS; [2]Institute of Engineering Physics for Biomedicine, National Research Nuclear University MEPhI; [3]Department of Faculty Surgery No.1, Sechenov First Moscow State Medical University, Russia

The optical properties of tissues are important information that allows planning various types of laser-induced effects on biological tissues. In this work, we propose an approach to simultaneous intraoperative measurements of the spectra of diffuse reflectance and transmittance of light through intestinal wall tissue to restore the optical properties of these tissues with customized variant of Kubelka-Munk model.

ThSYD-23 12:15-12:45

Experimental models of photodynamically-induced thrombi in blood vessels *(Invited paper)*

I.A. Mikhailova, N.N Petrishchev, T.G. Grishacheva, S.G. Meloyan, S.G. Chefu, G.Yu. Yukina; Pavlov First State Medical University, Russia

The review of commonly used experimental in vivo models of photothrombosis of vascular bed is presented. Herein we discuss some of their advantages and disadvantages of these models being applied to different areas of vascular bed.

ThSYD-24 12:45-13:15

The use of mid-infrared lasers in ophthalmology: prospects and advantages, a look at future development *(Invited paper)*

Yu.N. Yusef[1], D.V. Petrachkov[1], E.N. Korobov[1], I.M. Belousova[2], A.P. Zhevlakov[2], A.S. Narivonchik[2]; [1]Dept. Innovation Vitreoretinal Technology, Krasnov Research Institute of Eye Diseases; [2]Nanophotonics Department, Vavilov Optical Institute, Russia

We are evaluate the effect of laser radiation with a wavelength of 3 μm on the tissues of cadaver eyes and compare it under similar parameters with the 532-nm laser. The impact of laser radiation on eye tissues was assessed using a scanning electron microscope.

ThSYD-25 13:15-13:45

Singlet and triplet oxygen detection by time-correlated single photon counting *(Invited paper)*

P. Morozov[1], V.S. Andreev[1], M.V. Shirmanova[2], V.I. Shcheslavskiy[2,3], G.N. Goltsman[1]; [1]Scontel; [2]Privolzhskiy Research Medical University, Russia; [3]Becker&Hickl GmbH, Germany

We present the technique for molecular oxygen measurements both in ground and excited states. It is based on time-correlated single photon counting technique and use of a superconducting nanowire single-photon detector that has a high quantum efficiency and an extremely low dark count rate.

Location: Petrov-Vodkin 3 Room, Floor 2; Date: Thursday, July 04, 2024

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE 6

Session Chair:

ThSYD-26 15:00-15:30

The role of water in the biological activity of shungite carbon nanoparticles *(Invited paper)*

N.N. Rozhkova[1], S.P. Rozhkov[2]; [1]Institute of Geology KarRC RAS, [2]Institute of Biology KarRC RAS, Russia

The role of the network of water hydrogen bonds in the regulation of intermolecular interaction responsible for colloidal stability of dispersions has been studied in order to search for general patterns of interaction between water, nanoparticles and biomacromolecules. Raman spectra for dispersions of bovine serum albumin and its hybrids with shungite carbon nanoparticles were analyzed in the high wavenumber region.

ThSYD-27 15:30-15:45

New materials for photodynamic inactivation of viruses

I.M. Belousova[1], I.V. Bagrov[1], V.V. Zarubaev[2], V.M. Kiselev[1], I.M. Kislyakov[3], T.K Krisko[1], A.M. Starodubtsev[1]; [1]Joint Stock Company «Scientific and Production Association S.I. Vavilov State Optical Institute», Russia; [2]St. Petersburg Pasteur Research Institute of Epidemiology and Microbiology, Russia; [3]Photonic Integrated Circuits Center, Shanghai Institute of Optics and Fine Mechanics CAS, China

The studies carried out in this work on the effective generation of singlet oxygen in the volume and on the surface of polytetrafluoroethylene (fluoroplastic-4, also known under the trade mark as Teflon) when irradiated with ultraviolet and visible radiation made it possible to clarify the mechanisms and features of the antiviral action of this fluoropolymer under specific experimental conditions.

ThSYD-28 15:45-16:00

The combined use of methylene blue and chlorin E6 photosensitizers for photodynamic therapy and correction of the tumor microenvironement

D.V. Pominova[1,2], A.V. Ryabova[1,2], A.S. Skobeltsin[1,2], I.V. Markova[2], I.D. Romanishkin[1]; [1]Prokhorov General Physics Institute RAS, [2]National Research Nuclear University MEPhI, Russia

In this work we report the results of the study of combined use of methylene blue with chlorin e6 photosensitizer for tumor oxygenation control and the tumor microenvironment correction during photodynamic therapy in vitro and in vivo. Targeted destruction of macrophage cells of tumor-associated phenotype and synergistic effects due to the influence of methylene blue on tumor oxygenation were studied.

ThSYD-30 16:00-16:15

Spectroscopic verification of contrast enhancement methods in fluorescence diagnostics of basal cell carcinoma with scar tissue

A.A. Febenchukova[1], A.M. Udeneev[1,2], A.M. Kulichenko[1,3], N.A. Kalyagina[1,3], K.T. Efendiev[1,3], M.V. Loshchenov[1]; [1]National Research Nuclear University MEPhI, [2]Federal State Budgetary «Federal Scientific and Clinical Center for Medical Rehabilitation and Balneology of the Federal Medical and Biological Agency», [3]Prokhorov General Physics Institute RAS, Russia

Fluorescent diagnosis of skin malignancies requires contrast enhancement of fluorescent images. The contrast enhancement methods of dividing the chlorine e6 fluorescence by the auto fluorescence and subtracting the auto fluorescence from the drug fluorescence were tested spectrometrically. Both methods have shown the possibility of enhancing tumor-healthy tissue contrast, with localization more easily determined by subtraction and accumulation assessed by division.

ThSYD-31 16:15-16:30

Photodynamic therapy for cancer of external and visceral localizations in Russia

E.Ph. Stranadko[1], A.V. Baranov[1], T.I. Malova[2], M.V. Riabov[1], M.A. Andreeva[1]; [1]Skobelkin Scientific and Practical Center for Laser Medicine FMBA; [2]"VETA-GRAND" LLC, Russia

Photodynamic Therapy (PDT) for cancer at various stages and locations has been practiced in Russia for 32 years. PDT is utilized in the majority of oncology clinics. The effectiveness of PDT reached 95-96%. PDT fundamentally changes the status of a significant group of inoperable patients with various cancer localizations.

ThSYD-32 16:30-16:45

Endoscopic photodynamic recanalization for inoperable obstructive esophageal cancer

E.Ph. Stranadko[1], V.A. Duvansky[2], V.L. Shabarov[3], M.V. Riabov[1], T.I. Malova[4], M.A. Andreeva[1]; [1]Skobelkin Scientific and Practical Center for Laser Medicine FMBA, [2]RUDN University, [3]Moscow Regional Research and Clinical Institute ("MONIKI"), [4]"VETA-GRAND" LLC, Russia

PDT is effective in advanced obstructive esophageal cancer, improving the outcomes for this challenging group of patients and enhancing their quality and duration of life. The recanalization effect lasts for 6-7 months. In cases of dysphagia recurrence after stenting, PDT is the only possible method for eliminating the tumor stricture.

- Coffee Break -

SYD: PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE - POSTERS

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

ThSYD-p01 15:00-18:30

Comparison of Ce6 photobleaching rate on the surface and in the depth of basalioma during photodynamic therapy at a wavelength of 660 nm using registration of fluorescence excited in the red and violet ranges

A.M. Udeneev[1,2], A.A. Febenchukova[2], N.A. Kalyagina[1,2,3]; [1]Federal State Budgetary «Federal Scientific and Clinical Center for Medical Rehabilitation and Balneology of the Federal Medical and Biological Agency», [2]National Research Nuclear University MEPhI, [3]Prokhorov General Physics Institute RAS, Russia

The photobleaching measuring at different tissue depths is important for photodynamic therapy monitoring. Photodynamic therapy of basaliomas was conducted with a 660 nm LED source. Photobleaching was measured with camera and with violet and red LEDs. Dependencies of a photosensitizer bleaching rate at the depth and surface of the basalioma tissue were obtained and analysed.

ThSYD-p02 15:00-18:30

Singlet oxygen generation by Radachlorin photosensitizer in albumin-containing solutions

D.M. Beltukova[1], V.P. Belik[1], K.A. Chudakov[2], O.V. Smirnov[1], I.V. Semenova[1], O.S. Vasyutinskii[1]; [1]Ioffe Inst.; [2]Peter the Great Polytechnic Univ., Russia

We present experimental analysis of singlet oxygen (SO) generation by Radachlorin photosensitizer (PS) in solutions with human serum albumin (HSA) at different relative concentrations of PS and HSA molecules. The gradual decrease of the SO phosphorescence signal with rising amount of albumin molecules has been observed and interpreted.

ThSYD-p03 15:00-18:30

Study of photo-oxidation of tetrahydrobiopterin with the addition of Pt - Pd nanoparticles

D.A. Makarova[1], A.S. Nizamutdinov[1], T.A. Telegina[2], Yu.L. Vechtomova[2], A.A. Buglak[3]; [1]Institute of Physics, Kazan Federal University; [2]A.N. Bach Institute of Biochemistry, Research Center of Biotechnology RAS; [3]Faculty of Physics, St. Petersburg State University, Russia

In the work, it was shown that the addition of platinum and palladium nanoparticle suspension promotes the formation of dihydropterin dimers when irradiated with ultraviolet light (325 nm) in the presence of oxygen.

ThSYD-p04 15:00-18:30

Picosecond to millisecond transient absorption spectroscopy of carboxy- and oxyhemoglobin in the visible and mid-infrared spectral region

S.V. Lepeshkevich[1], I.V. Sazanovich[2], M.V. Parkhats[1], S.N. Gilevich[3], B.M. Dzhagarov[1]; [1]B.I. Stepanov Institute of Physics NAS Belarus, Belarus; [2]Central Laser Facility, Research Complex at Harwell, STFC Rutherford Appleton Laboratory, UK; [3]Institute of Bioorganic Chemistry NAS Belarus, Belarus

Picosecond to millisecond laser time-resolved transient absorption spectroscopy in the visible and mid-infrared spectral region was used to study carbon monoxide and molecular oxygen rebinding as well as conformational relaxation following ligand photodissociation in human hemoglobin. Significant functional non-equivalence of the alpha and beta subunits of hemoglobin in both the geminate ligand rebinding and concomitant structural relaxation was revealed.

ThSYD-p05 15:00-18:30

Optimization of energy parameters for laser-induced photodynamic therapy of cervical tissues using numerical simulation and fluorescent monitoring

P.M. Alekseeva[1], K.T. Efendiev[1,2], T.A. Savelieva[1,2], A.S. Moskalev[1], A.V. Gilyadova[3], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Institute RAS; [2]National Research Nuclear University MEPhI; [3]Sechenov First Moscow State Medical University, Russia

The main problem in the photodynamic therapy of tumors is insufficient light exposure to tissue depth or the appearance of undesirable surface effects. It is required to investigate the influence of energy density and radiation spot diameter on the photosensitizer photobleaching efficiency by depth.

ThSYD-p06 15:00-18:30

Absorption spectra of molecular oxygen at 800 - 1300 nm in aerated organic solvents and water

A.S. Kozlov[1], S.G. Zhuravlev[2], O.N. Egorova[2], O.I. Medvedkov[2], A.A. Krasnovsky[1]; [1]Federal Research Center of Biotechnology RAS; [2]Prokhorov General Physics Institute RAS, Russia

Fiber and diode lasers (800 -1300 nm) were applied to investigation of the quantum efficiency of singlet oxygen trapping in aerated organic and aqueous media. Two main absorption bands at 1070 and 1273 nm corresponding to the 0-1 and 0-0 transitions in oxygen molecules were revealed with the relative intensities of 1:100.

ThSYD-p07 15:00-18:30

Extracorporeal treatment of carbon monoxide poisoning stimulated by laser radiation. Model of physical and chemical processes

A.V. Smirnov, N.V. Kovalenko; Moscow Institute of Physics and Technology, Russia

One of the promising methods of treatment of carbon monoxide poisoning is to use the effect of photodissociation of carboxyhemoglobin with parallel oxygenation of blood. This paper considers the simplest device realizing this principle and develops a mathematical model of physical processes occurring in the device.

ThSYD-p08 15:00-18:30

Comparison of SERS spectra of intact and inactivated viruses via machine learning algorithms for the viral disease's diagnosis application

O. Andreeva[1], D. Danilenko[2], A. Tabarov[1], K. Grigorenko[1], A. Dobroslavin[1], A. Gorshkov[2], A. Zheltukhina[2], N. Gavrilova[2], A. Gazizulin[1], V. Vitkin[1]; [1]ITMO University; [2]Smorodintsev Research Institute of Influenza, Russia

This study explores using inactivated influenza A viruses instead of intact ones for creating a spectral database in a diagnostic method with SERS and machine learning. Spectral differences between the forms reveal limitations in using inactivated viruses for database creation and ML training for virus detection, but the data obtained can be utilized for vaccine quality monitoring technology.

ThSYD-p09 15:00-18:30

Effect of folic acid on photophysical properties and photosensitized singlet oxygen formation by cationic tetrapyridyl porphyrins

M.V. Parkhats[1], S.V. Lepeshkevich[1], M.V. Verameichyk[2], L. Mkrtchyan[3], T. Seferyan[3], A.A. Zakoyan[3], G.V. Gyulkhandanyan[3], B.M. Dzhagarov[1]; [1]B.I. Stepanov Institute of Physics, NASB, Belarus; [2]Belorussian State University, Belarus; [3]Institute of Biochemistry NAS of Armenia, Armenia

The effect of folic acid on photophysical properties and photosensitized singlet oxygen formation by cationic tetrapyridyl porphyrins was investigated. It was found a strong quenching of the porphyrin fluorescence and the efficiency of singlet oxygen formation in the presence of folic acid. The reasons for the observed changes are discussed.

ThSYD-p10 15:00-18:30

Wireless chronic electrical stimulation of peripheral nerves via organic optoelectronic device.

E.A. Iusupovskaia[1], G.A. Piavchenko[2], A.N. Konovalov[1,3], D.V. Telyshev[1,4], A.G. Markov[1]; [1]Institute for Bionic Technologies and Engineering, I. M. Sechenov First Moscow State Medical University, Russia; [2]Department of Histology, Cytology and Embryology, I.M. Sechenov First Moscow State Medical University (Sechenov University), Russia; [3]National Medical Research Center of Neurosurgery named after N.N. Burdenko, Russia; [4]Institute of Biomedical Systems, National Research University of Electronic Technology, Russia

Here we report chronic wireless electrical stimulation of the sciatic nerve in rats by an implanted multilayered organic semiconductor optoelectronic device that transduces deep-red light (625 nm) into electrical signals. In freely moving rats, fixation of the cuff around the sciatic nerve, 10 mm below the surface of the skin, allowed stimulation of the nerve for over 90 days.

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY

Location: Stenberg 2 Room, Floor 3; Date: Friday, July 05, 2024

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 10

Session Chair:

FrSYB-43 09:00-09:30

Made-to-order organ: the common future of biophotonics and biofabrication *(Invited paper)*

Peter Timashev; Science and Technology Park for Biomedicine of the Sechenov Medical University; Faculty of Chemistry, Lomonosov Moscow State University, Russia

Various strategies have been developed to produce biocompatible tissue-engineered constructs, including the use of natural biomaterials like collagen or functionalization of synthetic biomaterials. There is a trend towards bioactive constructs that stimulate tissue remodeling and integration. Challenges include quality control and imaging without destruction. Biophotonics offers instant tissue visualization. These approaches hold promise for revolutionizing regenerative medicine.

FrSYB-44 09:30-09:45

Plasmonic sensors for detection of protein aging in solution

A.A. Rubekina[1], V.I. Kukushkin[2], E.A. Shirshin[1]; [1]Physics department, Lomonosov Moscow State University; [2]Institute of Solid State Physics RAS, Russia

The aging process of proteins is accompanied by their oxidation and the formation of post-translational modifications. Their optical properties changes due to its oxidation: they acquire a fluorescent response in the near-infrared regions of the spectrum. This work examines the possibility of using plasmonic sensors to monitor the fluorescence of proteins during their aging process.

FrSYB-45 09:45-10:00

Singlet oxygen prevents the mitochondrial NADH depletion in β-amyloid induced neurotoxicity

O.A. Stelmashchuk[1], V.V. Dremin[1], A.Y. Abramov[1,2]; [1]Research & Development Center of Biomedical Photonics, Orel State University, Russia; [2]Department of Clinical and Movement Neurosciences, UCL Queen Square Institute of Neurology, UK

This paper demonstrates the results of the application of singlet oxygen in β-amyloid induced neurotoxicity. The experimental results of the use of 1267 nm laser for generating singlet oxygen in primary co-culture of cortical cells addition β-amyloid peptide fragment 25-35 (5 μM) are described.

FrSYB-46 10:00-10:30

Advanced Monte Carlo simulations in spectral and fluorescence optical diagnostics *(Invited paper)*

M.Yu. Kirillin[1], D.A. Kurakina[1], A.A. Getmanskaya[1,2], A.V. Khilov[1], V.V. Perekatova[1], V.A. Shishkova[1], I.V. Turchin[1], E.A. Sergeeva[1]; [1]A.V. Gaponov-Grekhov Institute of Applied Physics RAS; [2]N.I. Lobachevsky State University of Nizhny Novgorod, Russia

We report on the development of Monte Carlo based models of signal formation in systems of spectral and fluorescence imaging. Numerical simulations allow tracking photon trajectories providing imaging volume analysis, while parallel processor architecture allows to significantly speed up calculations.

FrSYB-47 10:30-10:45

Simulation of infrared radiation backscattering in multylayer tissue models

V.L. Kuzmin[1], Yu.A. Zhavoronkov[1,2], S.V. Ul'yanov[2]; [1]Peter the Great St. Petersburg Polytechnic University; [2]St. Petersburg State University, Russia

Calculating and studying the characteristics of infrared radiation scattered by multilayer systems expands the possibilities of noninvasive diagnostics. We present Monte Carlo simulation results of backscattering from a four-layer bio-tissue model based on the solution of the Bethe-Salpeter equation. The calculations reveal that backscatter intensity are extremely sensitive to the penetration of blood into the cerebrospinal fluid layer.

Location: Stenberg 2 Room, Floor 3; Date: Friday, July 05, 2024

SYB: LASER INTERACTION WITH CELLS AND TISSUES- CLINICAL IMAGING AND SPECTROSCOPY 11

Session Chair:

FrSYB-48 11:30-12:00

Human serum SERS analysis for non-infectional diseases detection: avoiding overestimation of classification models *(Invited paper)*

I.A. Bratchenko[1], Yu.A. Khrisoforova[1], P.A. Lebedev[2], M.A. Skuratova[3], L.A. Bratchenko[1]; [1]Laser and Bbiotech Dept., Samara National Research University; [2]Therapy Dept. Samara State Medical University; [3]Samara Regional Clinical Hospital named after VD Seredavin, Russia

The in vitro analysis of human serum was performed for more than 500 subjects for the detection of chronic heart failure, chronic kidney failure and other non-communicable diseases. Analyzed groups separation was performed based on deep learning was implemented using a separate one-dimensional convolutional neural network, projection on latent structures combined with discriminant analysis and other machine learning approaches.

FrSYB-49 12:00-12:30

Development of SERS-active substrates for Raman investigations of microorganisms *(Invited paper)*

V.V. Tregulov[1], E.V. Perevedentseva[2], A.I. Ivanov[1], D.S. Kostsov[2], N.N. Melnik[2]; [1]Ryazan State University named after S. Yesenin; [2]Lebedev Physical Institute RAS, Russia

The developing of active substrates for surface enhancement Raman scattering (SERS) based on porous silicon with Fano resonance is presented. Such structures provide both high amplification of the Raman signal and obtaining reproducible and clearly interpretable results for using SERS like a tool for detection, identification and research of pathogenic and non-pathogenic microorganisms.

FrSYB-50 12:30-12:45

Assignment of low-frequency bands in micro-Raman spectra of hair keratins

E.I. Travkina, N.N. Brandt; Faculty of Physics, Lomonosov Moscow State University, Russia

We identify conformation-sensitive bands in the low-frequency micro-Raman spectra of human hair keratins. A comparison of hair spectra measured at different orientations of the sample relative to the exciting radiation reveals changes in an interval of 110-190 cm-1, corresponding to vibrations of polarization sensitive α-helical structures. It was also shown that spectral interval of 235-353 cm-1 characterizes vibrations of β-structures.

FrSYB-51 12:45-13:00

Plasmon based tags for Raman bioimaging in silent region

A.I. Demenshin, V.N. Sorokoumov, E.V. Solovyeva; St. Petersburg State University, Russia

Surface-enhanced Raman scattering is characterized by high specificity, spatial resolution and signal-to-noise ratio which make it attractive for bioimaging purposes. The use of alkynes in combination with plasmonic materials opens up the possibility of multifunctional diagnostic agents. In this work, the tags based on gold nanorods functionalized with 4-aminotolan via covalent conjugation are developed for alkyne-targeted bioimaging and photothermal therapy.

- Lunch Break -

A1. EXHIBITION WORKSHOP

Зал Пьемонт, 3 этаж
3 Июля 2024, 15:00–17:00
Язык мероприятия: Русский
Модератор: Андрей Е. Чупров,
ООО «Специальные Системы. Фотоника», Россия

Piedmonte Room, 3rd floor
July 3, 2024, 15:00–17:00
Language of the event is Russian
Moderator: A.E. Chuprov,
Special Systems. Photonics, LLC, Russia

15:00–15:15

Обзор современных лазерных решений для научных и промышленных задач
А. Е. Чупров, ООО «Специальные Системы. Фотоника», Россия

Overview of modern laser solutions for scientific and industrial tasks
A. E. Chuprov, Special Systems. Photonics, LLC, Russia

15:15–15:30

Актуальные разработки лазерных источников и компонентов фотоники в ЛАССАРД
А. С. Щекин, ООО «Лассард», Россия

Latest innovations in laser sources and photonics components at LASSARD
A. S. Schekin, LASSARD, LLC, Russia

15:30–15:45

Лазеры для решения специальных задач
Д. А. Вельтберг, ООО «Лазерные компоненты», Россия

Lasers for specialized purposes
D. A. Weltberg, Laser Components Ltd., Russia

15:45–16:00

Современные тенденции в области конфокальной микроскопии и доступные технологии в области фотоники
А. М. Козьмин, ООО «Криотрейд Инжениринг», Россия

Current trends in confocal microscopy and available technologies in photonics
A. M. Kozmin, Cryotrade Engineering, LLC, Russia

16:00–16:15

Лазерные оптоакустические томографы медицинского назначения на основе высокочувствительных ультразвуковых гидрофонов
П. В. Субочев, ООО «БАРИ - НН», Россия

Laser optoacoustic tomography systems for biomedical applications based on highly sensitive ultrasound hydrophones
P. V. Subochev, BARI-NN Ltd., Russia

16:15–16:30

Новые разработки в семействе лазеров УКИ компании «АВЕСТА», в том числе титан-сапфировые осцилляторы со средней выходной мощностью более 1 Вт с прямой диодной накачкой
И. И. Курицын, К.Е. Резников, ООО «Авеста-Проект», Россия

Recent developments in Avesta's ultrafast laser family including direct diode-pumped Ti:Al_2O_3 oscillators with >1 W output average power
I. I. Kuritsyn, K.E. Reznikov, Avesta Project Ltd., Russia

16:30–16:45

Современные нанометровые и оптические методы измерений с помощью зондовых, спектральных и лазерных технологий
Н. М. Толкач, ООО «Активная фотоника», Россия

Modern nanometer and optical measurement methods using probe, spectral and laser technologies
N. M. Tolkach, ActivePhotonics, LLC, Russia

EXHIBITION “LASERS AND PHOTONICS”

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SLS Prime Technology is a manufacturer of lasers & laser systems for solving scientific and industrial tasks of any complexity.
The company's main specialization is development and production of pulsed solid-state lasers that generate laser radiation with specified characteristics in various spectral ranges from UV to IR.

We offer solutions in the following product lines:
- DPSS Lasers
- Flash Lamp Lasers
- OPOs & Tunable Laser Systems
- Custom Laser Systems

SPECIAL SYSTEMS. PHOTONICS LLC, RUSSIA
64, B. Sampsonievskiy pr.,
194044, St. Petersburg, Russia
Phone: + 7 812 385 58 24
E-mail: info@sphotonics.ru
www.sphotonics.ru

Special Systems. Photonics, LLC, specializes in the distribution of photonics solutions for various applications. Our team consists of professionals and rests primarily on engineering support in the implementation of products from leading world manufacturers.

We are dedicated to develop long-term and mutually beneficial partnerships with Russian and CIS customers. We have own test lab and service center with various equipment and components, so we are ready to provide technical support in the following areas:
- Pulsed lasers: nanosecond, picosecond, femtosecond;
- Laser diode stacks and pumping modules;
- Single-frequency fiber lasers, DPSS and diode lasers;
- Laser components and polarization optics;
- Spatial light modulators SLM (LCOS, DMD);
- RF and optical measurement equipment;
- Quantum technology;
- Technology station for fiber optic;
- Integrated photonics;
- High-precision positioners and stages;
- Optomechanics and optical tables;
- Educational kits.

SSPA «OPTICS, OPTOELECTRONICS, AND LASER TECHNOLOGY», BELARUS
68-1 Nezavisimosti ave.,
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State Scientific and Production Association of Optics, Optoelectronics and Laser Technology has been created by National Academy of Sciences of Belarus in 2011. SSPA "Optics, Optoelectronics and Laser Technology" includes such well-known organizations as B.I. Stepanov Institute of Physics of National Academy of Sciences of Belarus, Center of LED and Optoelectronic Technologies of National Academy of Sciences of Belarus, Centre of Geophysical Monitoring of National Academy of Sciences of Belarus etc. Main research and development activity of the SSPA "Optics, Optoelectronics and Laser Technology" belongs to the fields of laser physics, nonlinear optics and laser spectroscopy, microwave photonics, photoelectronics, robotic systems and sensors. Own mechanical and optical departments enable manufacturing of lasers and optics with required characteristics in the shortest time periods. One of the main directions is development and manufacturing of compact eye-safe pulsed erbium glass lasers, powerful diode-pumped Nd:YAG lasers, and optical parametric oscillators for wide temperature range.

АКТИВНАЯ ФОТОНИКА

ACTIVE PHOTONICS LLC, RUSSIA
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ACTIVE PHOTONICS LLC is a resident of Skolkovo. The company is a leading developer and manufacturer of equipment for microscopy and spectroscopy, high-end scientific instruments for experimental research in the field of nanotechnology.
The company's developments include:

- Raman and photoluminescent confocal microspectrometer
- Solid-state thermally stabilized visible and near-infrared lasers for Raman and photoluminescence spectroscopy
- Cooled low-noise detectors (CCD cameras) in visible range for spectral technology
- The company's products are ideally compatible with solutions for Scanning Probe Microscopy with various options and settings for research in STM and AFM modes in air, liquid and gas environments, with sample heating, using in-plane and out-plane magnetic fields. Combining the capabilities of AFM and Raman spectroscopy; MFM with Magneto-Optical Microscope and dual beam balanced polarimeter, etc.

SOLAR LS, BELARUS
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Phone: +375 17 347 95 90
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www.solar-laser.com

SOLAR LS CJSC is one of the major companies in Belarus in the field of development and production of laser systems and spectral instruments for scientific, industrial and medical applications.
SOLAR LS product line includes:
- nanosecond and sub nanosecond lamp and diode pumped lasers with harmonic generators;
- lasers with a kHz repetition rate with harmonic generators in visible, UV and IR spectral regions;
- diode pumped picosecond and femtosecond lasers with harmonic generators;
- tunable nanosecond laser systems with a tuning range 200nm - 20μm;
- modular spectrofluorometers for measuring stationary fluorescence;
- high-precision wavelength meters in the range of 190 nm-1.7 μm;
- spectrometers, monochromators, spectrographs, including customized products;
- powerful Xe light sources, tunable in the range of 250 nm-2.5 μm;
- medical aesthetic devices based on Nd:YAG, Alexandrite and CO2 lasers.

FEMTOVISION LLC, RUSSIA
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Femtovision, LLC is a manufacturer of innovative femtosecond laser equipment, unique pumping system and educational equipment for universities. Our solid-state titanium doped sapphire laser "TiS-Quantum" can generate pulses shorter than 30 femtoseconds at 100 MHz repetition rate. We have developed and patented multi-diode laser modules and used them to build the first Russian Ti:sapphire femtosecond laser employing multi-diode pump. Pumping femtosecond laser with our diode modules greatly reduces costs and power consumption of the system and makes it easier to run. The products we design are going to be more mobile, smaller in size and several times cheaper than similar lasers available today.

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Cryotrade Engineering was founded in 2008 in Moscow. The company has two different directions of the business – production of cryogenic equipment and sales of photonics and cryogenics equipment from foreign manufacturers.

The company has been operating in the Russian market for more than 10 years. During this time, we delivered hundreds of items of imported equipment and several more than a hundred systems of our own production. Production is based in Moscow on an area of more than 700 m^2.

We offer comprehensive confocal microscopes for different applications, any possible optics and optomechanics, analytical equipment, optical tables, DPSS and fiber lasers, Raman spectrometers, photon counting systems, etc.

SC «LLS», RUSSIA
off. 401,16 Birzhevaya line
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www.lenlasers.ru

SC «LLS» the largest Optics and Photonics distributor in Russia. Resident of ITMO University Technopark, member of the Laser Association.

Headquarter is located in St. Petersburg. Branch offices are located in Moscow, Novosibirsk and Vladivostok.

LLS offers a wide range of fiber-optic and laser components, including:

Optics and optomechanics;
Test and measurement equipment;
Laser systems and jets;
Fiber-optic components;
Optical fibers;
RF photonics;
Quantum technologies;
Telecommunication systems;
High-power lasers for material processing.

The company has its own research and engineering laboratory and production site, which covers the following areas:

Laser repair and service;
Demonstration and testing of equipment;
Equipment and components for fiber laser systems assembly and testing;
Measurement of fiber-optic components characteristics and laser radiation parameters

ETM PHOTONICS LLC, RUSSIA

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ETM Photonics, LLC supplies equipment for scientific research in the fields of photonics, laser physics and quantum optics. Founded in 2021 in St. Petersburg, with a branch in Moscow. All company employees have higher technical education or specialized education related to direct job responsibilities.

Since 2021, the company has been a member of the Lomonosov Moscow State University Quantum Technology Center.
We directly work with manufacturers and independently carry out customs clearance of imported products, which ensures fulfillment of warranty obligations and high-speed delivery at reasonable prices. At the same time, the company is constantly working to find new manufacturers of high-quality products, create new logistics chains and additional hubs in the most important regions for supplies, and establish financial and business relationships that allow us to maintain stability and uninterrupted supply of complex scientific equipment.

LASERS AND OPTICAL SYSTEMS, RUSSIA

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«Lasers & Optical Systems» Co. Ltd. is an industrial company producing solid state lasers and systems. We combine science and industrial experience to meet consumer demand and to innovate cutting-edge technologies into commercial products. We produce diode pumped solid state lasers, eye-safe lasers, environmental lidars and laser systems for various applications. We have been in the market for over 25 years and our brand is well-recognized both in Russia and abroad. LOS participates in the ITER Project in the European Fusion Programme.

BUREAU OF ACOUSTIC DEVELOPMENTS AND INNOVATIONS OF NIZHNY NOVGOROD LTD., RUSSIA

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Phone: +7 904 399 79 16
E-mail: bari-nn@yandex.ru
www.photoacoustics.ru

BARI-NN Ltd. offers custom-made piezo-polymer ultrasonic detectors for optoacoustic imaging. Our antennas have a record reception bandwidth from 100 kHz to 100 MHz and a receiving sensitivity of about 1 μV/Pa, making them ideal for biomedical applications. The acoustic impedance of PVDF antennas is close to the acoustic impedance of water and biological tissue, making them practically sound-transparent and not introducing impedance distortions into the measured acoustic fields.

We offer complete freedom in terms of geometric characteristics of your ultrasonic detector, with options including flat, cylindrical, conical, spherical, with frequencies from 100 kHz to 100 MHz, with the number of elements from 1 to 512, and with apertures from 0.5 mm to 10 cm. For ordering single element antennas, we recommend using the product code PVDF-Thickness-Focal distance-Aperture-Diameter-Length.

FEDAL, RUSSIA

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https://Fedal.com

FEDAL develops and produces laser electronics and accessories. FEDAL was founded in 2002. Working hard these years our specialists have got unique experience, that allows us to solve a wide range of technical tasks.
Our product line includes:
Laser diode drivers (power supplies) – CW, QCW or CW/QCW modes for lamp-, diode-pumping lasers;
Charging modules;
Multichannel systems;
Accessories (low-power electronics for laser systems).

We are developers, manufacturers, integrators. We supply our products all over the world. And we are always open to cooperation.

T8, RUSSIA
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T8 is the leading Russian vendor of wavelength-division Multiplexing telecommunication equipment (DWDM).
Headquartered in Moscow, the company is one of a few companies in the world, designing and manufacturing a line equipment with channel rate up to 800 Gbit/s. T8 also specializes in the development:

- 10 mW sub-kHz linewidth single frequency laser in butterfly-type package

Narrowband external cavity laser. Russian laser with an instantaneous linewidth of less than 2 kHz.

T8 offers integrated solutions for building DWDM systems for metro or long-haul core networks, data-center interconnections and other carrier-grade high capacity bandwidth networks including the infrastructure of 5G networks.
For many years T8 is listed among Russian high-tech innovative leaders, provides expertise to clients in network optimization and analytics for most efficient use or scalability of network resources.

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Polarus LLC is the developer and manufacturer of picosecond fiber lasers. We offer picosecond lasers with an average power of 5 to 50 W at a wavelength of 1030/1064 nm. The key feature of lasers manufactured by Polarus is a narrow optical spectrum of the output radiation. Our lasers can be used for cold ablation micromachining of various materials. We can design a laboratory micromachining laser system based on our lasers for your unique needs.
The product line of Polarus also includes a picosecond master laser and a set of electronic control units named “Laser Control System”, which can be used for high-power pulsed lasers and research purposes.

Laser Control System is designed to control a laser and power electronic components of medium and low output power pulsed lasers, in particular to control pump laser diodes and a master laser diode source (SEED), as well as to synchronize and stabilize temperatures of laser component

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21ST INTERNATIONAL CONFERENCE LASER OPTICS

8^{TH} INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS

EXHIBITION "LASERS AND PHOTONICS"