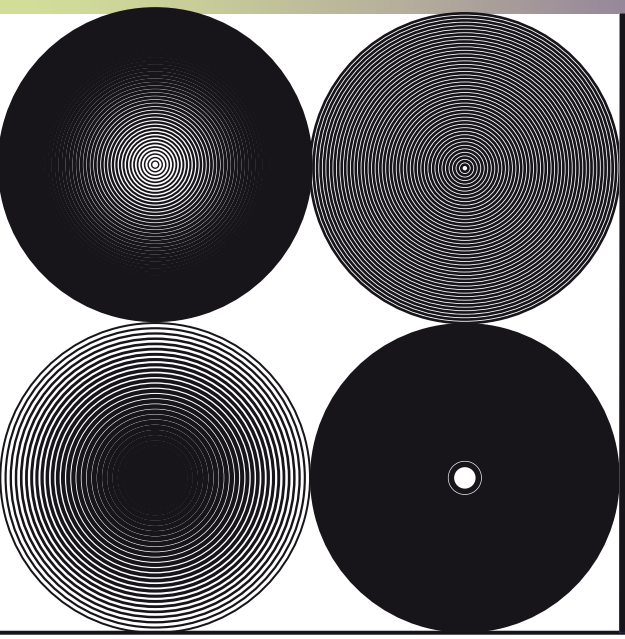
20th International Conference Laser Optics ICLO 2022

TECHNICAL PROGRAM



ICLO 2022

St. Petersburg, Russia
20—24 June, 2022

20th International Conference

Laser Optics

ICLO 2022

TECHNICAL PROGRAM

Saint Petersburg

2022

This year we hold the 20th anniversary International Conference Laser Optics. It's history began at the end of 1975 when Artur Mak, together with his closest colleagues at the Vavilov State Optical Institute proposed to organize a conference devoted to the recent advances in the Laser Physics and Optics. This idea was supported by the Nobel Prize winners Profs. A.M. Prokhorov and N.G. Basov and by the Soviet Academy of Sciences. The first Conference Laser Optics was held on 4-8 January 1977 in Repino near Leningrad (now St. Petersburg).

E. N. Tsarevsky (1nd from the left), A. A. Mak (2nd from the left), M. M. Miroshnikov (3rd from the left), A. M. Prokhorov (4th from the left), N. V. Karlov (4th from the right), V. I. Kurushin (3rd from the right), M. F. Bukhenskii (1st from the right)

THE 20TH INTERNATIONAL CONFERENCE LASER OPTICS ICLO 2022

is organized by

FUND FOR LASER PHYSICS,

technically co-sponsored by

IEEE PHOTONICS SOCIETY,

supported by

THE UNION OF INDUSTRIALISTS AND ENTREPRENEURS (EMPLOYERS) OF ST. PETERSBURG

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

LASER OPTICS
ОПТИКА ЛАЗЕРОВ
2022

SPONSORS AND PARTNERS

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"Photonika" Magazine

"Rhythm" Magazine

THE 20TH INTERNATIONAL CONFERENCE LASER OPTICS ICLO 2022

COMMITTEE

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Ioffe Institute, Russia, **Secretary**

TOPICS FOR ICLO 2022

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

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

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

TOPICS FOR ICLO 2022

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 solitons • Nonlinear optics with structured light, optical vortices • Self-modulation and nonlinear temporal effects • Supercontinuum and frequency comb generation • Fiber optics and telecommunications • Machine learning • Nonlinear nanophotonics and plasmonics • Nonlinear meta-optics and metamaterials • Nonlinear optical devices, including microresonators, waveguides, and PT-symmetric systems • Nonlinear topological photonics • Topological lasers • Nonlinear photonics with surfaces and interfaces • Polariton condensates • 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 and Quantum Photonics in Waveguide Systems

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 • Quantum optics in cavities • 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 • Optical data processing • 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

7TH INTERNATIONAL A. M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS

COMMITTEE

IVAN A. SHCHERBAKOV,
A. M. Prokhorov General Physics Institute of RAS, Russia, **Symposium Chair**

PETR I. NIKITIN,
A. M. Prokhorov General Physics Institute of RAS, Russia, **Program Committee Chair**

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NATALIA P. KHAKAMOVA,
A. M. Prokhorov General Physics Institute of RAS, Russia, **Secretary**

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

ROUND TABLE CENTENNIAL OF PROF. NIKOLAI BASOV, NOBEL PRIZE WINNER (1964)

ICLO 2022 will host a Special Session dedicated to the Centennial of Prof. Nikolai Basov, one of the quantum electronics founders and a Laureate of Nobel prize in physics.

Prof. Nikolai Basov (born December 14, 1922) was awarded the Nobel prize in physics in 1964 together with Profs. Aleksandr Prokhorov and Charles Townes "for fundamental work in the field of quantum electronics, which has led to the construction of oscillators and amplifiers based on the maser-laser principle". His detailed biography may be found in a book "Nikolai Gennadievich Basov. On the occasion of the 95th anniversary of his birth" (Ed. by A. A. Ionin):

https://www.lebedev.ru/ru/site-media/knigi.html

This Session A1 will be comprised of four invited presentations lasting 30 minutes each.

ANDREY A. IONIN,
Lebedev Physical Institute of RAS, Russia, **Chair**

YURY M. KLIMACHEV,
Lebedev Physical Institute of RAS, Russia, **Secretary**

Федеральное государственное бюджетное учреждение науки
Физический институт имени П.Н. Лебедева
Российской академии наук

The Round Table Centennial of Prof. Nikolai Basov is organized by Lebedev Physical Institute of RAS.

THE PHOTONIC NANOMATERIALS SCHOOL

PN2022 INTERNATIONAL SUMMER SCHOOL PHOTONIC NANOMATERIALS
June 21–24 • 2022 • Saint Petersburg • Russia https://www.laseroptics.ru/PN2022

The main goal of the Photonic Nanomaterials School is to review recent achievements in various fields related to advanced photonic nanostructures and provide high level courses and training for students.

ST1 Technical Topics:

- Synthesis of advanced nanostructures for photonics and applications
- Molecular beam epitaxy, metal-organic vapor phase epitaxy and related epitaxy techniques for growth of semiconductor nanostructures
- Diagnostics of nanostructures, including in situ growth monitoring
- Nanostructure modeling
- Semiconductor nanowires
- Quantum dots and related nanostructures
- Hybrid photonic nanostructures
- Wide bandgap nanomaterials
- Complex alloys and compounds
- Graphene and related 2D materials
- Micro-cavities and photonic crystals
- Methods of surface nanofabrication
- Nanostructures for optoelectronic devices
- Nanostructures for life sciences and environment

VLADIMIR G. DUBROVSKII,
St. Petersburg State University, Russia,
School Co-Chair

FRANK GLAS,
CNRS and Université Paris-Saclay, France,
School Co-Chair

St Petersburg University

RSF Russian Science Foundation

The Photonic Nanomaterials School (PN 2022) is organized by St. Petersburg State University.

Sponsored by the Russian Science Foundation (project No. 19-72-30004) and St. Petersburg State University.

THE SCHOOL "X-RAY SYNCHROTRON AND LASER RESEARCH METHODS IN MATERIALS SCIENCE"

The School "X-ray synchrotron and laser research methods in materials science" provides participants an interdisciplinary program to learn the opportunities in ultrafast X-ray and laser science and their impact on research in materials science. The invited lectures tackle various topics such as X-ray free electron lasers, X-ray photoelectron spectroscopy, X-ray microimaging, X-ray resonance reflectometry, X-ray structural analysis, X-ray absorption spectroscopy, X-ray twisted photons.

ST2 Technical Topics:

- Synchrotron X-ray microimaging at storage-ring and XFEL sources of "megascience"
- Commensurate and incommensurate superstructures in perovskite-based crystals and nano-heterostructures
- Free-electron laser as a source of hard X-ray twisted photons
- X-ray structural analysis in the study of biopolymer polyelectrolyte materials
- Biomedical applications of Raman spectroscopy
- X-ray resonance reflectometry as a multifunctional synchrotron method for studying magnetic nanofilms
- XPS study of halide perovskites electronic structure from core-level to valence band
- Application of some synchrotron-related spectroscopy techniques for studying electronic structure of advanced carbon nanostructures

ALEXEY E. ROMANOV,
ITMO University, Russia, **School Co-Chair**

PAVEL N. BRUNKOV,
Ioffe Institute, Russia, **School Co-Chair**

EVGENY A. VIKTOROV,
ITMO University, Russia, **Vice School Chair**

STANISLAV S. ROCHAS,
ITMO University, Russia, **School Secretary**

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МИНИСТЕРСТВО НАУКИ
И ВЫСШЕГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ

The School "X-ray synchrotron and laser research methods in materials science" is organized by ITMO University.

Supported by the Ministry of Science and Higher Education of the Russian Federation
(Project 075-15-2021-1349)

MONDAY, 20 JUNE

10.45-12.30	**ICLO 2022 - PLENARY SESSION** *PIEDMONTE ROOM - FLOOR 3*
13:45-17:30	**7TH INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS - PLENARY SESSION** *PIEDMONTE ROOM- FLOOR 3*
18.00-20.00	**WELCOME RECEPTION** *TOSCANA RESTAURANT*

TUESDAY, 21 JUNE

9.00-11.00	**POSTER SESSION** **R6, R7** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P. 21, 22*	***SYB*** LASER INTERACTION WITH CELLS AND TISSUES ... I ***PETROV-VODKIN 1*** *P. 75*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY I & II ***PETROV-VODKIN 2*** *P. 77*	***SYA*** ADVANCED LASER MEDICAL SYSTEMS & TECHNOLOGIES I ***PETROV-VODKIN 3*** *P. 73*	***R3*** NOVEL SEMICONDUCTOR-BASED DEVICES & APPS ***DEYNEKA*** *P. 4*
11.00-11.30	BREAK				
11.30-13.30	**POSTER SESSION** **R6, R7** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P. 21, 22*	**SYB** LASER INTERACTION WITH CELLS AND TISSUES ... II ***PETROV-VODKIN 1*** *P. 75*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY III ***PETROV-VODKIN 2*** *P. 78*	***SYA*** ADVANCED LASER MEDICAL SYSTEMS & TECHNOLOGIES II ***PETROV-VODKIN 3*** *P. 73*	***R3*** *THZ AND HIGH-SPEED PHOTONICS* ***DEYNEKA*** *P. 4*
13.30-15.00	BREAK				
15.00-17.00	**POSTER SESSION** **R3, SYA, SYC** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P. 16, 79, 79*	**SYB** LASER INTERACTION WITH CELLS AND TISSUES ... III ***PETROV-VODKIN 1*** *P. 76*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY III ***PETROV-VODKIN 2*** *P. 78*	***A2*** EXHIBITORS WORKSHOP ***PETROV-VODKIN 3***	***R7*** FREE ELECTRON LASERS ***DEYNEKA*** *P. 10*
17.00-17.30	BREAK				
17.30-19.30	**POSTER SESSION** **R3, SYA, SYC** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P. 16, 79, 79*		***R3*** SOLID STATE PHOTONICS ***PETROV-VODKIN 2*** *P. 5*		***ST2*** THE SCHOOL "X-RAY ..." ***DEYNEKA*** *P. 99*

WEDNESDAY, 22 JUNE

9.00-11.00	**POSTER SESSION** **R2, R9** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P. 37, 43*	**SYB** LASER INTERACTION WITH CELLS AND TISSUES ... IV ***PETROV-VODKIN 1*** *P. 82*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY IV ***PETROV-VODKIN 2*** *P. 84*	***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE I ***PETROV-VODKIN 3*** *P. 86*	***R3*** HIGH-POWER AND QUANTUM CASCADE LASERS ***DEYNEKA*** *P. 26*
11.00-11.30	BREAK				
11.30-13.30	**POSTER SESSION** **R2, R9** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P. 37, 43*	**SYB** LASER INTERACTION WITH CELLS AND TISSUES ... V ***PETROV-VODKIN 1*** *P. 82*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY V ***PETROV-VODKIN 2*** *P. 85*	***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE II ***PETROV-VODKIN 3*** *P. 86*	***R3*** IR LASERS AND SYSTEMS ***DEYNEKA*** *P. 26*
13.30-15.00	BREAK				
15.00-17.00	**POSTER SESSION** **R5, R10** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P.41, 51*	**SYB** LASER INTERACTION WITH CELLS AND TISSUES ... VI ***PETROV-VODKIN 1*** *P. 83*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY VI ***PETROV-VODKIN 2*** *P. 85*	***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE III ***PETROV-VODKIN 3*** *P. 87*	***R3*** A3B5 AND HYBRID STRUCTURES ***DEYNEKA*** *P. 27*
17.00-17.30	BREAK				
17.30-19.30	**POSTER SESSION** **R5, R10** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P.41, 51*	**POSTDEADLINE** ***PETROV-VODKIN 1+2*** *P. 35*			***ST2*** THE SCHOOL "X-RAY ..." ***DEYNEKA*** *P. 99*

MONDAY, 20 JUNE

ICLO 2022 - PLENARY SESSION
PIEDMONTE ROOM - FLOOR 3

7TH INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS - PLENARY SESSION
PIEMONTE ROOM - FLOOR 3

WELCOME RECEPTION
TOSCANA RESTAURANT

TUESDAY, 21 JUNE

R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID I ***STENBERG I*** *P. 2*	***R8*** NONLINEAR PHENOMENA WITH THZ RADIATION ***STENBERG 2*** *P. 11*	***R10*** NONCLASSICAL STATES AND QUANTUM CRYPTOGRAPHY ***RICHTER*** *P. 14*	***R5*** FAST PARTICLE GENERATION BY SUPER-INTENSE LIGHT FIELDS ***PUDOVKIN*** *P. 7*	
BREAK				
R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID II ***STENBERG I*** *P. 3*	***R8*** NONLINEAR PHENOMENA IN MICROCAVITIES ***STENBERG 2*** *P. 12*	***R10*** PHOTONIC MACHINE LEARNING AND DATA PROCESSING ***RICHTER*** *P. 15*	***R5*** INTERACTION OF SUPER-STRONG LASER FIELDS WITH UNDER-DENSE PLASMAS ***PUDOVKIN*** *P. 8*	
BREAK				
R1 MID-IR AND TUNABLE LASERS ***STENBERG 1*** *P. 1*	***R9*** OPTICAL NANOMATERIALS I ***STENBERG 2*** *P. 13*	***R4*** LASER BEAM CONTROL I ***RICHTER*** *P. 6*	***R5*** GENERATION OF INTENSE ULTRA-SHORT RADIATION ***PUDOVKIN*** *P. 8*	
BREAK				
R1 PULSED AND CW LASERS ***STENBERG 1*** *P. 1*		***R4*** LASER BEAM CONTROL II ***RICHTER*** *P. 6*	***R5*** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES ***PUDOVKIN*** *P. 9*	

WEDNESDAY, 22 JUNE

R6 LIDARS AND ENVIRONMENTAL SENSING ***STENBERG 1*** *P. 31*	***R1*** FIBER LASERS ***STENBERG 2*** *P. 24*	***R4*** LASER BEAM CONTROL III ***RICHTER*** *P. 28*	***R8*** SOLITONS AND GENERAL NONLINEAR PHOTONICS I ***PUDOVKIN*** *P. 33*	
BREAK				
R6 BIOIMAGING AND ANALYTICAL TECHNIQUES ***STENBERG 1*** *P. 32*	***R1*** OPTICAL MATERIALS, SPECTROSCOPY ***STENBERG 2*** *P. 25*	***R4*** LASER BEAM CONTROL IV ***RICHTER*** *P. 28*	***R8*** SOLITONS AND GENERAL NONLINEAR PHOTONICS II ***PUDOVKIN*** *P. 33*	
BREAK				
R5 APPLICATIONS OF STRONG LASER FIELDS ***STENBERG 1*** *P. 31*		***R4*** LASER BEAM CONTROL V ***RICHTER*** *P. 29*	***R8*** NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS V ***PUDOVKIN*** *P.34*	***A3*** OPEN MEETING OF THE TECHNICAL COMMITTEE... ***STENBERG 2***
BREAK				
				A3 OPEN MEETING OF THE TECHNICAL COMMITTEE... ***STENBERG 2***

THURSDAY, 23 JUNE					
9.00-11.00	**POSTER SESSION** **R1, R4** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P.56, 62*	**SYB** LASER INTERACTION WITH CELLS AND TISSUES ... VI ***PETROV-VODKIN 1*** *P. 88*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY VII ***PETROV-VODKIN 2*** *P. 90*	***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE IV ***PETROV-VODKIN 3*** *P. 92*	
11.00-11.30	BREAK				
11.30-13.30	**POSTER SESSION** **R1, R4** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P.56, 62*	**SYB** LASER INTERACTION WITH CELLS AND TISSUES ... VI ***PETROV-VODKIN 1*** *P. 88*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY VIII ***PETROV-VODKIN 2*** *P. 90*	***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE III ***PETROV-VODKIN 3*** *P. 93*	
13.30-15.00	BREAK				
15.00-17.00	**POSTER SESSION** **R8, SYB, SYD** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P.65, 94, 95*	**SYB** LASER INTERACTION WITH CELLS AND TISSUES ... VI ***PETROV-VODKIN 1*** *P. 89*	***SYC*** PHOTONICS AND NANOBIOTECHNOLOGY IX ***PETROV-VODKIN 2*** *P. 91*	***SYD*** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE IV ***PETROV-VODKIN 3*** *P. 93*	
17.00-17.30	BREAK				
17.30-19.30	**POSTER SESSION** **R8, SYB, SYD** ***NIKOLSKY FOYER*** ***LEVINSON FOYER*** *P.65, 94, 95*				

FRIDAY, 24 JUNE	
9:00-11:00	***ST2*** ***THE SCHOOL "X-RAY SYNCHROTRON AND LASER RESEARCH METHODS IN MATERIALS SCIENCE"*** ***STENBERG 2 ROOM***

THE EXHIBITION "LASERS AND PHOTONICS"

Nikolsky/Levinson Foyer, Exhibitors: see P.101
June 21 - 23, 2022 10:00 – 18:30
Exhibition manager: Olga P. Vinogradova, Fund for Laser Physics, Russia

SIDE-EVENTS WORKSHOPS:

A1. Round Table Centennial of Prof. Nikolai Basov, Nobel Prize winner (1964)
Official Language: Russian/English
Stenberg 1 Room, Floor 3
June 23, 2022 15:00-17:00
Chair: Andrey A. Ionin, Lebedev Physical Institute of RAS, Russia

The venue of the Conference ICLO 2022 is the Hotel "Holiday Inn Moskovskie Vorota"

THURSDAY, 23 JUNE					
R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID II ***STENBERG I*** *P. 46*	***ST1*** THE SCHOOL «PHOTONIC NANOMATERIALS» ***DEYNEKA*** *P. 98*		***R8*** NONLINEAR PHENOMENA IN FIBERS I ***PUDOVKIN*** *P. 47*		
BREAK					
R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS, AND HYBRID II ***STENBERG I*** *P. 46*	***ST1*** THE SCHOOL «PHOTONIC NANOMATERIALS» ***DEYNEKA*** *P. 98*		***R8*** NONLINEAR PHENOMENA IN FIBERS II ***PUDOVKIN*** *P. 48*		***A3*** OPEN MEETING OF THE TECHNICAL COMMITTEE... ***GABO***
BREAK					
A1 ROUND TABLE: CENTENNIAL OF PROF. NIKOLAI BASOV ***STENBERG I*** *P. 100*	***ST1*** *P. 98* ***R9*** OPTICAL NANOMATERIALS II ***DEYNEKA*** *P. 98*				
BREAK					
	ST2 THE SCHOOL "X-RAY ..." ***DEYNEKA*** *P. 99*				

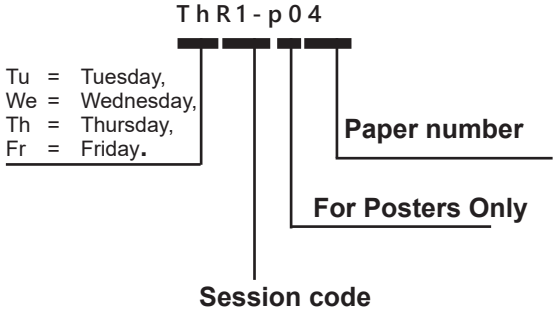
FRIDAY, 24 JUNE
ST2 ***THE SCHOOL "X-RAY SYNCHROTRON AND LASER RESEARCH METHODS IN MATERIALS SCIENCE"*** ***STENBERG 2 ROOM***

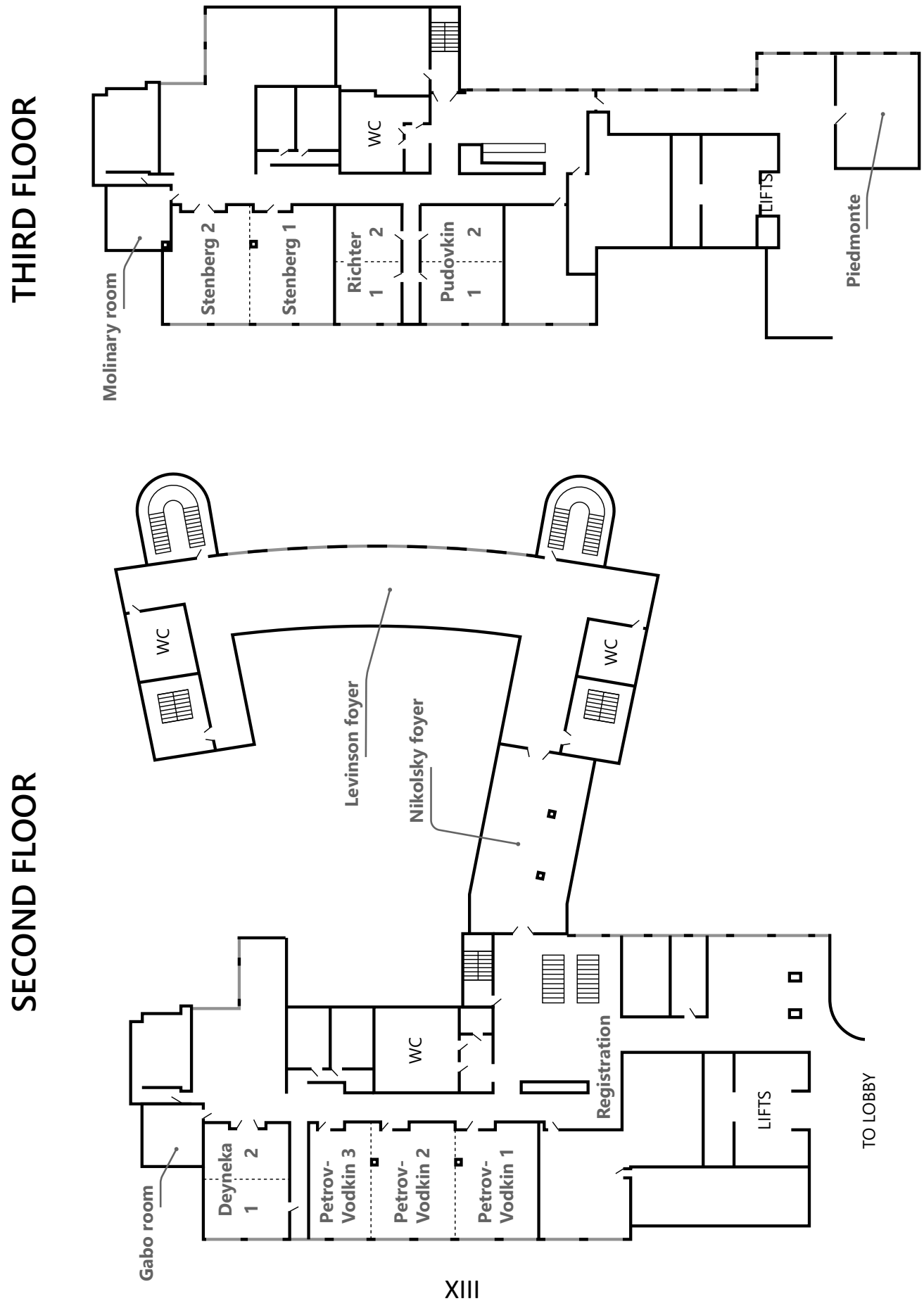
A2. Exhibitors Workshop

Official Language: Russian
Petrov-Vodkin 3 Room, Floor 2
June 21, 2022 15:00 - 17:00

A3. Open Meeting of the Technical Committee for Standartization 296 "Optics and photonics"

Official Language: Russian
June 22, 2022 15:00-18:00 - Stenberg 2 Room, Floor 3
June 23, 2022 11:30-13:30 - Gabo Room, Floor 2
Moderator: Irina V. Khloponina, Institute PhOOLIOS RC "Vavilov SOI", Russia




THIRD FLOOR
Molinary room
Stenberg 2
Stenberg 1
Richter 1 2
Pudovkin 1 2
WC
LIFTS
Piedmonte
SECOND FLOOR
WC
Levinson foyer
Nikolsky foyer
WC
WC
Registration
LIFTS
TO LOBBY
Gabo room
Deyneka 1 2
Petrov-Vodkin 3
Petrov-Vodkin 2
Petrov-Vodkin 1

THE 20TH INTERNATIONAL CONFERENCE LASER OPTICS ICLO 2022

PLENARY SESSION

Location: Piedmonte room, floor 3

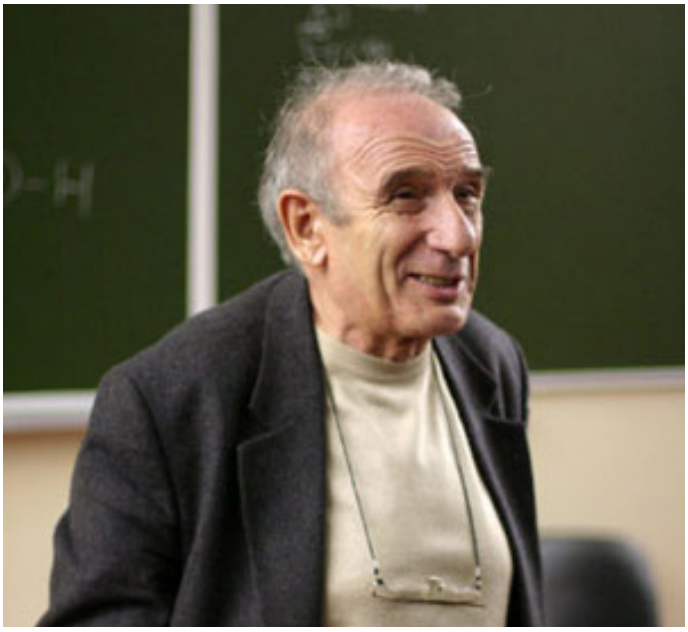
10:45–11:00 **Opening and welcome remarks**
G. S. Sokolovskii
Ioffe Institute, Russia

11:00–11:45 **DFB Lasers: our initial idea and a little bit around**
R. A. Suris
Ioffe Institute, Russia

11:45–12:30 **Compression of femtosecond laser pulses using self-phase modulation: from kilowatts to petawatts in 40 years**
E.A. Khazanov
Institute of Applied Physics, Russia

DFB Lasers: our initial idea and a little bit around

R. A. Suris
Ioffe Institute, Russia



Rudy Kazarinov and I were prompted to consider the use of laser structures with gratings for two reasons: a fairly wide spectral amplification line resulting in multiple-mode generation, and a large beam divergence in injection laser structures with output through end mirrors. A brief overview of the results of our initial work will be given, along with a mention of similar results by researchers around the world during the same period. The next topic I'm going to present is the first experimental results on very narrow output beams from surface grating lasers. A brief review of the theoretical analysis of works on the coherence of lasers with diffraction gratings will be given. And finally, I'll briefly present the results of a fun old experimental work regarding the resolution of photochemical etching of gratings on a semiconductor surface, and the theoretical interpretation of these results.

Short bio:

Robert Arnoldovich Suris was born in Moscow on December 31, 1936. He graduated (1960) from the Department of Theoretical Metallurgy at the Moscow Institute of Steel and Alloys. From 1960 he has been working in electronic industry. From 1964 up to 1988 he has been a member of the Scientific staff of Microelectronics Research Center, Zelenograd, Moscow. Simultaneously in 1970 - 1988 he was a lecturer and professor in Physics and Quantum Electronics Department at Moscow Physical-Technical Institute.

In 2001 Robert A. Suris was awarded State Prize of the Russian Federation in Science and Technology that is the highest Russian Scientific award, for fundamental investigations of the formation processes and the properties of heterostructures with quantum dots and the development of lasers based on these structures.

In 1998 Robert A. Suris was awarded with the Rank Prize for optoelectronics.

Since 2006, Robert A. Suris is a Fellow of the Russian Academy of Sciences (Corresponding member since 1997).

Robert A. Suris published about 270 papers in Russian, International and American journals on the theory of electric, photoelectric and optical phenomena in semiconductors, semiconductor structures and devices, the physics of semiconductor lasers, the semiconductors and semiconductor structures characterization, theory of the microlithography process, the theory of phase transitions, diffusion controlled kinetics and epitaxial growth. He is the author of a book and about 20 inventions in semiconductor technology.

Compression of femtosecond laser pulses using self-phase modulation: from kilowatts to petawatts in 40 years

E. A. Khazanov
Institute of Applied Physics, Russia

The pulse duration at the output of femtosecond lasers is usually close to the Fourier limit, and can be shortened by increasing the spectral width. To this end, use is made of self- phase modulation when a pulse propagates in a medium with cubic nonlinearity. Then, the pulse with a chirp (frequency dependence of the spectrum phase) is compressed due to a linear dispersion element, which introduces a chirp of the same modulus, but oppo- site in sign. This pulse post-compression, known since the 1960s, has been widely used and is being developed up to the present for pulses with energies from fractions of a nJ to tens of J. The review is devoted to the theoretical foundations of this method, problems of energy scaling, and a discussion of the results of more than 150 experimental studies.

Short bio:

Russian physicist, specialist in the field of laser physics and nonlinear optics, corresponding member of the Russian Academy of Sciences (2008), academician of the Russian Academy of Sciences (2019). Deputy Director of the Federal Research Center of the Institute of Applied Physics of the Russian Academy of Sciences, Head of the Department of Nonlinear Dynamics and Optics, Professor of the UNN, Head of the Laboratory "Physical Methods, Acousto-Optical and Laser Equipment for Diagnostics and Therapy of Oncological Diseases" at NUST MISIS. In 2018 he became a Laureate of the State Prize of the Russian Federation for creating the fundamental foundations and instrumental solutions to the problems of registering gravitational waves.

E. Khazanov is an author of more than 200 papers on solid-state lasers with diffraction divergence and high average power, thermooptics of solid-state lasers, optical parametric amplifiers of chirped femtosecond laser pulses, petawatt lasers, nonlinear optics, including the wavefront reversal techniques.

7TH INTERNATIONAL A. M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS
PLENARY SESSION

Location: Piedmonte room, floor 3

13:45–14:00 **Opening and welcome remarks**

14:00–14:45 **Valentin Gapontsev, ideas implementation. Prospects for fiber lasers**
N. N. Evtikhiev
"IRE-Polus" Ltd., National Research Nuclear University "MEPhI", Russia

14:45–15:30 **Biodegradable containers for drug delivery to tumours**
A. V. Zvyagin
MQ Photonics Centre, Faculty of Science and Engineering, Macquarie University, Sydney, Australia

16:00–16:45 **New opportunities for nanobiotechnology based on ultrasensitive methods of physical measurements**
P. I. Nikitin
Prokhorov General Physics Institute of RAS, Russia

16:45–17:30 **Multimodal photonic exploration of early embryonic development**
I. V. Larina
Baylor College of Medicine, USA

Valentin Gapontsev, ideas implementation. Prospects for fiber lasers

N. N. Evtikhiev,
"IRE-Polus" Ltd., National Research Nuclear University "MEPhI", Russia

It is believed that young years are the most fruitful for a great scientist. For Valentin Gapontsev, his young years were also a powerful start to his scientific career. But at the age of 50, when many are already beginning to rest on the laurels of the achievements of youth, Valentin Pavlovich dramatically changed the whole direction of work and life. The demolition that occurred in the country not only opened up new prospects, but forced us to work in a new way.

To open not just a commercial enterprise at the age of 50, but to get involved in many years of the hardest struggle for your ideas and achieve not only recognition, but grandiose practical success in their implementation — this required both talent, and character, and rich life experience, and incomprehensible skill use rare gifts of fate, which cannot be specially learned.

Valentin Gapontsev and his associates formed, in fact, a new direction in laser technology — fiber amplifiers and lasers. This technology has now become dominant in the laser industry. The international holding IPG Photonics, which has implemented unique fiber laser technologies in the form of large series production of hundreds of models of devices and systems for a huge number of applications, has become one of the leading laser companies in the world, a true leader in the laser industry.

The death of Valentin Gapontsev in October 2021 was not a disaster for his business. The scientific and technological teams created by him around the world continue to work in the new laser industry created by Valentin Gapontsev — the industry of fiber lasers.

Short bio:

N. N. Evtikhiev — Russian physicist, specialist in theoretical optics, Laureate of the Lenin Komsomol Prize (1979), Laureate of the State Prize of Russia (2004), Honored Scientist of Russia.

Nikolai Evtikhiev was born in Moscow on October 10, 1951. After graduating from high school, Nikolai Evtikhiev entered the Faculty of Experimental and Theoretical Physics of the Moscow Engineering Physics Institute (MEPhI). After graduating from the Moscow Engineering Physics Institute with honors (1974), he continued his postgraduate studies at this institute.

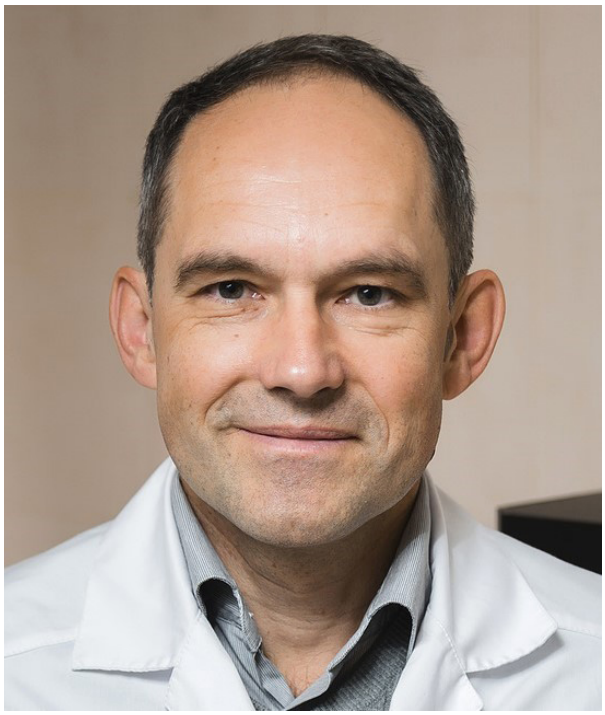
In 1977, Evtikhiev defended his dissertation on optoelectronics for the degree of Candidate of Physical and Mathematical Sciences, then worked at the Department of Quantum Electronics, headed by N. G. Basov. Led by N. N. Evtikhiev, the laboratory specialized in the processing of complex signals, including radar ones.

In 1988, he joined the research and production association "Vega" of the USSR Ministry of Radio Industry, where he initially headed one of the departments of the Research Institute of Radio Optics, and later worked as deputy director for scientific work of this institute. In 1993, N. N. Evtikhiev received the degree of Doctor of Physical and Mathematical Sciences, after which he took the position of First Deputy General Director of the Research Institute of Instrument Engineering — the head institute of NPO Vega. At the same time, he continued to teach at MEPhI, became a professor, co-author of a textbook on theoretical optics, and author of more than 200 scientific articles.

In 2001, N. N. Evtikhiev received an invitation to work in the city authorities, became the first deputy head of the department of science and industrial policy of the city of Moscow. From 2003 to 2010 N. N. Evtikhiev worked as Prefect of the Eastern Administrative District of Moscow.

Since 2010, N. N. Evtikhiev has been working at NTO IRE-Polus, since 2019 — General Director of NTO IRE Polus.

Biodegradable containers for drug delivery to tumours



A. V. Zvyagin
MQ Photonics Centre, Faculty of Science and Engineering, Macquarie University, Sydney, Australia

To mitigate the hindered transport of multifunctional diagnostics and therapeutics nanoagents in the tumour tissue, we introduce a new drug delivery concept, which relies on drug container passive accumulation in the tumour vasculature followed by a rapid release of small-molecule payload that penetrates through capillary walls to the tumour interstitium and results in deep penetration in the tumour.

Short bio:

Dr. Andrei Zvyagin is Associate Professor in the Department of Physics and Engineering at Macquarie University. Concurrently, he is Director of the Research Centre for Optical Theranostics at the University of Nizhny Novgorod and Director of the Research Centre of Bioimaging at the First Moscow Medical State University in Russia. Both institutions are among the top 20 universities in Russia. Zvyagin is an expert in multifunctional nanomaterials and their applications in cancer, optical monitoring and nanomaterial applications in personalised therapies. This research belongs to a new discipline called "theranostics", a combination of diagnostics and therapy. Zvyagin's academic program in this area aims at research translation, particularly in clinical medicine, and on industrial partnerships.

New opportunities for nanobiotechnology based on ultrasensitive methods of physical measurements

P. I. Nikitin
Prokhorov General Physics Institute of RAS, Russia

Several ultrasensitive optical and magnetic methods have been developed for nanobiotechnology and tested as the metrological tools for theranostics, medical diagnostics and food safety control. Based on the developed hybrid nanoparticles (NP) and their quantification methods, new results are obtained for a significant enhancement of the nanoagents delivery to cancer tumors in animals in vivo.

Short bio:

Dr. Petr Nikitin is the Head of Biophotonics Laboratory at the Prokhorov General Physics Institute, Russian Academy of Sciences. He developed a variety of highly sensitive optical and magnetic methods, including registration of molecular interactions by the phase discontinuity under the surface plasmon resonance and by the low coherent interferometry, quantification of magnetic particles, which enabled previously unconceivable in vivo biomedical studies on drug delivery and tumor suppression, etc. The developments have been effectively used in biophysical research, medical diagnostics, food control, and environmental monitoring.

Functional optical coherence tomography for investigation of early embryonic development

Irina V. Larina
Baylor College of Medicine, USA

Photonic technologies hold a great potential for developmental biology research, while highly dynamic and diverse developmental processes with variety of challenging and exciting questions provide a great platform for laser physicists and optical engineers to develop new imaging and manipulation methods, pushing forward technological developments in optical engineering. We develop functional OCT imaging methods to investigate dynamic processes of embryonic development in mice in vivo, to reveal never-before-seen processes, which potentially can inform management of fertility failures and congenital defects in humans.

Short bio:

Dr. Irina V. Larina is an Associate Professor at the Department of Molecular Physiology and Biophysics and a co-Director of the Optical Imaging and Vital Microscopy Core at the Baylor College of Medicine, Houston, USA. Dr. Larina's research focuses on development of novel methods for intravital, optical imaging in mouse models to understand normal development and the nature of congenital defects and reproductive disorders in humans. She received Masters Degree in Physics from the Saratov State University, Russia, in 1996, PhD degree in Physiology and Biophysics and Bioengineering from the University of Texas Medical Branch at Galveston in 2005, and completed postdoctoral training at the Baylor College of Medicine in Houston. She is a recipient of Arthur V. Simmang Academic Scholarship for Excellence in Academic Achievement, Ralph and Mary Spence Centennial Scholarship for Superior Academic Performance, High Personal and Professional Ethics, Values and Standards, Katherina Siebert Award for Excellence in Oncologic Research, Louis C. Sheppard Award, fellowship from the American Heart Association named in honor of Paula McCann-Harris, and a finalist for the Burrows Wellcome Fund Award at Scientific Interface. Dr. Larina is an author of over 50 peer-reviewed publications and 11 book chapters, and her research activities are funded by multiple grants from the National Institutes of Health.

R1: Solid State Lasers

MID-IR and tunable lasers

Location: Stenberg 1 Room, floor 3. 15:15-17:00

TuR1-01 15:15-15:45

Wavelength tuned mid-IR lasers based on Cr^{2+}-doped single-crystalline or polycrystalline chalcogenides with 2.1 μm pumping *(Invited paper)*

O.L. Antipov; Inst. of Applied Physics RAS, Russia

Acousto-optically tuned lasers at 2.3-2.7 μm based on the poly- and single-crystalline Cr2+:ZnSe elements pumped by the repetitively-pulsed 2.1 μm Ho3+:YAG or CW diode lasers at 1.94 μm will be presented. The power scaling in the master oscillator – power amplifier laser systems of the wavelength-tuned Cr2+:ZnSe output will be discussed.

This research was supported by RFBR Grant(s) # Ministry of Education and Science of the Russian Federation (project № 0030-2021-0012), and Russian Research Institute of Cosmic Systems (project "Technology-SG-3.2.1.2")

TuR1-02 15:45-16:00

Development of the widely tunable hybrid photonic integrated laser on the hybrid Silicon on Lithium Niobate photonic integrated platforms

I.A. Kazakov[1], E.E. Volkova[1], S.M. Kontorov[1], N.A. Orlikovsky[2], A.A. Denisov[2], U.O. Salgaeva[2], A.A. Kondakov[2], A.V. Shipulin[1]; [1]Center for Photonic Science and Engineering, Skolkovo Inst. of Science and Technology; [2]Research Facilities Center, Skolkovo Inst. of Science and Technology; [2]Perm State Univ., Russia

Widely tunable lasers based on a cascade of three tunable asymmetric Mach-Zender Interferometers were analytically and numerically investigated. We study the dependence of the laser parameters in reliance on the type of external resonator, material platform (Silicon on Lithium Niobate and InP), and parameters of the interface between the resonator chip and amplifier.

TuR1-03 16:00-16:15

Syncronous generation of nanosecond pulses at 1064 nm and 1240 nm in all-fiber laser

B.N. Nyushkov[1,2], A.V. Ivanenko[1], S.V. Smirnov[1], G.E. Vishnyakov[1], S.M. Kobtsev[1]; [1]Novosibirsk State Univ.; [2]Novosibirsk State Technical Univ., Russia

We demonstrate, for the first time, efficient generation of synchronized pulses at wavelengths of 1064 and 1240 nm in an all-fiber nested-cavity laser. We exploited Raman conversion in a P2O5-doped fiber incorporated into the same cavity in addition to a quasi-synchronously pumped Yb-doped fiber. An external DFG stage allows conversion of the laser output into pulsed radiation at ~7.5 μm.

This research was supported by RFBR Grant(s) # The work was supported by the Ministry of Science and Higher Education of the Russian Federation (FSUS-2020-0036)

TuR1-04 16:15-16:30

Development of mid-IR chalcogenide fiber emitters

V.S. Shiryaev, E.V. Karaksina, T.V. Kotereva, M.V. Sukhanov, A.P. Velmuzhov, G.E. Snopatin; Inst. of Chemistry of High-Purity Substances RAS, Russia

The recent data on the preparation of active core-clad fibers on the basis of high-purity REE-doped chalcogenide glasses are presented. Chalcogenide glass fibers doped with Pr(3+), Tb(3+), Dy(3+) and Sm(3+) ions have low optical losses and high emission characteristics that are suitable for the development of mid-IR fiber emitters.

This research was supported by RFBR Grant(s) # Grant RSCF 21-13-00194

TuR1-05 16:30-17:00

Progress in Fe doped femtosecond lasers/amplifiers and their application for driving extreme nonlinear optics *(Invited paper)*

E.A. Migal, A.V. Pushkin, E.I. Mareev, B.V. Rumiantsev, F.V. Potemkin; Lomonosov Moscow State Univ., Russia

The talk will give an insight into the cutting edge achievements in the development of femtosecond oscillators and amplifiers based on iron-doped chalcogenide crystals as well as their application for driving mid-IR nonlinear optics and photonics.

– Break –

Pulsed and CW lasers

Location: Stenberg 1 Room, floor 3. 17:30-19:15

TuR1-06 17:30-17:45

Module-designed picosecond Nd:YAG laser for high-precision satellite laser ranging

A.F. Kornev[1], V.V. Koval[1], A.A. Mak[2], Y.I. Merenkova[3], V.V. Murashkin[3], V.D. Nenadovich[3], A.L. Sokolov[3]; [1]"Lasers & Optical Systems" Co. Ltd.; [2]Inst. PhOOLIOS RC "Vavilov SOI"; [3]JSC RPC "PSI", Russia

We report on the development of picosecond Nd:YAG laser applied for high precision satellite laser ranging. Laser generates 35 ps pulses at 532 nm wavelength with 2.5 mJ pulse energy and 500 Hz pulse repetition rate. The main feature of the developed system is modular design.

TuR1-07 17:45-18:00

Yb:YAG chirped-pulse amplifier with passive coherent combining

I.I. Kuznetsov, S.A. Chizhov, O.V. Palashov; Inst. of Applied Physics RAS, Russia

Passive coherent combining for the two-channel Yb:YAG chirped-pulse amplifier is successfully implemented that allowed doubling output pulse energy in comparison with a single amplifier limited by the optical breakdown. 10mJ pulse energy at 1.5 kHz repetition rate and 5mJ at 6kHz is demonstrated together with high gain coefficient and perfect beam quality.

TuR1-08 18:00-18:15

10 mJ, 20 Hz Sub-picosecond Hybrid Yb:YAG Laser

A. Kazakevičius[1,2], R. Burokas[1,2], A. Zaukevičius[2], R. Danilevičius[2], A. Michailovas[1,2]; [1]National Center for Physical Sciences and Technology; [2]Ekspla ltd., Lithuania

We demonstrate 10 mJ sub-picosecond hybrid laser system, operating at 20 Hz repetition rate which consists of a high energy fiber seed source and two Yb:YAG amplifier stages operating at room temperature.

TuR1-09 18:15-18:30

Room temperature Ce-doped chalcogenide glass laser

S.O. Leonov[1,2], M.P. Frolov[1], Yu.V. Korostelin[1], P. Fjodorow[1,3], Ya.K. Skasyrsky[1], S.E. Sverchkov[4], B.I. Denker[4], B.I. Galagan[4], V.V. Koltashev[5], M.V. Sukhanov[6], A.P. Velmuzhov[6], V.G. Plotnichenko[5], V.I. Kozlovsky[1]; [1]Lebedev Physical Inst. RAS; [2]Bauman Moscow State Technical Univ., Russia; [3]Inst. for Combustion and Gas Dynamics – Reactive Fluids, Univ. of Duisburg-Essen, Germany; [4]Prokhorov General Physics Inst. RAS; [5]Dianov Fiber Optics Research Center, Prokhorov General Physics Inst. RAS; [6]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

In this work, we demonstrate a Ce-doped chalcogenide glass laser pumped by a Fe:ZnSe pulsed laser at room temperature. The laser performance of the Ce-doped active element under different pump wavelengths is realized and compared. The thermal effects that occurred in the Ce-doped active element are discussed.

This research was supported by RFBR Grant(s) # Russian Foundation for Basic Research (18-29-20079)

TuR1-10 18:30-18:45

Development of CW and Q-switched thin disk laser for material processing

A.B. Kozlov, N.P. Badalyan, E.V. Kuznetsov, A.V. Shestakov, I.A. Shestakova; Stelmakh Polyus Research and Development Inst., Russia

This paper discusses the results of the development of Q-switched thin disk lasers in the R&D Ins. Polyus of M.F. Stelmakh and the possibilities of their use for material processing. The main constructive elements of the thin disk laser and the demands to its technical characteristics are considered too.

TuR1-11 18:45-19:00

Thermally induced birefringence and mode-selective properties of passively Q-switched Nd:YAG lasers

M.V. Bogdanovich, A.V. Grigor'ev, V.N. Dudikov, K.I. Lantsov, A.G. Ryabtsev, G.I. Ryabtsev, P.V. Shpak, M.A. Shchemelev; Stepanov Inst. of Physics NAS Belarus, Belarus

The mechanism associated with the thermally introduced birefringence and resulting in the single-mode regime for the side-diode-pumped Nd:YAG laser with passive Q–switch is presented. Peculiarity of the operation of such single-mode laser as a master part of optical parametric oscillator is also discussed.

TuR1-12 19:00-19:15

The effect of retention the radiation frequency of laser with dynamic intracavity gratings

A.P. Pogoda[1], I.S. Khakhalin[1], V.M. Petrov[2], A.S. Boreysho[1]; [1]Ustinov Baltic State Technical Univ. "VOENMEH"; [2]ITMO Univ., Russia

A detailed statistical analysis was carried out, as a result of which the probability of preserving the frequency of radiation of successive pulses was experimentally obtained. We demonstrate the effect of preserving the frequency of radiation of Nd:YAG phase conjugate laser and determine the probability of preserving the frequency of neighboring pulses in train.

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

High power lasers: solid state, gas and hybrid I

Location: Stenberg 1 Room, floor 3. 09:00-11:00

TuR2-01 09:00-09:30

The study and development of OPRGL *(Invited paper)*

Yu. A. Adamenkov, M.A. Gorbunov, A.A. Kalacheva, V.A. Shaydulina; RFNC-VNIIEF, Russia

We present output characteristics of OPRGL depending on different parameters such as: partial pressure and percentage of active gas, longitudinal or transversal pump, resonator features and pump spectral width. The perspectives of further development of OPRGL are also represented.

TuR2-02 09:30-10:00

IR laser generation based on atomic transitions of cesium and rubidium when pumping to high-located levels *(Invited paper)*

A.A. Babin, M.V. Volkov, S.G. Garanin, S.A. Kovaldov, A.V. Kopalkin, F.A. Starikov, V.V. Feoktistov; RFNC-VNIIEF, Russia

We obtain laser generation on cesium and rubidium atoms at wavelengths in the range of 2 – 5.5 μm when pumping to high-located levels (7P – 10P for cesium atoms and 6P – 8P for rubidium atoms). The pumping conversion efficiency into lasing energy is investigated.

TuR2-03 10:00-10:15

Dependence of the optically pumped Ne*-He lasing threshold on the position of the pump beam

A.P. Torbin, A.K. Chernyshov, M.I. Svistun, P.A. Mikheyev; Lebedev Physical Inst., Samara, Russia

The dependence of pumping thresholds of the optically pumped Ne*-He laser on the position of the pump beam between the electrodes was obtained for s5→p9(p8) pumping transitions. It was found that pumping thresholds strongly depended on the position of the pumping beam, and the minimum is reached near the center. The ratio of p8/p9 thresholds at their minima is 13.

TuR2-04 10:15-10:30

Shock-ignition Inertial Fusion Energy beam profiling and self-focusing beam mitigation at high-power GARPUN KrF laser

V.D. Zvorykin, A.V. Shutov, P.V. Veliev, N.N. Ustinovskii; Lebedev Physical Inst. RAS, Russia

We propose to combine a pulse form for the shock-ignition Inertial Fusion Energy application in simultaneous amplification of short & long pulses and discuss how to avoid negative nonlinear effects such as beam self-focusing and filamentation along 100-m pass in atmospheric air

This research was supported by RFBR Grant(s) # RFBR 22-22-01021

TuR2-05 10:30-10:45

On the operation of KrCl excimer laser with 222 nm UV -C wavelength

E.V. Ionushaite[1,2], A.V. Shutov[1], A.D. Vorontsova[1,3], V.D. Zvorykin[1]; [1]Lebedev Physical Inst. RAS; [2]Lomonosov Moscow State Univ.; [3]National Research Nuclear Univ. "MEPHI", Russia

We discuss the operation of discharge pumped KrCl excimer laser at 222-nm laser wavelength. Optimal operating conditions such as gas mixtures, optical cavity parameters and several ways to increase specific pump power are considered.

TuR2-06 10:45-11:00

Pulsed inductive Ne I laser

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

Lasing at the 3p-3s transitions of neon with wavelengths of 540.1, 585.3, and 614.3 nm pumped neon and its mixtures (with NF3, SF6, and H2 gases) by a pulsed inductive discharge was obtained. The features of the spectral, spatial and temporal characteristics of the radiation are studied.

– Break –

High power lasers: solid state, gas and hybrid II

Location: Stenberg 1 Room, floor 3. 11:30-14:15

TuR2-07 11:30-12:00

Nanosecond Nd:glass laser with variable radiation coherence of "Kanal-2" facility *(Invited paper)*

A.T. Sahakyan, A.N. Starodub, V.N. Puzyrev, T.T. Kondratenko; Lebedev Physical Inst. RAS, Russia

A multimode neodymium glass laser with the possibility of varying spatial and temporal coherence is discussed. Its resonator is designed in such a way to generate close to the maximum number of transverse and longitudinal modes. Such type of radiation enables to improve the homogeneity of target irradiation and reduce the negative factors impact significantly.

TuR2-08 12:00-12:30

Compact multifunctional cryogenic slab RF discharge carbon monoxide lasers and their applications *(Invited paper)*

A.Yu. Kozlov, A.A. Ionin, Yu.M. Klimachev, A.A. Kotkov, O.A. Rulev, D.V. Sinitsyn, M.V. Ionin; Lebedev Physical Inst. RAS, Russia

Slab RF discharge CO laser facilities with cryogenically cooled electrodes were developed. The free-running lasing was obtained with average output up to 40 W on fundamental band and 6 W on first-overtone band. Frequency conversion of these lasers emission in nonlinear crystals made it possible to expand the output spectral range up to ~2 – 20 μm.

TuR2-09 12:30-12:45

23kW LMA-48/400-YDF laser fiber

A. Lin; Inst. of Chemical Materials (ICM), CAS Engineering Physics (CAEP), China

This presentation introduced the breakout and upgradation of high-power Yb-doped large-mode-area silica laser fibers in ICM of CAEP, P.R. China. With specially-designed low numerical aperture, LMA-48/400-YDF laser fiber was successfully fabricated and presented 23kW laser output power with good beam quality, marking a historic breakout all over the world in specialty optical fiber fabrication to date.

TuR2-10 12:45-13:00

High-energy Yb:YAG laser amplifier with near surface propagation of elliptical beam

A.V. Starobor, D.A. Kuzin, I.I. Kuznetsov, O.V. Palashov; Inst. of Applied Physics RAS, Russia

We proposed to use new laser active element scheme using elliptical beams propagate through an element of rectangular section along the only cooled side, differing from the thin slabs by higher efficiency of fabrication and mounting. 15 mJ pulse energy is achieved at the output of such amplifier at 1.5 kHz repetition rate limited by quality of the coatings.

TuR2-11 13:00-13:15

Laser amplification in active elements with high temperature gradient

G.V. Kuptsov[1,2], V.A. Petrov[1,2], A.O. Konovalova[1,3], A.V. Laptev[1], V.V. Petrov[1,2,3]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State Technical Univ.; [3]Novosibirsk State National Research Univ., Russia

The model of laser amplification with accounting of the active media thermophysical and laser characteristics dependencies on the temperature distribution, the dependence of the gain medium laser characteristics on the seed wavelength and the effect of amplified spontaneous emission is developed and simulation data is compared to experimental results.

This research was supported by RFBR Grant(s) # RFBR project 20-02-00529

TuR2-12 13:15-13:30

Ultrashort pulses amplification in Er-Yb composite fiber

A.D. Zverev[1], V.A. Kamynin[1], B.I. Denker[1], S.E. Sverchkov[1], V.V. Vel'miskin[2], I.S. Panyaev[3], P.A. Itrin[3], D.A. Korobko[3], I.O. Zolotovskii[3], V.A. Ribenek[3], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center; [3]S.P. Kapitsa Scientific Technological Research Inst., Ulyanovsk State Univ., Russia

A comparison of ultrashort pulses with a central radiation wavelength of 1.53 μm amplification in standard silica-based and composite active fibers was made. We have shown that pulse shape distortion in a composite fiber with Er/Yb co-doped phosphate glass core and silica cladding occurs at large values of the signal gain coefficient.

This research was supported by RFBR Grant(s) # RFBR project No. 20-02-00425 "Composite optical fibers activated by rare-earth ions"

TuR2-13 13:30-13:45

200 W ultrafast electro-optic comb at tunable GHz repetition rate

H. Ye[1], F. Leroi[2], L. Pontagnier[1], G. Santarelli[1], J. Boullet[2], E. Cormier[1,3]; [1]Lab. Photonique Numérique et Nanosciences (LP2N), CNRS-IOGS-Univ. Bordeaux; [2]ALPhANOV, Inst. d'optique d'Aquitaine; [3]Inst. Univ. de France (IUF), France

We present an electro-optic comb seeded ultrafast nonlinear fiber amplification system that provides up to 200 W average power centered at 1030 nm. Characterizations show the output picosecond pulses are compressible down to hundreds of femtoseconds across 12-18 GHz and <200 fs at 2 GHz.

TuR2-14 13:45-14:15

Terahertz generation from femtosecond plasma channels *(Invited paper)*

O.G. Kosareva[1,2], D.E. Shipilo[1,2], I.A. Nikolaeva[1,2], D.V. Pushkarev[1,2], G.E. Rizaev[2], D.V. Mokrousova[1,2], A.V. Koribut[2], Y.V. Grudtsyn[1,2], N.A. Panov[1,2], L.V. Seleznev[1,2], A.P. Shkurinov[1,3,4], A.A. Ionin[2]; [1]Lomonosov Moscow State Univ.; [2]Lebedev Physical Inst. RAS; [3]ILIT RAS-Branch of the FSRC 'Crystallography and Photonics' RAS; [4]The National Univ. of Science and Technology MISiS, Russia

We measured and simulated frequency-angular distribution of terahertz emission from the plasma channel of a single-color filament biased by electrostatic field. Pronounced on-axis maximum of terahertz emission was observed for the electric field above 3.2 kV/cm. Directional diagrams of frequencies <1 THz reveal a flat-top shape due to the constructive interference of terahertz waves emitted by dipole local sources.

R3: Semiconductor Lasers, Materials and Applications

Novel semiconductor-based devices and applications

Location: Deyneka Room, floor 2. 09:00-11:00

TuR3-01 09:00-09:30

Development of 230nm Far-UVC LED panel for application to human-safe virus inactivation *(Invited paper)*

H. Hirayama; RIKEN (Inst. of Physical and Chemical Research), Japan

TuR3-02 09:30-10:00

High speed VCSEL photonics for datacenter networks *(Invited paper)*

F. Koyama; Tokyo Inst. of Technology, Japan

We present our recent activity on high-speed transverse-coupled-cavity VCSEL array for datacenter networks. A single-mode 1060nm metal-aperture VCSELs array is demonstrated toward high-speed operation and low-power consumptions, which offers high-density I/O platform

TuR3-03 10:00-10:15

Partially coherent conical refraction: Phase fluctuation and the Bessel-Gauss model

V.Yu. Mylnikov[1], E.U. Rafailov[2], G.S. Sokolovskii[1]; [1]Ioffe Inst., Russia; [2]Optoelectronics and Biomedical Photonics Group, AIPT, Aston Univ., UK

We derive a theory of the conical refraction for partially spatially coherent light, which is based on the phase fluctuation representation, and demonstrate non-diffractive propagation of the low-coherent conically refracted radiation in the far-field region.

TuR3-04 10:15-10:30

Bessel beam generation from conically refracted laser diode radiation

S.H. Abdulrazak, V.Yu. Mylnikov, D.V. Chistyakov, S.N. Losev, N.G. Deryagin, V.V. Dudelev, G. S. Sokolovskii; Ioffe Inst., 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.

TuR3-05 10:30-11:00

Spatially modulated photonic-crystal lasers for vector beams generation *(Invited paper)*

K. Kitamura[1,2], S. Noda[2]; [1]Kyoto Inst. Tech.; [2]Kyoto Univ., Japan

We show a single-chip vector beam generator that does not require any external optical elements by designing spatial modulation of photonic crystals. The results pave the way to realize many advanced applications with a compact system.

– Break –

THz and high-speed photonics

Location: Deyneka Room, floor 2. 11:30-13:30

TuR3-06 11:30-12:00

Fabrication of mode-locked laser diodes using highly stacked InAs quantum dots grown on InP(311)B substrate *(Invited paper)*

K. Akahane[1], A. Matsumoto[1], T. Umezawa[1], N. Yamamoto[1], Y. Yata[2], T. Maeda[2], H. Sotobayashi[2], A. Kanno[1]; [1]National Inst. of Information and Communications Technology; [2]Aoyama Gakuin Univ., Japan

Model-locked laser diodes were fabricated using highly stacked quantum dots as a gain medium and saturable absorber. They were lased at a low threshold current of approximately 25 mA. An ultra-short optical pulse with a pulse width of 680 fs and repetition rate of 20–80 GHz was obtained.

TuR3-07 12:00-12:15

Bifurcation bridges In mode-locked frequency-swept feedback lasers

A.V. Kovalev[1], K.M. Grigorenko[1], S. Slepneva[2,3,4], N. Rebrova[3], A.G. Vladimirov[5], G. Huyet[2], E.A. Viktorov[1]; [1]ITMO Univ., Russia; [2]Univ. Côte d'Azur, France; [3]Cork Inst. of Technology, Ireland; [4]Tyndall National Inst., Univ. College Cork, Ireland; [5]Weierstrass Inst., Germany

We describe and explain the periodic mode-locked regime and its mechanisms of occurrence in a frequency swept SG-DBR laser source with continuous optical feedback. We propose that mode-locked operation results from the resonant perturbation of bridges of periodic solutions existing in a non-swept system with feedback.

TuR3-08 12:15-12:30

Terahertz radiation generation in epitaxial InAs

V.N. Trukhin, V.A. Solov'ev, I.A. Mustafin, M.Y. Chernov; Ioffe Inst., Russia

The results of the investigation of terahertz generation in InAs epitaxial films fabricated on semi-isolating and heavily alloyed GaAs substrates by the optical excitation of femtosecond pulses are presented.

TuR3-09 12:30-12:45

Terahertz radiation sources and frequency converters based on topological insulators

K.A. Kuznetsov[1], S.P. Kovalev[2], I.E. Ilyakov[3], D.A. Safronenkov[1], A.D. Frolov[1], P.I. Kuznetsov[3], G.Kh. Kitaeva[1]; [1]Lomonosov Moscow State Univ., Russia; [2]Helmholtz Zentrum Dresden Rossendorf (HZDR), Germany; [3]Kotelnikov IRE RAS, Russia

Topological insulators made of bismuth chalcogenides are promising materials for sources and converters of terahertz radiation. The operation of a topological insulator nanofilm photoconductive antenna is demonstrated. The generation of the third and fifth harmonics of the terahertz frequency radiation in topological insulators of various chemical compositions is observed

This research was supported by RFBR Grant(s) # Russian Science Foundation Grant No. 22-22-00758

TuR3-10 12:45-13:00

Temperature dependences of spectral and power characteristics of quantum cascade lasers with frequencies from 2.3 to 4.1 THz

D.A. Belov[1], A.V. Ikonnikov[1], S.S. Pushkarev[2], R.R. Galiev[2], D.S. Ponomarev[2], D. R. Khokhlov[1], S.V. Morozov[3], V.I. Gavrilenko[3], R.A. Khabibullin[2]; [1]Lomonosov Moscow State Univ., Russia; [2]Inst. of Ultra-High Frequency Semiconductor Electronics RAS, Russia; [3]Inst. for Physics of Microstructures RAS, Russia

We conduct research of quantum cascade lasers (QCLs) emitting at 2.25, 2.27, 3.2 and 4.1 THz. Measuring the output power, we consider the potential mechanisms of QCL temperature degradation. Moreover, we present the spectra of the lasers measured in a wide temperature range 5 – 120 K, as well as the analysis of inter-mode distance and lasing frequency temperature drift.

TuR3-11 13:00-13:30

THz quantum cascade lasers with two-photon emission in the gain module *(Invited paper)*

R.A. Khabibullin[1,2], S.S. Pushkarev[1,2], R.R. Galiev[1,2], D.S. Ponomarev[1], I.S. Vasil'evskii[3], A.N. Vinichenko[3], A.N. Klochkov[3], T.A. Bagaev[4], M.A. Ladugin[4], A.A. Marmalyuk[4], K.V. Maremyanin[5], V.I. Gavrilenko[5], D.V. Ushakov[6], A.A. Afonenko[6]; [1]V.G. Mokerov Inst. of Ultra-High Frequency Semiconductor Electronics RAS; [2]Ioffe Inst.; [3]National Research Nuclear Univ. Mephi; [4]POLYUS Research Inst. of M.F. Stelmakh; [5]Inst. for Physics of Microstructures RAS, Russia; [6]Belarusian State Univ., Belarus

A new lasing scheme with sequential two-photon emission in the gain module for terahertz quantum cascade laser (THz QCL) is proposed and experimentally demonstrated. An optimized two-photon design based on GaAs/Al0.15Ga0.85As was grown by MBE and MOCVD. THz QCLs based on both MBE and MOCVD structures have a lasing frequency of 3.8 THz and maximum operation temperature around 100 K.

This research was supported by RFBR Grant(s) # Russian Science Foundation project no. 21-72-30020

Solid state photonics

Location: Petrov-Vodkin 2 Room, floor 2. 17:30-19:30

TuR3-12 17:30-18:00

Room temperature macroscopic quantum phase transitions: superfluorescence in hybrid perovskites *(Invited paper)*

K. Gundogdu[1], F. So[2]; [1]NC State Univ., Physics Department, USA; [2]NC State Univ., MSE Department, USA

Superfluorescence is a macroscopic quantum phase transition, in which optically created dipoles spontaneously develop macroscopic coherence and radiate an intense burst of photon. Here we will show experimental results on high temperature superfluorescence in hybrid perovskites. We will further present a model that explains the fundamental mechanism that extends the electronic coherence of optically excited dipoles at high temperatures.

TuR3-13 18:00-18:15

Low-threshold lasing from submicrometer $CsPbBr_3$ cuboids on the metal-dielectric substrate

D. Khmelevskaia[1], A.P. Pushkarev[1], S.V. Makarov[1], H.V. Demir[2,3]; [1]ITMO Univ., Russia; [2]Bilkent Univ. UNAM, Turkey; [3]NTU, Singapore

The impressive properties of perovskite submicron lasers can be improved via integration with plasmonic materials. Herein, we demonstrate efficient single-mode lasing from submicron CsPbBr3 cuboids on the metal-dielectric substrate. The obtained are smaller than the emission wavelength, operate at room temperature and low-threshold regimes. We found our results promising for further lasers miniaturization, which is crucial for laser applications.

TuR3-14 18:15-18:45

Bright laser produced x-ray source based on interaction of solid Xe target and high fluence fs laser pulses *(Invited paper)*

O. Khodykin; KLA Corp., USA

TuR3-15 18:45-19:00

220 nm wideband, 1.45 μm band wavelength-swept laser with two semiconductor optical amplifiers

G.H. Lee[1], M.S. Kim[1], S. Ahn[1], J.S. Kim[1], B.K. Choi[1], S. Pagidi[2], M.Y. Jeon[1,2]; [1]Dept. of Physics, Chungnam National Univ.; [2]Inst. Quantum Systems (IQS), Chungnam National Univ., Korea

We report 1.45 um band wavelength-swept laser using two semiconductor optical amplifiers (SOAs) and a polygonal mirror scanning wavelength filter. We have achieved 220 nm scanning bandwidth from 1348 nm to 1568 nm.

TuR3-16 19:00-19:30

Lasers with asymmetric barrier layers: Obstacles toward ideal performance *(Invited paper)*

C. Hammack, L.V. Asryan; Virginia Polytechnic Inst. and State Univ., USA

The recombination of electron-hole pairs outside of the quantum-confined active is a major factor that adversely affects the operating characteristics in conventional semiconductor lasers. To suppress this parasitic recombination, the use of asymmetric barrier layers (ABLs) has been proposed. In this paper, the obstacles toward ideal performance of lasers with the ABLs are discussed.

R4: Laser Beam Control

Laser beam control I

Location: Richter Room, floor 3. 15:00-17:00

TuR4-01 15:00-15:30

Generation of circular polarization under tight focusing condition of linearly polarized light *(Invited paper)*

S.S. Stafeev[1,2], V.D. Zaicev[1,2], V.V. Kotlyar[1,2]; [1] Image Processing Systems Inst. RAS – Branch of the FSRC "Crystallography and Photonics" RAS; [2]Samara National Research Univ., Russia

We have investigated the tight focusing of laser light with linear polarization using Richards-Wolf integral. It was shown that before and after the focal plane there are regions in which the polarization is circular (elliptical). In the focal plane the light remains linear polarization

This research was supported by RFBR Grant(s) # 18-19-00595

TuR4-02 15:30-16:00

Intense high-order harmonics and attosecond pulses carrying angular momentum *(Invited paper)*

J. Wang[1], S.G. Rykovanov[2], Y. Leng[1], R. Li[1]; [1]Shanghai Inst. of Optics and Fine Mechanics, CAS, China; [2]Skolkovo Inst. of Science and Technology, Russia

We show that angular momentum can be transferred during the nonlinear process of surface harmonics generation driven by relativistic lasers. This results in intense harmonics with spin and orbital angular momentum. Such kinds of harmonics can also be combined coherently into attosecond pulses carrying angular momentum, which are useful in probing the chiral interactions on the sub-femtosecond time-scale

TuR4-03 16:00-16:30

Orbital Poincaré solid-state lasers *(Invited paper)*

T. Omatsu[1,2]; [1]Graduate School of Engineering, Chiba Univ.; [2]Molecular Chirality Research Center, Chiba Univ., Japan

We review the direct generation of structured light beams, such as Laguerre-Gaussian modes, from laser cavities, and we also address our current research progress concerning ultra-compact diode-pumped, optical Poincaré Pr:YLF laser sources, enabling the selective generation of all eigenstates represented on the orbital Poincaré sphere.

TuR4-04 16:30-16:45

Orbital part of the transverse component of the Poynting vector of fundamental mode and low loss regimes in solid core photonic crystal fibers

G.K. Alagashev[1], S.S. Stafeev[1,2], V.V. Kotlyar[2], A.D. Pryamikov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Image Processing Systems Inst. RAS - Branch of the FSRC "Crystallography and Photonics" RAS, Russia

Loss dependence of the fundamental mode (FM) on wavelength for all solid band gap fibers (ASBGs) have a sharp decrease at certain set of ASBGF geometric parameters. At the same time, losses in holey fibers (HFs) change monotonically. This difference in behavior of leakage loss is determined by singularities arising in orbital part of the transverse Poynting vector in ASBGF.

This research was supported by RFBR Grant(s) # The work was supported by the Russian Science Foundation (grant 22-22-00575)

TuR4-05 16:45-17:00

Development of optical vortices in a beam propagating in a turbulent atmosphere

F. Kanev[1], A. Rukosuev[2], N. Makenova[1,3], I. Veretekhin[1]; [1]Zuev Inst. of Atmospheric Optics SB RAS; [2]Sadovsky Inst. of Geosphere Dynamics RAS; [3]Tomsk Polytechnic Univ., Russia

Development of singular points in a coherent beam is considered in the paper. The initial phase of radiation was set by Zernike polynomials and by a random phase screen simulating atmospheric turbulence. Several methods of detection were used to register optical vortices.

– Break –

Laser beam control II

Location: Richter Room, floor 3. 17:30-19:15

TuR4-06 17:30-18:00

High-power discrete vortex with phase locked lasers *(Invited paper)*

V. Dev, V. Pa; Indian Inst. of Technology Ropar, India

We generate high-power discrete vortices from a phase-locked array of lasers in a degenerate cavity. We have observed that the divergence of discrete vortices is independent of the topological charge, opposed to conventional continuous vortices. Further, we have found that discrete vortices exhibit good self-healing abilities against the obstructions in the source plane as well as propagated plane.

TuR4-07 18:00-18:15

Scalar vortex generation using retrorefectors

K.N. Gavril'eva[1], A.A. Sevruygin[1], A. L. Sokolov[2], E.V. Shalymov[1], V. Yu. Venediktov[1]; [1]St.Petersburg Electrotechnical Univ. "LETI"; [2]Research-and-Production Corporation, Precision Systems and Instruments (RPC PSI), Russia

This article describes an experimental study of the scalar optical vortex formation using beams reflected from a combination of two cube-corner reflectors with a special interference phase-shifting coating. Previously our team experimented with retroreflective spatial-polarization interferometer, creating a vector vortex beam. In this experiment creation of a scalar vortex beam is considered.

TuR4-08 18:15-18:45

Requirement for dynamic characteristics of adaptive optical systems *(Invited paper)*

V.P. Lukin; Zuev Inst. of Atmospheric Optics SB RAS, Russia

The dynamic characteristics of adaptive optics (AO) systems operating in a turbulent atmosphere are analyzed. The analysis is based on analytical calculations of the Strehl parameter for an optical wave formed in a turbulent atmosphere, performed using the generalized Huygens-Kirchhoff principle. The analysis uses the simplest model of an active correcting mirror.

TuR4-09 18:45-19:00

B-spline approximation of a wavefront of the ring-shaped detail measured by Shack-Hartmann sensor

I.V. Galaktionov[1], A.N. Nikitin[1], J.V. Sheldakova[1], A.V. Kudryashov[1]; [1]Inst. of Geosphere Dynamics, Russia

In this work we implemented the approach of the approximation of the wavefront measured by Shack-Hartmann sensor using B-spline polynomials. We demonstrate that this approach is quite effective for non-circular light beam apertures. We present the results of approximation of the complex ring-shaped wavefront using B-Spline polynomials.

This research was supported by RFBR Grant(s) # Russian Science Foundation project # 20-69-46064

TuR4-10 19:00-19:15

The calculation of the actuators influence functions of a rectangular deformable mirror with free edges

D.A. Yagnyatinskiy, V.N. Fedoseyev; LUCH JSC, Russia

Analytically calculated actuators influence functions for a rectangular deformable mirror with free edges are obtained. The deflection is expanded into a series of natural vibration modes of a rectangular plate, which can be grouped into three classes: ordinary modes and two additional families of extraordinary modes. Analytical results have been compared with finite-element simulatons for different parameters of DMs.

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

Fast particle generation by super-intense light fields

Location: Pudovkin Room, floor 3. 09:00-11:00

TuR5-01 09:00-09:30

Laser based source of electrons/ions for nuclear medicine and nuclear waste transmutation *(Invited paper)*

A.V. Brantov[1,2], V.G. Lobok[1,2], O.E. Vais[1,2], S.G. Bochkarev[1,2], V.Yu. Bychenkov[1,2]; [1]Lebedev Physics Inst. RAS; [2]Dukhov Research Inst. of Automatics (VNIIA), Russia

In this report, we presented the results of a comprehensive simulation of PIC-GEANT4 (particle-in-cell and Monte-Carlo) codes for the generation of high-energy electron or ion bunches by a short laser pulse and their application to assess the possibility of medical isotope production and nuclear waste transmutation.

This research was supported by RFBR Grant(s) # Russian Foundation for Basic Research (Grant 20-21-00023)

TuR5-02 09:30-09:45

Laser accelerated electrons based radiotherapy

M.G. Lobok[1,2], V.Yu. Bychenkov[1,2]; [1]Lebedev Physical Inst. RAS; [2]Center of Fundamental and Applied Research, All-Russia Research Inst. of Automatics, Russia

Short laser pulse interaction with a near critical gas plasma target may result in pulse propagation regime which maximize the charge of the high-energy electron bunches. This relativistic self-trapping regime (RST) of electron acceleration provides a record number of high energy electrons, that could be used in radiotherapy.

TuR5-03 09:45-10:00

Optimized production of charged particles and thermonuclear neutrons from large nanoclusters irradiated with a relativistically intense ultrashort laser pulse

S.G. Bochkarev[1,2], D.A. Gozhev[1], M.G. Lobok[1,2], A.V. Brantov[1,2], V.Yu. Bychenkov[1,2]; [1]Lebedev Physics Inst. RAS; [2]Center for Fundamental and Applied Research, All-Russian Research Inst. of Automatics, Russia

In this work, we study the interaction of ultrashort laser pulses of subrelativistic intensity with large nanoclusters. The cluster target parameters were optimized based on 3D PIC simulations to find the laser plasma regime that maximizes the number of high energy deuterons and the thermonuclear fusion neutron yield.

This research was supported by RFBR Grant(s) # 20-21-00023

TuR5-04 10:00-10:15

Fusion neutrons from femtosecond laser-irradiated sub-micron aggregates in rapid expanding jet of supercritical CO2+CD3OD mixture

T.A. Semenov[1,2], M.S. Dzhidzhoev[1], K.A. Ivanov[1,4], A.V. Lazarev[3], E.I. Mareev[1,2], N.V. Minaev[2], D.N. Trubnikov[3], I.N. Tsymbalov[1], R.V. Volkov[1], A.B. Savel'ev[1,4], V.M. Gordienko[1]; [1]Faculty of Physics, Lomonosov Moscow State Univ.; [2]Inst. of Photon Technologies of FSRC "Crystallography and Photonics"; [3]Faculty of Chemistry, Lomonosov Moscow State Univ.; [4]Lebedev Physical Inst., Russia

For the first time fusion neutrons with a peak output of 3x10^3 neutron/pulse/4pi and efficiency of 6x10^4 neutron/J were obtained under interaction of 3x10^18W/cm2 intensity of Ti:Sa laser with submicron aggregates produced from supercritical CO2+CD3O mixture. A significantly enhanced conversion efficiency of 10^7 neutron/J can be achieved by the use incident laser pulse possessing joule level energy.

This research was supported by RFBR Grant(s) # RFBR grant No.18-29-06035, RSF grant No.21-79-10207

TuR5-05 10:15-10:30

Multi MeV high charge electron beam source utilizing 1 TW laser and shock wave in gas jet target

K.A. Ivanov[1,2], I.N. Tsymbalov[1,3], D.A. Gorlova[1,3], I.P. Tsygvintsev[4], Yu.V. Kochetkov[5], R.V. Volkov[1], A.B. Savel'ev[1,2]; [1]Lomonosov Moscow State Univ.; [2]Lebedev Physical Inst. RAS; [3]Inst. of Nuclear Research RAS; [4]Keldysh Inst. of Applied Mathematics RAS; [5]NRNU MEPHI, Russia

The high charge electron beam is generated at interaction of 1 TW laser pulse with gas target tailored by nanosecond prepulse forming a shock wave. Propagation of intense femtosecond pulse through complex plasma slab accelerates electrons up to 10 MeV. The debris free target has potential to kHz laser application and electrons energy enhancement using more powerful femtosecond laser pulse.

TuR5-06 10:30-10:45

X-ray diagnostics of laser-induced plasma embedded in strong magnetic field with a varied orientation

E.D. Filippov[1,2], S.S. Makarov[2,3], W. Yao[4,5], G. Revet[4,7], A. Fazzini[4], B. Khiar[5], S. Bolanos[4], K.F. Burdonov[1,4], S.N. Chen[7], M. Starodubtsev[1], J. Béard[8], A. Ciardi[5], I.Yu. Skobelev[2,9], S.A. Pikuz[2,9], J. Fuchs[1,5]; [1]Inst. of Applied Physics RAS; [2]Joint Inst. for High Temperatures RAS; [3]Lomonosov Moscow State Univ., Russia; [4]LULI-CNRS, École Polytechnique, CEA, Univ. Paris-Saclay; [5]Sorbonne Univ., Observatoire de Paris, PSL Research Univ.; [6]Center for Intense Lasers and Applications, Univ. Bordeaux, France; [7]"Horia Hulubei" National Inst. for Physics and Nuclear Engineering, Romania; [8]LNCMI-T, CNRS, France; [9]National Research Nuclear Univ., Russia

The present work is aimed at the experimental study of the dynamics of laser-induced plasma immersed in a strong poloidal magnetic field with a variable orientation (0–90 degrees depending on the plasma expansion) and amplitude (up to 30 T). The significance of such studies is especially important for the tasks of laboratory astrophysics and inertial confinement fusion.

This research was supported by RFBR Grant(s) # RFBR, project number 19-32-60008

TuR5-07 10:45-11:00

High charge collimated MeV electron beam generation in the plasma of film target

I.N. Tsymbalov[1,2], D.A. Gorlova[1,3], K.A. Ivanov[1,2], A.B. Savel'ev[1,2]; [1]Faculty of Physics and International Laser Center Lomonosov Moscow State Univ.; [2]Lebedev Physical Inst. RAS; [3]Inst. for Nuclear Research RAS, Russia

This paper presents an efficient method for generating collimated electron beams with energies of a few MeV and a charge of 100 pC during the interaction of a terawatt laser pulse with a special plasma target - a film ablated by an additional nanosecond laser pulse.

This research was supported by RFBR Grant(s) # #19-32-60069

– Break –

Interaction of super-strong laser fields with under-dense plasmas

Location: Pudovkin Room, floor 3. 11:30-13:15

TuR5-08 11:30-11:45

Ionization of microobjects by few-cycle and unipolar radiation pulses

N.N. Rosanov[1,2], D.V. Tumakov[1,2], M.V. Arkhipov[2], R.M. Arkhipov[1,2]; [1]Ioffe Inst.; [2]St. Petersburg State Univ., Russia

We investigate, analytically and numerically, the photoionization yield for various quantum systems irradiated by few- and half-cycle pulses shorter than "the Kepler period" of electron oscillations in the ground state. The analysis shows that the photoionization probability is determined by the ratio of the pulse electric area and its characteristic value inversely proportional to the size of the electron localization.

This research was supported by RFBR Grant(s) # The research is supported by the Russian Science Foundation, Project No. 21-72-10028

TuR5-09 11:45-12:00

Efficient generation of positrons in laser plasma for measuring super-high laser intensities

I.A. Aleksandrov[1,2], A.A. Andreev[1,3,4]; [1]St. Petersburg State Univ., Russia; [2]Ioffe Inst., Russia; [3]ELI-ALPS, Hungary; [4]Max-Born Inst., Germany

We investigate the possibility of extracting super-high laser intensities by measuring the number of positrons produced via a combination of nonlinear Compton scattering and the Breit-Wheeler mechanism. We address the cascade process by means of a recursive numerical procedure. This diagnostics has a relative uncertainty of about ten percent in a wide range up to super-intense fields launching QED cascades.

TuR5-10 12:00-12:15

Resonance of the annihilation channel of a laser-assisted electron-positron scattering in super-strong fields

S.P. Roshchupkin, D.V. Doroshenko, V.V. Dubov; Peter the Great St. Petersburg Polytechnic Univ., Russia

The resonance of the annihilation channel of a laser-assisted electron-positron scattering in super-strong fields is investigated theoretically. Resonant conditions and kinematics of the process is studied in detail. The resonant differential cross-section is obtained analytically. It is shown that the resonant cross-section significantly exceeds the corresponding cross-section without an external field for super-strong fields with intensities up to 10^27 W/cm^2.

TuR5-11 12:15-12:30

Phase space investigation of electron acceleration in direct laser acceleration (DLA)

E. Starodubtseva[1], I. Tsymbalov[1,3], D. Gorlova[1,2], A. Savel'ev[1,3]; [1]Lomonosov Moscow State Univ.; [2]Inst. for Nuclear Research RAS; [3]Lebedev Physical Inst. RAS, Russia

Developed simplified analytically solvable model of DLA, supported by the numerical integration of equation of motion, demonstrates the possibility of ionization injection into the plasma channel at a rather wide range of its parameters and initial phases.

TuR5-12 12:30-12:45

Characteristics of bright betatron radiation from relativistic self-trapping of a short laser pulse in near-critical density plasma

O.E. Vais[1,2], M.G. Lobok[1,2], I.A. Andriyash[3], V. Malka[4], V.Yu. Bychenkov[1,2]; [1]Lebedev Physical Inst. RAS; [2]VNIIA, Russia; [3]ENSTA-CNRS-Ecole Pol., France; [4]Weiz. Inst. of Sci., Israel

X-ray generation with low divergence and high brightness was demonstrated in relativistic self-trapping regime of laser pulse propagation in dense plasma by the three-dimensional particle-in-cell simulations. Here we discuss the impact of a laser pulse on angular-spectral characteristics of betatron radiation and connection of these characteristics with laser-plasma parameters.

TuR5-13 12:45-13:00

Generation of relativistic magnetized plasmas in ultra-intese laser-plasma interaction

A.V. Korzhimanov, M.A. Lazareva; Inst. of Applied Physics RAS, Russia

The paper considers the possibility of generating a relativistic magnetized plasma in the interaction of superstrong subpicosecond laser pulses with targets of various configurations. In particular, self-generation of magnetic fields in a plasma expanding from the rear side of thin solid-state-density targets is considered. As well as the interaction with a transparent plasma with a transverse density profile is discussed.

TuR5-14 13:00-13:15

Doppler effect in transparent laser plasmas

N. Mikheytsev, A.V. Korzhimanov; Nizhny Novgorod State Univ., Russia

In this work, we draw attention to a fact that even in transparent plasmas, an effective reflection of intense laser radiation with a significant Doppler redshift leading to the generation of mid-infrared pulses is possible and find optimal parameters for most efficient low frequency generation.

– Lunch Break –

Generation of intense ultra-short radiation

Location: Pudovkin Room, floor 3. 15:00-17:00

TuR5-15 15:00-15:30

Lightwave control of relativistic plasma mirrors *(Invited paper)*

M. Ouillé[1,2], J. Kaur[1], Z. Cheng[1], S. Haessler[1], L. Rovige[1], J. Huijts[1], A. Vernier[1], I. Andriyash[1], J. Faure[1], R. Lopez-Martens[1]; [1]Lab. d'Optique Appliquée, CNRS, Ecole Polytechnique, ENSTA Paris, Inst. Polytechnique de Paris; [2]ARDOP Industrie, Cité de la Photonique, France

TuR5-16 15:30-15:45

Carrier-envelope phase of an elliptically polarized mid-IR light bullet

A.E. Dormidonov[1,2], E.D. Zaloznaya[1,2,3], V.P. Kandidov[2,3], V.O. Kompanets[2], S.V. Chekalin[2]; [1]Dukhov Automatics Research Inst.; [2]Inst. of Spectroscopy RAS; [3]Lomonosov Moscow State Univ., Russia

For the first time, the formation of a mid-IR single-cycle light bullet during propagation of a femtosecond laser pulse with an arbitrary initial polarization ellipticity of the light field has been experimentally and numerically investigated. It is established that the polarization ellipticity determines the effect of the carrier-envelope phase on the nonlinear-optical interaction of the light bullet with the medium.

This research was supported by RFBR Grant(s) # Russian Science Foundation (project no. 18-12-00422)

TuR5-17 15:45-16:00

Generation of zepto-second scale hard X-ray pulses by Peta-Watt laser

A.A. Andreev[1,2], Zs. Lecz[2], K.Yu. Platonov[1]; [1]St. Petersburg State Univ., Russia; [2]ELI-ALPS, Hungary

We investigated the feasibility of generating multi-KeV photon pulses of several hundred zepto-seconds duration via setup, where PW laser produces multi GeV electrons, which create hard X-ray (zs) pulses in propagation through undulator. The interaction regime of effective production of ultrashort hard pulses was found with help of analytical modelling and numerical simulations by EPOCH and PUFFIN codes.

TuR5-18 16:00-16:15

Formation of low-cycle femtosecond pulses from the radiation of a sub-ps ytterbium laser

K.A. Glushkov, I.B. Mukhin, E.A. Perevezentsev, I.A. Yakovlev; Inst. of Applied Physics, Russia

A laser system has been developed for generating low-cycle femtosecond pulses with a central wavelength of 910 nm (or 2100 nm), a duration of several field oscillations, and a kilohertz pulse repetition rate. The main advantage of the original approach is the optical synchronization of fs pulses with pump laser radiation.

TuR5-19 16:15-16:30

SRS-SBS competition and nonlinear laser energy absorption in a high temperature plasma

S.A. Shekhanov[1,2], V.T. Tikhonchuk[1,3]; [1]ELI-Beamlines Center, Inst. of Physics CAS; [2]Faculty of Nuclear Sciences and Physical Engineering, Czech Technical Univ. in Prague, Czech Republic; [3]Centre of Lasers Intenses and Applications, Univ. of Bordeaux, CNRS, CEA, France

We demonstrate the possibility of controlling the level of nonlinear laser absorption and scattering in a hot, weakly collisional plasma, by controlling the Brillouin backscattering through variation such plasma parameters as ion acoustic wave damping, divergence of the plasma expansion velocity or the laser bandwidth.

TuR5-20 16:30-16:45

Comparative analysis of collinear and noncollinear schemes for coherent combining of high-power few-cycle femtosecond pulses

S.A. Frolov[1], V.I. Trunov[1,2]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State Univ., Russia

The results of the optimization of coherent combining schemes for ultrahigh-power pulses in collinear and noncollinear geometries are discussed. Focusing with a parabolic mirror is considered, as well as spherical, ring and two row ring geometries. A comparative analysis of the requirements on the parameters of the combined pulses to achieve high efficiency of coherent combining is carried out.

TuR5-21 16:45-17:00

Multiterawatt laser pulse conversion into THz range: nonlinear crystals vs gas plasma

M.M. Nazarov[1], A. V. Mitrofanov[1,3,4], D.A. Sidorov-Biryukov[1,2,4], P.A. Scheglov[1], M.V. Chaschin[1], S.Yu. Sarkisov[5], A.M. Zheltikov[1,2,4], V.Ya. Panchenko[1,2,3]; [1]Kurchatov Inst. National Research Center; [2]Lomonosov Moscow State Univ.; [3]SRC "Crystallography and Photonics" Inst. of Laser and Information Technologies RAS; [4]Russian Quantum Center; [5]Lab. for Terahertz Research, Tomsk State Univ., Russia

2-10 TW, 30-fs, 800-nm laser radiation is converted into THz range with relatively high efficiency in two schemes: large aperture thin nonlinear crystals (LiNbO3 and GaSe) and low pressure, two-color gas discharge. 2-10 uJ energy pulse in THz range is obtained with tunable bandwidth up to 6 THz.

This research was supported by RFBR Grant(s) # RFBR grant 20-21-00140

– Break –

THz and harmonic radiation production by short laser pulses

Location: Pudovkin Room, floor 3. 17:30-19:15

TuR5-22 17:30-17:45

Cumulative terahertz emission from a magnetized Cherenkov wake

S.A. Sychugin, M.I. Bakunov; Univ. of Nizhny Novgorod, Russia

We propose a scheme for cumulative ejection of narrowband terahertz radiation generated by a powerful laser driver in a magnetized plasma column. The radiation propagating in the plasma at different angles to the laser path is cumulated by a pair of dielectric prisms of total internal reflection and ejected from the prisms collinearly to the laser beam with high efficiency.

TuR5-23 17:45-18:00

High harmonics of an optical pump in presence of a strong terahertz field

I. Babushkin[1], A. Demircan[1], U. Morgner[1], A. Savel'ev[2,3]; [1]Inst. for Quantum Optics, Leibniz Univ. Hannover, Germany; [2]Lomonosov Moscow State Univ.; [3]Lebedev Physical Inst. RAS, Russia

We show that a relatively weak optical pulse superimposed with a strong terahertz driver allows efficient generation of harmonics of the optical frequency. For few-cycle optical pulse, the harmonics merge into a broad continuum

This research was supported by RFBR Grant(s) # Russian Science Foundation, project 20-19-00148

TuR5-24 18:00-18:15

Intense source of laser-produced unipolar Terahertz pulses

A.V. Brantov[1,2], V.F. Kovalev[2,3], A.S. Kuratov[1,2], V YU. Bychenkov[1,2]; [1]Lebedev Physics Inst.; [2]Dukhov Research Inst.; [3]Keldysh Inst. of Applied Mathematics, Russia

A three-dimensional analytical solution for the near field for a terahertz unipolar pulse based on Maxwell's equations is shown. It is calculated in a transition sample in free space by a laser bunch of relativistic electrons as a result of radiation of a thin foil by a femtosecond laser pulse.

TuR5-25 18:15-18:30

Efficient generation and characterization of THz radiation in TW laser-plasma interaction

D.A. Gorlova[1,2], I.N. Tsymbalov[1,3], K.A. Ivanov[1,3], A.B. Savel'ev[1,3]; [1]Lomonosov Moscow State Univ.; [2]Inst. for Nuclear Research RAS; [3]Lebedev Physical Inst. RAS, Russia

Generation of THz radiation in the interaction of 1 TW laser system with tape target was studied both experimentally and numerically. The proposed scheme can be relatively easily implemented on the kHz laser systems, resulting in a high-intensity high-flux THz radiation source.

TuR5-26 18:30-18:45

THz generation by optical rectification in DAST pumped by femtosecond near and mid-IR (1.2-2.4 μm) pulses generated in optical parametric amplifier based on BBO (II) crystals

D.Z. Suleimanova, N.A. Zhidovtsev, F.V. Potemkin; Lomonosov Moscow State Univ., Russia

The generation of terahertz radiation based on optical rectification in DAST crystal pumped by mid-infrared radiation generated via optical parametric amplification is experimentally demonstrated. Possibility of increasing the optical-to-terahertz conversion efficiency was theoretically studied and it was shown that increase in the conversion efficiency up to 3.6% can be achieved by chirping the femtosecond mid-IR pulses up to 200 fs.

TuR5-27 18:45-19:00

Doughnut-shaped laser modes as a source for HHG process in atomic gas

A.V. Andreev, O.A. Shoutova, S.M. Trushin; Lomonosov Moscow State Univ., Russia

The problem of high harmonics generation by atomic medium interacting with inhomogeneously polarized fields (radial, azimuthal and hybrid doughnut-shaped modes), described in the framework of the Richards-Wolf vector theory, was investigated theoretically. The aim of the research was to trace the presence of a vortex components in the emission radiation and the evolution of local polarization ellipses described in 3D.

This research was supported by RFBR Grant(s) # №18-02-40014

TuR5-28 19:00-19:15

Low-order harmonics generation driven by femtosecond mid-IR Fe:ZnSe laser system

B.V. Rumiantsev[1], K.E. Mikheev[1], E.A. Migal[1], S.Yu. Stremoukhov[1,2], F.V. Potemkin[1]; [1]Lomonosov Moscow State Univ.; [2]National Research Center "Kurchatov Institute", Russia

The generation of low-order harmonics in the gas medium by femtosecond laser radiation of unique mid-IR Fe:ZnSe laser system operating at 4.5 um wavelength is investigated. The dependence of the harmonics generation efficiency on the experimental parameters is studied. The present work is a new step towards high-order harmonics generation driven by low-frequency laser fields.

This research was supported by RFBR Grant(s) # 19-29-12030

R7: Free Electron Lasers

Free electron lasers

Location: Deyneka Room, floor 2. 15:00-17:15

TuR7-01 15:00-15:30

New time-domain spectroscopic methods at Novosibirsk FEL *(Invited paper)*

V.V. Kubarev[1,2], E.N. Chesnokov[3]; [1]Budker Inst. of Nuclear Physics; [2]Novosibirsk State Univ.; [3]Voevodsky Inst. of Chemical Kinetics and Combustion, Russia

Powerful highly coherent pulse-periodical radiation of the terahertz Novosibirsk free-electron laser allows unique experiments in the field of time-domain spectroscopy. Different new spectroscopic methods from ultra-fast sub-nanosecond to super-high practically unlimited resolution are presented.

TuR7-02 15:30-16:00

Six European XFEL scientific instruments *(Invited paper)*

E.O. Tikhodeeva[1]; [1]ITMO Univ., Russia

The European X-Ray Free-Electron Laser (European XFEL) is a research facility that opens the way to unprecedented time (up to 15 fs) and spatial resolution. This review contains a short description of the 6 European XFEL instruments and studies implemented on them.

TuR7-03 16:00-16:15

New class of X-ray visualization materials based on Luminescent Diamond-based Composites

S.V. Kuznetsov[1], V.S. Sedov[1], A.K. Martyanov[1], S.Ch. Batygov[1], M.S. Nikova[2], I.S. Chikulina[2], D.S. Vakalov[2], K.N. Boldyrev[3], V.A.Tarala[2]; [1]Prokhorov General Physics Inst. RAS; [2]Scientific and Lab. Complex Clean Room, North Caucasus Federal Univ.; [3]Inst. of Spectroscopy RAS, Russia

We present the X-ray visualization screens based on luminescence diamond composites. Composites consist of diamond films with embedded nanoparticles of yttrium-aluminum (YAG:Ce) and gadolinium-aluminum (GdAG:Ce) garnets doped by cerium. The compositions of YAG:Ce and GdAG:Ce with high intensity X-ray luminescence were revealed.

This research was supported by RFBR Grant(s) # The reported study was funded by Russian Science Foundation, project N◦22-13-00401

TuR7-04 16:15-16:30

Artificial intelligence in Raman spectroscopy for bio-medical issues

V.V. Vitkin, A.V. Tabarov; ITMO Univ., Russia

To solve problems in biology and medicine, it is necessary to improve the approaches to processing the obtained data. Raman spectroscopy is often used to diagnose various pathogens, as it provides sufficient accuracy, speed. In this paper, we explore the possibilities of artificial intelligence to classify measured samples and detect the presence of a pathogen.

This research was supported by RFBR Grant(s) # The work is supported by Ministry of Science and Higher Education of the Russian Federation grant No. 94-2219-E-011-007.

TuR7-05 16:30-16:45

Generation of twisted photons in helical undulators

G.K. Sizykh, D.V. Karlovets; ITMO Univ., Russia

Production of photons with orbital angular momentum in helical undulators is considered. The emphasis is put onto measurement scheme. Measurement of the fianl electron azimuthal angle leads to a projection onto a planewave state, while the abscense of such a measurement allows us to obtain twisted photons form a helical undulator.

TuR7-06 16:45-17:15

XFEL phase-contrast imaging studies of micron-scale phenomena in a turbulent laser-produced plasma. *(Invited paper)*

S.A. Pikuz[1,2], G. Rigon[3], B. Albertazzi[3], T. Pikuz[1,4], P. Mabey[3], V. Bouffetier[5], N. Ozaki[6,7], T. Vinci[3], F. Barbato[5], E. Falize[8], Y. Inubushi[9], N. Kamimura[6], K. Katagiri[6], S. Makarov[1,2], M.J.-E. Manuel[10], K. Miyanishi[9], O. Poujade[8,11], K. Sueda[9], T. Togashi[9], Y. Umeda[6,12], M. Yabashi[9], T. Yabuuchi[9], G. Gregori[13], R. Kodama[6], A. Casner[5,14], M. Koenig[3,6]; [1]JIHT RAS; [2]NRNU MEPhI, Russia; [3]LULI École Polytechnique, France; [4]IOTRI Osaka Univ., Japan; [5]CELIA Bordeaux Univ., France; [6]GSE Osaka Univ., Japan; [7]ILE Osaka Univ., Japan; [8]CEA-DAM, France; [9]RIKEN SPring-8, Japan; [10]General Atomics, USA; [11]Univ. Paris-Saclay, France; [12]IPM Okayama Univ., Japan; [13]Oxford Univ., UK; [14]CEA-CESTA, France

Turbulent spectrum in the evolution of a Rayleigh–Taylor unstable system in a laser-plasma experiment is measured down to Kolmogorov micron scales. It is found to be overall consistent with existing turbulent theory while possessing unexpected features. The data allows the verification of turbulence theory and simulations up to the dissipation phase for ICF and a wide range of astrophysical objects.

R8: Nonlinear Photonics: Fundamentals and Applications

Nonlinear phenomena with THz radiation

Location: Stenberg 2 Room, floor 3. 09:00-11:00

TuR8-01 09:00-09:30

Nonlinear terahertz photonics of nanocluster media *(Invited paper)*

A.P. Shkurinov; Lomonosov Moscow State Univ., Russia

The results of study of the nonlinear optical properties of nano-gas-cluster jets under the action of high-power femtosecond pulses are presented. The control of the terahertz radiation pattern and terahertz pulse duration is analyzed. The possibility of using a nano-cluster jet as a source of electrons accelerated by the field of a terahertz pulse is discussed.

TuR8-02 09:30-09:45

Efficient Cherenkov -type optical-to-terahertz conversion of nJ-energy femtosecond laser pulses

N.A. Abramovsky, A.I. Shugurov, M.I. Bakunov; Univ. of Nizhny Novgorod, Russia

We demonstrate experimentally that a sandwich-like structure comprising a thin layer of LiNbO3 clamped between two Si prisms of total internal reflection can serve as an efficient converter of nJ-energy level laser pulses from a femtosecond optical oscillator to a high-quality beam of broadband terahertz radiation. The converter has an additional advantage of workability at different laser wavelengths.

TuR8-03 09:45-10:00

Terahertz-field-induced second harmonic generation of optical radiation for surface and bulk interfaces diagnostic

S.B. Bodrov[1,2], Yu.A. Sergeev[2], A.I. Korytin[2], E.A. Burova[1], M.I. Bakunov[1], A.N. Stepanov[2]; [1]Univ. of Nizhny Novgorod; [2]Inst. of Applied Physics RAS, Russia

Terahertz-field-induced second harmonic generation (TFISHG) of optical radiation was used to investigate silicon surface and characterize of low-contrast interface in transparent materials. The TFISHG technique helps to reveal the dominant generation mechanism from Si surface, find the magnitude of built-in-electric-field, and estimate third-order susceptibility. Adhesive layer sandwiched between plates of fused quartz was detected and its third-order susceptibility was measured.

This research was supported by RFBR Grant(s) # Ministry of Science and Higher Education of the Russian Federation (No. 0729-2020-0035)

TuR8-04 10:00-10:15

From triple to quadruple frequencies generation due to single-cycle terahertz pulse propagation through cubic nonlinear medium

I.R. Artser, A.O. Ismagilov, M.S. Guselnikov, A.N. Tcypkin, M.V. Melnik, S.A. Kozlov; ITMO Univ., Russia

High-intensity optical femtosecond radiation causes the generation of pulsed THz radiation with a great efficiency. In this work the experimental and theoretical results show that intense single-cycle THz pulse propagation through a cubic nonlinear medium generates radiation at quadruple frequency while the expected radiation at triple frequency is absent.

TuR8-05 10:15-10:30

Angular distribution of different spectral components of THz radiation from femtosecond laser filament in static electric field

G.E. Rizaev[1,2], D.V. Mokrousova[1], D.V. Pushkarev[1], A.V. Koribut[1], Y.V. Grudtsyn[1], D.E. Shipilo[1,3], N.A. Panov[1,3], I.A. Nikolaeva[1,3], S.A. Savinov[1], Y.A. Mityagin[1], L.V. Seleznev[1], O.G. Kosareva[1,3], A.A. Ionin[1]; [1]Lebedev Physical Inst. RAS; [2]Moscow Inst. of Physics and Technology; [3]Lomonosov Moscow State Univ., Russia

The angular distributions of the THz radiation generated in single-color filament plasma are studied. The propagation of various THz spectral components turns out to differ significantly in case of DC-biased filamentation - the emergence of high-frequency THz spectral components propagating on the axis causes the transformation of the total THz emission pattern from a hollow cone to a filled one.

This research was supported by RFBR Grant(s) # 20-02-00114

TuR8-06 10:30-10:45

40-meter postfilament evolution in air

D.V. Pushkarev[1,2], D.V. Mokrousova[1,2], N.A. Panov[1,2,3], I.A. Nikolaeva[1,3], D.E. Shipilo[1,3], N.A. Zhidovtsev[3], G.E. Rizaev[1,2], D.S. Uryupina[2,3], A.V. Koribut[1], A.B. Savel'ev[1,3], O. G. Kosareva[1,3], L.V. Seleznev[1,2], A.A. Ionin[1]; [1]Lebedev Physical Inst. RAS, Russia; [2]Zuev Inst. of Atmospheric Optics SB RAS, Russia; [3]Lomonosov Moscow State Univ., Russia

We performed full characterization of postfilament on the extended indoor path. Single-shot angle-wavelength spectra, beam diameters and self-correlation functions were measured. Two zones in the postfilamentation process were revealed: the Stokes zone where the Kerr nonlinearity strongly affects the temporal and spectral pulse properties and the zone where the only effect of the Kerr nonlinearity is balancing the diffraction.

This research was supported by RFBR Grant(s) # This research was supported by Russian Science Foundation, grant number 21-12-00109

TuR8-07 10:45-11:00

Filamentation of collimated 744 nm beam under amplitude modulation

D.V. Mokrousova[1,2], G.E. Rizaev[1,2], A.V. Koribut[1], N.A. Panov[1,2,3], I.A. Nikolaeva[1,3], D.E. Shipilo[1], E.V. Mitina[3], D.V. Pushkarev[1,2], A. Couairon[4], A. Houard[5], A.B. Savel'ev[1,3], O.G. Kosareva[1,3], L.V. Seleznev[1,2], A.A. Ionin[1]; [1]Lebedev Physical Inst. RAS; [2]Zuev Inst. of Atmospheric Optics SB RAS; [3]Lomonosov Moscow State Univ., Russia; [4]CPHT, CNRS, Ecole Polytechnique; [5]LOA, ENSTA Paris, CNRS, Ecole polytechnique, France

We study the propagation of ultrashort laser pulse in filamentation and postfilamentation regimes at the distances up to 95 m. In order to control the start of the filament and spectrum broadening we insert meshes inside the beam. For all beam configurations we found distances range where laser pulse triggers high-voltage discharge.

– Break –

Nonlinear phenomena in microcavities

Location: Stenberg 2 Room, floor 3. 11:30-13:30

TuR8-08 11:30-11:45

Generation of platicons in high-Q optical microresonators due to thermal effects

V.E. Lobanov[1], M. Karpov[1,2], N.M. Kondratiev[1]; [1]Russian Quantum Center, Skolkovo, Russia; [2]Swiss Centre for Electronics and Microtechnology (CSEM), Switzerland

We first demonstrate generation of platicons in optical microresonators at normal group velocity dispersion via thermal effects. We found that platicon excitation is possible if thermal effect is negative and microresonator quality factor is large enough. Different generation regimes were determined. Parameter ranges providing platicon excitation were found for different values of thermal relaxation time, frequency scan rate, dispersion coefficient.

TuR8-09 11:45-12:00

Simultaneous self-injection locking of two laser diodes to a single integrated microresonator

D.A. Chermoshentsev[1,2,3,4], A.E. Shitikov[1], E.A. Lonshakov[1], G.V. Grechko[1,2], E.A. Sazhina[2], N.M. Kondratiev[1], A.V. Masalov[1,4], I.A. Bilenko[1,5], A.I. Lvovsky[1,4,6], A.E. Ulanov[1,2]; [1]Russian Quantum Center; [2]Moscow Inst. of Physics and Technology; [3]Skolkovo Inst. of Science and Technology; [4]Lebedev Physical Inst. RAS; [5]Lomonosov Moscow State Univ., Russia; [6]Univ. of Oxford, UK

We demonstrate the dual-laser SIL of two multifrequency laser diodes to different and to the same modes of an integrated Si$_3$N$_4$ microresonator. Simultaneous spectrum collapse of both lasers, as well as linewidth narrowing and high-frequency noise suppression, as well as strong nonlinear interaction of the two fields with each other, are observed.

This research was supported by RFBR Grant(s) # 20-32-90172

TuR8-10 12:00-12:15

Nonlinear effects in tellurite glass microresonators: experimental advances and theoretical explanations

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

The 1st-order and 2nd-order Raman lasing and optical frequency combs are demonstrated experimentally for the first time in tellurite microresonators (Q-factor=5e7@1.55microns). Brillouin lasing up to the 4th order was also obtained. The main experimental features were explained theoretically including simultaneous Raman lasing at different Stokes wavelengths and switching between them. Normal-dispersion combs may correspond to dark solitons in simulations.

TuR8-11 12:15-12:30

Spectral properties of coupled silica microresonators

M.P. Marisova[1,2], A.V. Andrianov[1], E.A. Anashkina[1,2]; [1]Inst. of Applied Physics RAS; [2]Lobachevsky State Univ. of Nizhny Novgorod, Russia

We theoretically studied mode hybridization of two coupled optical silica microresonators with whispering gallery modes (WGMs). Output spectra and supermode electric field distributions were calculated for various geometric parameters. For microresonators with slightly different diameters the coupling of the fundamental and non-fundamental WGMs was observed, leading to asymmetry in the spectra and the spatial field distributions of the supermodes.

TuR8-12 12:30-12:45

Palm-size dual-microcomb source

N.Yu. Dmitriev[1,2], S.N. Koptyaev[3] , A.S. Voloshin[4] , N.M. Kondratiev[1], V.E. Lobanov[1], E.A. Lonshakov[1], K.N. Min'kov[1], I.A. Bilenko[1,5]; [1]Russian Quantum Center; [2]Moscow Inst. of Physics and Technology; [3]Samsung R&D Inst. Russia, Russia; [4]Swiss Federal Inst. of Technology Lausanne, Switzerland; [5]Lomonosov Moscow State Univ., Russia

For the first time we demonstrate dual-comb source based on broadband (300nm) Kerr-microcombs generated using high-Q SiN microresonators and self-injection locked laser diodes. We demonstrate down-conversion of the optical spectrum from 1400 nm to 1700 nm into the radio-frequency domain, which is valuable for fast wide-band Fourier spectroscopy, which was previously not available with chip-scale devices.

TuR8-13 12:45-13:00

Spatio-temporal dissipative Kerr solitons in chainsof optical microresonators

A. Tusnin, A. Tikan, T.J. Kippenberg; Inst. of Physics, Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland

We theoretically study Dissipative Kerr solitons (DKS) in chains of optical microresonators. We show two fundamentally different dynamical regions: hyperbolic and elliptic. Exciting a collective state in the elliptic region, we show the formation of a spatiotemporal soliton.

TuR8-14 13:00-13:30

Microresonator - from combs to topology in time *(Invited paper)*

D.V. Skryabin; Department of Physics, Univ. of Bath, UK

I will present and discuss the recent results by the Bath group demonstrating all-optical Autler-Townes splitting known in the strong photon-atom interaction, all-optical polaritons, new mechanisms of the soliton modelocking across the octave, the microresonator manifestation of chirality in time, and describe topological soliton crystals.

R9: Optical Nanomaterials

Optical nanomaterials I

Location: Stenberg 2 Room, floor 3. 15:00-16:45

TuR9-01 15:00-15:30

Functions for describing non-exponential photoluminescence decay kinetics in semiconductor nanocrystals *(Invited paper)*

A.L. Simões Gamboa[1], E.N. Bodunov[2]; [1]ITMO Univ., Russia; [2]Emperor Alexander I St. Petersburg State Transport Univ., Russia

We suggest functions for the description of the photoluminescence decay of colloidal semiconductor quantum dots whose parameters have a straightforward physical meaning. In particular, we introduce a function that accounts for the long-time tails of the decays, highlighting processes that may be related to blinking, and provides information concerning the nature of the trap states involved in charge carrier recombination.

TuR9-02 15:30-15:45

Plasmon resonance broadening in hybrid structures

A.V. Uskov[1], J.B. Khurgin[2], I.V. Smetanin[1], I.E. Protsenko[1], N.V. Nikonorov[3]; [1]Lebedev Physical Inst. RAS, Russia; [2]John Hopkins Univ., USA; [3]ITMO Univ., Russia

Landau Damping in hybrid plasmonic structures (metal core/dielectric shell) is strongly affected by the permittivity and the electron effective mass in the dielectric. The physical reason for this effect is identified as electron spillover into the dielectric where the electric field is higher than in the metal and as the presence of quasi-discrete energy levels in the dielectric shell.

TuR9-03 15:45-16:00

Transverse magnetophotonic intensity effect in plasmonic nanostructures with broken spatial symmetry

O.V. Borovkova[1,2], H. Hashim[3,4], M.A. Kozhaev[1], S.A. Dagesyan[2], A.N. Kalish[1,2], A.N. Shaposhnikov[5], V.N. Berzhansky[5], V.I. Belotelov[1,2]; [1]Russian Quantum Center; [2]Lomonosov Moscow State Univ., Russia; [3]Faculty of Science, Tanta Univ., Egypt; [4]Immanuel Kant Baltic Federal Univ.; [5]Vernadsky Crimean Federal Univ., Russia

The transmittance of any nanostructure can be controlled by proper engineering of its dielectric and spatial properties. Applied magnetic field determines the dielectric properties of the ferrimagnetic nanostructures as well. We address the transverse magneto-optical intensity effect in two types of the nonsymmetric plasmonic nanostructures. It is shown that the effect depends on the asymmetry of the structure.

TuR9-04 16:00-16:15

Perovskite-polymer nanocomposites based on nanofibers for flexible solar cells

M.A. Bkkar, R.O. Olekhnovich, M.V. Uspenskaya; ITMO Univ., Russia

We study the crystallinity and light absorption properties of CsPbI3: polyvinylpyrrolidone nanofibers, which can be used as active layers for solar cells. Experimental results show that the black phase of CsPbI3 nanocrystals can be manipulated using the annealing parameters.

TuR9-05 16:15-16:30

Functional hybrid structures based on porphyrins and gold nanoparticles for optical sensors

A.V. Povolotskiy, D.A. Soldatova, A.V. Povolotckaia, O.S. Smirnova, D.A. Lukyanov; St. Petersburg State Univ., Russia

The mechanisms of interaction between optically excited porphyrins and gold nanoparticles determine the functional properties of hybrid structures based on them and make it possible to create various optical sensors. The mechanisms of charge and energy transfer, luminescence quenching and the temperature dependence of the luminescence intensity have been studied.

TuR9-06 16:30-16:45

The formation of one-dimensional LCC quasi-crystals deposited on a substrate

V. Samyshkin[1] , S. Kutrovskaya[1,2,3], A. Osipov[1,3], I. Chestnov[1,2,3], A. Kucherik[1]; [1]Stoletov Vladimir State Univ., Russia; [2]School of Science, Westlake Univ., China; [3]Inst. of Natural Sciences, Westlake Inst. for Advanced Study, China

We stabilize monoatomic carbon chains in water by attaching them to gold nanoparticles (NPs) by means of the laser ablation process. Resulting nanoobjects represent pairs of NPs connected by multiple straight carbon chains of several nanometer lengths. We deposit them on a glass substrate by the sputtering method in the presence of static electric fields.

This research was supported by RFBR Grant(s) # This work was also partially supported by RFBR grants 20-21-00038

R10: Nonlinear and Quantum Photonics in Waveguide Systems

Nonclassical states and quantum cryptography

Location: Richter Room, floor 3. 09:15-11:00

TuR10-01 09:15-09:30

Kerr squeezing in optical fibers for sensitivity enhancement of interferometers

N.A. Kalinin[1], E.A. Anashkina[1,2], G. Leuchs[1,3], A.V. Andrianov[1]; [1]Inst. of Applied Physics RAS; [2]Advanced School of General and Applied Physics, Lobachevsky State Univ. of Nizhny Novgorod, Russia; [3]Max Planck Inst. for the Science of Light, Germany

We developed a new simple all-fiber setup for generation of polarization-squeezed states. The setup reliably generates -5 ± 0.5 dB of squeezing which is stable for a long time without any adjustments. We applied this polarization squeezed light to a polarization interferometer and demonstrated an increase of the signal-to-noise ratio by 4 ± 0.5 dB.

This research was supported by RFBR Grant(s) # 19-29-11032

TuR10-02 09:30-09:45

From the nonlinear to quantum phenomena in ultra-high-Q optical microresonators

N.M. Lebedev[1,2], S.N. Balybin[1,2], N.M. Kondratiev[2], E.A. Lonshakov[2], V.E. Lobanov[2], F.Ya. Khalili[2], I.A. Bilenko[1,2]; [1]Lomonosov Moscow State Univ.; [2]Russian Quantum Center, Russia

Ultra-high-quality factor (ultra-high-Q) optical microresonators with a weak Kerr nonlinearity are widely used for frequency comb generation. It was shown that simultaneous self-injection lockring of two lasers onto neighboring modes of such microresonator exhibits its mutual influence via the non-linearity. Moreover, self- and cross-phase modulations make it possible to implement purely quantum effects: non-classical state preparation and QND measurement.

TuR10-03 09:45-10:00

Coherent conversion between one and two photons in waveguides with engineered dispersion

A.S. Solntsev[1], S.V. Batalov[2,3], N.K. Langford[1], A.A. Sukhorukov[4,5]; [1]School of Mathematical and Physical Sciences, Univ. of Technology Sydney, Australia; [2]Inst. of Metal Physics, UB RAS; [3]Inst. of Physics and Technology, Ural Federal Univ., Russia; [4]Research School of Physics, Australian National Univ.; [5]ARC Centre of Excellence for Transformative Meta-Optical Systems (TMOS), Australia

High-efficiency photon-pair production is a long-sought-after goal for many optical quantum technologies, and coherent photon conversion processes are promising candidates for achieving this. We show theoretically how to control coherent conversion between a narrow-band pump photon and broadband photon pairs in nonlinear optical waveguides by tailoring frequency dispersion for broadband quantum frequency mixing.

TuR10-04 10:00-10:15

Squeezed light generation via frequency degenerate parametric down-conversion with cascaded up-conversion

A.V. Rasputnyi, D.A. Kopylov; Lomonosov Moscow State Univ., Russia

We present the results of the analytical and numerical analysis of the generation of squeezed states via frequency-degenerate PDC with CUpC. We demonstrate the dynamics of the quadrature squeezing of the PDC and CUpC modes inside the nonlinear crystal. With the use of Reid criterion we show the conditions, when PDC and CUpC modes are entangled or separable.

TuR10-05 10:15-10:30

Laser damage attack on a simple optical attenuator widely used in fiber-based QKD systems

K.E. Bugai[1,3], A.P. Zyzykin[1], D.S. Bulavkin[1,3], S.A. Bogdanov[1,2], I.S. Sushchev[1,2], D.A Dvoretskiy[1,3]; [1]SFB Laboratory, Ltd.;[2]Quantum Technology Centre and Faculty of Physics, Lomonosov Moscow State Univ.; [3]Bauman Moscow State Technical Univ., Russia

We present the results of an experimental study of laser damage attack (LDA) from the CW laser power up to 5.5 W at a wavelength of 1561 at a simple type of commercially available attenuator widely used in telecommunications and fiber-based QKD systems.

TuR10-06 10:30-10:45

Measuring the "backflash" probability of a single-photon detector with a time correlator

S.A. Bogdanov[1,2], I.S. Sushchev[1,2], A.N. Klimov[2], K.E. Bugai[1,3], D.S. Bulavkin[1,3], D.A. Dvoretskiy[1,3]; [1]SFB Laboratory, Ltd.; [2]Quantum Technology Centre and Faculty of Physics, Lomonosov Moscow State Univ.; [3]Bauman Moscow State Technical Univ., Russia

We present an experimental setup for the research of photon re-emission ("backflash") of a single-photon detector depending on the time parameters. The uniqueness of this experimental setup with a time correlator lies in the very low amount of dark and parasitic noise, as well as in the negligibly small contribution of reflected photons in the histograms obtained.

TuR10-07 10:45-11:00

Quantum noise generator with electrically-controllable beamsplitter based on a $LiNbO_3$ chip

V.V. Lebedev[1,2], I.V. Ilichev[1,2], P.M. Agruzov[1,2], A.V. Shamrai[1,2], V.M. Petrov[1]; [1]ITMO Univ.; [2]Ioffe Inst., Russia

The operation of a broadband quantum noise source based on a controlled integrated optical beam splitter formed on a LiNbO3 chip is considered.

– Break –

Photonic machine learning and data processing

Location: Richter Room, floor 3. 11:30-12:30

TuR10-08 11:30-12:00

Machine learning for ultrafast nonlinear photonics *(Invited paper)*

Ch. Finot[1], A. Sheveleva[1], J. Peng[2], J.M. Dudley[3], S. Boscolo[4]; [1]Lab. Interdisciplinaire CARNOT Bourgogne Univ. de Bourgogne-Franche-Comté CNRS, France; [2]State Key Lab. of Precision Spectroscopy, East China Normal Univ., China; [3]Inst. FEMTO-ST, Univ. de Bourgogne Franche-Comté CNRS, France; [4]Aston Inst. of Photonic Technologies, Aston Univ., UK

We review our recent progress on the application of machine-learning techniques in the field of ultrafast nonlinear fibre optics. We demonstrate that neural networks can both efficiently predict the temporal and spectral features after propagation and solve the associated inverse problem. We also show that evolutionary algorithms can be used to control complex nonlinear dynamics of ultrafast lasers.

TuR10-09 12:00-12:15

Nonlinear synthetic photonic lattices for optical neural networks

A.V. Pankov[1], I.D. Vatnik[1], A.A. Sukhorukov[2]; [1]Novosibirsk State Univ., Russia; [2]Australian National Univ., Australia

We show that synthetic photonic lattices based on coupled waveguide loops can serve as feed-forward neural networks for processing of optical pulse sequences in time domain. We prove the capabilities of the system in solving three representative tasks, including channel equalization in a linear telecommunication link, nonlinear transformation of the pulse amplitude and phase, and discrimination of pulse sequences.

TuR10-10 12:15-12:30

Reconstruction of a unitary transformation of an integrated interferometer using coherent light

I.V. Kondratyev, N.S. Klushnikov, N.N. Skryabin, I.V. Dyakonov, S.P. Kulik; Quantum Technology Centre, Lomonosov Moscow State Univ., Russia

Integrated optics fastens its place in becoming one of the most promising technology. Once optical integrated chip is fabricated it is needed to be characterized to have exact knowledge of its operation. Therefore, trustful methods of chip transformation reconstruction are of interest. Here we have performed unitary transformation reconstruction of the femtosecond laser written optical chip with coherent light.

Device design and quantum metrology

Location: Rihter Room, floor 3. 12:30-13:45

TuR10-11 12:30-12:45

Influence of radiation at wavelength near 1.5 µm on efficiency of inter-modal FWM in a few mode fiber in the region of 1 µm

V.P. Tsypkin[1,2], A.Yu. Ostapiv[1,2], G.Yu. Ivanov[1,2], I.A. Larionov[2], V.A. Tyrtyshyy[2]; [1]Moscow Inst. of Physics and Technology (National Research Univ.); [2]NTO "IRE-Polus", Russia

We introduce an experimental and theoretical study of inter-modal four wave mixing (IMFWM) in a few mode optical fiber in the region of 1 µm. Influence of radiation with wavelengths near 1.5 µm on the efficiency of this process was shown.

TuR10-12 12:45-13:00

Microresonators on surface of active fibers with active core for all-optical tuning

D.V. Kudashkin, I.D. Vatnik; Novosibirsk State Univ., Russia

We present a mechanism of tuning a WGM microresonator formed on the surface of an active fiber by launching light into its core. We utilize this approach to create a feedback loop stabilizing the microcavity resonances.

TuR10-13 13:00-13:15

Double electron-electron resonance for investigation spin bath in diamond

O.R. Rubinas[1,2,3], V.V. Soshenko[2,3], S.V. Bolshedvorskii[2,3], I.S. Cojocaru[2,4], V.V. Vorobyov[5], V.N. Sorokin[2], V.G. Vins[6], A.P. Yeliseev[6], A.N. Smolyaninov[3], A.V. Akimov[7,3,4]; [1]MIPT Moscow Inst. of Physics and Technology, Russia; [2]Lebedev Physical Inst. RAS, Russia; [3]SST LLC Sensor Spin Technologies, Russia; [4]Russian Quantum Center, Russia; [5]Univ. of Stuttgart, Germany; [6]LLC Velman, Russia; [7]TAMU Texas A&M Univ., College Station, USA

NV-centers in diamonds are promising sensors of magnetic fields due to the possibility to control their state optically. The coherence of NV centers in diamond is limited by other paramagnetic impurities - C-centers. Unlike the NV-center, the C-center is a dark defect. This work demonstrates the detection, state control, and concentration determination of C-centers through their interaction with NV-centers.

This research was supported by RFBR Grant(s) # the Russian Foundation for Basic Research (according to the research project No. 20-32-90025, Grant Aspirants)

TuR10-14 13:15-13:30

Towards ultra-precision quantum optical coherence tomography

A.V. Romanova[1], A.V. Pashchenko[1], K.G. Katamadze[1,2,3], S.P. Kulik[1]; [1]Quantum Technology Centre, Lomonosov Moscow State Univ.; [2]Valiev Inst. of Physics and Technology RAS; [3]National Research Nuclear Univ. MEPhI, Russia

We present experimental results on obtaining biphoton fields with a super-broadband spectrum and ultra-narrow correlation function for high-precision quantum optical tomography using a new approach based on strong pump focusing. We also report the first results showing the behavior of the biphoton correlation function in the Michelson interferometer in the absence and presence of a dispersive medium.

This research was supported by RFBR Grant(s) # 20-32-70153

TuR10-15 13:30-13:45

Super resolution imaging technique, based on target mode shaping and photon number distribution analysis.

K.G. Katamadze[1,2,3], B.I. Bantysh[2], A.Yu. Chernyavskiy[2], Yu.I. Bogdanov[2], S.P. Kulik[1]; [1]Quantum Technology Centre, Lomonosov Moscow State Univ.; [2]Valiev Inst. of Physics and Technology RAS; [3]National Research Nuclear Univ. MEPhI, Russia

We propose a novel imaging technique, based on the multi-shot photon number measurements in the modulated target beam scanning the sample. Image parameters are then estimated by fitting the photon number distribution model to the collected data. In contrast with previous techniques our approach allows precise estimation of complex objects with 2+ independent parameters.

This research was supported by RFBR Grant(s) # 20-32-70153

R3: Semiconductor Lasers, Materials and Applications

TuR3-p01 15:00-18:30

Mirror-assisted tuning of laser stabilization via self-injection locking to high-Q microresonator

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

In this work we theoretically study a scheme of a self-injection locking to a high-Q microresonator with drop-port coupled mirror, in which optical feedback level is optimally adjusted by tuning the drop-port mirror coupling.

TuR3-p02 15:00-18:30

High-power 4.5-µm quantum cascade lasers with two-stage epitaxial growth

V.V. Dudelev[1], D.A. Mikhailov[1], A.V. Babichev[1], E.D. Cherotchenko[1], A.G. Gladyshev[2], S.N. Losev[1], I.I. Novikov[3], A.V. Lyutetskiy[1], S.O. Slipchenko[1], N.A. Pikhtin[1], A.Yu. Andreev[4], I.V. Yarotskaya[4], K.A. Podgaetskiy[4], A.A. Marmalyuk[4], A.A. Padalitsa[4], M.A. Ladugin[4], L.Ya. Karachinsky[3], A.Yu. Egorov[3], G.S. Sokolovskii[1]; [1]Ioffe Inst.; [2]Connector Optics LLC; [3]ITMO Univ.; [4]JSC MF Stelmakh Polyus Res Inst., Russia

We study room-temperature performance of high-power mid-infrared quantum cascade lasers fabricated from the heterostructures grown by a combination of MBE and MOCVD epitaxial methods.

TuR3-p03 15:00-18:30

Random bit generation based on coupled quantum dot micropillar laser arrays

A.A. Petrenko, A.V. Kovalev, V.E. Bougrov; ITMO Univ., Russia

We investigate the dynamics of quantum dot micropillar laser arrays globally coupled by optical feedback. The observed dynamical chaos can be used for high-speed random bit generation. We discuss the possibility of time-delay signature suppression in the system.

This research was supported by RFBR Grant(s) # This work was supported by the Ministry of Science and Higher Education of the Russian Federation, research project no. 2019-1442

TuR3-p04 15:00-18:30

High-power pulsed semiconductor lasers with integrated thyristor

A.I. Zhelnin, M.A. Ladugin; Stel'makh R&D Inst. "Polyus", Russia

High-power hybrid semiconductor lasers – thyristors consisting of thyristor crystals soldered with an integrated semiconductor laser are studied. The output power of the integrated laser – thyristor is ~120 W at a turn-on voltage of 18 V. The turn-on voltage of a hybrid laser – thyristor is 28 V, and the peak output power reaches ~170 W.

TuR3-p05 15:00-18:30

The influence of growth parameters of AlGaAs waveguide layers grown by MOCVD on the output characteristics of high-power laser diodes

E.V. Ershov, A.V. Fomin, S.H. Nazhmetov, A.A. Naidin, O.A. Rogachkov, M.V. Lupachev; RFNC-VNIITF, Russia

The work present the result of investigation into the influence of growth parameters of AlGaAs waveguide layers (temperature, gas mixture composition) on the output characteristics of laser diodes. Epitaxial growth modes have been considered at which minimum background concentration of holes in heterostructure waveguide layers is achieved.

TuR3-p06 15:00-18:30

High-power semiconductor 1.3 - 1.6 µm DFB-lasers

O.O. Bagaeva, A.I. Danilov, A.I. Ivanov, V.D. Kurnosov, K.V. Kurnosov, R.V. Chernov, V.V. Shishkov, Y.V. Kurnyavko, M.A. Ladugin, A.A. Marmalyuk, V.I. Romantsevich, Y.L. Ryaboshtan, V.N. Svetogorov, V.A Simakov; Stel'makh R&D Inst. "Polyus", Russia

The current-voltage, light-current and spectral characteristics of 1.3 - 1.6 µm high-power single-frequency DFB-lasers with a laterally coupled Bragg diffraction grating were experimentally studied.

TuR3-p07 15:00-18:30

A new method for the treatment of venous and arteriovenous malformations of the head and neck in children using a semiconductor laser

S.V. Iamatina, D.Y. Komelyagin, A.V. Petukhov, S.A. Dubin, F.I. Vladimirov, D.V. Khaspekov; Children's Municipal Clinical Hospital of St. Vladimir, Russia

Children with venous (VM) and arteriovenous (AVM) malformations of the maxillofacial region are a complex contingent of patients. There is no single treatment protocol for this group of patients. The use of a semiconductor laser has increased the effectiveness of treatment of manifestations of AVM and VM in hard-to-reach areas of the head and neck.

TuR3-p08 15:00-18:30

High-power laser modules of spectral range 975 nm for fiber lasers pumping

A.N. Ignatev, A.V. Fomin, S.R. Usmanov, E.V. Kadigrob; Zababakhin Research Inst. of Technical Physics (RFNC - VNIITF), Russia

The paper presents the results of the development of laser modules for pumping fiber lasers. Spatial combining of the radiation of several single laser diodes with subsequent coupling into an optical fiber is considered. The efficiency of the implemented optical scheme is experimentally evaluated, the spectral and power characteristics of the manufactured laser modules are presented.

TuR3-p09 15:00-18:30

Mode selection in the external cavity of a single-mode lasers microarray (1060nm)

A.A. Podoskin, V.V. Zolotarev, I.S. Shashkin, S.O. Slipchenko, D.N. Romanovich, O.S. Soboleva, V.A. Strelets, V.A. Kapitonov, K.V. Bakhvalov, A. Kazakova, E. Fomin, N. A. Pikhtin; Ioffe Inst., Russia

The effect of an external resonator on the operation of a single-mode stripes laser bar based on an asymmetric InGaAs/AlGaAs/GaAs heterostructure is studied. It is shown that the external resonator increases the efficiency of optical coupling between bar stripes and to obtain laser generation in a high-order common mode with radiation pattern individual lobes about 1 deg.

This research was supported by RFBR Grant(s) # RSF 19-79-30072

TuR3-p10 15:00-18:30

High-power strain-compensated 1.9-2.0 µm GaInAs/AlGaInAs laser diodes.

V.N. Svetogorov[1], Yu.L. Ryaboshtan[1], M.A. Ladugin[1], A.A. Marmalyuk[1], K.V. Bakhvalov[2], D.A. Veselov[2], A.V. Lyutetskii[2], V.A. Strelets[2], S.O. Slipchenko[2], N.A. Pikhtin[2]; [1]Stel'makh R&D Inst. "Polyus"; [2]Ioffe Inst. RAS, Russia

High-power laser diodes based on GaInAs/AlGaInAs/InP emitting near 2.0 µm were grown by MOCVD. Due to a highly stressed active region an cw output optical power of laser diodes equal 1 W was achieved at room temperature.

TuR3-p11 15:00-18:30

Tuning DFB laser for dynamic interrogation of fast processes

Yu.S. Borisov[1], O.V. Ivanov[2]; [1]Ulyanovsk State Technical Univ.; [2]Ulyanovsk Branch of Kotelnikov Inst. of Radioengineering and Electronics RAS, Russia

We demonstrate the possibility of measuring fast processes using fiber Bragg gratings interrogated by a low-cost DFB laser with wavelength tuned by temperature and pump current modulated at frequencies up to megahertz, which allowed us to achieve registration of fast processes with duration of tens of microseconds. Mechanical oscillations with frequency of 0.5 kHz are measured.

TuR3-p12 15:00-18:30

Multicomponent chalcogenide Pb-based thin films for Mid-IR photodetectors

L.A. Mochalov[1,2], A.A. Logunov[1,2], M.A. Kudryashov[1,2], I.O. Prokhorov[1], M.A. Vshivtsev[1], Yu.P. Kudryashova[1], E.U. Rafailov[3], A.N. Baranov[1,4]; [1]Alekseev Nizhny Novgorod State Technical Univ.; [2]Lobachevsky Univ. of Nizhny Novgorod, Russia; [3]Aston Univ. UK; [4]Univ. of Montpellier, France

PbS1-xSex films of various stoichiometry and phase composition were prepared by plasma-enhanced chemical vapor deposition. The selenium content has a considerable influence on resistivity, carrier concentration, and carrier mobility in PbS1-xSex films.

TuR3-p13 15:00-18:30

Phase-change material based nanolaser

S.I. Lepeshov[1,3], A.A. Vyshnevyy[2], A.E. Krasnok[3]; [1]School of Physics, ITMO Univ.; [2]Center for Photonics and[2]D materials, Moscow Inst. of Physics and Technology, Russia; [3]Department of Electrical and Computer Engineering, Florida International Univ., USA

We propose a design of a nanolaser based on a semiconductor nanoparticle with gain coated with a film of a phase change material switchable between lasing and cloaking (non-scattering) modes at the same operating frequency.

TuR3-p14 15:00-18:30

Obtaining the multispectral grade of ZnS by hot isostatic pressing

R.V. Chkalov, M.N. Gerke, D.A. Kochuev, D.G. Chkalova; Vladimir State Univ., Russia

The paper describes a method for improving the optical characteristics of zinc sulfide using hot isostatic pressing technology. The curves of temperature and pressure for a typical technological process of ZnS processing are given. The result of processing zinc sulfide samples at various operating parameters is shown.

TuR3-p15 15:00-18:30

Features of random lasing of Cr:ZnSe powders

S.V. Kurashkin[1,2], A.P. Savikin[2], O.V. Martynova[2], R. Shahin[2]; [1]Inst. of Chemistry of High-Purity Substances; [2]Nizhny Novgorod State Univ., Russia

Random lasing was obtained on micropowders of zinc selenide activated by divalent chromium ions by pumping with laser radiation at a wavelength of 1.94 μm. The dependences of the spectral composition and shape of the emission spectra of powders with various morphologies on the exciting radiation power density are studied.

TuR3-p16 15:00-18:30

Anisotropic texturing amorphous silicon thin films by femtosecond laser irradiation

S.V. Zabotnov, D.V. Shuleiko, M.N. Martyshov, D.E. Presnov, L.A. Golovan, P.K. Kashkarov; Lomonosov Moscow State Univ., Russia

Femtosecond laser irradiation of amorphous hydrogenated silicon films led to fabrication of periodic surface structures and increases the films dark conductivity up to 4 orders of magnitude due to plasmon-polaritons photoexcitation and formation of Si nanocrystalline phase, respectively. Dark conductivity and photoconductivity anisotropy were revealed in the irradiated films with the anisotropic relief.

This research was supported by RFBR Grant(s) # Russian Science Foundation Grant #22-19-00035

TuR3-p17 15:00-18:30

Design of asymmetric barrier layers for suppression of parasitic recombination in laser diodes with GaAs waveguide

F.I. Zubov[1,2], M.E. Muretova[1], L.V. Asryan[3], Yu.M. Shernyakov[4], M.V. Maximov[1,2], A.E. Zhukov[2,1]; [1]Alferov Univ.; [2]HSE Univ., Russia; [3]Virginia Polytechnic Inst. and State Univ., USA; [4]Ioffe Inst., Russia

We developed a design of a 980 nm laser diode with thin asymmetric barrier layers (ABLs) placed close to both sides of the active region. The use of AlGaAsSb ABL (or alternatively three AlInAs barriers separated by GaAsP spacers of different thicknesses) for blocking electrons and GaInP ABL for blocking holes suppresses parasitic recombination in the waveguide by 99%.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Science Foundation (grant # 22-22-00949, https://rscf.ru/project/22-22-00949/)

TuR3-p18 15:00-18:30

Thermal properties of coupled-waveguide-based semiconductor lasers

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

We show experimentally how, utilizing coupled cavities, one can simultaneously improve the key parameters of diode lasers: internal optical loss and thermal resistance. Obtained results are promising for coming high-power semiconductor lasers.

TuR3-p19 15:00-18:30

Surface emitting ring quantum-cascade lasers made by focused ion beam milling

A.V. Babichev[1], D.A. Mikhailov[2], E.S. Kolodeznyi[1], A.G. Gladyshev[1], G.V. Voznyuk[2], M.I. Mitrofanov[2], S.O. Slipchenko[2], A.V. Lyutetskii[2], V.V. Dudelev[2], V.P. Evtikhiev[2], L.Ya. Karachinsky[1], I.I. Novikov[1], G.S. Sokolovskii[2], N.A. Pikhtin[2], A.Yu. Egorov[3,4]; [1]ITMO Univ.; [2]Ioffe Inst.; [3]Connector Optics LLC; [4]Alferov Univ., Russia

The results on the fabrication and studies of ring quantum-cascade lasers with radiation output through a second-order diffraction grating are presented. The grating was formed over the entire surface of the ring cavity by the focused ion beam milling. Lasing surface-emission was observed near 7.75 μm at room temperature.

This research was supported by RFBR Grant(s) # n/a

TuR3-p20 15:00-18:30

Dual-lobe optical frequency comb laser

A.I. Borodkin[1,2], A.V. Kovalev[2], M. Giudici[1], G. Huyet[1], M. Marconi[1], E.A. Viktorov[2]; [1]Univ. Côte d'Azur, Centre National de La Recherche Scientifique, Inst. de Physique de Nice, France; [2]ITMO Univ., Russia

We report the observation of a dual lobe optical and RF spectrum in the output of a 8 GHz integrated passively mode-locked laser. We demonstrate the independent tuning of the mode beating frequencies of each lobe by applying a RF modulation of the saturable absorber.

This research was supported by RFBR Grant(s) # The work is supported by the Ministry of Science and Higher Education of the Russian Federation, research project no. 2019-1442

TuR3-p21 15:00-18:30

Mathematical modeling of optical amplifier processes with modification of the active area

V.V. Belyaev[1,2], E.R. Kozhanova[3], I.M. Tkachenko[4], A.V. Marusin[1]; [1]Academy of Engineering, Peoples' Friendship Univ. of Russia; [2]Moscow Region State Univ.; [3]Inst. of Electronic Engineering and Instrumentation, Yuri Gagarin State Technical Univ., Russia; [4]École de Technologie Supérieur, Canada

The paper presents the simulation of the design of an optical amplifier on quantum dots, which includes the application of mathematical modeling for the gain recovery process of an optoelectronic device by changing and finding the optimal values of the characteristics and parameters of the active region of the device.

TuR3-p22 15:00-18:30

Influence of spatial characteristics of high-power quantum-cascade laser beams on the fiber-coupling efficiency

V.V. Dudelev[1], D.A. Mikhailov[1], A.V. Babichev[1], E.D. Cherochenko[1], A.G. Gladyshev[2], S.N. Losev[1], I.I. Novikov[3], A.V. Lyutetskiy[1], S.O. Slipchenko[1], N.A. Pikhtin[1], T.V. Sakharova[4], V.G. Artyushenko[4], L.Ya. Karachinsky[3], A.Yu. Egorov[3], G.S. Sokolovskii[1]; [1]Ioffe Inst.; [2]Connector Optics LLC; [3]ITMO Univ., Russia; [4]Art Photonics GmbH, Germany

We study the influence of spatial characteristics of radiation of high-power mid-infrared quantum-cascade lasers on the efficiency of coupling to the optical fiber.

This research was supported by RFBR Grant(s) # This research is supported by RSF (project ID: 21-72-30020)

TuR3-p23 15:00-18:30

Optical properties of rear earth doped chalcogenide glasses near the fundamental absorption band edge

E.A. Romanova[1,2], N.D. Parshina[1], V.I. Kochubey[1], M.V. Sukhanov[2], V.S. Shiryaev[2]; [1]Saratov State Univ.; [2]Inst. of Chemistry of High Purity Substances RAS, Russia

On the base of transmittance and reflectance spectra measurements near the fundamental absorption band edge, optical characteristics of chalcogenide glasses doped with Tb3+ and Dy3+ are obtained and discussed.

TuR3-p24 15:00-18:30

Plasma prepared nanostructured complex oxide materials for advanced UV -visible detectors

L.A. Mochalov[1,2], A.A. Logunov[1,2], M.A. Kudryashov[1,2], I.O. Prokhorov[1], M.A. Vshivtsev[1], E.U. Rafailov[3], Yu.P. Kudryashova[1], Yu.M. Spivak[4], V.A. Moshnikov[4], A.V. Knyazev[2], E.N. Bulanov[2], A.V. Barykin[1]; [1]Alekseev Nizhny Novgorod State Technical Univ.; [2]Lobachevsky Univ. of Nizhny Novgorod, Russia; [3]Aston Univ. United Kingdom; [4]St. Petersburg Electrotechnical University «LETI», Russia

Oxide semiconductors for ultraviolet (UV) - visible detection have attracted attention in recent years. The extreme sensitivity and resolution of these materials, as well as their radiation resistance, are grounds for their potential widespread use in various applications.

TuR3-p25 15:00-18:30

Transverse mode structure of mid-infrared quantum-cascade lasers: experiment and numerical simulations

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

We study the evolution of the transverse mode structure of the high-power mid-infrared quantum-cascade lasers in the near- and far - field with an increase of pump current.

TuR3-p26 15:00-18:30

Near-ultraviolet lasing in ZnO microrod ensemble

A.P. Tarasov, A.S. Lavrikov; Federal Scientific Research Centre "Crystallography and Photonics" RAS, Russia

Near-UV whispering gallery lasing in ZnO microrod ensemble was observed. Low density of lasing microrods grown on side faces of the substrate made it possible to excite lasing in individual crystals. Study of as-grown crystals allowed us to avoid optical losses due to contact of crystals' lasing part with a substrate. Larger-diameter microrods exhibited better lasing performance than smaller-diameter microrods.

TuR3-p27 15:00-18:30

Investigation of Long-Wavelength VCSEL for Microwave Photonics Applications

M.E. Belkin, A.S. Sigov; Moscow Technological Univ. MIREA, Russia

In this paper, a number of potential applications for LW-VCSEL-based microwave photonic devices are proposed and discussed.

TuR3-p28 15:00-18:30

High feedback self-injection-locking and external cavity regime of a semiconductor laser

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

The self-injection locking theories mainly use the weak feedback approximation. We developed a universal theory,that takes into account the secondary reflections from the laser, applicable for a wide range of backscattering values. The limits of applicability of the developed theory was analysed.

TuR3-p29 15:00-18:30

Lateral mode selection in a surface DBR ridge-waveguide laser diode

V.V. Zolotarev, A.E. Rizaev, S.O. Slipchenko, N.A. Pikhtin; Ioffe Inst., Russia

Theoretical studies of lateral mode selection in ridge waveguide laser diode with a surface DBR are presented. The coupling coefficient was calculated for various grating depths, ridge widths, mesagroove depths. The DBR coupling coefficient is different for the TE00 and TE01 modes, which determines the selection. It allows to increase the width of lateral waveguide while maintaining the single-mode generation.

This research was supported by RFBR Grant(s) # The study was supported by the Russian Scientific Foundation (project no. 19-79-30072)

TuR3-p30 15:00-18:30

Influence of waveguide composition on the efficiency of 940-980 nm InGaAs/AlGaAs/GaAs laser diodes

N.V. Gultikov[1], N.A. Volkov[1], K.Y. Telegin[1], T.A. Bagaev[1], A.Yu. Andreev[1], I.V. Yarotskaya[1], A.A. Padalitsa[1], M.A. Ladugin[1], A.A. Marmalyuk[1], L.I. Shestak[2], A.A. Kozyrev[2], V.A. Panarin[2]; [1]Sigm Plus Ltd, Russia; [2]RPE Inject Ltd, Saratov, Russia

Approaches to improve L-I characteristics of laser diodes emitting at 940-980 nm based on InGaAs/AlGaAs/GaAs separate confinement double heterostructures with an asymmetric broadened waveguide are studied. It is shown that a decrease in the mole fraction of AlAs in the waveguide allows improving output characteristics even with a decrease in the QW energy depth.

TuR3-p31 15:00-18:30

Wafer-fused 1300-nm VCSELs with an active region based on superlattice

V.V. Andryushkin[1,2], S.A. Blokhin[3], A.V. Babichev[1,2], A.G. Gladyshev[4], L.Ya. Karachinsky[1,2], I.I. Novikov[1,2], A.A. Blokhin[3], M.A. Bobrov[3], N.A. Maleev[3], S.S. Rochas[2], K.O. Voropaev[5], I.O. Zhumaeva[5], V.M. Ustinov[6], A.Yu. Egorov[1]; [1]Alferov Univ.; [2]ITMO Univ.; [3]Ioffe Inst., Russia; [4]Connector Optics LLC, Russia; [5]JSC OKB-Planeta; [6]Submicron Heterostructures for Microelectronics, Research & Engineering Center, Russia

1300-nm VCSELs based on InGaAs/InGaAlAs superlattice and GaAs/AlGaAs distributed Bragg reflectors are fabricated using molecular-beam epitaxy and wafer-fusion technologies. Single-mode operation at power of 6 mW and open eye diagrams up to 10 Gbps are demonstrated.

TuR3-p32 15:00-18:30

Intracavity difference frequency generation in the GaAs phonon reststrahlen band within two-frequency quantum well GaAs - based lasers

A.A. Dubinov; Inst. for Physics of Microstructures RAS, Russia

We consider the possibility of difference frequency generation in the GaAs phonon reststrahlen band within two-frequency GaAs-based lasers at room temperature. Sufficient generation efficiency is achieved via the resonant increase of GaAs second order nonlinear susceptibility in this spectral range. The outcoupling power conversion efficiency is anticipated to be up to 4−8 1/MW in the laser designs studied.

TuR3-p33 15:00-18:30

Dynamics of a laser diode self-injection locked to a whispering gallery mode microresonator

M.L. Galkin[1,2], E.A. Lonshakov[1], N.M. Kondratiev[1], V.E. Lobanov[1], K.N. Minkov[1], I.A. Bilenko[1,3]; [1]Russian Quantum Center; [2]Skolkovo Inst. of Science and Technology; [3]Lomonosov Moscow State Univ., Russia

We have studied a laser diode self-injection locking to the modes of whispering gallery mode microresonator (WGMM) in a wide range of and derived several regularities allowing locking process optimization. We investigated in detail the optimization process, based on the thermal nonlinearity of the WGMM modes, when the laser frequency is tuned smoothly to the WGMM frequency (adiabatic tuning).

TuR3-p34 15:00-18:30

1550-nm waveband VCSELs made by wafer-fusion technique

S.S. Rochas[1], A.V. Babichev[1], S.A. Blokhin[2], A.G. Gladyshev[3], L.Ya. Karachinsky[1], I.I. Novikov[1], A.A. Blokhin[2], M.A. Bobrov[2], A.G. Kuzmenkov[2], N.A. Maleev[2], N.A. Nevedomsky[2], V.V. Andryushkin[1], K.O. Voropaev[4], I.O. Zhumaeva[4], V.M. Ustinov[5], A.Yu. Egorov[3], V.E. Bougrov[1]; [1]ITMO Univ.; [2]Ioffe Inst.; [3]Connector Optics LLC; [4]JSC OKB-Planeta; [5]Submicron Heterostructures for Microelectronics, Research & Engineering Center RAS, Russia

1550-nm VCSELs with an active region based on ten compressive-strained InGaAs quantum wells, separated by the InP lattice-matched InAlGaAs barrier layers and GaAs/AlGaAs distributed Bragg reflectors are fabricated using wafer-fusion and molecular-beam epitaxy methods. Single-mode operation at output optical power of 4.8 mW, stationary and dynamic characteristics are demonstrated.

TuR3-p35 15:00-18:30

AlGaInN LED pump system for Ti:Sapphire lasers

A.V. Aladov[1], A.E. Chernyakov[1], Yu.V. Fedorova[2], A.E. Ivanov[1], A.L. Zakgeim[1]; [1]Submicron Heterostructures for Microelectronics Research and Engineering Center RAS; [2]ITMO Univ., Russia

Comprehensive studies of the power and spectral˙ characteristics of LEDs in short-pulse modes used for pumping of Ti-Sapphire lasers were carried out. The energy capabilities and spectral properties of LED excitation of Ti-Sapphire were revealed. Designs of LED arrays and a laser head have been developed, the distribution of pumping in the active element have been simulated.

TuR3-p36 15:00-18:30

Free carrier absorption measurement in mid-infrared quantum cascade lasers

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

Free carrier absorption is one of the main parameters affecting the threshold current and optical power in quantum cascade lasers. We demonstrate the technique that allows to measure these optical losses in mid-infrared laser cavity.

This research was supported by RFBR Grant(s) # This research is supported by RSF (project ID: 21-72-30020)

TuR3-p37 15:00-18:30

As -Se:Yb thin films for active Mid-IR optical elements

L.A. Mochalov[1,2], A.A. Logunov[1,2], M.A. Kudryashov[1,2], I.O. Prokhorov[1], M.A. Vshivtsev[1], Yu.P. Kudryashova[1], V.M. Malyshev[1]; [1] Alekseev Nizhny Novgorod State Technical Univ.; [2]Lobachevsky Univ., Russia

The PECVD method was used for the synthesis of IR transparent As-Se films doped with Yb in the range of 1-8 at.%. Dependence of the photoluminescence on the composition of the films was also studied.

TuR3-p38 15:00-18:30

Excitation of surface plasmon resonance in a randomly distributed single-walled carbon nanotube networks and gold nanoparticles for surface-enhanced Raman scattering.

B. Aïssa[1,2]; [1]Space & Photonics Division, MPB Communications Inc., Canada; [2]Qatar Environment and Energy Research Inst. (QEERI), Hamad Bin Khalifa Univ., Qatar Foundation, Qatar

Au nanoparticles (NPs) were deposited onto a laser-ablated SWCNT random network for SERS. The Raman spectroscopy of these Au-decorated SWCNTs networks shows a scattering enhancement factor of the order of 1×E3 and is Au-NPs surface density dependent. This effect is tunable through the number of laser ablation pulses employed in this Laser ablation process.

TuR3-p39 15:00-18:30

Effect of current localization on the output optical power in high-power laser thyristors based on AlGaAs/GaAs/InGaAs heterostructures

P.S. Gavrina[1], A.A. Podoskin[1], I.V. Shushkanov[1], O.S. Soboleva[1], I.V. Miroshnikov[1], S.O. Slipchenko[1], N.A. Pikhtin[1], T.A. Bagaev[2], M.A. Ladugin[2], A.A. Marmalyuk[2], V.A. Simakov[2]; [1]Ioffe Inst.; [2]Stel'makh Research and Development Inst. "Polyus", Russia

The operation of a semiconductor laser-thyristor based on AlGaAs/GaAs/InGaAs heterostructures with a p-GaAs base thickness of 4.4 μm was studied. At the same supply voltage of 22 V, the drive current amplitude of 138 mA gives a more noticeable current localization near mesa-stripe edge in comparison with the case of the drive current of 1 mA.

This research was supported by RFBR Grant(s) # RSF 19-79-30072

TuR3-p40 15:00-18:30

Multiplets generation in a semiconductor laser diode subject to delayed optoelectronic feedback

Md Shariful Islam[1, 2], G.O. Danilenko[3], A.V. Kovalev[3], E. A. Viktorov[3], A. Locquet[1, 2], D. S. Citrin[1, 2]; [1]Georgia Tech Lorraine, France; [2]Georgia Inst. of Technology, USA; [3]ITMO Univ., Russia

Positive time-delayed optoelectronic feedback in a multiple-quantum-well semiconductor laser diode is found to produce pulsing at loop-delay repetition rate for injection current slightly below threshold. Double pulsing and gradual clustering around Jth with an increasingly higher number of pulses are noticed. The experimental observations confirm the existence of three distinct regimes in the laser dynamics with delayed optoelectronic feedback.

TuR3-p41 15:00-18:30

Improving the efficiency of terahertz antennas on topological insulators

P.M. Kovaleva[1], K.A. Kuznetsov[1], D.V. Lavrukhin[2], A.A. Klochkov[3], Yu.G. Goncharov[2], P.I. Kuznetsov[4], G.Kh. Kitaeva[1]; [1]Lomonosov Moscow State Univ.; [2]Prokhorov General Physics Inst. RAS; [3]Moscow Engineering Physics Inst.; [4]Kotelnikov IRE RAS, Russia

We study photoconductive antennas based on thin film of topological insulator and semiconductor heterostructure. A shift of the spectrum of a dipole antenna on a topological insulator to the long-wavelength region was found in comparison with a similar semiconductor antenna.

This research was supported by RFBR Grant(s) # Russian Science Foundation Grant No. 22-22-00758

TuR3-p42 15:00-18:30

Ultraviolet photodetectors based on high-quality molybdenum disulphide films for biosensing applications

S.J. Park, B.C. Kang, T.J. Ha; Kwangwoon Univ., Republic of Korea

We will demonstrate visible-blind UV photodetectors based on high-quality MoS2 films for biosensing applications. The sensitivity and selectivity of the UV photodetector were investigated by performing current-voltage measurements under in-situ illumination of white, blue, and UV. We will also discuss the optical mechanism of charge transfer on the MoS2 surface when irradiated by various light sources with photon flux.

TuR3-p43 15:00-18:30

Co:$MgAl_2O_4$ ceramic saturable absorbers fabricated by pressure slip casting and HIPing

V. Vitkin[1], P. Loiko[2], L. Basyrova[2], A. Polishchuk[1], D. Zavirukha[1], J. Klimke[3], A. Goldstein[4]; [1]ITMO Univ., Russia; [2]Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Univ. de Caen Normandie, France; [3]Polycrystal Design GmbH, Germany; [4]Israel Ceramic and Silicate Inst., Technion City, Israel

Transparent cobalt-doped spinel ceramics 0.02 – 0.1 at.% Co:MgAl2O4 were fabricated by Hot Isostatic Pressing using green bodies formed by pressure slip casting. Their microstructure, optical and spectroscopic properties were studied. For the 0.02 at.% Co-doped ceramic, the saturation fluence at 1535 nm is 0.36 J/cm2 and the laser induced damage threshold is about 4 J/cm2.

TuR3-p44 15:00-18:30

Influence of the alpha factor on the dynamics of wide-aperture lasers with external optical injection

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

In this paper, we consider a system describing the dynamics of a vertical cavity laser with allowance for the Henry factor. The influence of the alpha factor on this system is investigated and the stabilizing effect of optical injection is confirmed.

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

TuR3-p45 15:00-18:30

Far field dynamics of strongly coupled narrow stripe ridge-waveguide laser arrays (1060 nm)

I.S. Shashkin, S.O. Slipchenko, D.N. Romanovich, O.S. Soboleva, V.A. Strelets, V.A. Kapitonov, K.V. Bakhvalov, A.E. Kazakova, E.V. Fomin, N. A. Pikhtin, P.S. Kop`ev; Ioffe Inst., Russia

The temporal behavior of the far field is studied for a laser array (λ=1060nm) based on InGaAs/AlGaAs/GaAs. An array of ridge-waveguide lasers demonstrates that despite the strong optical coupling between adjacent array elements the lateral far fields only slightly varies in width at half maximum by ±0.5° at different moments of the pulse (130ns/1kHz) at pump current amplitude of 5A.

This research was supported by RFBR Grant(s) # RSF 19-79-30072

TuR3-p46 15:00-18:30

Numerical simulation of selective Laser-Assisted Bonding (LAB) process for photonic integration

A.E. Aydin, A.A. Vlasov, T. Uusitalo, H. Virtanen, S.-P. Ojanen, J. Viheriälä, M. Guina; Optoelectronics Research Center (ORC), Physics, Tampere Univ., Finland

The need for high-speed telecommunication networks and higher performance optical devices require optical components integration methods. This work is related to numerical simulation of selective laser-assisted bonding process parameters for implementation in photonic integration applications. The results are of great help for the development of reliable and safe bonding process for a wide range of devices and setup parameters.

TuR3-p47 15:00-18:30

High-power ridge-waveguide laser diodes and highly dense arrays with stable lateral far field based on them (1060nm)

S.O. Slipchenko, I.S. Shashkin, N.V. Voronkova, A.D. Bondarev, D.N. Nikolaev, A.V. Lyutetskiy, A.Y. Leshko, N.A. Pikhtin, P.S. Kop`ev; Ioffe Inst., Russia

Ridge-waveguide semiconductor lasers operating in CW up to 500 mW with one TE00 mode and up to 2 W with few TE modes at RT are demonstrated. Highly dense arrays with stable Gaussian lateral far field (10 emitters, 200 μm total aperture) are shown to demonstrate 5 W in CW and 25 W in pulsed mode at RT.

This research was supported by RFBR Grant(s) # RSF 19-79-30072

TuR3-p48 15:00-18:30

Gain switching sub-ns pulse laser diode optimization for time-of-flight laser rangefinding

V.S. Golovin, S.O. Slipchenko, A.A. Podoskin, M.G. Rastegaeva, N.A. Pikhtin; Centre of Nanoheterostructure Physics, Ioffe Inst., Russia

The problem of designing laser heterostructures for generating sub-ns laser pulses of a given duration with a maximum peak power in the gain-switching mode is considered. An algorithm for numerical multiparameter optimization based on lumped rate equations is proposed.

This research was supported by RFBR Grant(s) # The study was supported by the Russian Scientific Foundation (project no. 19-79-30072)

TuR3-p49 15:00-18:30

Calculation of the Characteristics of Pulse High-power GaAs-based Semiconductor Lasers

Yu.K Kirichenko, D.A. Veselov, Z.N. Sokolova, L.S. Efremov, A.E. Rizaev, S.O. Slipchenko, N.A. Pikhtin; Ioffe Inst., Russia

The results of the laser diode power characteristics calculations are presented. We have developed a mathematical model capable of calculating the internal optical loss and output optical power dependences for semiconductor lasers operating in pulse mode at high current levels.

TuR3-p50 15:00-18:30

Analysis of turn-on delay of quantum cascade lasers under pulsed pumping with linear front edge

K.V. Kusakina[1,2], G.S. Sokolovskii[3,2]; [1]Lomonosov Moscow State Univ.; [2]Lobachevsky Univ., Nizhny Novgorod; [3]Ioffe Inst., Russia

We analyze turn-on delay of quantum cascade lasers under pulsed pumping with linear front edge. The analytical results are in a good qualitative agreement with numerical simulations.

TuR3-p51 15:00-18:30

Unipolar heterostructures with effective interband radiative recombination under current pumping

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

Design principles of isotype heterostructures for efficient interband recombination under electric current pumping are developed. Transport and radiative recombination features are studied for the InGaAs/AlGaAs/GaAs isotype heterostructure using the energy balance model.

TuR3-p52 15:00-18:30

Analysis and application of multilayer mirror coatings for quantum cascade lasers in the spectral range of 4-9 microns

K.A. Podgaetskiy, A.V. Lobintsov, M.A. Ladugin, A.A. Marmalyuk; Stel'makh Research Inst. Polyus, Russia

This work presents the results of numerical calculations of mirror coatings for quantum cascade lasers (QCLs) at wavelengths of 4.5 μm and 8 μm. The advantages and disadvantages of dielectric and metal-dielectric mirrors are analyzed. It was shown that the output optical power increased by 1.5 times after applying a mirror coating on the back facet of the QCL.

TuR3-p53 15:00-18:30

Hybrid and integrated laser-thyristors with one and three emitting sections

A.I. Zhelnin[1], T.A. Bagaev[1], N.V. Gultikov[1], M.A. Ladugin[1], A.A. Marmalyuk[1], Yu.V. Kurnyavko[1], V.V. Krichevskii[1], A.A. Morozyuk[1], V.P. Konyaev[1], V.A. Simakov[1], S.O. Slipchenko[2], A.A. Podoskin[2], N.A. Pikhtin[2], A.E. Kazakova[2], D.N. Romanovich[2], V.A. Kryuchkov[2]; [1]JSC "Research inst. "Polyus" them. M.F.Stelmah"; [2]Ioffe Inst. RAS, Russia

High-power hybrid semiconductor lasers – thyristors (λ = 900 – 920 nm) consisting of thyristor crystals soldered in series with an integrated semiconductor laser with one and three emitting sections are studied. The output characteristics of optimal source (hybrid laser-thyristor with three emitting sections) is P = 73 W, t= 6.4 ns, f = 100 kHz.

R6: Lasers and Systems for Imaging, Green Photonics and Sustainability

TuR6-p01 10:00-13:30

Ghost imaging based on broadband Terahertz radiation

A.O. Ismagilov, A.K. Lappo-Danilevskaya, Y.V. Grachev, L.S. Leibov, B.A. Nasedkin, V.V. Zalipaev, O.A. Tcypkina, N.V. Petrov, A.N. Tcypkin; ITMO Univ., Russia

In this work we present our research on possibility of speckle structures formation by propagation broadband terahertz radiation through transparent object with phase inhomedinity and their utilizing for realisation of ghost imaging technique. Numerically shown the possibility of successful use of spectrally resolved THz field amplitude distributions in the ghost imaging algorithm.

This research was supported by RFBR Grant(s) # This work was supported by the Ministry of Science and Education of the Russian Federation (Passport No.2019-0903)

TuR6-p02 10:00-13:30

Spectral diagnostics of spherical laser plasma expansion in a magnetic field and vacuum

M.S. Rumenskikh, M.A. Efimov, A.A. Chibranov, A.G. Berezutsky, P.A. Trushin, V.G. Posukh, I.F. Shaikhislamov; Inst. of Laser Physics (ILP SB RAS), Russia

Spherical expansion of a laser plasma in a magnetic field and vacuum was explored with using spectral diagnostics. A nontrivial dependence of the luminosity of various spectral lines on external conditions was found. A shift of the maxima and inhomogeneous line broadening were observed, which indicates a nontrivial plasma flow in presence of magnetic field.

This research was supported by RFBR Grant(s) # 19-02-00993, 18-29-21018, project of the Ministry of science and higher education of the Russian Federation (№121033100062-5)

TuR6-p03 10:00-13:30

Time-lapse microscopy of polyamine-immobilized diatoms: towards novel biosensors

E.E. Lebedev, D.S. Andreyev; Univ. of Tyumen, Russia

We present a low-cost biomonitoring system based on the movement of diatom organelles and diatom replication. Monitoring of organelle motion in the immobilized mother cell, unbound thecae structure and offspring cells provide multi-factor insight to environment composition. The monitoring require only a smartphone, a lens-clip and a replaceable "cartridge" with a microfluidic circuit and immobilized cells.

TuR6-p04 10:00-13:30

Development, creation and research of a laboratory model of a pulsed 3D-lidar based on the SPAD array

P.A. Goncharov[1], A.P. Mineev[1], S.M. Nefedov[1], O.M. Stelmakh[1], V.M. Gontar[2], A.N. Matazov[2], V.G. Voronkin[2], V.A. Zimoglyad[2]; [1]GPI RAS, Russia; [2]"UniqueICs" Ltd., Russia

Article presents the results of the development of a pulsed 3D-lidar, based on an 8x16 APD array. On the tests at a distance ~10 m accuracy is 3–5 cm. Such devices can have a wide range of possible applications, from UV to space navigation, to ensure the safe landing of automatic spacecraft on the surface of planets.

TuR6-p05 10:00-13:30

Laser monitors for imaging in visible and near-infrared spectrum ranges.

M.V. Trigub; Laboratory of Quantum Electronics, Inst. of Atmospheric Optics SB RAS, Russia

The paper presents active optical systems with gas optical signal amplifiers. The media on metal halide vapors is used as brightness amplifiers. The use of the CuBr and MnCl2 with high PRF power supplies allows building laser monitors operated in two spectrum ranges - visible and near-infrared. main features are discussed. Some fields of applications are determined.

TuR6-p06 10:00-13:30

Fully biodegradable solar cells for environmental sensors

A.G. Bakanov, A.N. Bobylev, N.O. Azarapin, D.S. Andreyev; Univ. of Tyumen (UTMN), Russia

Here we present a cheap and practical method to create eco-friendly fully biodegradable photovoltaic cells based on thin-layer ITO structures covered with a photoactive layer of natural anthocyanin dyes applied on flexible cellulose films with efficiency coefficient up to 13 %.

TuR6-p07 10:00-13:30

Airflow turbulence testing by decomposition of the wavefront of probing laser radiation by Zernike polynomials

A.L. Rukosuev[1], A.N. Nikitin[1], V.N. Belousov[1], J.V. Sheldakova[1], V.V. Toporovsky[1], A.V. Kudryashov[1,2]; [1]Sadovsky Inst. of Geosphere Dynamics RAS; [2]Moscow Polytechnic Univ., Russia

The results of experiments on probing the thermal airflow by laser radiation are presented. The reconstruction of the laser radiation wavefront was carried out using Zernike polynomials. Statistical processing of the sample using the Fourier transform made it possible to determine the bandwidth occupied by each polynomial, as well as the amplitude of individual aberrations

TuR6-p08 10:00-13:30

Monitoring of alloying components burnout during laser powder cladding by Laser-induced breakdown spectroscopy

K.A. Frolov, A.A. Voznesenskaya, D.S. Gusev, D.A.Kochuev, A.B. Lyukhter, A.V. Zavitkov; Vladimir State Univ., Russia

The paper describes the application of the Laser-induced breakdown spectroscopy method for monitoring the burnout of alloying elements during laser powder cladding. The diagram of the installation for this diagnosis is presented. The features of the process of obtaining apectral signal suitable for analysis are described

TuR6-p09 10:00-13:30

Ultracompact fluorescence LIDAR for drone based autonomous monitoring in agriculture

V.N. Lednev[1], M.Ya. Grishin[1], P.A. Sdvizhenskii[1], S.M. Pershin[1], V.A. Zavozin[1], R.K. Kurbanov[2], M.A. Litvinov[2]; [1]Prokhorov General Physics Inst. RAS; [2]Federal Scientific Agroengineering Center VIM, Russia

Ultracompact (~300 g) fluorescence LIDAR have been developed and installed at airborne drone for remote sensing of vegetation. LIDAR was based on diode laser (405 nm, 150 mW) and ultracompact diffraction spectrometer but the instrument acquired fluorescence spectra from a 3 m distance. The field tests have demonstrated the prospects of autonomous lidar monitoring for early crop disease detection.

TuR6-p10 10:00-13:30

Application of phase-shifting interferometry to analyze the dynamics of UV photochemical degradation of organic pollutants on the TiO_2 surfaces in aqueous medium

E.V. Dorofeeva[1], I.S. Manuylovich[2], P.Yu. Lobanov[2], O.E. Sidoryuk[2]; [1]Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS; [2]Stel'makh R&D Inst. "Polyus", Russia

Photocatalytic heterogeneous oxidation of aliphatic and aromatic compounds is studied using the method of laser phase-shifting interferometry. The TiO2 samples were subjected to UV irradiation in cuvettes with aqueous solutions of organic impurities with monitoring of the distributions near their surface. The approach is convenient for evaluating the efficiency of various catalysts and improves understanding of the photocatalytic oxidation mechanism.

TuR6-p11 10:00-13:30

Analysis of hartmannogram images for scattered laser beam focusing by means of high-resolution stacked-actuator mirror

I.V. Galaktionov, V.V. Toporovsky, J.V. Sheldakova, A.V. Kudryashov; Inst. of Geosphere Dynamics (IDG RAS), Russia

In this paper we demonstrate the use of the high-resolution stacked-actuator deformable mirror with 61 actuators on the round 60 mm aperture for focusing of a laser beam propagated through the relatively thick layer of a moderately scattering medium.

This research was supported by RFBR Grant(s) # State assignment of Ministry of Science and Higher Education of the Russian Federation No1021052706254-7-1.5.4

TuR6-p12 10:00-13:30

10 decades range of SF_6 laser photo-acoustic gas analyzer

I.V. Sherstov[1,2], V.A. Vasiliev[1]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State Univ., Russia

A laser photoacoustic SF6 gas analyzer based on a waveguide RF-excited CO2 laser and a resonant differential photo-acoustic detector has been developed. The dynamic range of SF6 concentration measurements was from ~0.1 ppb to 100% (~10 decades).

This research was supported by RFBR Grant(s) # Russian Science Foundation grant 17-72-30006

TuR6-p13 10:00-13:30

Combined laser ultrasound and photoacoustic real-time tomography

V.A. Simonova[1,2], A.S. Bychkov[3], I.A. Kudinov[3], A.A. Karabutov[2,3]; [1]Dukhov Automatics Research Inst. (VNIIA); [2]Wave Research Center Prokhorov General Physics Inst. RAS; [3]The National Univ. of Science and Technology MISiS, Russia

Combined LU and PA real-time imaging integrated into one system with toroidal sensors array for multimodal imaging of investigated object.

TuR6-p14 10:00-13:30

Hardware-software complex for emulation of laser radiation wavefront tilts at the stand of the adaptive optical system

L.V. Antoshkin, A.G. Borzilov, V.V. Lavrinov, L.N. Lavrinova, A.A. Selin; Zuev Inst. of Atmospheric Optics SB RAS, Russia

In this work are presented software and hardware emulation of the tilt of the wavefront of optical radiation that involves the reproduction of premodeled tilt t and their elimination from the radiation image in the focal plane.

TuR6-p15 10:00-13:30

Numerical analysis of algorithms for centering the optical radiation image in the focal plane

L.V. Antoshkin, V.V. Lavrinov, L.N. Lavrinova, A.A. Selin; Zuev Inst. of Atmospheric Optics SB RAS, Russia

This work presents the results of evaluating algorithms that determine the coordinates of the energy center of gravity of the focal spot within the recorded intensity distribution.

TuR6-p16 10:00-13:30

Supercontinuum based multiwavelength computational ghost imaging

E.N. Oparin, V.S. Shumigai, A.V. Chernykh, B.A. Nasedkin, A.N. Tcypkin; ITMO Univ., Russia

One of the main ghost imaging technique drawbacks is the low speed of image reconstruction. We have proposed to use supercontinuum as a light source for computational ghost imaging. The use of multiple wavelengths will allow to speed up the reconstruction process. This makes the proposed technique more attractive for high-speed demanding applications such as communication and remote sensing.

TuR6-p17 10:00-13:30

2D temperature field reconstruction using OFDR and machine learning algorithms

A.A. Wolf[1], N.A. Shabalov[1,2], A.Yu. Kokhanovskiy[2], V.A. Kamynin[3], S.A. Babin[1]; [1]Inst. of Automation and Electrometry SB RAS; [2]Novosibirsk State Univ.; [3]Prokhorov General Physics Inst. RAS, Russia

We present experimental result on 2D temperature field reconstruction on the surface of the aluminum plate with embedded optical fiber. The principle of reconstruction is based on the backscattering optical signal processing by a trained machine-learning algorithm.

TuR6-p18 10:00-13:30

Eye safe laser rangefinder for transport safety

V.M. Polyakov, K.V. Fomichev, I.N. Kaliteevsky; "GK R-AERO" Ltd Co, Russia

We develop an ultracompact and lightweight eyesafe laser rangefinder for distances up to 10 km. It gives 0,5 m RMS accuracy at distances up to 5 km and 1 m RMS accuracy up to 8 km. The design is robust and vehicle capable. The dimensions are 90x60x40 mm, weight is 200 g. Repetition rate is up to 5 Hz.

TuR6-p19 10:00-13:30

LED and laser induced fluorescence in situ methodfor downhole fluid analysis for contaminationmonitoring

A.S. Bobe[1,2], A.L. Pavlova[1,3], V.M. Polyakov[1,3]; [1]Geophotonica, [2]ITMO Univ., [3]GK "R-AERO" ltd Co., Russia

A method and criterion of qualitative analysis of downhole fluid composition based on LED and laser induced fluorescence in laboratory conditions is proposed. The results can be utilized in situ at specifed conditions of 150 °C and 100 MPa in the downhole analysis systems.

TuR6-p20 10:00-13:30

Fluid fraction spectroscopic analysis with artificial neural network

S.A. Temnova[1], A.S. Bobe[1,2], S.I. Tomashevich[1,2], V.M. Polyakov[2]; [1]ITMO Univ.; [2]Geophotonica Ltd Co, Russia

Downhole analyzer of fluid was used to obtain optical density spectral distributions for the different fluid compounds. Convolutional neural network was used to analyze and classify 70% of the obtained spectrograms as a training set. The rest spectrograms were used as a test set, recognition accuracy was obtained about 98%.

TuR6-p21 10:00-13:30

Terahertz security vision system in pandemic environment

G.S. Rogozhnikov[1], V.V. Kostromykina[1,2], A.A. Skrybykina[1,2]; [1]FSUE "Russian Federal Nuclear Center - VNIIEF"; [2]Lomonosov Moscow State Univ., Sarov branch, Russia

We developed a testbed that helped to measure the transmission of different means of individual protection in the 2mm wavelength range, reflection of THz waves by human skin and absorption of THz waves by exhalted air. Using this testbed we managed to recover the relief of human face hidden behind the opaque materials.

TuR6-p22 10:00-13:30

Design of high spectral analyzing system for ozone depleting substances based on Raman spectroscopy

E.P. Tyurikova, M.A. Kustikova, S.Z. Fakhrtdinova; ITMO Univ., Russia

The work is devoted to the development of identification system for refrigerants related to ozone-depleting substances. Calculation and experimental studies were performed to design a system block diagram. The installation includes two laser sources with different wavelengths. Based on the diagram, the identification algorithm of ozone-depleting substances was described.

R7: Free Electron Lasers

TuR7-p01 10:00-13:30

Dislocation activity of micro-bubbles in sapphire shaped crystals detected using Synchrotron Radiation

Zh.V. Gudkina[1,2], A.D. Moiseenko[1,3], M.Yu. Gutkin[2,3,4], T.S. Argunova[1]; [1]Ioffe Inst. RAS; [2]ITMO Univ.; [3]Peter the Great St. Petersburg Polytechnic Univ.; [4]Inst. of Problems of Mechanical Engineering RAS, Russia

We present the approach to evaluating critical strains for the basal plane slip in sapphire ribbons. Using computer simulations to calculate the elastic sresses around a spherical micro-bubble, we have obtained actual bubble size which is below the resolution limit of conventional optical microscopes. Matching synchrotron phase-contrast images and x-ray diffraction topographs confirms the generation of dislocations at the bubbles.

This research was supported by RFBR Grant(s) # № 19-29-12041

TuR7-p02 10:00-13:30

XPS study of halide perovskites electronic structure from core-level to valence band

S. Khubezhov, A.P. Pushkarev, S.V. Makarov; Lebedev Physical Inst. RAS, Russia

The lecture focused on the review of the surface analysis method - X-ray photoelectron spectroscopy (XPS). There has been presented the practical application of XPS in various fields of science, engineering and technology, in particular, the study of the electronic properties of halide perovskites.

TuR7-p03 10:00-13:30

The interest of synchrotron x-ray microtomography for the study of defects in sapphire articles fabricated by bulk crystallization

A.D. Moiseenko[1,2], T.S. Argunova[1], V.M. Krymov[1]; [1]Ioffe Inst. RAS; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

We present a Synchrotron X-ray tomography investigation of sapphire crystals of a complicated shape. The Stepanov concept of crystal shaping while the growth from the melt allows avoiding tooling and loss of material. The present communication deals with the distributions of defects in sapphire tubes and ribbons. We approve that microtomography provides the non-destructive visualization of micro-sized gas inclusions.

This research was supported by RFBR Grant(s) # RFBR, project no. 19-29-12041 mk

TuR7-p04 10:00-13:30

X-ray structural analysis in the study of biopolymer polyelectrolyte materials

A. Podshivalov; ITMO Univ., Russia

The lecture is devoted to a review of current scientific data on the use of X-ray diffraction analysis methods in the study of the supramolecular and molecular structure of materials based on biopolyelectrolytes. The lecture will cover aspects of the analysis of the crystal structure and phase contrast of biopolymer matrices based on polyelectrolytes, including multicomponent ones, using X-ray emitting.

This research was supported by RFBR Grant(s) # Ministry of Science and Higher Education of the Russian Federation (agreement № 075-15-2021-1349)

TuR7-p05 10:00-13:30

X-ray resonant reflectometry as a multifunctional synchrotron method for studying magnetic nanofilms

S.M. Suturin, P.A. Dvortsova, A.M. Korovin; Ioffe Inst., Russia

X-ray resonant magnetic reflectometry is a synchrotron based non-destructive method of investigation of electronic and magnetic depth profiles in nanoscale multilayers. The choice of photon energy close to the absorption edges makes it selective to oxidation state, environment and magnetization of individual elements. An enhanced technique to acquire and model the angle-energy reflectance maps is discussed in the present contribution.

TuR7-p06 10:00-13:30

Ferroelectric to incommensurate fluctuations crossover in PbHfO3-PbSnO3

M.A. Kniazeva[1], A.E. Ganzha[1], I. Jankowska-Sumara[2], M. Paściak[3], A. Majchrowski[4], A.V. Filimonov[1,5], K. Roleder[6], R.G. Burkovsky[1]; [1]Peter the Great St. Petersubrg Polytechnic Univ., Russia; [2]Inst. of Physics, Pedagogical Univ. of Cracow, Poland; [3]FZU - Inst. of Physics CAS, Czech Republic; [4]Inst. of Applied Physics, Military Univ. of Technology, Poland; [5]Alferov Univ., Russia; [6]Inst. of Physics, Univ. of Silesia, Poland

TuR7-p07 10:00-13:30

On the possibility of modeling of photon-photon interaction at the European X-ray Free Electron Laser.

A.N. Popov[1], S.V. Bobashev[1], K.I. Rachkov[2], N.O. Bezverkhnii[1], A.A. Sorokin[1,3]; [1]Ioffe Inst.; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia; [3]DESY, Germany

The possibility of performing the experimental research in the field of fundamental physics based on European X-ray Free Electron Laser is considered. The calculations of the reaction $\gamma + \gamma \rightarrow e+ + e-$ cross section for gamma quanta with $E \sim (1-100)$ GeV energy with X-ray photons are performed. The possibility of experimental registration of reaction product are reviewed.

TuR7-p08 10:00-13:30

Design of morphology and physical properties of chitosan-gelatin nanofibers by coaxial electrospinning

M.Yu. Litvinov, A.V. Podshivalov; ITMO Univ., Russia

Chitosan and gelatin solutions were subjected to coaxial electrospinning. The formation of core-sheath nanofibers with an average diameter from 79 to 90 nm was shown. According to the analysis of the mechanical properties of nanofiber materials, a twofold increase in the Young's modulus was revealed with an increase in the content of acetic acid from 50 to 90 vol.%.

R1: Solid State Lasers

Fiber lasers

Location: Stenberg 2 Room, floor 3. 09:00-11:00

WeR1-14 09:00-09:15

Cladding-pumped bismuth-doped fiber laser with brightness enhancement

A.S. Vakhrushev, A.V. Kharakhordin, Ya.Zh. Ososkov, A.M. Khegai, S.V. Alyshev, K.E. Riumkin, E.G. Firstova, M.A. Melkumov, S.V. Firstov; Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center, Russia

We present results on the bismuth-doped fiber laser that acts not only as a wavelength converter, but also as a brightness converter. The output characteristics of a Bi-doped fiber laser cladding-pumped by multimode laser diodes at a wavelength of 808 nm were investigated.

WeR1-15 09:15-09:30

Self-sweeping Er-doped ring fiber laser with sweeping direction control

N.R. Poddubrovskii[1,2], I.A. Lobach[1], S.I. Kablukov[1]; [1]Inst. of Automation and Electrometry SB RAS, Russia; [2]Novosibirsk State Univ., Russia

We present here a self-sweeping Er-doped ring fiber laser generating near 1606 nm with possibility of sweeping rate and direction control by pump power variation. Reverse and normal self-sweeping operations with sweeping rates of -1 and 0.5 pm/s are observed at low and high pump powers respectively. The developed laser source can be in demand for sensor applications.

WeR1-16 09:30-09:45

Fiber Bragg grating interrogattion based on self-sweeping Yb-doped ring fiber laser

R.V. Drobyshev, A.Y. Tkachenko, I.A. Lobach, S.I. Kablukov; Inst. of Automation and Electrometry of SB RAS, Russia

We demonstrate a fiber Bragg grating (FBG) interrogation technique based on a self-sweeping Yb-doped ring fiber laser. The laser generates a sequence of single-frequency with rectangular pulses with optical frequency step ~ 10 MHz and quasi-CW intensity dynamics. An FBG spectrum is measured. It is comparable with spectrum obtained with a standard optical spectrum analyzer.

WeR1-17 09:45-10:00

900 nm wavelength band all-fiber polarization maintaining mode-locked laser

A.A. Mkrtchyan[1], M.S. Mischevsky[1], Y.G. Gladush[1], M. Melkumov[2], A. Khegai[2], K. Sitnik[1], P.G. Lagoudakis[1], A.G. Nasibulin[1,3]; [1]Skolkovo Inst. of Science and Technology, Russia; [2]Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center, Russia; [3]Aalto Univ., Department of Chemistry and Materials Science, Finland

Here we demonstrate for the first time all-fiber polarization-maintaining mode-locked rectangular shape pulse laser operating at 905 nm wavelength in NALM scheme. Numerical simulation showed perfect correspondence of obtained pulses to dissipative soliton resonance regime.

This research was supported by RFBR Grant(s) # 20-32-90233

WeR1-18 10:00-10:15

5.2 Microns Tb^{3+}-doped chalcogenide glass fiber laser

V.V. Koltashev[1], V.G. Plotnichenko[1], B.I. Denker[2], B.I. Galagan[2], S.E. Sverchkov[2], G.E. Snopatin[3], M.V. Sukhanov[3], A.P. Velmuzhov[3]; [1]Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center; [2]Prokhorov General Physics Inst. RAS; [3]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

5.2 μm laser was built on the basis of Tb3+ doped high purity chalcogenide glass fiber. Laser action was obtained in 5-36 cm long fibers with variable output mirrors as well as without any outcoupler due to 15 % Fresnel reflection from the fiber end. The highest peak output power reached 30 mW.

WeR1-19 10:15-10:30

Efficient approach for gain spectrum management of Bi-doped fibers

A.M. Khegai[1], A.S. Lobanov[2], Y.Zh. Ososkov[1], A.S. Vakhrushev[1], K.E. Riumkin[1], A.V. Kharakhordin[1], S.V. Alyshev[1], E.G. Firstova[1], A.N. Guryanov[2], M.A. Melkumov[1], S.V. Firstov[1]; [1]Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center ; [2]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

We present an efficient approach to manage the optical properties of Bi-doped phosphosilicate fibers by means of phosphorus content in the fiber core. Changing the concentration of phosphorus, we managed to vary the ratio between two types of bismuth active centers associated with silicon and phosphorus and, as a result, significantly modify gain characteristics.

WeR1-20 10:30-10:45

Sweeping range optimization in Er-doped self-sweeping fiber laser

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

We report here about self-sweeping range optimization in an erbium-doped fiber laser generating in the telecom L-band near 1603 nm. The cavity mirror reflection coefficient and the pump wavelength are varied during the optimization. The maximum scanning range obtained is 3.4 nm at the pump wavelength of 1548 nm and the mirror reflection coefficient of ~ 36%.

This research was supported by RFBR Grant(s) # Russian Science Foundation (Grant No. 18-12-00243)

WeR1-21 10:45-11:00

New designs of Bi-doped fibers for efficient optical devices operating near 1400-1500 nm

S.V. Alyshev[1], A.A. Umnikov[2], A.S. Lobanov[2], A.V. Kharakhordin[1], A.S. Vakhrushev[1], K.E. Riumkin[1], E.G. Firstova[1], A.N. Guryanov[2], M.A. Melkumov[1], S.V. Firstov[1]; [1]Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center; [2]Devyatyh Inst. of Chemistry of High-Purity Substances RAS, Russia

We proposed new designs of Bi-doped germanosilicate fibers, which allowed us to create a Bi-doped fiber laser with a record efficiency of 72%, and a 20-dB Bi-doped amplifier with a pump power of 45 mW having a high-gain efficiency of 0.52 dB/mW.

– Break –

Optical materials, spectroscopy

Location: Stenberg 2 Room, floor 3. 11:30-13:30

WeR1-22 11:30-11:45

Narrowing of the generation line of a DFB laser to subhertz width in hybrid configuration

M.I. Skvortsov, S.R. Abdullina, A.A. Wolf, A.V. Dostovalov, A.A. Vlasov, E.V. Podivilov, S.A. Babin; Inst. of Automation and Electrometry SB RAS, Russia

We present the results of characterization of the linewidth of distributed feedback (DFB) fiber laser based on pi-phase-shifted fiber Bragg grating with additional random DFB provided by fiber spool spliced to the DFB laser. It is shown that for a hybrid resonator, the linewidth becomes more than two orders of magnitude narrower than the linewidth of DFB laser.

This research was supported by RFBR Grant(s) # Gratn of Russian Science Foundation (21-72-30024)

WeR1-23 11:45-12:00

Magneto-optical materials for Faraday isolators operating at the laser wavelength of ~2 μm

I.L. Snetkov; Inst. of Applied Physics RAS, Russia

High-power laser radiation greatly affects the Faraday isolators (FI) characteristics, thereby significantly narrowing the choice of magneto-optical materials. The report provides an overview of promising magneto-optical materials for the manufacture of FI operating at the laser radiation ~2 μm, results of recent studies of their properties, and some results of the study of the realized FI based on such materials

This research was supported by RFBR Grant(s) # 19-2911019

WeR1-24 12:00-12:15

High-purity Ga(x)Ge(40-x)S(60) and Ga(x)Sb(40-x)S(60) glasses as promising materials for laser optics

A.P. Velmuzhov, M.V. Sukhanov, B.S. Stepanov, S.V. Mishinov, L.A. Ketkova; IChPS RAS, Russia

New methods for preparation high-purity glasses of Ga-Ge-S and Ga-Sb-S systems with a low content of hydrogen, oxygen impurities and heterogeneous inclusions have been developed. A comprehensive study of the glasses properties has been carried out. The optimal compositions of glasses for use in fiber optics have been determined.

WeR1-25 12:15-12:30

Thulium ion pair enriched saturable absorber fibres for high-power self-mode-locking

D.C. Kirsch[1], P. Varák[2], P. Honzátko[2], P. Peterka[2], M. Chernysheva[1]; [1]Ultrafast Fibre Lasers, Leibniz Inst. of Photonic Technology, Germany; [2]Inst. of Photonics and Electronics of the CAS, Czech Republic

We investigate the impact of thulium clustering on self-mode-locking and achieve a significant reduction in pulse duration to 350 fs. The self-starting, long-term-stable Tm-doped all-fibre oscillator features a 45 MHz repetition rate and 80 mW average power. We observed that a 1.6-fold Thulium clustering fraction increases the modulation depth by 30%.

WeR1-26 12:30-12:45

Cascaded OPG based on $BaGa_4Se_7$ to broadband continuum generation in mid IR range

N.Yu. Kostyukova[1,2,3], V.I. Trunov[1,2,3], D.B. Kolker[1,2,3], E.Yu. Erushin[1,2,3], M.D. Kolker[1,3], A.A. Boyko[1,2], L.I. Isaenko[1,4]; [1]Novosibirsk State Univ.; [2]Inst. of Laser Physics SB RAS; [3]Novosibirsk State Technical Univ.; [4]V.S. Sobolev Inst. of Geology and Mineralogy SB RAS, Russia

This work is devoted to the development of a broadband continuous spectrum source in the mid-IR range. This source is based on a cascaded picosecond optical parametric generation in a BaGa4Se7 crystal. The first cascade is a PPLN optical parametric amplifier tunable with tunable injection seeding by PPLN optical parametric oscillator.

WeR1-27 12:45-13:00

Development and optimization of integrated photonic waveguide and passive devices on the silicon on lithium niobate material platform towards the creation of the phase modulator

E.E. Volkova[1], I.A. Kazakov[1], N.A. Orlikovsky[1], S.M. Kontorov[1], U.O. Salgaeva[2], A.A. Kondakov[2], A.V. Shipulin[1]; [1]Center for Photonic Science and Engineering, Skolkovo Inst. of Science and Technology; [2]Perm State Univ., Russia

The numerical design procedure for the special type of waveguide, its parameters, and based on this waveguide directional and MMI coupler is discussed. We focus on the waveguide dimensions optimization for the phase modulator which appeared to be 90x900 nm for efficient modulation. The minimum bending radius, minimal distances between waveguides, and directional and MMI-coupler topology were obtained.

WeR1-28 13:00-13:15

Mode decomposition of pump and Stokes emission of graded-index multimode Raman fiber laser

M.D. Gervaziev[1,2], D.S. Kharenko[1,2], A.G. Kuznetsov[2], E.V. Podivilov[1,2], S. Wabnitz[1,3], S.A. Babin[1,2]; [1]NOWS Lab, Novosibirsk State Univ., Russia; [2]Inst. of Automation and Electrometry SB RAS, Russia; [3]DIET, Sapienza University of Rome, Italy

In this work we report on the successful mode decomposition (MD) of a continuous-wave (CW) graded-index multimode (GRIN MM) Raman fiber laser operating in different regimes. We investigated the intermodal dynamics during the transition through the laser threshold, and observed the effects which allow us to figure out and describe the Raman beam cleaning mechanism.

WeR1-29 13:15-13:30

Mid-infrared laser operation of transparent ceramic $(Er(0.07)\,La(0.10)\,Y(0.83))_2O_3$

L. Basyrova[1], P. Loiko[1], S. Balabanov[2], D. Permin[2], S. Filofeev[2], T. Evstropov[2], J.-L. Doualan[1], A. Braud[1], P. Camy[1]; [1]CIMAP, UMR6252 CEA-CNRS-ENSICAEN, Univ. de Caen Normandie, France; [2]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

We report on the synthesis, spectroscopy, and mid-infrared laser operation of a sesquioxide transparent ceramic with a composition of (Er0.07La0.1Y0.83)2O3 fabricated by vacuum sintering at 1780 °C. A continuous-wave ceramic laser generated 300 mW at 2840 nm with a slope efficiency of 27.7%.

This research was supported by RFBR Grant(s) # Russian Science Foundation, research project No. 21-13-00397

R3: Semiconductor Lasers, Materials and Applications

High-power and quantum cascade lasers

Location: Deyneka Room, floor 2. 09:00-11:00

WeR3-17 09:00-09:30

High power green and UV lasers based on gain switched laser diodes and active tapered fiber amplifiers *(Invited paper)*

M. Odnoblyudov[1,2], A. Petrov[2], G. Mikhailovsky[1,3], K. Kozlyakova[3], A. Komarova[3], M. Kozlyakov[3]; [1]Peter The Great Polytechnical Univ.; [2]ITMO Univ.; [3]Nordlase Ltd, St. Petersburg, Russia

We present recent results on experiment study of high power second and third harmonic generation by a simple picosecond MOPA system based on a gain switch semiconductor laser diode and active tapered fiber amplifier.

WeR3-18 09:30-09:45

Hight power 840 nm SLDs with large optical cavities

S.N. Il'chenko[1], A.E. Kireeva[1], K.V. Pushkov[2], S.Yu. Yurchuk[2], S.D. Yakubovich[1]; [1]Opton Ltd; [2]NUST MISIS, Russia

Two types of SLDs of 800-900nm spectral range with broadened waveguide layers were studied. Two waveguide widths of 0.36μm and 0.5μm were considered. Light-emitting modules have demonstrated free space CW output power of up to 240mW, at spectral bandwidth of 30nm. COD threshold was not reached due to device overheating at a current of 1A and a power of 240mW.

WeR3-19 09:45-10:00

High fill-factor kW -level tunnel-coupled diode laser bar (λ=910 nm) for 100-ns pulse sources

A.A. Podoskin[1], S.O. Slipchenko[1], D.A. Veselov[1], V.A. Strelets[1], N.A. Rudova[1], N.A. Pikhtin[1], T.A. Bagaev[2], M.A.Ladugin[2], A.A. Marmalyuk[2], P.S. Kop'ev[1]; [1]Centre of Nanoheterostructure Physics, Ioffe Inst.; [2]Stel'makh Research and Development Inst. "Polyus", Russia

Pulsed 910 nm laser sources based on triple tunnel-coupled AlGaAs/InGaAs/GaAs heterostructures were developed and studied. High fill-factor (96%) microbars with 3x800 μm aperture were fabricated and studied under pumping by high-current pulse source (up to 750A/130ns/1kHz). Peak optical power up to 1150W at 25ºC and 905W at 75ºC were demonstrated.

This research was supported by RFBR Grant(s) # The study was supported by the Russian Scientific Foundation (project no. 19-79-30072)

WeR3-20 10:00-10:15

High-power laser diodes with multiplied efficiency based on single transverse mode multi-junction heterostructures

S.O. Slipchenko, I.S. Shashkin, V.V. Shamakhov, V.A. Kryuchkov, D.N. Nikolaev, L.S. Vavilova, N.A. Rudova, N.A. Pikhtin, P.S. Kop`ev; Ioffe Inst., Russia

A heterostructure design aimed at a multiple increase of the 1060nm laser output efficiency is proposed. To multiply the internal and external quantum efficiency, tunnel p-n junctions (TJ) were placed in the waveguide. Designed and MOCVD-grown heterostructures including two TJs demonstrate. Fabricated laser diodes demonstrate a stable second-order mode operation and a slope efficiency of 2.4W/A.

This research was supported by RFBR Grant(s) # RSF 19-79-30072

WeR3-21 10:15-10:30

Compact transportable CH_4 PAD gas analyzer based on quantum cascade laser

D.B. Kolker[1,2,3], I.V. Sherstov[1,2], A.V. Pavluck[1], M.B. Miroshnichenko[1], N.Yu. Kostyukova[1,2,3], A.A. Boyko[1,2]; [1]Research Lab. of Quantum Optics Technologies, Novosibirsk State Univ.; [2]Inst. of Laser Physics SB RAS; [3]Novosibirsk State Technical Univ., Russia

The compact transportable photo-acoustic (PA) methane gas analyzer (315×165×110 mm, 2.5 kg) based on a quantum cascade laser (QCL; ~7.7 μm/1800 Hz/24 mW), a resonant differential PA detector, and a sealed gas-filled cell was created.

This research was supported by RFBR Grant(s) # FSUS 2020-0036, Russian Science Foundation grant 17-72-30006

WeR3-22 10:30-10:45

Very low threshold InAs-based quantum cascade lasers

K. Kinjalk[1], D.A. Díaz-Thomas[1], A. Meguekam[1], Z. Loghmari[2], M. Bahriz[1], R. Teissier[2], A.N. Baranov[1]; [1]IES, Univ. of Montpellier, CNRS; [2]MirSense, France

We present InAs-based quantum cascade lasers operating near 14 μm with a threshold current density as low as 630 A/cm2 at room temperature, outperforming the best reported to date InP-based lasers.

WeR3-23 10:45-11:00

Efficiency of 8 μm - emitting quantum cascade lasers with various upper cladding compositions

V.V. Dudelev[1], E. D. Cherotchenko[1], D.A. Mikhailov[1], A.V. Babichev[1], A.G. Gladyshev[2], S.N. Losev[1], I.I. Novikov[3], A.V. Lyutetskiy[1], S.O. Slipchenko[1], N.A. Pikhtin[1], A.Yu. Andreev[4], I.V. Yarotskaya[4], K.A. Podgaetskiy[4], A.A. Marmalyuk[4], A.A. Padalitsa[4], M.A. Ladugin[4], L.Ya. Karachinsky[3], A.Yu. Egorov[3], G.S. Sokolovskii[1]; [1]Ioffe Inst.; [2]Connector Optics LLC; [3]ITMO Univ.; [4]JSC MF Stelmakh Polyus Res Inst, Russia

We study 8μm-emitting quantum-cascade lasers with different compositions of upper cladding. The maximum room-temperature peak power exceeds 14W, which is the highest reported value at this wavelength to the best of our knowledge.

This research was supported by RFBR Grant(s) # This research is supported by RSF (project ID: 21-72-30020)

– Break –

IR lasers and systems

Location: Deyneka Room, floor 2. 11:30-13:30

WeR3-24 11:30-12:00

Towards mid- and far-infrared HgCdTe-based lasers *(Invited paper)*

V. Gavrilenko; Inst. for Physics of Microstructures RAS, Russia

The paper is devoted to recent achievements in investigation of stimulated emission in HgCdTe quantum well structures with dielectric waveguides in a wide spectral range from 3-5 um atmospheric transparence window to 30 um as well as to the first results on laser action in the samples with disc and Fabry-Perot resonators.

WeR3-25 12:00-12:15

24 micron stimulated emission in HgCdTe heterostructure under continuous-wave excitation

S.V. Morozov[1,2], V.V. Utochkin[1], M.A. Fadeev[1], V.V. Rumyantsev[1,2], V.I. Gavrilenko[1,2], N.N. Mikhailov[3]; [1]Inst. for Physics of Microstructures RAS; [2]Lobachevsky Univ. of Nizhny Novgorod; [3]Inst. of Semiconductor Physics SB RAS, Russia

We report on stimulated emission in the HgCdTe waveguide heterostructure with multiple quantum wells at 24 μm wavelength under continuous-wave CO2 laser excitation. This result was provided by waveguide design optimization – thickness increase of CdTe passive waveguide layer, which suppressed mode "leakage" into the GaAs substrate in comparison with the previous design.

This research was supported by RFBR Grant(s) # Ministry of Science and Higher Education of the Russian Federation, grant #075-15-2020-797 (13.1902.21.0024)

WeR3-26 12:15-12:30

Mid-Infrared lasing from HgCdTe heterostructures

M.A. Fadeev[1], V.V. Utochkin[1,2], V.V. Rumyantsev[1,2], A.A. Dubinov[1,2], E.E. Morozova[1], D.V. Shengurov[1], N.N. Mikhailov[3], S.A. Dvoretskii[3], V.I. Gavrilenko[1,2], S.V. Morozov[1,2]; [1]Inst. for Physics of Microstructures RAS; [2]Lobachevsky State Univ. of Nizhny Novgorod; [3]Rzhanov Semiconductor Physics Inst. SB RAS, Russia

Stimulated emission from HgCdTe-based waveguide heterostructures was obtained at the wavelengths up to 31 μm, demonstrating the possibility of light amplification. In this work we demonstrate for the first time the spectra of laser generation from ridge resonators formed on HgTe/HgCdTe heterostructures by ion etching

WeR3-27 12:30-12:45

Performance of InGaAs/GaAs microdisk lasers with improved thermal resistance

N.V. Kryzhanovskaya[1,2], F.I. Zubov[1,2], M.V. Maximov[1,2], E.I. Moiseev[1,2], A.S. Dragunova[1,2], N.A. Fominykh[1,2], K.A. Ivanov[1], I.S. Makhov[1], A.M. Mozharov[2], N.N. Kaluzhnyy[3], S.A. Mintairov[3], Yu. Guseva[3], N.Yu. Gordeev[3], A.E. Zhukov[1]; [1]HSE Univ.; [2]Alferov Univ.; [3]Ioffe Inst., Russia

We discuss characteristics of microdisk lasers with InGaAs/GaAs quantum dots in the active region with improved thermal resistance. We managed to place the active region very close (870 nm) from the laser surface using two coupled resonant planar waveguides. The record low thermal resistance of 0.17 K/mW was achieved in lasers bonded onto a heat-conducting substrate.

WeR3-28 12:45-13:00

Optical loss and noise modelling in microdisk lasers with InGaAs quantum well-dots

A.E. Zhukov[1], E.I. Moiseev[1], A.M. Nadtochiy[1], N.A. Fominykh[1], K.A. Ivanov[1], I.S. Makhov[1], A.S. Dragunova[1], N.V. Kryzhanovskaya[1], F.I. Zubov[2,1], M.V. Maximov[2,1], S.A. Mintairov[3], N.A. Kalyuzhnyy[3], Yu.M. Shernyakov[3], N.Yu. Gordeev[3]; [1]HSE Univ.; [2]Alferov Univ.; [3]Ioffe Inst., Russia

Microdisk lasers with InGaAs quantum dots were studied. Optical loss is primarily determined by surface absorption while the slope efficiency is controlled by surface scattering. The 3-dB modulation bandwidth of ~8 GHz was measured in microlasers hybrid integrated with Si. Side-mode suppression ratio reaches 27 dB. Relative intensity noise was evaluated to be small enough for error-free optical data transmission.

This research was supported by RFBR Grant(s) # Russian Science Foundation grant 19-72-30010

WeR3-29 13:00-13:30

Semiconductor optical amplifier for time-of-flight optical phased array LiDAR system *(Invited paper)*

Y. Nakano; Univ. of Tokyo, Japan

– Lunch Break –

A3B5 and hybrid structures

Location: Deyneka Room, floor 2. 15:00-16:30

WeR3-30 15:00-15:30

Thick-film SiN platform for hybrid integrated lasers *(Invited paper)*

A. Stroganov[1,2]; [1]LIGENTEC, Switzerland; [2]ITMO Univ., Russia

Thick-film SiN integrated photonics platforms only recently became widely accessible. Gaining momentum outside of nonlinear optics domain, they may bring considerable benefits in a wide range of applications. Recent advances of the thick-film SiN integrated photonics as a platform for hybrid lasers are reported: the current state of the technology, relevant showcases and the future outlook are discussed.

WeR3-31 15:30-15:45

Tunable low-loss silicon nitride integrated circuits

A.S. Baburin[1,2], E.S. Lotkov[1,2], E.V. Sergeev[1,2], M. Andronic[2], D.A. Baklykov[1,2], V.E. Stukalova[1,2], K.A. Buzaverov[1,2], S.S. Avdeev[1,2], I.A. Ryzhikov[2,3], I.V. Dyakonov[4], N. Skryabin[4], M.Yu. Saygin[4], S.P. Kulik[4], I.A. Rodionov[1,2]; [1]Dukhov Automatics Research Inst., Federal State Unitary Enterprise, (VNIIA); [2]FMN Lab., Bauman Moscow State Technical Univ.; [3]Inst. for Theoretical and Applied Electromagnetics RAS, Russia; [4]Quantum Technology Centre MSU, Russia

We present tunable photonic integrated circuits platform with low losses in a wide wavelength bandwidth from 900 to 1550 nm based on Si3N4 waveguides.

WeR3-32 15:45-16:00

Effect of polarisation on optical gain of InGaN/GaN quantum wells

A. Udai, T. Aggarwal, V. Pendem, S. Ganguly, D. Saha; Indian Inst. of Technology Bombay, India

III-nitride semiconductors are crucial for solid state lighting applications, especially in the blue and ultraviolet regions. They have polarisation fields and charges inside them which modify their optoelectronic properties. In this article, we study the effect of the polarisation fields on the band structure and optical gain of an InGaN/GaN quantum well.

WeR3-33 16:00-16:15

Purcell effect and beaming of emission in hybrid AlGaAs nanowires with GaAs quantum dots

M.A. Kaliteevski[1,2], R.R. Reznik[1], G.E. Cirlin[1], K.P. Kotlyar[1], I.V. Ilkiv[1], N. Akopian[3], L. Leandro[3], V.V. Nikolaev[1,2], A.V. Belonovski[2]; [1]St.Petersburg Academic Univ., Russia;[2]ITMO Univ., Russia; [3]Department of Photonics Engineering, Technical Univ. of Denmark, Denmark

Here we report the beaming of the emitted light by NW with multiply GaAs quantum dots, which does not support efficient emission into waveguided modes, including the mode HE11.

WeR3-34 16:15-16:30

Integration of interdigitated electrodes to quantum dot based photoconductive antenna unconventionally enhances pulsed Terahertz generation

A. Yadav[1], A. Gorodetsky[2], S.V. Smirnov[1,3], D.V. Lavrukhin[4], I.A. Glinskiy[4], R.A. Khabibullin[4], D.S. Ponomarev[4], E.U. Rafailov[1]; [1]Aston Inst. of Photonic Technologies, Aston Univ., UK; [2]School of Physics and Astronomy, Univ. of Birmingham, UK; [3]ITMO Univ.; [4]Inst. of Ultra High Frequency Semiconductor Electronics RAS; [5]Prokhorov General Physics Inst. RAS, Russia

We investigate and compare the THz power generated by QD PCAs with and without interdigitated gap. We also present a comparison of THz output from interdigitated PCA and commercial PCA.

R4: Laser Beam Control

Laser beam control III

Location: Richter Room, floor 3. 09:30-11:00

WeR4-11 09:30-09:45

The influence of a local refractive index change on the splitting ratio of an integrated optical Y-branch on lithium niobate substrate

M.V. Parfenov[1,2], A.V. Shamrai[1]; [1]Ioffe Inst.; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

The power splitting ratio tuning of a LiNbO3 integrated optical Y-branch caused by a local refractive index change was investigated. Controllable local refractive index change was produced by photorefractive effect at external laser irradiation. The dependences of splitting ratio change on position of laser irradiation had interferometric nature. The effect could be used for precise tuning of Y-branch splitting ratio.

WeR4-12 09:45-10:00

Investigation of bend loss in multimode core-shell silver halide MIR fibres

E.A. Korsakova, D.D. Salimgareev, A.E. Lvov, A.A. Yuzhakova, A.S. Korsakov, L.V. Zhukova; Ural Federal Univ. named after the first President of Russia B. N. Yeltsin, Russia

We describe the experimental study of bend losses in single-layer multimode silver halide polycrystalline fibres in a PEEK shell bent into a circle. The experiment was conducted for Ø 525-µm AgBr0.9I0.1 fibre over the bend radius range of 1.5–52.5 mm for the wavelength sweep of 4-25 µm. The revealed dependencies can be very useful for designing fibre-optic systems.

WeR4-13 10:00-10:15

Performance study of acousto-optic deflectors for femtosecond laser pulses

G.D. Slinkov[1,2], A.I. Chizhikov[1], V.V. Gurov[1], K.B. Yushkov[1], V.Ya. Molchanov[1]; [1]National Univ. of Science and Technology MISIS; [2]Lomonosov Moscow State Univ., Russia

Theoretical and experimental analysis of angular chirp at the output of an acousto-optic deflector (AOD) is performed. Theoretical AOD dispersion model is developed and experimentally accessed for a paratellurite AOD operating with broadband femtosecond laser pulses at 800 nm. Optimization strategy for AOD design aimed at femtosecond laser radiation is discussed in the report.

WeR4-14 10:15-10:30

Acousto-optic two-dimensional modulators based on monoclinic KYW crystal

A.I. Chizhikov, V.Ya. Molchanov, N.F. Naumenko, K.B. Yushkov; National Univ. of Science and Technology MISIS, Russia

Symmetries of acousto-optic interaction in monoclinic crystals enable design of two-coordinate modulators and deflectors. We designed and fabricated a series of acousto-optic devices based on potassium yttrium tungstate crystal, KY(WO4)2. The prototypes of monolithic acousto-optic modulators are capable of two-coordinate deflection of unpolarized laser beams and controlling output polarization.

This research was supported by RFBR Grant(s) # 20-07-00115

WeR4-15 10:30-10:45

Acousto-optic modulators/frequency shifters pigtailed with single-mode optic fibers

V.M. Epikhin[1], M.M. Mazur[1], A.V. Ryabinin[1], P.V. Karnaushkin[2], L.I. Mazur[1], L.L. Paltsev[1]; [1]Russian Research Inst. of Physicotechnical and Radio Engineering Measurements; [2]Perm State Univ., Russia

Acousto-optic modulators/frequency shifters based on TeO2 crystals pigtailed with single-mode optical fibers supporting and not supporting polarization for collimated and focused light beams at radiation wavelengths of 785, 1064, 1550 nm have been developed, produced and experimentally investigated.

WeR4-16 10:45-11:00

Optoacoustic measurement of the mid-IR laser pulse properties

B.V. Rumiantsev[1], I.A. Slovinsky[1], A.S. Bychkov[2], A.V. Pushkin[1], E.I. Mareev[1,3], F.V. Potemkin[1]; [1]Faculty of Physics, Lomonosov Moscow State Univ.; [2]National Univ. of Science and Technology MISiS; [3]IPT RAS, FSRC "Crystallography and Photonics", Russia

In the present work the single-shot optoacoustic method of the TEM00 mode laser pulse parameters retrieval (pulse duration and beam radius) is proposed and demonstrated experimentally with use of Er:YAG laser radiation (wavelength is 2.94 µm, pulse energy is up to 10 mJ, pulse duration is 150 ns). The theoretical pre-requisites and physical limitations of the method is considered.

– Break –

Laser beam control IV

Location: Richter Room, floor 3, 11:30-13:30

WeR4-17 11:30-11:45

Measuring chromatic aberrations with holographic wavefront sensors based on correlation

N.G. Stsepuro, M.S. Kovalev, G.K. Krasin, I.V. Gritsenko, S.I. Kudryashov; P.N. Lebedev Physical Inst. RAS, Russia

Research is devoted to the stability and invariance of the holographic method in detecting and measuring the phase of a light wave to a change in the radiation wavelength. The possibility of measuring chromatic aberrations in the position of an optical system is demonstrated.

This research was supported by RFBR Grant(s) # 20-32-90161

WeR4-18 11:45-12:00

Adaptive phase correction of laser beam under conditions of incomplete phase conjugation

A.V. Nemtseva, V.A. Bogachev, F.A. Starikov; Russian Federal Nuclear Center – VNIIEF, Russia

The paper presents the results of numerical simulation of the adaptive wavefront correction of the non-diffractive laser beam focussing in turbulent atmosphere under conditions of imperfect phase conjugation. It is shown the Strehl ratio for laser beam at the remote receiver is equal to the product of the Strehl ratio for reference beam and Strehl ratio for outgoing laser beam.

WeR4-19 12:00-12:15

Two-wavelength holography applications for additive manufacturing

V.V. Sementin[1], E.E. Popov[1,2], I.S. Khakhalin[1], A.P. Pogoda[1], V.M. Petrov[2], A.S. Boreysho[1]; [1]BSTU «VOENMEH» named after D.F. Ustinov; [2]ITMO Univ., Russia

The experimental setup, based on a two-wavelength holography method is described. The possibility of recognizing defects of the order of 25 µm are demostrated. The ability of pulsed two-wavelength holography with o new inexpensive laser source is demonstrated.

WeR4-20 12:15-12:30

Method of adaptive digital holography for controlling the wavefront of laser radiation

A.O. Nehryienko, V.V. Kabanov; Inst. of Physics NAS Belarus, Belarus

The concept and experimental implementation of an adaptive digital holographic (ADH) system for controlling the wavefront of a laser beam using a digital camera (DC), a spatial light modulator (SLM) and a specialized microprocessor are presented. The key element of the ADH system is the presence of feedback, which allows software processing of the hologram.

WeR4-21 12:30-12:45

Speckle correlometry processing algorithms in application to randomly inhomogeneous media study

E.A. Isaeva[1,2], A.A. Isaeva[1,2], D.A. Zimnyakov[1,2] ;[1] Yuri Gagarin Saratov State Technical Univ., Saratov, Russia;[2] Inst. of Precision Mechanics and Control RAS, Russia

In this work the investigations of the water solutions of technical or food gelatin with added nanoparticles and foamy phantoms by use of the full field speckle correlometry method are represented. The statistical analysis of the stochastic intensity distributions caused by the multiple scattered radiation give the opportunity to evaluate the media structural morphology and the internal dynamic processes.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Science Foundation (project No 21-79-00051).

WeR4-22 12:45-13:15

Noble metal selenides for all-optical switching *(Invited paper)*

J. Wang, I.M. Kislyakov; Shanghai Inst. of Optics and Fine Mechanics CAS, China

Amazing saturable absorption performances in combination with a broad and tunable bandwidth and a high air resistance somewhat distinguish noble metal selenides and sulfides among other 2D materials, which attracts attention when designing all-optical switches. Using the examples of PtSe2, PdSe2, and other 2D compounds we investigate the nature of their brilliant nonlinear optical properties.

WeR4-23 13:15-13:30

Optical limiting properties of low-symmetry magnesium phthalocyanine complex bearing a pentachlorocyclotriphosphazene moiety

M.S. Savelyev[1,2,3], P.N. Vasilevsky[1,3], A.Yu. Tolbin[3,4], A.Yu. Gerasimenko[1,2,3]; [1]MIET; [2]Sechenov Univ.; [3]INME RAS; [4]IPAC RAS, Russia

Phthalocyanines are represented as the conjugated electronic system that can be readily affected by simple chemical reactions to create effective optical limiters. This work demonstrates the result of the interaction of nanosecond laser radiation at the second harmonic with the solution of asymmetrically substituted magnesium phthalocyanine complex, containing one pentachlorocyclotriphosphazene fragment at the periphery, in the tetrahydrofuran.

– Lunch Break –

Laser beam control V

Location: Richter Room, floor 3, 15:00-16:15

WeR4-24 15:00-15:15

Autofocused asymmetric aberration laser beams

S. Singh, V. Dev, V. Pal; Indian Inst. of Technology Ropar, India.

We have generated asymmetric aberration laser beams (aALBs) with auto-focusing properties. The asymmetry in the phase distribution of aALBs is deliberately exploited for controlling spatial intensity distribution and thereby generating high-power densities, useful for several applications. We have also calculated the empirical relations for the asymmetry parameter, which controls the formation of high-power densities at a desired spatial location.

WeR4-25 15:15-15:30

Laser interferometric measuring system for the SOIGA space gravitational wave detector project

S.S. Donchenko, R.A. Davlatov, E.A. Lavrov, D.A. Sokolov, I.O. Skakun; FSUE «Russian metrological inst. of technical physics and radio engineering», Russia

The paper describes the architecture of the SOIGA project's optical interferometric system. The sensitivity of the ground model of the interferometric system at the level of 100 pm is confirmed. Ways of improving the model to achieve the required accuracy of several pm are shown. The results on the development of the optical beam guidance system are also presented.

This research was supported by RFBR Grant(s) # RFBR 11022 mk

WeR4-26 15:30-15:45

Metrological studies of a digital autocollimator

A.N. Korolev[1], A.Ya. Lukin[2], Yu.V. Filatov[1], V.Yu. Venediktov[1]; [1]Electrotechnical Univ. "LETI"; [2]Peter the Great St.Petersburg Polytechnic Univ., Russia

The study of a digital autocollimator with two dimensional multi-element mark is considered in the report. 5 megapixel digital camera with a pixel size of 3.45 microns was used as a photoreceiver. The results showed that the error of the autocollimator is in the limit of 0.01 arc-sec.

WeR4-27 15:45-16:00

Evaluation of parasitic effects in a ring confocal resonator when operating as a gyroscope sensing element

Yu.N. Filatov, A.S. Kukaev, E.V. Shalymov, V.Yu. Venediktov; St. Petersburg State Electrotechnical Univ., Russia

The paper analyzes and evaluates the parasitic effects that can manifest in a ring confocal resonator when it operates as a sensitive element of an optical resonator gyroscope.

WeR4-28 16:00-16:15

The state primary standard of the unit of length - the meter GET 2

N.A. Kononova, Yu.G. Zackharenko, Z.V. Fomkina; D.I. Mendeleyev Inst. for Metrology (VNIIM), Russia

The report is about the The State Primary Standard of the Unit of Length – the meter GET 2

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

Applications of strong laser fields

Location: Stenberg 1 Room, floor 3. 15:00-17:15

WeR5-30 15:00-15:30

Dynamic stabilization of plasma instability *(Invited paper)*

S. Kawata[1], Y. J. Gu[2]; [1]Utsunomiya Univ. retired; [2]Inst. Laser Engineering, Osaka Univ., Japan

A dynamic stabilization mechanism for plasma instabilities was proposed in [Phys. Plasmas 19, 024503(2012)], based on a perturbation phase control. Normally the perturbation phase is unknown. However, if the perturbation phase is known, the instability growth can be controlled by a superimposition of perturbations actively. We present the application results of the dynamic stabilization mechanism to plasma instabilities.

WeR5-31 15:30-15:45

Effects limiting the compression in direct drive ICF targets

S.I. Glazyrin[1,2], E.M. Urvachev[1], K.E. Gorodnichev[1], S.E. Kuratov[1], P.P. Zakharov[1], A.V. Brantov[2,1], S.A. Karpov[1], V.Yu. Bychenkov[2,1]; [1]FSUE VNIIA; [2]LPI RAS, Russia

The conditions in ICF targets hot-spot are sensitive to physical processes during compression: extra effects could alter the dynamics and reduce the compression efficiency. The paper analyses the impact of Rayleigh-Taylor instability, hot electrons from laser-plasma instabilities and nonlocal electron transport on ignition and neutron yield in direct drive targets.

WeR5-32 15:45-16:00

Binary two-phase gratings formed on the surface of $Ge_2Sb_2Te_5$ thin film by femtosecond laser pulses

M.P. Smayev[1], P.I. Lazarenko[2], I.A. Budagovsky[1], A.O. Yakubov[2], Yu.V. Vorobyov[3], T.S. Kunkel[4], S.A. Kozyukhin[5]; [1]Lebedev Physical Inst. RAS; [2]National Research Univ. of Electronic Technology; [3]Ryazan State Radio Engineering Univ.; [4]Moscow Inst. of Physics and Technology; [5]Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia

The formation of binary amorphous-crystalline periodic surface structures on the Ge2Sb2Te5 thin film during a single pass of a femtosecond laser beam has been studied. We recorded biphase stripes up to several mm long consisted of 50 parallel amorphous/crystalline lines. These stripes had a period equal to the recording beam wavelength and exhibited reflective diffraction grating behavior.

This research was supported by RFBR Grant(s) # 20-03-00379

WeR5-33 16:00-16:15

Direct laser writing of Bragg gratings in silica glass by helical motion of a lenticular beam waist

V.V. Likhov[1,2], S.A. Vasiliev[1], A.G. Okhrimchuk[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]Mendeleev Univ. of Chemical Technology, Russia

High quality uniform Bragg gratings of the third order have been inscribed in a single-mode silica-based fiber by a helical motion of a lenticular beam waist of the femtosecond laser. The technique developed paves the way for fabrication of helical fiber Bragg gratings able to change the orbital angular momentum of light.

WeR5-34 16:15-16:30

Spontaneous decay of the laser pulse into a pair of surface plasmon-polaritons as a mechanism of LIPSS formation

I.V. Oladyshkin; Inst. of Applied Physics RAS, Russia

The decay of an optical pulse incident normally on a flat metal surface into a pair of counter-propagating surface plasmon-polaritons is considered. The instability growth time is estimated as 10-50 fs at near-damaging conditions. The proposed mechanism probably plays an important role in the formation of laser-induced periodic surface structures (LIPSS) in metals in the single-pulse regime.

WeR5-35 16:30-16:45

Mid-IR femtosecond micromachining of silicon

E.I. Mareev[1,2], A.V. Pushkin[1], E.A. Migal[1], K.V. Lvov[1,3], S.Y. Stremoukhov[1,3], F.V. Potemkin[1]; [1]Lomonosov Moscow State Univ.; [2]Inst. of Photon Technologies FSRC "Crystallography and Photonics" RAS; [3]National Research Centre "Kurchatov Inst.", Russia

We achieved the deposited energy density ~ 6 kJ/cm3 under tight focusing of mid-IR femtosecond laser radiation inside the bulk of the silicon. In this regime, we have successfully performed single-pulse silicon microstructuring.

This research was supported by RFBR Grant(s) # 21-32-70021

WeR5-36 16:45-17:00

Multiscale modeling of dielectric material modifications by a femtosecond Bessel-Gauss laser beam

B. Chimier[1], R. Beuton[2], P. Quinoman[1], P. González Alaiza de Martínez[1], R. Nuter[2], G. Duchateau[2]; [1]Univ. of Bordeaux-CNRS-CEA, CELIA, France; [2]CEA/CESTA, France

Dielectric material structuration with a femtosecond Bessel–Gauss laser beam is investigated by using a 2D/3D multiscale modeling. The laser pulse propagation coupled to the electron dynamics is first simulated, and the calculated absorbed energy is then used to perform thermo-elasto-plastic simulations of material relaxation. Results show that the laser ionized matter induces a limitation of the laser energy deposition.

WeR5-37 17:00-17:15

Pump-probe diagnostics of a nonequilibrium supercritical state in molecular liquids under nanosecond laser-plasma impact

E.I. Mareev[1,2], N.V. Minaev[1], A.P. Sviridov[1], V.M. Gordienko[1]; [1]Inst. of Photon Technologies FSRC "Crystallography and Photonics" RAS; [2]Lomonosov Moscow State Univ., Russia

Using an all-optical approach we demonstrated that under nanosecond laser impact molecular liquids (H2O, CO2) undergoes under supercritical conditions, characterized by high-density fluctuations and cluster formations.

This research was supported by RFBR Grant(s) # 19-32-60072, 18-29-06035

R6: Lasers and Systems for Imaging, Green Photonics and Sustainability

LIDARs and environmental sensing

Location: Stenberg 1 Room, floor 3. 09:00-11:00

WeR6-01 09:00-09:15

Compact laser diode Lidar has opened new era an environmental sensing without eyes protection. To 100-anniversary of Nikolay Basov

S.M. Pershin; Prokhorov General Physics Inst. RAS, Russia

In 1991 Russian scientist have opened the new era of an environmental sensing by eye-safe lidar. For the first time to our knowledge we have proposed the new lidar principles for environmental sensing by extreme low pulse energy when the probability of a return photon registration is <1. We have developed and tested the lidar with eye-safe energy density.

This research was supported by RFBR Grant(s) # Russian Science Foundation 19-19-00712

WeR6-02 09:15-09:30

Improving magmatic aerosol detection by LIDAR above the Elbrus magma chamber

S.M. Pershin[1], V.A. Zavozin[1], D.G. Artemova[1], M.Ya. Grishin[1], K.Kh. Kanonidi[2], V.N. Lednev[1], V.S. Makarov[3], Ya.Ya. Ponurovskii[1]; [1]Prokhorov General Physics Inst. RAS; [2]Schmidt Inst. of Physics of the Earth RAS; [3]Space Research Inst. RAS, Russia

A new eye-safe LIDAR for detecting aerosol variations has been developed. The measurements were carried out in the dead-end tunnel of the Baksan Neutrino Observatory located above the Elbrus magma chamber. A synchronization has been discovered between signals measured by two inclinometers aligned with North-South and East-West directions, atmospheric pressure sensor, high precision thermometer, air humidity sensor and the LIDAR.

This research was supported by RFBR Grant(s) # Russian Science Foundation, project no. 19-19-00712

WeR6-03 09:30-09:45

Lidar-based infrared remote gas sensor for atmosphere anthropogenic pollution and natural emissions monitoring

V.V. Meshcherinov[1,2], M.V. Spiridonov[1,2], V.A. Kazakov[1,2], A.V. Rodin[1]; [1]Moscow Inst. of Physics and Technology, Russia; [2]Space Research Inst. RAS, Russia

An implementation of laser absorption wavelength-modulation spectroscopy technique combined with quadrature detection of scattered radiation for remote monitoring of atmospheric industrial pollution or natural emissions by means of a compact lidar gas sensor, that may be installed at unmanned aerial vehicles, is presented. The instrument provides sensitivity level of tens ppm*m at typical distances of tens meters.

This research was supported by RFBR Grant(s) # 18-29-24204

WeR6-04 09:45-10:00

Raman spectroscopy for offshore hydrocarbon deposits detection

V.V. Pozdniakova, M.A. Kustikova; ITMO Univ., Russia

Using Raman remote monitoring system for Arctic seas offshore hydrocarbon deposits detection is proposed. The results of using Raman spectroscopy for indicators substances are presented in this study.

WeR6-05 10:00-10:15

Differential laser atmospheric remote sensing system for environmental monitoring

S.L. Verkhoshentseva, O.V. Nepomnyashiy, A.S. Tsipotan, L.V. Makuha; Siberian Federal Univ., Russia

The relevance of the study is due to the need for remote monitoring of the atmosphere for the presence of suspended substances. The use of this method for geological exploration will allow identifying areas with a high content of suspended substances in the atmosphere, which will allow registering local natural gas outputs in real time, carrying out topographic mapping.

WeR6-06 10:15-10:30

Mid-IR spectroscopic sensing based on mulitmode chalcogenide fibers

E.A. Romanova[1,2], S.V. Korsakova[1], A.P. Velmuzhov[2], M.V. Sukhanov[2], T.V. Kotereva[2], V.S. Shiryaev[2]; [1]Saratov State Univ., Russia; [2]Inst. of Chemistry of High Purity Substances RAS, Russia

Theoretical and technological peculiarities of creating a multimode chalcogenide fiber based platform for the remote real time mid-IR spectroscopy of liquids are discussed.

WeR6-07 10:30-10:45

Modeling of laser vibrometer-rangefinder based on self-sweeping Yb-doped fiber laser

A.M. Volikova, I.A. Lobach, S.I. Kablukov; Inst. of Automation and Electrometry SB RAS, Russia

We present a scheme for the simultaneous measurement of the absolute distance to the target and its vibrations. The vibration effects modeling is carried out and the influence of tuning laser stability is discussed.

This research was supported by RFBR Grant(s) # Russian Science Foundation (18-12-00243)

WeR6-08 10:45-11:00

Numerical simulations of the electromagnetic fields' distribution in dielectric microspheres with high size parameter

A. Mermoul[1,2], G. Ferrini[1]; [1]Interdisciplinary Lab. for Advanced Materials Physics (I-LAMP), Dipartimento di Matematica e Fisica, Univ. Cattolica del Sacro Cuore, UCSC, Italy; [2]Department of Chemistry, KU Leuven, Belgium

The near-field electromagnetic distribution arising from the light scattering of a large dielectric microsphere is discussed in the framework of the Mie theory. Particular attention is devoted to the formation of photonic nanojets. We aim to characterize the conditions to exploit the microsphere as probes for surface-sensitive spectroscopy and imaging applications.

– Break –

Bioimaging and analytical techniques

Location: Stenberg 1 Room, floor 3. 11:30-13:45

WeR6-09 11:30-11:45

Cell-specific multimodal nonlinear imaging of acidosis and oxidative stress in mouse brain in vivo

A.S. Chebotarev[1,2], A.A. Lanin[1,2], I.V. Kelmanson[5,6], G.N. Martynov[1,2], A.A. Ivanov[1,2,8], D.S. Bilan[5,6], A.B. Fedotov[1,2,3], V.V. Belousov[5,6,7], A.M. Zheltikov[1,2,3,4]; [1]Lomonosov State Univ.; [2]Russian Quantum Center, Russia; [3]Department of Physics and Astronomy, Texas A&M Univ., USA; [4]Kazan Quantum Center, Tupolev Kazan National Research Technical Univ.; [5]Shemyakin and Ovchinnikov Inst. of Bioorganic Chemistry RAS; [6]Pirogov Russian National Research Medical Univ.; [7]Federal Center of Brain Research and Neurotechnologies; [8]Photochemistry Center, FSRC "Crystallography and Photonics" RAS, Russia

Multimodal nonlinear microscopy combining second and third harmonic generation with two- and three-photon excited fluorescence is shown to provide a powerful resource for high-fidelity cell-specific imaging of dynamics of acidosis and oxidative stress in a mouse brain using a suitably tailored genetically encoded fluorescent staining.

This research was supported by RFBR Grant(s) # RSF 22-22-00792

WeR6-10 11:45-12:00

Carbon dots-based fluorescent multimodal nanosensor to measure heavy metal ions concentrations

O.E. Sarmanova[1,2], K.A. Laptinskiy[2], G.N. Chugreeva[1], S.A. Burikov[1], T.A. Dolenko[1]; [1]Faculty of Physics, Lomonosov Moscow State Univ.; [2]Skobeltsyn Inst. of Nuclear Physics, Lomonosov Moscow State Univ., Russia

We propose to develop a fluorescent carbon dots-based nanosensor for determining concentration of heavy metal ions in liquid multicomponent media using neural networks. The developed sensor enables simultaneous determination of Cu2+, Ni2+, Cr3+ ions' concentrations with root mean squared errors of 0.28 mM, 0.79 mM, 0.24 mM respectively. This nanosensor's accuracy indicates its potential for controlling waste, technological, waters composition.

WeR6-11 12:00-12:15

Downhole analyzer of fluid

V.M. Polyakov[1,2], I.N. Kaliteevsky[1,2], A.L. Pavlova[1,2], D.S. Denk[1,2], A.S. Bobe[1,3], S.I. Tomashevich[1,3], T.E. Galiakbarov[1,2], A.A. Kharitonov[1,2,3], A.A. Prokofieva[2], D.N. Kaliteevsky[1,2], S.G. Alexeev[1]; [1]Geophotonica Ltd Co; [2]"GK R-AERO" Ltd Co; [3]ITMO Univ., Russia

We introduce a downhole optical fluid analyzer for a fraction, component and phase composition of the formation fluids. Key features are extreme downhole operation conditions at +150C and 100 MPa. The solutions for several complicated optoelectronic cases are discussed

WeR6-12 12:15-12:30

Single photon ghost polarimetry applied to samples with amplitude anisotropy

D.P. Agapov, S.A. Magnitskiy, A.S. Chirkin; Lomonosov Moscow State Univ., Russia

The theory of single photon ghost polarimetry is presented, which describes the reconstruction of ghost polarization images of samples with amplitude anisotropy in biphoton fluxes generated in the process of spontaneous parametric down-conversion.

WeR6-13 12:30-12:45

Multichannel diode laser spectrometer DLS·L for in-situ study of samples pyrolytically evolved from lunar regolith onboard «LUNA-27» mission

V.V. Meshcherinov[1,2], I.I. Vinogradov[2], V.A. Kazakov[1,2], Yu.V. Lebedev[2], M.V. Spiridonov[1,2], G. Durry[3], M. Ghysels-Dubois[3]; [1]Moscow Inst. of Physics and Technology, Russia; [2]Space Research Inst. RAS, Russia; [3]Univ. of Reims Champagne Ardenne, France

The DLS-L spectrometer was designed to study products, pyrolytically evolved from soil samples of a close location near the Lunar probe «Luna-27» landing point, for further understanding of physics and chemistry of the Lunar body. The key aims are measurement of pyrolytical output dynamics, integral content of H2O, CO2, and retrieving of its isotopic ratios D/H, 18O/17O/16O, 13C/12C.

This research was supported by RFBR Grant(s) # 18-29-24204

WeR6-14 12:45-13:00

Nanothermometers based on neodymium doped yttrium gadolinium oxide powders

I.M. Sevastianova[1], V.A. Aseev[1], A.N. Babkina[1], N.K. Kuzmenko[1], M.A. Khodasevich[2], S.K. Evstropiev[1], N.V. Nikonorov[1]; [1]ITMO Univ., Russia; [2]Inst. of Physics NAS Belarus, Belarus

Chemical stability and luminescence at NIR, which overlaps with the biological optical transparency window, make Oxide crystals doped with neodymium ion good candidate for nanothermometry. The aim of this work is to research the dependence of temperature sensitivity on the energy gap between the 4F5/2, 4F3/2 levels of the neodymium ion in (Gd(1-x)xY)2O3:Nd powder.

This research was supported by RFBR Grant(s) # 20-58-00054 Bel-A

WeR6-15 13:00-13:15

Effect of linewidth enhancement on the stability of Fourier Domain Mode-Locked (FDML) lasers

Ö.E. Aşırım[1], R. Huber[2], C. Jirauschek[1]; [1]Technical Univ. of Munich; [2]Univ. of Lübeck, Germany

The marked elimination of dips (holes), which often cause instabilities in the intensity pattern of FDML lasers, is shown via a gradual reduction of the linewidth enhancement factor (LWEF). The findings are attained by numerical simulations.

WeR6-16 13:15-13:30

Diffractive holographic elements for solar energy

P.P. Sokolov, N.D. Vorzobova; ITMO Univ., Russia

The possibility of using various types of holographic structured elements as diffractive deflectors for solar energy is considered and the conditions for the expansion of the angular range corresponding to the high diffraction efficiency are determined. The efficiency of elements use is assessed taking into account the trajectory of the Sun.

WeR6-17 13:30-13:45

High-speed remote imaging systems with metal vapor brightness amplifiers

M.V. Trigub, N.A. Vasnev; Lab. of Quantum Electronics, Inst. of Atmospheric Optics SB RAS, Russia

Active media on self-terminating transitions in metal vapors are widely used to image the high-speed processes with powerful background light. The paper represents review of such systems features and their applications for remote imaging.

R8: Nonlinear Photonics: Fundamentals and Applications

Solitons and general nonlinear photonics I

Location: Pudovkin Room, floor 3. 09:00-10:45

WeR8-15 09:00-09:30

Non-linear polaritonics: from novel coherent light sources to optical digital and analogue computing *(Invited paper)*

P.G. Lagoudakis; Skoltech, Russia

WeR8-16 09:30-09:45

Generating NN-states of surface plasmon-polariton pairs in a nonliner nanoparicle on a metalic substrate

N.A. Olekhno[1], M.I. Petrov[1], I.V. Iorsh[1], A.A. Sukhorukov[2], A.S. Solntsev[3]; [1]School of Physics and Engineering, ITMO Univ., Russia; [2]ARC Centre of Excellence for Transformative Meta-Optical Systems (TMOS), Research School of Physics, The Australian National Univ.; [3]School of Mathematical and Physical Sciences, Univ. of Technology Sydney, Australia

We study the generation of surface plasmon-polariton pairs with a gallium arsenide nanoparticle located at the silver-air interface. We demonstrate theoretically that robust generation of N00N-states of surface plasmon-polariton pairs with N=2 can be obtained.

WeR8-17 09:45-10:00

The concept of a pulsed neuromorphic optical system based on a 3D model of an optical neuron

M.A. Pankov, E.M. Pritotskii; ILIT RAS - Branch of FSRC "Crystallography and Photonics" RAS, Russia

A 3D-model of an artificial optical neuron is proposed for scalable implementation of pulsed neuromorphic optical system.

This research was supported by RFBR Grant(s) # Grant from the Russian Science Foundation No. 22-29-01054, https://rscf.ru/project/22-29-01054/

WeR8-18 10:00-10:15

Energy and momentum of electromagnetic field in media with nonlocality of nonlinear optical response

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

The analytical expressions for energy and momentum densities and flux densities of light in media with nonlocal nonlinear optical response are obtained in first order to the spatial nonlocality parameter.

WeR8-19 10:15-10:45

Tunable metasurfaces for frequency conversion at the nanoscale *(Invited paper)*

C. De Angeles; Univ. Brescia, Italy

– Break –

Solitons and general nonlinear photonics II

Location: Pudovkin Room, floor 3. 11:30-13:45

WeR8-20 11:30-12:00

Nonlinear metasurfaces for quantum state generation *(Invited paper)*

T. Pertsch; Univ. Jena, Germany

We report on experimental and theoretical investigations of nonlinear metasurfaces from nanostructured thin films of lithium niobate and metasurfaces hybridized with transition metal dichalcogenide monolayers. We show that the second-order nonlinear interactions in metasurfaces enable tailorable harmonic frequency generation as well as entangled photon pair sources by spontaneous parametric down-conversion.

WeR8-21 12:00-12:30

Squeezed light and interferometric sensitivity - a novel scheme, practical and robust *(Invited paper)*

G. Leuchs[1,2,3], N.A. Kalinin[1,2], A.A. Sorokin[1,2], T. Dirmeier[2,3], E.A. Anashkina[1,4], A.V. Andrianov[1]; [1]Inst. of Applied Physys RAS, Russia; [2]Max Planck Inst. Science of Light; [3]Univ. Erlangen-Nürnberg, Germany; [4]Lobachevsky State Univ., Russia

Probably the most robust generation of squeezed light is provided by the Kerr-effect in an optical fibre. However, the produced squeezed state forms an ellipse in phase space oriented under a skewed angle requiring certain manipulations before being useful. Now, we have found a novel scheme which is fairly user friendly and thus well suited for applications such as interferometry.

WeR8-22 12:30-12:45

Unconventional quantum statistics in an exciton-polariton system

T.A. Khudaiberganov, S.M. Arakelian; Department of Physics and Applied Mathematics, Stoletovs Vladimir State Univ., Russia

We are consistency considered two cases. Firstly, we consider exciton-photon statistic radiation from pillar microcavity. We obtained unconventional photon antibunching and small polariton antibunching. Secondly, we use two strong-coupled pillar microcavities to achieve pronounced polariton antibunching.

This research was supported by RFBR Grant(s) # Грант РФФИ № 20-02-00515 А; Государственное задание № 0635-2020-0013

WeR8-23 12:45-13:15

Laser solitons with phase and polarization singularities *(Invited paper)*

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

We investigate, analytically and numerically, phase and polarization singularities of 2D-laser spatial solitons in a wide-aperture semiconductor laser with vertical cavity and saturable absorber. We present a wide family of such vector solitons characterizing the phase singularities by their integer topological charges for the two circular polarizations and by half-integer Poincaré index for polarization singularities.

This research was supported by RFBR Grant(s) # The Russian Science Foundation, grant 18-12-00075

WeR8-24 13:15-13:45

Linear and nonlinear surface nanoscale axial photonics *(Invited paper)*

M. Sumetsky; Aston Univ., UK

Surface Nanoscale Axial Photonics (SNAP) employs whispering gallery modes circulating and slowly propagating along the fiber surface. First, I discuss our recent experimental and theoretical results in linear SNAP including interplay of slow and tunnelling light, bat microresonators, and slow-cooked microresonators. Next, I consider nonlinear SNAP including transportation of light by light at the microscale and frequency comb generators.

– Lunch Break –

Nonlinear phenomena in lasers

Location: Pudovkin Room, floor 3. 15:00-17:15

WeR8-25 15:00-15:30

Floquet defect solitons *(Invited paper)*

S.K. Ivanov[1,2], Ya.V. Kartashov[1,2], V.V. Konotop[3]; [1]ICFO-Inst. de Ciencies Fotoniques, The Barcelona Inst. of Science and Technology, Spain; [2]Inst. of Spectroscopy RAS, Russia; [3]Departamento de Física and Centro de Física Teórica e Computacional, Faculdade de Ciências, Univ. de Lisboa, Portugal

We consider a square waveguide array with a few tilted central layers. Such Floquet system supports line defect modes, that are localized in the direction transverse to tilt direction. In the presence of nonlinearity, branches of defect solitons bifurcate from linear defect modes. We show that our system supports both bright and dark Floquet defect solitons. Russian Science Foundation (21-12-00096).

WeR8-26 15:30-16:00

Resonant interaction of short pulses and continuous waves in laser systems *(Invited paper)*

A. Yulin[1], O. Melchert[2,3,4], I. Babushkin[2,3], S. Willms[2,3], S. Bose[3,4], I. Oreshnikov[5], U. Morgner[2,3,4], A. Demircan[2,3,4]; [1]ITMO Univ., Russia; [2]Cluster of Excellence Phoenix; [3]Leibniz Univ. Hannover, Inst. of Quantum Optics; [4]Hannover Centre for Optical Technologies; [5]Max Planck Inst. for Intelligent Systems, Germany

We consider propagation and mutual interaction of the pulses in lasing systems with two-color pumps creating gain in the frequency ranges lying in the both normal and anomalous regions of dispersion.

WeR8-27 16:00-16:15

A single-cycle gigawatt carrier-envelope-phase-tailored driver for strong-field nonlinear optics

I.V. Savitsky[1], E.A. Stepanov[1,2], A.A. Lanin[1,2], A.B. Fedotov[1,2,3], A.M. Zheltikov[1,2,3,4]; [1]Lomonosov State Univ.; [2]Russian Quantum Center, Russia; [3]Department of Physics and Astronomy, Texas A&M Univ., USA; [4]Kazan Quantum Center, Tupolev Kazan National Research Technical Univ., Russia

An idler-wave output of an optical parametric amplifier is compressed in a gas-filled antiresonance-guiding hollow-core photonic-crystal fiber to yield a single field cycle waveform of near-to-mid-infrared radiation with an energy 28 μJ, peak power 4 GW, and pulse width down to 6.6 fs with a stabilized carrier–envelope phase.

This research was supported by RFBR Grant(s) # RSF 20-12-00088

WeR8-28 16:15-16:30

Generation of a frequency comb with a gain-switched laser in a self-injection locking regime

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

Optical frequency combs provide unique opportunities for many practical applications and cutting-edge technologies. Hereby we demonstrate experimentally a generation of a frequency comb in visible range at 638 nm with a Fabry-Perot laser diode in a gain-switched regime and self-injection locked to a whispering gallery mode microresonator.

WeR8-29 16:30-16:45

Intracavity stimulated low-frequency Raman scattering - spectroscopy and Q-switch applications

D. Bi[1], M. Wu[2], T.V. Mironova[1], M.A. Shevchenko[1], S.F. Umanskaya[1], N.V. Tcherniega[1], A.D. Kudryavtseva[1]; [1]Lebedev Physycal Inst. RAS; [2]Bauman Moscow State Technical Univ., Russia

Intracavity stimulated low-frequency stimulated Raman scattering was applied for submicron (nanosized) particles morphological properties definition. Several high order Stokes components were registered for suspensions of submicron diamonds, quartz, latex, silver particles and nanocomposites on the base of synthetic opal matrices. Using these systems as Q-switchers the laser pulses of several hundred nanoseconds duration were obtained.

This research was supported by RFBR Grant(s) # RFBR Grant 20-52-00002-Bel_a and Belarus Foundation for Basic Research (Grant F20R-013).

WeR8-30 16:45-17:15

Theory of exciton-polariton lasing in 2D photonic lattices *(Invited paper)*

O.A. Egorov; Inst. of Condensed Matter Theory and Optics, Friedrich Schiller Univ. of Jena, Germany

This talk reviews recent achievements in theoretical description of collective dynamics of exciton-polaritons trapped in appropriately-designed potential landscapes. In particular the modelling of actual experiments on polariton lasing in 2D photonic lattices will be discussed.

Postdeadline Session

Location: Petrov-Vodkin Room, floor 2. 17:30-19:20

WePD-01 17:30-17:40

Application of wearable multimodal devices to study microcirculatory-tissue systems under microgravity conditions

A.V. Dunaev[1], E.V. Zharkikh[1], Y.I. Loktionova[1], A.A. Fedorovich[2,3], V.V. Sidorov[4], A.V. Vasin[5], A.A. Misurkin[5], V.I. Dubinin[5]; [1]Orel State Univ.; [2]National Medical Research Center for Therapy and Preventive Medicine of the Ministry of Healthcare of the Russian Federation; [3]Inst. of Biomedical Problems RAS; [4]SPE "LAZMA" Ltd; [5]Gagarin Research and Test Cosmonaut Training Center, Russia

This paper presents the first results of the study of changes in microcirculatory-tissue systems functioning under spaceflight conditions. The experiment with a crew of astronauts during the International Space Station visiting expedition was carried out. The study revealed significant changes in microcirculatory function during the first 2-3 days of the astronauts stay at the ISS.

WePD-02 17:40-17:50

Direct optical generation of singlet oxygen induces the apoptosis of tumor cells

I.N. Novikova[1], E.V. Potapova[1], V.V. Dremin[1,2], A.V. Dunaev[1]; [1]Orel State Univ., Russia; [2]Aston Univ., UK

The paper presents the study results the effect of singlet oxygen-induced by a laser with a wavelength of 1267 nm on the production of reactive oxygen species, oxidative stress, and cell viability of tumor B16 melanoma cells compared to control fibroblasts. Identified specific vulnerability of tumor cells to singlet oxygen may be used as a potential treatment in some cancers.

WePD-03 17:50-18:00

Temporal dynamics of flipping vortex cluster produced by beating Ince-Gaussian modes in trapped polariton condensate.

K.A. Sitnik[1], S. Alyatkin[1], J.D. Topfer[1], I. Gnusov[1], T. Cookson[1], H. Sigurdsson[2, 3], P.G. Lagoudakis[1,3]; [1]Hybrid Photonics Lab. Skolkovo Inst. of Science and Technology, Russia; [2]Science Inst., Univ. of Iceland, Iceland; [3]Department of Physics and Astronomy, Univ. of Southampton, United Kingdom

We experimentally and theoretically investigate the cell of 2 charge flipping vortex-anti-vortex pairs spontaneously forming under non-resonant optical ring-shaped excitation in polariton condensate. Vortices in such system appear due to simultaneous presence of two Ince-Gaussian modes with energy splitting of approx. 20 ueV. Such system demonstrates beating behavior with charge flipping twice per period of 200 ps.

This research was supported by RFBR Grant(s) # 20-32-90128

WePD-04 18:00-18:10

Silicon nitride photonic integrated circuits losses minimization

A.S. Baburin[1,2], E.V. Sergeev[1,2], S.S. Avdeev[1,2], E.S. Lotkov[1,2], M. Andronic[2], D.A. Baklykov[1,2], V.E. Stukalova[1,2], I.V. Dyakonov[3], N.N. Skryabin[3], M.Yu. Saygin[3], S.P. Kulik[3], I.A. Ryzhikov[2], I.A. Rodionov[1,2]; [1]Dukhov Automatics Research Inst.; [2]FMN Lab., Bauman Moscow State Technical Univ. [3]Quantum Technology Centre MSU, Russia

In this work we show possible ways and give guidelines for silicon nitride photonic integrated circuits fabrication process optimization. Most attention is paid to a key steps of fabrication process – e-beam lithography of e-beam resist and reactive ion etching of silicon nitride

WePD-05 18:10-18:20

Underwater navigation: LiDAR sensing in water to 9 m distance through semi-transparent obstacles

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

A model experiment on LiDAR underwater navigation has been carried out. A 9-m-long tube filled with water was used as a model water medium. The laser beam of the compact LiDAR (Light Detection and Ranging, 532 nm, ~2 ns, ~2 μJ/pulse,4 kHz) was directed into the tube, and a non-transparent object (wall of the room) was sensed through the water

WePD-06 18:20-18:30

Engineering ultrashort pulses in infrared and upper terahertz bands using a laser pulse and a nanostructured target

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

Characteristics of infrared and terahertz radiation in three laser-target interaction modes are found with 2D simulations. Choosing appropriate target nanostructure, the shape of the generated pulse can be engineered and a train of such pulses with controlled delay between them can be produced. Radiation amplitude can reach subrelativistic values with conversion efficiency about one percent.

This research was supported by RFBR Grant(s) # The study was supported by RFBR project 19-52-45035-Ind-a

WePD-07 18:30-18:40

Optical control of photon statistics in a spinor polariton condensate

S. Baryshev[1], A. Zasedatelev[1,2], H. Sigurdsson[3,2], I. Gnusov[1], J.D. Töpfer[2], A. Askitopoulos[1], P.G. Lagoudakis[1,2]; [1]Hybrid Photonics Lab., Skolkovo Inst. of Science and Technology, Russia; [2]School of Physics and Astronomy, Univ. of Southampton, United Kingdom; [3]Science Inst., Univ. of Iceland, Iceland

We investigate the photon statistics of optically confined condensate of exciton-polaritons and reveal condensate pseudospin dynamics, with regimes of stochastic polarization switching, limit cycles and fixation onto stable points. We show optical control over the photon statistics of the polarization components and demonstrate transition from highly coherent light source to a source, photon statistics of which is super-thermal.

This research was supported by RFBR Grant(s) # RFBR Project No. 20-32-90120

WePD-08 18:40-18:50

Advanced microlasers and micro-optics enabled by femtosecond laser processing of halide perovskites

A.A. Kuchmizhak[1,2], A.Yu. Zhizhchenko[1,2], S.V. Makarov[3]; [1]Far Eastern Federal Univ.; [2]Inst. of Automation and Control Processes, Far Eastern Branch RAS; [3]ITMO Univ., Russia

In our work, we justified direct femtosecond-laser ablation as a highly efficient, flexible and non-destructive tool for nanopatterning of halide perovskite monocrystals. The achieved resolution of 150 nm allowed us to realize various reflection- and transmission-type micro-optics elements (Fresnel lenses, fork-shaped diffraction gratings and vortex beam generators), holograms and nanotextured perovskite micro-lasers with controlled stimulated emission outcoupling.

WePD-09 19:50-19:00

Femtosecond high repetition rate fiber laser-driven plasma microfocus X-ray source for imaging applications

A.A. Garmatina[1,2], V.E. Asadchikov[2], A.V. Buzmakov[2], I.G. Dyachkova[2], A.I. Baranov[3], D.V. Myasnikov[3], N.V. Minaev[2], V.M. Gordienko[2,4]; [1]NRC «Kurchatov Inst.»; [2]FSRC "Crystallography and Photonics" RAS; [3]NTO IRE-Polus; [4]Lomonosov Moscow State Univ., Russia

We present new approach to femtosecond laser-plasma X-ray source driven by low energy 0.1MHz rate ytterbium fiber laser interacted with metal target in ambient atmosphere environment. The results of the generation line X-ray with a flux more than 10^7 photons/s in 2π for X-ray imaging applications are discussed.

WePD-10 19:00-19:10

Direct femtosecond laser printing of plasmonic colors in reflection at 25,000 DPI

V.S. Lapidas[1,2], A.Yu. Zhizhchenko[1,2], A.A. Kuchmizhak[1,2]; [1]Far Eastern Federal Univ.; [2]Inst. for Automation and Control Processes, Russia

Direct femtosecond laser nanopatterning of metal-insulator-metal sandwich designed to support Fabry-Perot mode in the visible spectral range was proved usefulness for high-resolution multi-color printing of structural colors images in reflection at 25,000 dots per inch resolution.

WePD-11 19:10-19:20

Dual-band two-photon excited photoluminescence from the doped Yb^{3+}:CsPbClxBr^{3-}x perovskite nanocrystals

E.V. Ushakova[1], A.V. Sokolova[1], A.O. Ismagilov[2], D.A. Tatarinov[1], A.A. Kalinichev[3], A.V. Koroleva[3], E.V. Zhizhin[3], M.A. Baranov[1], A.P. Litvin[1,2]; [1]Center of Information Optical Technologies, ITMO Univ.; [2]Laboratory of Quantum Processes and Measurements, ITMO Univ.; [3]Research Park, St. Petersburg State Univ., Russia

All-inorganic lead halide perovskite nanocrystals doped with ytterbium demonstrate dual-band emission with visible band tunable by halide ratio change. Both visible and NIR emissions can be excited via two-photon absorption by the perovskite matrix. It should be noted that the energy transfer from the perovskite matrix to the Yb3+ center is nonlinear and depends on temperature and excitation power.

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

WeR2-p01 15:00-18:30

Measurement of the absorption cross section of transitions in cesium and rubidium atoms using nonharmonic pumping

A.A. Babin, A.V. Strakhov; RFNC-VNIIEF, Russia

We consider and implement a method for measuring the absorption cross section of alkali metal atoms pumped by radiation with a finite spectrum width. We demonstrate a comparison of the calculated and experimentally measured values of cross section for the one transition in Rb atoms that are in a good agreement taking into account the nonmonochromaticity of the pumping.

WeR2-p02 15:00-18:30

OPRGL operating in closed and open cycle

A.A. Kalacheva, Yu.A. Adamenkov, M.A. Gorbunov, V.A. Shaidulina; FSUE "Russian Federal Nuclear Center - VNIIEF", Russia

We represent output parameters of optical pumped Ar-metastable laser Operating in different conditions such as: closed and open cycle, Different gas flow rate, percentage of Ar atoms in mixture. The achieved output Power level is in this work.

WeR2-p03 15:00-18:30

A method for parameters calculating of an unstable resonator taking into account intracavity aberrations and energy losses

S.Yu. Strakhov, A.V. Trilis, N.V. Sotnikova; Ustinov Baltic State Technical Univ. «VOENMEH», Russia

The main features of unstable resonators of flowing gas lasers associated with the implementation of multi-pass schemes are considered. A technique for designing an unstable multi-pass resonator has been developed, taking into account the influence of optical inhomogeneities of the active medium, thermal deformation and disalignment of mirrors and other factors on the parameters of laser radiation.

WeR2-p04 15:00-18:30

Polarization properties of radiation from a planar CO_2-laser with a hybrid waveguide-unstable resonator

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

The polarization instability of radiation from a planar CO2-laser is studied as a function of the tuning of a waveguide-unstable resonator consisting of two concave mirrors and a hollow waveguide formed by metal electrodes of discharge. Mounting a ZnSe plate at the Brewster angle and an additional mirror made it possible to obtain a stable state of laser radiation polarization.

WeR2-p05 15:00-18:30

Envelope control of chirped ns laser pulses with SLM-base shaper

I.V. Kuzmin, S.Yu. Mironov, M.A. Martyanov, A.K. Potemkin; Federal Research Center Inst. of Applied Physics RAS, Russia

A possibility of producing laser pulse shaping of infrared chirped pulses (1nm spectral width, 1 ns duration) is investigated. It is shown, that SLM-based shaper can be used for the pulse shape precompensation before an amplifier chain.

WeR2-p06 15:00-18:30

Planar CO- and CO_2-lasers with an unstable cavity and additional feedback

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

The radiation of planar RF-excited CO and CO2 lasers with an unstable resonator and one coupling element is spatially superimposed. The divergence and emission spectrum are investigated. It is shown that in CO and CO2 lasers it is possible, by acting on the peripheral part of the composite resonator, to increase the output power and lower the lasing threshold.

WeR2-p07 15:00-18:30

All-fiber Erbium-doped ultrashort pulse laser with switchable generation mode

A.Yu. Fedorenko, I.O. Orekhov, D.A. Dvoretskiy, S.G. Sazonkin, L.K. Denisov, V.E. Karasik; Bauman Moscow State Technical Univ., Russia

We demonstrate the erbium-doped ultrashort pulse (USP) hybrid mode-locked fiber laser with 2 switchable generation modes - similariton-like pulses and dissipative soliton. The developed fiber laser generates femtosecond pulses with average power up to 7 mW at slightly positive net-cavity dispersion parameter β2 with a repetition rate of 8,1 MHz.

WeR2-p08 15:00-18:30

Pump and idler beams parameters dependence on pump power under conditions of mid-infrared difference frequency generation in PPLN

A.Yu. Ostapiv[1,2], V.P. Tsypkin[1,2], P.S. Cherpak[2], A.S. Gulyashko[2], I.A. Larionov[2], V.A. Tyrtyshnyy[2]; [1]Moscow Inst. of Physics and Technology (National Research Univ.); [2]NTO "IRE-Polus", Russia

In this work, aspects of the spatial distribution of pump and idler beams was studied under conditions of a two-stage mir-IR difference frequency generation in a single periodically poled lithium niobate crystal. Significant change (up to 40 %) in the diameter and position of beam waists was experimentally observed depending on the pump power in 5–50 W range.

WeR2-p09 15:00-18:30

Polarization maintaining all-fiber narrow-band laser with a spectral linewidth of not more than 0.1 nm

A.V. Bochkov, A.N. Slobozhanin, M.G. Slobozhanina, K.V. Goroshkina, D.V. Saraseko, S.S. Ketov, A.V. Ketova; RFNC-VNIITF, Russia

The work is devoted to the development of a polarization maintaining all-fiber narrow-band laser with a spectral linewidth of not more than 0.1 nm. The results of studies carried out during the realization of this type of lasers are presented.

WeR2-p10 15:00-18:30

Thin films deposition using high-power e-beam controlled CO_2-laser by fast scanning of solid target

V.A. Shitov; Inst. of Electrophysics UrB RAS, Russia

To obtain high-quality thin films the reduction of exposure time was achieved by spatial displacement of the CO2-laser radiation pulse over the target surface due to mirror rotation. The sizes and number of droplets decreases with an increase in scanning speed up to 100 m/s. At a pulse frequency of 20 Hz the deposition rate reaches 10 μm/min.

WeR2-p11 15:00-18:30

Mid-infrared emission properties of transparent Er:$YScO_3$ laser ceramic

V. Shitov[1], L. Basyrova[2], P. Loiko[2], R. Maksimov[1,3], O. Samatov[1], D. Vasin[1,3], J.-L. Doualan[2], A. Braud[2], P. Camy[2]; [1]Inst. of Electrophysics UrB RAS, Russia; [2]Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), Univ. de Caen Normandie, France; [3]Ural Federal Univ. named after the first President of Russia B.N. Yeltsin, Russia

Comparative study of structural features and spectroscopic properties of Er:Y2O3 and Er:YScO3 transparent ceramics is reported. The ceramic samples were fabricated using vacuum sintering of nanoparticles synthesized by laser ablation. The lattice parameter decreases and the average grain size increases with the addition of Sc2O3 into Er:Y2O3. Disordered Er:YScO3 ceramic exhibits strong inhomogeneous broadening of absorption and mid-infrared emission spectra.

This research was supported by RFBR Grant(s) # 21-53-15014

WeR2-p12 15:00-18:30

Calculation of Cross-Beam Energy Transfer linear gain in direct-drive targets

S.V. Bondarenko[1], I.R. Smagin[1], O.O. Sharov[1]; [1]RFNC-VNIIEF, Russia

A simplified model, which allows quick estimations of energy transfer level in linear regime by CBET (Cross-Beam Energy Transfer) mechanism in coronal plasma of direct-drive targets, is proposed. The CBET linear gain at a self-similar rarefaction wave front has been calculated for typical conditions of direct-drive inertial confinement fusion experiments.

WeR2-p13 15:00-18:30

Laser radiation losses in passive optical fibers with copper winding

I.O. Khramov[1], O.A. Ryabushkin[2]; [1]Moscow Inst. of Physics and Technology (National Research Univ.); [2]Kotelnikov Inst. of Radioengineering and Electronics RAS (Fryazino branch), Russia

Thermal effects and optical losses in passive optical silica fibers with copper winding were investigated. The radiation transmitted through the fiber is partly scattered and absorbed in the fiber or by the wire. This leads to the sensor heating and to the coil electrical resistance change measured by an ohmmeter. A method for fiber lasers optical power measurements is proposed.

WeR2-p14 15:00-18:30

The criterion for accounting for stimulated nonlinear scatterings in the development of optical schemes of high-power single-mode fiber lasers

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

The paper proposes a new approach to fixing the threshold for stimulated nonlinear scattering in active and passive optical fibers. It's proposed to fix the power of the Stokes component at a certain criterion level, which makes it possible to determine the threshold values of the primary radiation powers, which characterize the expected manifestation of stimulated nonlinear scattering.

WeR2-p15 15:00-18:30

Self-terminating metal ion lasers operating at high pulse repetition frequency

M.A. Lavrukhin[1], P.A. Bokhan[1], P.P. Gugin[1], I.M. Ananyev[2], D.E. Zakrevsky[1,2]; [1]Rzhanov Inst. of Semiconductor Physics SB RAS; [2]Novosibirsk State Technical Univ., Russia

Experimental results of the lasers operating on the barium, calcium and mercury ions self-terminating transitions investigations are presented. A significant improvement of the output characteristics of these lasers by employing a novel high-voltage nanosecond switch (eptron) capable to operate at high pulse repetition frequency (more than 50 kHz) is demonstrated.

WeR2-p16 15:00-18:30

Optimization of the optical scheme of weak absorption measurement in transparent materials

A.V. Kirpichnikov[1], V.V. Petrov[1,2,3], V.I. Trunov[1,2,3], P.A. Statsenko[1], S.I. Trashkeev[1]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State Technical Univ.; [3]Novosibirsk State National Research Univ., Russia

Comparative results of experimental studies and numerical analysis are presented using the developed original technique for simulating an installation for measuring ultralow absorption based on PCI. The possibility of reducing the detection threshold for volume absorption by the PCI method is shown to be significantly lower than 10-6 cm-1, absorption on the surface less than 1 ppm.

This research was supported by RFBR Grant(s) # RFBR project 20-02-00529

WeR2-p17 15:00-18:30

Externally-triggered joule-level nanosecond pulses hybrid laser source

A.I. Trikshev, V.A. Kamynin, V.B. Tsvetkov, V.V. Bukin, T.V. Dolmatov, B.D. Ovcharenko; Prokhorov General Physics Inst. RAS, Russia

A hybrid laser system based on DFB laser diode, three-stage Yb-doped fiber amplifier and a multi-pass system of Nd:YAG bulk amplifiers for generating an arbitrary laser pulse shape with an energy of up to 1 J were demonstrated. External triggering made it possible to obtain a pulse on demand.

This research was supported by RFBR Grant(s) # Ministry of Science and Higher Education of Russian Federation grant № 075-15-2020-912

WeR2-p18 15:00-18:30

A method for forming a tubular beam of radially polarized laser radiation

T.T. Kondratenko, V.N. Puzyrev, A.T. Sahakyan; Lebedev Physical Inst. RAS, Russia

A method and a device for forming a tubular beam of radially polarized laser radiation with a limited or increased number of modes have been developed. The basis of an optical quantum generator consists of a hollow thin-walled active element with end faces in the form of Brewster cones at the large bases.

WeR2-p19 15:00-18:30

Generation characteristics of low pressure nitrogen laser

I.V. Login; Ryazan State Radio Engineering Univ., Russia

A correlation was established between the conditions of pumping a nitrogen laser and the distribution of laser radiation over the beam cross section. The conditions for the realization of a uniform radiation distribution with a minimum contribution of "halos" surrounding the central spot to the laser radiation power are determined.

WeR2-p20 15:00-18:30

SBS generation in an optical fiber

K.G. Aksenov[1,2], S.V. Tyutin[2], O.L. Techko[2], T.I. Kozlova[2], S.M. Kulikov[2], S.G. Garanin[2], A.V. Kopalkin[2], Ya.A. Kryukov[2], N.A. Zaretsky[2], M.I. Konovaltsov[2], S.V. Khokhlov[2], A.A. Lastovkin[2], A.V. Vesnovsky[2], G.N. Kachalin[2]; [1]MSU Sarov, Russia; [2]RFNC-VNIIEF, Russia

This paper presents results of an experimental and numerical study of the generation parameters of stimulated Brillouin scattering (SBS) in an optical fiber. The dynamics of the grid induced in the fiber was studied, and some methods for increasing the threshold of SBS generation were also considered.

WeR2-p21 15:00-18:30

Improvement of spectral-optical characteristics of ceramics based on Er: Y_2O_3 by hot isostatic pressing

M.N. Gerke[1], R.V. Chkalov[1], D.A. Kochuev[1], K.A. Frolov[1], V.V. Balashov[2], A.V. Fedin[1,4], K.N. Gorbachenya[3], V.E. Kisel'[3], S.M. Kozlova[2], N.V. Kuleshov[3], K.V. Lopukhin[2]; [1]Vladimir State Univ.; [2]Kotelnikov Inst. of Radioengineering and Electronics RAS, Russia; [3]Belarusian National Technical Univ., Belarus; [4]Kovrov State Technological Academy, Russia

This work is devoted to the problem of improving the spectral and luminescent properties of optical ceramics based on Y2O3 sesquioxide doped with Er3+ ions. A technology for processing ceramics by hot isostatic pressing has been proposed. SEM-images of Er:Y2O3 samples subjected to the HIP treatment are shown.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Foundation for Basic Research under grant no. 20-52-00015 Bel_a

WeR2-p22 15:00-18:30

Laser induced damage threshold characterization in KDP crystal by ultrasonic measurements

G.A. Luchinin, A.I. Pavlikov, V.V. Chernov, I.V. Kuzmin, V.V. Lozhkarev; Federal Research Center Inst. of Applied Physics RAS, Russia

An in situ method of laser induced damage threshold characterization in KDP crystal is proposed. It is based on spectral analysis of generated ultrasonic surface acoustic waves under action of laser radiation with ns duration.

WeR2-p23 15:00-18:30

Experimental and simulative analysis of cladding-pumped EYDFA gain evolution

S. Olonkins[1], K. Zakis[2], A. Udalcovs[2], A. Supe[2], O. Ozolins[2], J. Grube[3], S. Spolitis[2], V. Bobrovs[2]; [1]AFFOC Solutions; [2]Inst. of Telecommunications, Riga Technical Univ.; [3]Inst. of Solid State Physics, Univ. of Latvia, Latvia

Signal gain evolution of a cladding-pumped single-core erbium-ytterbium co-doped fiber amplifier (EYDFA) at different doped fiber lengths is analyzed. The research is performed both experimentally and using a simulation model based on the measured signal parameters and EYDF characteristics. The results are compared to estimate the possibility of using such simulations for gain characteristics prediction prior to EYDFA experimental implementation.

WeR2-p24 15:00-18:30

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

Yu. N. Panchenko[1], M. V. Andreev[1], A.V. Puchikin[1], E.V. Gorlov[2], V.I. Zharkov[2]; [1]Inst. of High Current Electronics SB RAS; [2]Zuev Inst. of Atmospheric Optics SB RAS, Russia,

The results of studies of the formation of a structured diffuse discharge in an XeCl laser with a specific output energy of ~ 15 J / L, are presented. Plasma-chemical processes occurring in such a discharge at a maximum concentration of electrons in the plasma of ~ 7 E15 cm-3 are considered.

This research was supported by RFBR Grant(s) # Russian Science Foundation Project No. 20-79-10297

WeR2-p25 15:00-18:30

Pulse-periodical TEA-laser functioning on a mixture of carbon dioxide and air

B.A. Kozlov[1], D.S. Makhanko[2], A.Ya. Payurov[2]; [1]Ryazan State Radio Engineering Univ.; [2]PLASMA, JSC Research Inst. of Gas–Discharge Devices, Russia

A variant of the TEA–CO2 laser with a closed cycle of transverse pumping of gas mixtures based on "CO2 + air", operating at pulse repetition frequencies up to 1 kHz, has been implemented. With an active volume V =18x0.8x0.8 cm3, the maximum average radiation power of 32 W at a pulse repetition frequency of 600 Hz was achieved.

WeR2-p26 15:00-18:30

TEA-N_2 laser with pulse repetition rate up to 12 kilohertz

B.A. Kozlov[1], D.S. Makhanko[2], A.Ya. Payurov[2]; [1]Ryazan State Radio Engineering Univ.; [2]PLASMA, JSC Research Inst. of Gas–Discharge Devices, Russia

Electrode structures of the "set of needles – plane" type ensure the operation of the TEA – N2 laser at pulse repetition rates up to 12 kHz. A mixture of nitrogen and helium is used at a pressure of 760 Torr. Stabilization of the laser energy parameters is ensured by continuous renewal of the gaseous medium in the active element.

WeR2-p27 15:00-18:30

Thick Cu cylinder CAP welding with fiber laser under high vacuum conditions

S. Hann[1], H.S. Jang[1], Z. Choi[2]; [1]Laser Research Center, Korea Photonics Technology Inst., KOPTI; [2]Dept of Laser System, Laservall Technology, Korea

We experimentally developed laser vacuum welding for Cu thick cylinder by using >2kW at 1080nm wavelength fiber laser. Under the high vacuum 10-5 Torr, It can eliminate the oxidation of Cu seam welding parts as well as the fewer spatters during welding process without changing the laser windows.

WeR2-p28 15:00-18:30

Fabrication of hydrophobic surfaces of aluminum alloys by laser irradiation

A. Abramov[1], V.V. Samyshkin[1], A. Osipov[1], S. Kutrovskaya[1,2,3]; [1]Stoletov Vladimir State Univ., Russia; [2]School of Science, Westlake Univ., China; [3]Inst. of Natural Sciences, Westlake Inst. for Advanced Study, China

In this work, we propose the creation of hydrophobic surfaces with macrogeometry controlled by the laser beam trajectory, and microgeometry determined by the target surface modification processes during local laser heating.

This research was supported by RFBR Grant(s) # 20-21-00038

WeR2-p29 15:00-18:30

Designing Mamyshev oscillator cavity by particle swarm optimization algorithm

E. Kuprikov[1], A. Perepelov[1], A. Kokhanovskiy[1], I.A. Bednyakova[1], S. Turitysin[1,2]; [1]Division of Laser Physics and Innovative Technologies, Novosibirsk State Univ., Russia; [2]Aston Inst. of Photonic Technologies, Aston Univ., UK

We apply particle swarm algorithm for numerical optimization of a Mamyshev oscillator. We demonstrate that our approach can be used for design of laser configuration with megawatt peak power scale.

This research was supported by RFBR Grant(s) # This work was supported by Russian Science Foundation (17-72-30006)

WeR2-p30 15:00-18:30

Numerical study of the plasma charge for the case of a cylindrical bunch irradiated with a laser pulse

M.V. Timshina[1], N.V. Kalinin[1]; [1]Ioffe Inst., Russia

Numerical simulation with non-equilibrium ionic composition of a cylindrical plasma bunch under the influence of an external laser pulse with an intensity of <10^14 W /cm^2 is performed. Pulse parameters are varied. A nonstationary one-dimensional two-temperature radiation-hydrodynamic model is used. The model and results may be interesting regarding the formation of active media for EUV and SXR lasers.

This research was supported by RFBR Grant(s) # grant RFBR № 20-38-90259

WeR2-p31 15:00-18:30

Study of luminescence during sputtering of lithium in noble gas by a nanosecond electron beam

K. Samarkhanov[1], E. Batyrbekov[2], M. Khasenov[3], Yu. Gordienko[1], Yu. Ponkratov[1], Ye. Martynenko[1], Ye. Tulubayev[1], V. Bochkov[1]; [1]Inst. of Atomic Energy, Branch of the National Nuclear Center of the Republic of Kazakhstan; [2]National Nuclear Center of the Republic of Kazakhstan; [3]School of Sciences and Humanities, Nazarbayev Univ., Kazakhstan

In experiments to study lithium sputtering in noble gas, a target with a deposited lithium layer is placed in path of e-beam. Analysis of obtained results allowed determining a temperature dependence of luminescence intensity, as well as promising mixtures of noble gases, atomic transitions for conducting experiments at the IGR pulsed nuclear reactor.

WeR2-p32 15:00-18:30

Experimental facility to study the possibility of laser action at the p-s transition of noble gas atom under excitation by 6Li(n,α)3H nuclear reaction products

K. Samarkhanov[1], E. Batyrbekov[2], M. Khasenov[3], Yu. Gordienko[1], A. Kotlyar[1], Ye. Martynenko[1], Yu. Ponkratov[1], Ye. Tulubayev[1], V. Bochkov[1], Z. Kozhabayev[1]; [1]Inst. of Atomic Energy, Branch of the National Nuclear Center of the Republic of Kazakhstan; [2]National Nuclear Center of the Republic of Kazakhstan; [3]School of Sciences and Humanities, Nazarbayev Univ., Kazakhstan

The work describes experimental facility to study the possibility of laser action under gas mixtures excitation by 6Li(n,α)3H nuclear reaction products in the pulsed nuclear reactor core. For justification of irradiation device design configuration and safe implementation during in-pile experiments, a series of neutron-physical and thermal-physical calculations were performed.

WeR2-p33 15:00-18:30

Modeling of optical inhomogeneities in Cr:CdSe laser with a moving active element

M.V. Volkov[1,2], V.A. Garyutkin[1], N.G. Zakharov[1,2], G.M. Mishchenko[1], V.O. Ryabov[3], F.A. Starikov[1]; [1]Inst. of Laser Physics Research, Russian Federal Nuclear Center - All-Russian Research Inst. of Experimental Physics (ILFI RFNC-VNIIEF); [2]Lobachevsky State Univ. of Nizhny Novgorod; [3]Branch of the Lomonosov Moscow State Univ. in Sarov, Russia

The results of numerical investigations of optical inhomogeneities in high-power Cr:CdSe lasers with a moving active element are presented. It has been shown that the beam quality of Cr:CdSe lasers depends on the speed of movement of the active element. The maximum power has limited by the efficiency of the resonator and the cooling system of active element.

WeR2-p34 15:00-18:30

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

A.V. Mezhenin, A.D. Kapitonov; Samara National Research Univ., Russia

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

WeR2-p35 15:00-18:30

Investigation of the divergence and spectral characteristics of radiation from a planar cw laser with an unstable resonator and additional feedback

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

The properties of a cw planar CO- and CO2-lasers with an unstable resonator of the negative branch of the stability diagram and additional optical elements (mirror - translucent plate, diffraction grating) located outside the working model of the laser were studied. The problems of divergence and spectral selection of laser radiation are considered.

WeR2-p36 15:00-18:30

Concentration quenching of the Fe^{2+} luminescence in a ZnSe single crystal

N.N. Il'ichev, V.P. Kalinushkin, E.S. Gulyamova, S.A. Mironov, M.I. Studenikin, A.V. Sidorin, V.V. Tumorin, P.P. Pashinin; Prokhorov General Physics Inst. RAS, Russia

It is measured the kinetics of the luminescence of Fe2+ in ZnSe at liquid nitrogen temperature at excitation by short laser pulse with wavelength 2940 nm. It was showed that the form of luminescence decay curve depends on concentration of Fe2+. This was interpreted as a manifestation of concentration quenching of upper state of Fe2+.

This research was supported by RFBR Grant(s) # e RFBR grant No. 18-29-20048

WeR2-p37 15:00-18:30

Stimulated absorption in Holmium fibers in the wavelength range of 1.5-1.75 μm

V.A. Kamynin[1], A.A. Wolf[2], S.A. Filatova[1], I.V. Zhluktova[1], A.I. Fedoseev[3], I.A. Lobach[2], S.A. Babin[2], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Inst. of Automation and Electrometry SB RAS; [3]Lomonosov Moscow State Univ., Russia

We study the excited-state absorption for holmium-doped optical fibers in the spectral range of 1.5–1.75 μm. The pump-induced absorption spectra and temporal transmission dynamics for fibers with different ion concentrations and lengths are measured.

This research was supported by RFBR Grant(s) # GPI RAS thanks Ministry of Science and Higher Education of Russian Federation grant № 075-15-2020-912; IA&E part is supported by RF state budget

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

WeR5-p01 15:00-18:30

Interaction of powerful repetition rate femtosecond laser pulses with selfproducted copper nanostructure

N.S. Pulkin[1,2], A.A. Shimko[1], E.A. Klementev[1], A.A. Andreev[1,3]; [1]St. Petersburg State Univ.; [2]ITMO Univ.; [3]Ioffe Inst. RAS, Russia

This report is focused on the opportunities of using high energy femtosecond laser radiation for metal nano-structuring and subsequent effective X-ray emission from self-produced nano-structures. We consider the interaction of high energy high repetition rate femtosecond laser pulses from Coherent Astrella Ultrafast Ti:Sapphire Amplifier with shaped copper targets and effective generation of X-ray radiation.

WeR5-p02 15:00-18:30

Ultra-wide spectral range X-ray diagnostics of relativistic femtosecond laser plasma

A.I. Sivko[1], K.A. Ivanov[1,2], I.N. Tsymbalov[1,3], E.A. Bolkhovitinov[2], A.A. Kologrivov[2], S.A. Pikuz[4,5], R.V. Volkov[1], A.A. Rupasov[2], A.B. Savel'ev[1,2]; [1]Lomonosov Moscow State Univ.; [2]Physical Inst. RAS; [3]INR RAS; [4]JIHT; [5]MEPHI, Russia

The X-ray emission of relativistic laser plasma was investigated in the spectral range from XUV to gammas by a set of detectors and techniques. Thermal and hot electron components generation was studied in dependence of the peak laser intensity and contrast of the laser pulse.

This research was supported by RFBR Grant(s) # 19-02-00740

WeR5-p03 15:00-18:30

The effect of strong and super-strong laser fields on the resonant spontaneous bremsstrahlung radiation of super ultrarelativistic electrons on nuclei

S.P. Roshchupkin[1], V.V. Dubov[1], A. Dubov[1,2], S.S. Starodub[3]; [1]Russian Univ., Russia; [2]Finland Univ., Finland; [3]NAS of Ukraine, Ukraine

Theoretically used the resonant spontaneous bremsstrahlung (SB) radiation during the scattering of super ultrarelativistic electrons with energies of the order 100 GeV by the nuclei in super strong laser fields with intensities up to 10^24 W/cm^2. It is shown that the resonant cross-section can significantly exceed the corresponding cross-section without an external field.

WeR5-p04 15:00-18:30

Resonance of the direct amplitude of the Compton effect for ultrarelativistic electron energies in a strong laser field

S.P. Roshchupkin[1], V.N. Nedoreshta[2]; [1]Russian Univ.; [2]NAS of Ukraine, Ukraine

Theoretically used the resonant Compton scattering at initial electron energies of the order 100 GeV in super strong laser fields with intensities up to 10^24 W/cm^2. It is demonstrated that the resonant cross section of scattering may be several orders of magnitude higher than the cross section of Compton effect in the absence of the external field.

WeR5-p05 15:00-18:30

Free carriers' dynamics in the bulk of silicon under mid-IR femtosecond laser excitation

K.V. Lvov[1], E.I. Mareev[1,2], S.Yu. Stremoukhov[1,3], F.V. Potemkin[1]; [1]Lomonosov Moscow State Univ.; [2]Inst. of Photon Technologies FSRC "Crystallography and Photonics" RAS; [3]National Research Center "Kurchatov Institute", Russia

Results of numerical simulation of free carriers' dynamics under femtosecond laser excitation in the mid-IR range (4.6 μm) in the bulk of silicon are presented. The electrons heating up to 8 eV as well as the promotion of supercritical carrier concentration (8.5·10^21 cm^-3) is demonstrated. These are critical to achieve the energy threshold (4.2 kJ/cm^3) for melting silicon crystal lattice.

WeR5-p06 15:00-18:30

Stress-strained state of brittle materials after picosecond laser treatment in package high-frequency pulsation mode

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

The mathematical model is proposed that describes the physical picture of mechanical processes occurring in solid brittle materials when exposed to picosecond pulsed laser radiation. The paper shows the application of the developed model to the calculation of the modes of laser processing of glass-carbon and molybdenum when creating micropoint structures.

WeR5-p07 15:00-18:30

Femtosecond laser-induced periodic surface structuring of metal and semiconductor nitrides

K. Bronnikov[1], S. Gladkikh[1], K. Okotrub[1], A. Simanchuk[1], A. Zhizhchenko[2,3], A. Kuchmizhak[2,4], A. Dostovalov[1]; [1]Inst. of Automation and Electrometry SB RAS; [2]Inst. of Automation and Control Processes FEB RAS; [3]Far Eastern Federal Univ.; [4]Pacific Quantum Center, Far Eastern Federal Univ., Russia

Highly regular thermochemical laser-induced periodic surface structures (TLIPSS) were produced on the surface of TiN, CrN and Ge3N4 glass-supported thin films using femtosecond laser pulses. Systematic studies of the TLIPSS morphology variation as a function of key laser processing parameters and ambient atmosphere revealed the processing regimes providing high-regular 2D and 3D morphologies promising for optical and optoelectronic applications

This research was supported by RFBR Grant(s) # Russian Science Foundation grant (No. 21-72-20162)

WeR5-p08 15:00-18:30

Laser welding of borosilicate glass using by femtosecond fiber lasers

M.A. Murzakov[1], N.N. Evtikhiev[1,2], A.A. Oreshkin[1], A.S. Schekin[1,2], D.M. Kataev[1]; [1]LLC "IRE-POLUS" LTD; [2]National Research Nuclear Univ. MEPhI, Russia

The work shows the principal possibility laser welding borosilicate glass using by IPG Photonics femtosecond fiber lasers. The main physical mechanisms of laser glass welding are considered. Laser welding of glass or transparent dielectrics is based on the mechanisms of nonlinear absorption high-intensity laser radiation. The main technological features of the process laser welding of borosilicate glass are demonstrated.

WeR5-p09 15:00-18:30

Laser plasma characteristic X-ray radiography of an unstably compressed ICF target

D.S. Bespalov[1], K.Yu. Platonov[2], A.A. Andreev[1,3]; [1]St. Petersburg State Univ.; [2]St. Petersburg State Polytechnic Univ.; [3]Ioffe Physical Technical Inst., Russia

In the present report, we analyze analytically and numerically laser back-lighter scheme for ICF with He-α line emission of Zinc secondary target. The images of multi-shell targets in case of occurrence of turbulent mixing were described. The model presented in this report, allows us to simulate target images with and without mixing layers and determine necessary parameters from its comparison.

WeR5-p10 15:00-18:30

Multifilament arrays from terawatt femtosecond beam over an extended atmospheric path

E. Mitina[1], D. Uryupina[1,2], D. Pushkarev[1,3], N. Zhidovtsev[1], R. Volkov[1], O. Kosareva[1,3], A. Savel'ev[1,3]; [1]Faculty of Physics and International Laser Center, Lomonosov Moscow State Univ.; [2]Zuev Inst. of Atmospheric Optics; [3]Lebedev Physical Inst. RAS, Russia

Amplitude modulated laser filaments appeared at the distance that is determined by the Fresnel lens formed by a hole, not by the self focusing theory for the unrestricted (Gaussian like) beam. This lens focuses 1/3 of the energy passing through the hole to the beam spot ~1 mm in diameter.

This research was supported by RFBR Grant(s) # 20-32-90191, 21-12-00109

WeR5-p11 15:00-18:30

Angular distribution of THz emission from cluster beam and electron dynamics in cluster plasma

N.A. Kuzechkin[1,2], A.V. Balakin[1,2], P.M. Solyankin[2], A.P. Shkurinov[1,2]; [1]Lomonosov Moscow State Univ.; [2]ILIT RAS – Branch of the FSRC «Crystallography and Photonics» RAS, Russia

In this work, we present and discuss experimental results of the angular power distribution of THz radiation from cluster jets that differ in cluster size and internal density of electrons in ionized clusters. The aim of the experiments was to verify the theoretical model of the mechanism of low-frequency generation in cluster plasma.

WeR5-p12 15:00-18:30

Contribution of collective electron dynamics to the polarization response of an atom in synchronized IR and XUV pulses

A.A. Romanov[1,2], A.A. Silaev[1,2], N.V. Vvedenskii[1,2], A.V. Flegel[3], M.V. Frolov[1,3]; [1]Univ. of Nizhny Novgorod; [2]Inst. of Applied Physics RAS; [3]Department of Physics, Voronezh State Univ., Russia

We study the polarization response of different noble-gas atoms in an intense IR laser field and a weak XUV pulse based on the numerical solution of the time-dependent Kohn-Sham equations. Collective multi-electron dynamics significantly enhance atomic polarizabilities and third-order nonlinearities both in IR and XUV range. The interference of XUV-induced response and IR-induced high harmonic generation is analyzed.

WeR5-p13 15:00-18:30

Generation of even harmonics of intense laser pulses in gases in the presence of lower-frequency feld

A.A. Silaev[1,2], A.A. Romanov[1,2], N.V. Vvedenskii[1,2]; [1]Inst. of Applied Physics RAS; [2]Univ. of Nizhny Novgorod, Russia

We investigate the mechanisms of low-order and high-order even harmonic generation during the interaction of the femtosecond laser pulses with atomic and molecular gases in the presence of lower-frequency electric field. We demonstrate the possibilities for using the even-harmonic generation of the intense laser pulse for the detection of co-propagating broadband terahertz and mid-infrared pulses.

WeR5-p14 15:00-18:30

Multilayer volumetric modification of fused silica by femtosecond laser radiation

R.V. Chkalov, A.S. Chernikov, D.G. Chkalova; Vladimir State Univ., Russia

We demonstrate the possibility of multilayer information writing in the volume of transparent media by femtosecond laser. The results of multilayer ordered structures formation in the bulk of the transparent fused silica glass samples are demonstrated. Examples of modification of a refractive index by means of interaction ultrashort laser pulses are shown.

WeR5-p15 15:00-18:30

Distributed random reflectors inscribed in a single-mode optical fiber with femtosecond laser pulses

A.A. Wolf[1], Zh.E. Munkueva[1,2], A.V. Dostovalov[1], S.A. Babin[1]; [1]IA&E SB RAS, Russia; [2]Novosibirsk State Univ., Russia

We present experimental results on direct femtosecond pulse inscription of different-type random reflectors in single-mode optical fibers. In particular, we compare the backscattering efficiency of randomly chirped fiber Bragg gratings, multipoint Fresnel reflectors, and continuous Rayleigh/Mie reflectors.

WeR5-p16 15:00-18:30

Resonance multielectron effects in high-order harmonic generation by Xenon

A.A. Romanov[1,2], A.A. Silaev[1,2], T.S. Sarantseva[2,3], M.V. Frolov[2,3], N.V. Vvedenskii[1,2]; [1]Inst. of Applied Physics RAS; [2]Univ. of Nizhny Novgorod; [3] Voronezh State Univ., Russia

Using the time-dependent density-functional theory, we study high harmonic generation (HHG) in xenon in intense infrared laser pulse assisted by XUV pulse. The enhancement of HHG spectrum in near 100 eV is demonstrated and explained by the interaction of the rescattering electron with inner-shell electrons. The contribution of different channels to additional high-frequency plateau in HHG spectrum is discussed.

WeR5-p17 15:00-18:30

Enhanced diagnostics of radiating relativistic singularities and BISER by nonlinear post-compression of optical probe pulse

A.V. Kotov[1], T.Zh. Esirkepov[2], A.A. Soloviev[1], A. Sagisaka[2], K. Ogura[2], A. Bierwage[3], M. Kando[2], H. Kiriyama[2], M.V. Starodubtsev[1], E.A. Khazanov[1], S.Yu. Mironov[1], A.S. Pirozhkov[2]; [1]Inst. of Applied Physics RAS, Russia; [2]Kansai Photon Science Inst., National Inst. for Quantum Science and Technology, Japan; [3]Rokkasho Fusion Inst., National Inst. for Quantum Science and Technology, Japan

The enhancement of the resolution of pump-probe optical diagnostics for ultrafast processes by compressing the probe pulse duration using the CafCA approach is considered on an example of the BISER soft-X-ray generation with the J-KAREN-P laser.

This research was supported by RFBR Grant(s) # The research was supported by the RFBR, Rosatom (under project No. 20-21-00123), JSPS Kakenhi 19H00669 and Strategic Grants by the QST President: Creative Research #20

WeR5-p18 15:00-18:30

Angular dispersion boost of high order laser harmonics interacting with dense plasma clusters

L.A. Litvinov[1], A.A. Andreev[1,2]; [1]St. Petersburg State Univ.; [2]Ioffe Inst., Russia

We propose a nanosphere array target in the plasma phase as an efficient dispersive medium for the intense XUV light. The scattering process is studied with numerical simulations and resonance conditions from the analytical model. We show the angular distribution of harmonics after scattering can be good described by the Bragg-Wolfe diffraction theory.

WeR5-p19 15:00-18:30

Optimal parameters for generation of extreme magnetic fields by relativistic intense circularly polarized laser pulse interacting with nanoclusters

K.Yu. Platonov[1], Zs. Lecz[3], A.A. Andreev[2,3]; [1]St. Petersburg State Technical Univ., Russia; [2]St. Petersburg State Univ., Russia; [3]ELI-ALPS, Hungary

Optimal parameters of cluster target and circularly polarized laser pulse were found using 3D PIC modeling, which permit to obtain a quasi-stationary magnetic field above 10 GG. The optimal magnetic field is significantly larger than the laser one. It is shown that such magnetic field slows down thermal cluster expansion and increases the yield of nuclear reactions in laser plasma.

WeR5-p20 15:00-18:30

Optical antennas interfaces formation by selective femtosecond laser ablation

R.V. Chkalov, D.G. Chkalova, A.S. Chernikov, D.A. Kochuev; Vladimir State Univ., Russia

The paper proposes a technology for optical antennas interfaces formation using femtosecond laser radiation. An experimental scheme of the laser micromachining procedure is presented. The possibility of large-length thin-film microsized structures formation has been proved.

WeR5-p21 15:00-18:30

Waveform retrieving of attosecond pulse using high-order harmonics generation of the time-delayed infrared field

T.S. Sarantseva[1,2], A.A. Romanov[1,3], A.A. Silaev[1,3], M.V. Frolov[1,2], N.V. Vvedenskii[1,3]; [1]Univ. of Nizhny Novgorod; [2]Department of Physics, Voronezh State Univ.; [3]Inst. of Applied Physics RAS, Russia

All-optical method for attosecond pulse metrology is discussed. It is shown analytically that high-order harmonic generation (HHG) yield for an intense infrared pulse and time-delayed attosecond pulse keeps encoded waveform of the attosecond pulse. The retrieval method is demonstrated by modeling HHG from Ne atom within time-dependent Kohn-Sham equations.

WeR5-p22 15:00-18:30

Relativistically nonlinear resonance absorption and high harmonic generation of laser radiation in an inhomogeneous plasma

I.I. Metelskii[1,2], V.F. Kovalev[2,3], V.Yu. Bychenkov[1,2]; [1]Lebedev Physical Inst. RAS; [2]Dukhov Automatics Research Inst. (VNIIA), ROSATOM; [3]Keldysh Inst. of Applied Mathematics RAS, Russia

Analytical theories of relativistically nonlinear resonant absorption and high harmonic generation of intense laser radiation in an inhomogeneous plasma are constructed. The effect of resonance absorption suppression with an increase in the laser field intensity is demonstrated, and secondary radiation spectra with a power-law decay of the harmonic intensity with an increase in their number are obtained.

R9: Optical Nanomaterials

WeR9-p01 10:00-13:30

Investigation of Volt-Ampere characteristics of crystalline materials AgBr-AgI system

A.M. Turabi[1], N.N. Akif'eva[1], A.S. Korsakov[1], A.A. Yuzhakova[1], D.D. Salimgareev[1], J.O. Zelenkova[1], M.S. Korsakov[1], K.A. Karpov[1], L.V. Zhukova[1]; [1]Ural Federal Univ. named after the first President of Russia B. N. Yeltsin., Russia

In this work, the dependence of the volt-ampere characteristics for optical infrared materials of the AgBr-AgI system solid solutions is studied depending on the composition of the material and temperature in the range of 298-423 K. It is established that an increase in the iodine content for crystalline materials of AgBr-AgI systems leads to a decrease in electrical conductivity.

WeR9-p02 10:00-13:30

Study of the electrical properties of InAs nanowires / Si substrate for IR photodetector

A.M. Mozharov[1], V.V. Fedorov[2], K.Yu. Shugurov[2], A.A. Vorobyev[2], D.A. Kudryashov[2]; [1]St. Petersburg State Univ.; [2]Laboratory of Renewable Energy Sources, Alferov Univ., Russia

In this work, InAs nanowire arrays were synthesized by molecular beam epitaxy on a p-type Si substrate. Post-growth processing of the synthesized structure was carried out, including electrical isolation of the substrate surface and NW tips, formation of ohmic contacts to the substrate and the NWs. The volt-ampere characteristics of the formed structure demonstrate diode behavior.

WeR9-p03 10:00-13:30

Determination of refractive indices of the AgBr-AgI system crystals in the infrared range

P.V. Pestereva, D.D. Salimgareev, A.E. Lvov, A.A. Yuzhakova, D.A. Belousov, A.S. Korsakov, L.V. Zhukova; Ural Federal Univ. named after the first President of Russia B. N. Yeltsin, Russia

This work is devoted to the determination of the refractive index of crystals with a composition from 0 to 36 mol. % AgI in AgBr. For measurements, we used polycrystalline plates based on the single crystals AgBr-AgI. The samples refractive indices were determined by the spectroscopic method in the wavelength range from 3.0 to 14.0 μm.

WeR9-p04 10:00-13:30

High-sensitive dual-center ratiometric luminescence thermometers: co-doping vs mixture

I.E. Kolesnikov[1], E.V. Afanaseva[2], M.A. Kurochkin[1], E.I. Vaishlia[2]; [1]St. Petersburg State Univ., Russia; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

We report on dual-center ratiomentric luminescence thermometers LuVO4:Nd3+/Yb3+ constructed via co-doping and mixing approaches. The suggested sensors were successfully demonstrated for temperature measurements within quite wide thermal range of 123-573 K. Effect of dispersion system type and Yb3+ doping concentration on thermometric characteristics including thermal sensitivity and temperature resolution was studied and discussed.

WeR9-p05 10:00-13:30

Development of the alloyed quantum dots luminescence quenching based biosensor systems

D.D. Drozd, A.S. Moshkov, S.A. Mescheryakova, D.A. Kornilov, O.A. Goryacheva, I.Yu. Goryacheva; Saratov State Univ., Russia

Photoluminescent alloyed quantum dots are a promising material for biosensor development due to the high sensitivity of their optical properties to media conditions. The presentation describes sensing approaches based on quantum dots photoluminescence quenching. The advantages and perspectives of alloyed quantum dots application will be discussed.

This research was supported by RFBR Grant(s) # RSF project 20-13-00195

WeR9-p06 10:00-13:30

Design of a narrowband filter based on Fabri - Perot etalon for implementing the undersamping method in terahertz time-domain spectrometer

A.A. Rybak[1,2], S.A. Kuznetsov[1,3], N.A. Nikolaev[1,2]; [1]Novosibirsk State Univ.; [2]Inst. of Automation and Electrometry; [3]Rzhanov Inst. of Semiconductor Physics SB RAS, Novosibirsk Branch TDIAM, Russia

In this paper, we consider an approach to the disign of a narrow-band quasi-optical filter with a center frequency ν = 806 GHz, designed to implement the undersampling method in pulsed terahertz spectroscopy.

This research was supported by RFBR Grant(s) # The reported study was funded by RFBR according to the research project № 20-32-90137

WeR9-p07 10:00-13:30

Ga_2O_3 and GaN nanoparticles synthesis by femtosecond laser ablation in ammonia environment

A.S. Chernikov, D.A. Kochuev, R.V. Chkalov, A.V. Egorova, D.G. Chkalova; Vladimir State Univ., Russia

In the present work beta-gallium oxide and gallium nitride nanoparticles have been synthesized on silicon wafer surface by femtosecond pulsed laser ablation of a metallic gallium target in ammonia vapor environment of various concentrations under the action of an electrostatic field. The obtained nanomaterials were characterized by X-ray diffraction. The optical characterization of synthesized nanoparticles were also studied.

WeR9-p08 10:00-13:30

Laser-induced phase transitions of GeTe and $Ge_2Sb_2Te_5$ thin films

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

Thin film phase-change materials (PCM) based on germanium telluride (GeTe, Ge2Sb2Te5) are widely used in photonic and optoelectronic devices. We demonstrate a reversible change in the optical properties of thin-film samples associated with phase transitions under the influence of pulsed laser radiation according to the pump-probe scheme.

WeR9-p09 10:00-13:30

Assessment of cell viability of non-cadmium quantum dots

T.S. Ponomaryova, V.V. Olomskaya, E.A. Mordovina, D.V. Tsupka, A.S. Novikova, I.Yu. Goryacheva; Saratov State Univ., Russia

The small (<10 nm) size-selected thiol-capped AgInS2/ZnS quantum dots (QDs) were produced by precipitation from an aqueous colloidal ensemble. To demonstrate the potential of synthesized QDs for bioimaging, cellular uptake and localization within the cell lines were evaluated using L929 cells. These water-soluble AgInS2/ZnS QDs exhibited excellent biocompatibility and can be used for labeling the cell lines and in bioassay.

This research was supported by RFBR Grant(s) # RSF project number 21-73-00102

WeR9-p10 10:00-13:30

Spectral properties of sodium-modified Bi-doped GeO_2 glasses

K.S. Serkina, I.V. Stepanova, A.A. Trofimova, D.V. Volkova; D. Mendeleev Univ. of Chemical Technology, Russia

Bismuth-germanium oxide glasses with the addition of sodium oxide have been synthesized and their spectral characteristics have been investigated. It is shown that modification with sodium leads to a decrease in the synthesis temperature and an increase in the optical quality of glasses with a low content of bismuth oxide.

WeR9-p11 10:00-13:30

Powder and thin-film hybrid materials emitting in the IR-range, based on tris(8-hydroxyquinolate) Yb (III) in CaF_2, PbF_2 and PbO matrices

K.I. Runina, A.U. Sekacheva, L.V. Popkova, O.B. Petrova, I.Ch. Avetissov; D. Mendeleev Univ. of Chemical Technology, Russia

Organic-inorganic hybrid materials based on ytterbium (III) tris(8-hydroxyquinolate) were obtained in fluoride and oxide inorganic matrices by solid-phase synthesis. Thin films were prepared using the obtained powder hybrid materials by capillary deposition technique. The films demonstrated photoluminescence in the visible and infrared regions.

WeR9-p12 10:00-13:30

Down-conversion luminescence of Yb^{3+} ions in Yb:$CaWO_4$ single crystals

K.A. Subbotin[1,2], A.I. Titov[1,2], D.A. Lis[1], E.V. Chernova[1], O.N. Lis[1], K.V. Kuleshova[2], Y.S. Didenko[2], Y.I. Zimina[2], E.V. Zharikov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Mendeleev Univ. of Chemical Technology of Russia, Russia

Ytterbium and ytterbium–niobium doped sheelite single crystals have been grown by the Czochralski method and subjected to additional annealing in air, in CO/CO2 atmosphere, and in forevacuum. Comparative investigations of optical absorption and photoluminescence spectra of the crystals upon UV excitation were performed. The nature of the donor centers involved into the process of down-conversion in the crystals were explained.

WeR9-p13 10:00-13:30

Few-layer graphene: growth and potential applications in optoelectronics

V.Y. Aristov[1,2], A.N. Chaika[2,3], O.V. Molodtsova[1,4], S.V. Babenkov[1,5], D.V. Potorochin[1,4,6], A. Locatelli[7], T. Mentes[7], A. Sala[7], D. Marchenko[8]; [1]Deutsches Elektronen-Synchrotron DESY, Germany; [2]Inst. of Solid-State Physics RAS, Russia; [3]CRANN, School of Physics, Trinity College Dublin, Ireland; [4]ITMO Univ., Russia; [5]LIDYL, CEA Saclay, Gif-sur-Yvette, France; [6]Inst. für Experimentelle Physik, Freiberg, Germany; [7]Elettra Sincrotrone, Italy; [8]Helmholtz-Zentrum Berlin für Materialien und Energie, Germany

Using SiC/Si(001) vicinal wafers, it is possible to synthesize self-aligned graphene nanoribbons with a transport gap on the order of 1 eV, a large in-plane positive magnetoresistance, and the potential to operate as a spin filter, opening up possibilities for electronic devices and applications of spintronics. The work was supported by the Russian Foundation for Basic Research (grant no. 20-02-00489).

This research was supported by RFBR Grant(s) # RFBR grant no. 20-02-00489

WeR9-p14 10:00-13:30

Metasurface light encoders for ultrafast hyperspectral imaging

M. Makarenko[1], A. Burguete-Lopez[1], Qizhou Wang[1], F. Getman[1], A. Fratalocchi[1]; [1]KAUST, Saudi Arabia

This work introduces the HOCULUS, a metasurface-based imaging system for real-time hyperspectral image capturing and processing. HOCULUS leverages metasurfaces to compress high-dimensional spectral data into a low-dimensional space via suitably defined projectors, designed with end-to-end learning of large hyperspectral datasets. This compression allows the HOCULUS system to achieve up to 10 Tb/s information processing speed.

WeR9-p15 10:00-13:30

Hexagonal Ge on the side facets of GaAs and AlGaAs nanowires

I.V. Ilkiv[1], K.P. Kotlyar[1,2], D.A. Kirilenko[3], I.P. Soshnikov[2], S.V. Mikushev[1], V.G. Dubrovskii[1,3], G.E. Cirlin [1,3]; [1]St. Petersburg State Univ.; [2]Nanotechnology Research and Education Centre, Alferov Univ.; [3]Ioffe Inst., Russia

rowth of hexagonal Ge stripes on the side facets of wurtzite AlGaAs and GaAs nanowires is considered. It is shown experimentally and explained within a model that Ge forms stripes on AlGaAs nanowires, while it covers conformally GaAs nanowires. The effect is explained by different surface and interface energies in the two material systems.

WeR9-p16 10:00-13:30

Terahertz lasing condition in the cavity with graphene hyperbolic medium: optimisation

O.N. Kozina[1], L.A. Melnikov[2]; [1]Kotel'nikov Inst. of Radio-Engineering and Electronics RAS, Saratov Branch; [2]Yuri Gagarin State Technical Univ. of Saratov, Russia

Complex resonator with thin hyperbolic media inside is investigated in the way of developing theory of THz laser. The eigen waves of the cavity contains asymmetrical hyperbolic medium based on graphene-semiconductor multilayer structure with optics axis tilted with respect to outer boundary have been calculated. Optimal conditions for efficient THz lasing have been clarified.

WeR9-p17 10:00-13:30

The use of THz metamaterials for studying the adsorption of the SARS-CoV-2 virus spike protein by vibrational spectroscopy

M.R. Konnikova[1,2], O.P. Cherkasova[2,3,4], E.S. Dizer[2,5], A.A. Man'kova[1], I.S. Vasilievskii[5], A.A. Butylin[1], Yu.V. Kistenev[4], V.V. Tuchin[4,6,7], A.P. Shkurinov[1,2,4]; [1]Lomonosov Moscow State Univ.; [2]Inst. on Laser and Information Technologies, Branch of the Federal Research Centre 'Crystallography and Photonics' RAS; [3]Inst. of Laser Physics SB RAS; [4]National Research Tomsk State Univ.; [5]National Research Nuclear Univ. MEPhI; [6]Saratov State Univ.; [7]Inst. for Problems of Precision Mechanics and Control RAS, Russia

Adhesion of the spike protein of the SARS-CoV-2 virus is studied by vibrational spectroscopy using terahertz metamaterials. The features of metastructure absorption upon the deposition of histidine, albumin, and the receptor-binding domain of the spike protein films are investigated. An original technique for quantitative assessment of the efficiency of virus adhesion on the metamaterial surfaces are proposed and experimentally tested.

This research was supported by RFBR Grant(s) # No. 20-04-60505, No. 0748-2020-0012, No. 075-15-2021-615, The Interdisciplinary Scientific and Educational School of Moscow University "Photonic and Quantum Technologies. Digital Medicine"

WeR9-p18 10:00-13:30

The spectral properties of Er^{3+}/bismuth active centers co-doped germanate glasses

I.V. Stepanova, L.M. Savenko, A.V. Efimochkina; D. Mendeleev Univ. of Chemical Technology, Russia

Erbium-doped bismuth-germanate glasses have been synthesized and their spectral characteristics have been studied. The contour of the absorption spectra in the region of 450-550 nm is represented by the superposition of the bands of erbium and bismuth active centers (BACs). It was found that the erbium does not destroy BACs, which makes it possible to expand the range of NIR-luminescence.

WeR9-p19 10:00-13:30

Spectral properties of $CsPbI_3$ perovskite nanocrystals in borogermanate glass

R. Kharisova[1], A. Babkina[1], K. Zyryanova[1], N. Kuzmenko[1], A. Pavliuk[1], V. Klinkov[2], N. Nikonorov[1]; [1]ITMO Univ., Russia; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

The spectral properties of CsPbI3 perovskite nanocrystals in borogermanate glass were investigated. The nanocrystals luminescence bands were shifted from 670 to 710 nm with crystal size increase. The maximum quantum yield obtained was 34%.

WeR9-p20 10:00-13:30

Synthesis of luminescent hybrid materials in the PbF_2 - La(Y)F -(8-hydroxyquinolate) lithium system by co-precipitation technique

P.V. Strekalov[1], M.N. Mayakova[2], M.U. Andreeva[1], K.I. Runina[1], O.B. Petrova[1], R.I. Avetisov[1]; [1]Mendeleev Univ. of Chemical Technology; [2]Prokhorov General Physics Inst. RAS, Russia

Organic-inorganic luminescent hybrid materials with an inorganic matrix based on mixed lead and rare-earth fluorides and (8-hydroxyquinolate) lithium as an organic phosphor by co-precipitation from aqueous solutions have been synthesized. Their phase compositions and spectral characteristics have been investigated. The synthesized hybrid materials showed efficient broadband photoluminescence in the 390-700 nm region.

WeR9-p21 10:00-13:30

Plasmon-exciton interaction improves two-photon properties of semiconductor quantum dots

V. Krivenkov[1,2], P. Samokhvalov[2], I.S. Vasilyevskij[2], N. I. Kargin[2], Y. Rakovich[1,3,4], I. Nabiev[2,5]; [1]Univ. del Pais Vasco (UPV/EHU) and Centro de Física de Materiales (MPC, CSIC-UPV/EHU), Spain; [2]National Research Nuclear Univ. MEPhI, Russia; [3]Donostia International Physics Center (DIPC), Spain; [4]IKERBASQUE, Basque Foundation for Science, Spain; [5]Lab. de Recherche en Nanosciences, Univ. de Reims Champagne-Ardenne, France

To enhance the two-photon absorption (TPA) of quantum dots (QDs), we designed a plasmon–exciton hybrid material. The TPA of QDs near plasmon nanoparticles was increased by an order of magnitude. We designed a near-infrared photodetector based on the plasmon–exciton material and found an order of magnitude increase in the photocurrent compared to the detector filled with QDs alone.

WeR9-p22 10:00-13:30

Single mode extruded silver halides fibers for CO_2 laser with losses less than 1 dB/m

A.L. Butvina, L.N. Butvina, A.G. Okhrimchuk; Prochorov General Physics Inst. RAS, Dianov Fiber Optics Research Center, Russia

The optical loss of a extruded single-mode polycrystalline fiber AgCl0.5Br0.5\AgCl0.55Br0.45 was 0.8 dB / m. For the first time, a polycrystalline single-mode fiber at a wavelength of 10.6 μm with a step-index profile AgCl0.25Br0.75 / AgCl0.5Br0.5 and the world's lowest optical loss of 0.5 dB / m was extruded.

This research was supported by RFBR Grant(s) # Grant of RSF № 19-12-09134

WeR9-p23 10:00-13:30

Investigation of the interaction of excitons with light in mesoscopic structures

A.B. Belonovskii[1,2], K.M. Morozov[1,2], E.I. Girshova[1,2], G. Pozina[3], M.A. Kaliteevski[1,2]; [1]St. Petersburg Academic Univ.; [2]ITMO Univ., Russia; [3]Department of Physics, Chemistry and Biology (IFM), Linköping Univ., Sweden

Interaction of cavity modes with exciton in meso-cavity (the structure supporting several cavity modes separated by energy interval comparable to Rabi-splitting of exciton and cavity modes) has been analyzed using a quantum-mechanical approach. Simultaneous interaction of exciton and several cavity modes results in a few novel effects.

WeR9-p24 10:00-13:30

Thermodynamic analysis of borate formation in the synthesis of glass-ceramics based on BaO - B_2O_3 - Bi_2O_3 and Er:YAG

A.D. Plekhovich, A.M. Kut'in, E.E. Rostokina, M.E. Komshina, K.V. Balueva, K.F. Ignatova; G.G. Devyatykh Inst. of Chemistry of High Purity Substances RAS, Russia

The temperature conditions for the formation of aluminum, yttrium, erbium, barium, and bismuth borates from the glass-ceramic phase were determined by the Gibbs energy minimization method. The use of thermodynamic information in the interpretation of the results of thermal, XRD, and SEM analyzes of glass-ceramic samples contributed to the optimization of the modes of their sol-gel synthesis.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Science Foundation (project No. 20-73-10110)

WeR9-p25 10:00-13:30

Up-conversion luminescence quantum yields of MF_2:Yb:R (M=Ca, Sr, Ba, Pb; R=Er, Tm, Ho) single crystals for photonics

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We present the measurements of up-conversion luminescence quantum yields of MF2:Yb:R (M=Ca, Sr, Ba, Pb; R=Er, Tm, Ho) single crystals at 0.1-490.0 W/cm2 pumping (976 nm). We revealed the solid solution compositions, which demonstrated the highest quantum yields.

This research was supported by RFBR Grant(s) # The reported study was funded by RFBR (project number 21-53-12017) and DFG (project number TU 487/8-1)

WeR9-p26 10:00-13:30

Optical properties of composite ZnO-Er_2O_3-Yb_2O_3 ceramics: effect of annealing

E. Gorokhova[1], O. Dymshits[1], I. Venevtsev[2], L. Basyrova[3], I. Alekseeva[1], A. Khubetsov[1], S. Eron'ko[1], E. Oreschenko[1], A. Seroglazova[4], P. Camy[3], P. Loiko[3], A. Zhilin[5]; [1]Vavilov State Optical Inst., Russia; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia; [3]CIMAP, UMR[6]252 CEA-CNRS-ENSICAEN, Univ. de Caen Normandie, France; [4]St. Petersburg State Inst. of Technology, Russia; [5]Efremov Inst. of Electrophysical Apparatus, Russia

Composite optical ceramics ZnO-Er2O3-Yb2O3 were prepared by uniaxial hot pressing of commercial oxide powders at 1180 °C in vacuum. Their structure, optical absorption, luminescence and X-ray induced luminescence have been studied. The annealing of ceramics at 1200 °C modified the ZnO grain morphology, enhanced up-conversion luminescence of Er3+ ions, affected the shape of the XRIL spectra and their decay kinetics.

WeR9-p27 10:00-13:30

Accurate optical detection of low-concentrated hydrogen halide vapors by $CsPbBr_3$ nanowire laser

D.I. Markina, A.P. Pushkarev, S.V. Makarov; School of Physics and Engineering, ITMO Univ., Russia

Novel highly responsive optical sensor of hydrogen halide vapors based on lead halide perovskite nanowire laser is developed and comprehensively studied. It is shown that a small spectral shift of high-Q lasing modes invoked by chlorine-rich shell formation on the CsPbBr3 nanowire surface in presence of HCl allows detection of extremely low amounts of hydrogen halide vapors in surrounding air.

WeR9-p28 10:00-13:30

Optical nonlocality in dynamics of ultrashort laser pulses in hyperbolic metamaterials

V.B. Novikov, T.V. Murzina; Lomonosov Moscow State Univ., Russia

We reveal theoretically the effects of fast and slow light in transmission of femtosecond laser pulses through a silver nanorod-based hyperbolic metamaterial (HMM) and demonstrate the decisive role of optical nonlocality of HMMs in the appearance of these phenomena in the spectral vicinity of the epsilon-near-zero regime of HMM. Results sustain our recent experimental investigations of these effects.

WeR9-p29 10:00-13:30

Luminescent properties of Er/Lu-codoped transparent lead fluoroborate glass-ceramics

O.B. Petrova, D.A. Butenkov, A.V. Bakaeva, K.I. Runina; Mendeleev Univ. of Chemical Technology, Russia

Lead fluoroborate glasses co-doped with Er3+/Lu3+ have been synthesized. Glass-ceramics have been made by heat-treatment. In a glass-ceramic the rare-earth ions were located in fluoride crystal nanoparticles distributed in a glass. The changes in structural, mechanical, optical and luminescent properties of the glass-ceramics were revealed in comparison with the initial glasses.

WeR9-p30 10:00-13:30

Influence of laser radiation on carbon nanostructures in order to improve their electrophysical characteristics

A.V. Kuksin[1], Y.P. Shaman[2], E.P. Kitsyuk[2], O.E. Glukhova[3,4], A.Yu. Gerasimenko[1,3]; [1]National Research Univ. of Electronic Technology; [2]Scientific-Manufacturing Complex "Technological Centre"; [3]I.M. Sechenov First Moscow State Medical Univ.; [4]Saratov State Univ., Russia

This paper presents a method for creating electrically conductive nanostructures from carbon nanotubes (CNT) and reduced graphene oxide (rGO) by laser irradiation and a method for structuring vertical CNT arrays. Electrically conductive CNT/rGO network was obtained by pulsed laser radiation. Also, laser and chemical BaO treatment led to the structuring of a vertically grown CNT array with improved emission characteristics.

WeR9-p31 10:00-13:30

Optical characterization of CdTe/CdMgTe quantum well structure containing ultrathin manganese layers at interfaces

V.F. Agekyan[1], N.G Filosofov[1], G. Karczewski[2], A.Yu. Serov[1], I.V. Shtrom[1]; [1]St.-Petersburg Univ., Russia; [2]Inst. of Physics, Polish Academy of Science, Poland

The aim of this work was to grow and study the optical properties of heterostructures with ultrathin inclusions at interfaces, which improve the quality of interfaces.

WeR9-p32 10:00-13:30

Synthesis, crystallization and luminescent properties of lead chlorosilicate glasses and glass-ceramics Nd-doped

D.A. Butenkov, K.I. Runina, A.M. Slastuhina, O.B. Petrova; Mendeleev Univ. of Chemical Technology, Russia

Nd-doped lead oxochloride silicate glasses were synthesized and their spectral characteristics were studied. Glass-ceramics, including those with lead chloride phase, were obtained using heat treatments. The influence of controlled crystallization on the spectral-luminescent properties of glasses has been investigated.

WeR9-p33 10:00-13:30

Phase and chemical transformations kinetics in the synthesis of a $BaO-B_2O_3-Bi_2O_3$ - $(Y(1-x)Er(x))3Al_5O_{12}$ functional glass-ceramics

A.D. Plekhovich, A.M. Kut'in, E.E. Rostokina, M.E. Komshina, K.V. Balueva, K.F. Ignatova; Devyatykh Inst. of Chemistry of High Purity Substances RAS, Russia

The kinetics chemical and phase transformations in the interaction of the glass-forming system BaO-B2O3-Bi2O3 with (Y1-xErx)3Al5O12 in the glass-ceramics formation process were studied by DSC. The samples were characterized by powder X-ray diffraction and scanning electron microscope methods. The presence of devitrification according to DSC data proves that the samples synthesized in the temperature range 800-1300ºC are glass-ceramic materials.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Science Foundation (project No. 20-73-10110)

WeR9-p34 10:00-13:30

Sensitivity of random array of gold nano islands for biosensing applications

J.P. Cuanalo-Fernández[1], A. Reyes-Coronado[2], M.B. De-la-Mora-Mojica[3], N. Korneev[1], I. Cosme-Bolaños[1], J.A. Urrutia-Anguiano[2], S.F. Guerra-Hernández[1], R. Ramos-García[1] , S. Mansurova[1]; [1]Dep. Óptica, INAOE, Puebla; [2]Dep. Física, UNAM, Ciudad de México; [3]Dep. micro y nanotecnologías, UNAM, Ciudad de México, México

Metal nanoparticles have unique optical properties, so their potential applications are of great interest in industry as well as in the medical area, especially for biosensing. Its fabrication represents a real challenge due to its stability, shape, size, etc. This paper presents the study of sensitivity of self-assembly monolayer gold nano islands as well as a theoretical comparation.

WeR9-p35 10:00-13:30

Photostimulation of thin C -Au films

A. Lelekova[1], V. Samyshkin[1,2], A. Osipov[1], S. Kutrovskaya[1,3,4], A. Kucherik[1]; [1]Stoletov Vladimir State Univ.; [2]Inst. of Chemistry, St. Petersburg State Univ., Russia; [3]School of Science, Westlake Univ.; [4]Inst. of Natural Sciences, Westlake Inst. for Advanced Study, China

Studies have conducted on the stimulating effect of laser radiation on the hybrid thin-film gold-carbon system. Gold nanoparticles stabilized by a porous carbon matrix demonstrate a stable response at frequencies close to plasmon resonance.

This research was supported by RFBR Grant(s) # 20-21-00038

WeR9-p36 10:00-13:30

Investigation of the polymeric thin films deposed on the surfaces of optical elements using the laser multiparametric method

A.V. Belikov[1], I.S. Klochkov[1,2]; [1]ITMO Univ.; [2]JSC Scientific and Production Corporation "Precision Instrumentation Systems", Russia

The deposition zones that formed on the surface of the optical elements of a sealed volume when it is heated up to 100°C and exposed to YAG:Nd laser radiation are studied. The study was performed using a new laser multiparametric method, traditional scanning microscopy and radiometry.

WeR9-p37 10:00-13:30

Nanostructure assisted laser desorption of Au^+/Au^- ions from gold surface below plasma threshold

I.I. Kuzmin[1], P.K. Laptinskaya[2], S.M. Nikiforov[2], A.V. Pento[2], Ya.O. Simanovsky[2]; [1]Vernadsky Inst. of Geochemistry, Analytical Chemistry RAS; [2]Prokhorov General Physics Inst. RAS, Russia

The process of Au+ and Au- ions formation on a surface of nanostructured gold plate under pulsed laser irradiation with energy density below plasma threshold is studied. The role of nanoscale objects produced on the surface under laser irradiation higher than the plasma threshold in the ion formation process is discussed.

WeR9-p38 10:00-13:30

The excitation modes of porous silicon microcavities with an embedded conjugated polymer for detecting vapors of nitroaromatic compounds

T.A. Kharinoeva, O.K. Malyshev, I.L. Martynov, A.A. Chistyakov; National Research Nuclear Univ. MEPhI, Russia

Currently, fluorescent sensors for detection of explosives are being actively developed. One of the important issues is the stability of the fluorescence of a sensitive luminophore under the action of exciting radiation. In this work, we study the fluorescence response of MDMO-PPV embedded in a porous silicon microcavity to trinitrotoluene vapors under the action of exciting radiation with different intensities.

WeR9-p39 10:00-13:30

Anion exchange in Yb-doped all-inorganic perovskite NCs

A.S. Sokolova, D.A. Tatarinov, S.A. Cherevkov, A.P. Litvin; Lab. 'Optics of Quantum Nanostructures', ITMO Univ., Russia

At present, Yb-doped perovskites CsPbCl3 are popular optical nanomaterials for the development of the next-generation electronic devices due to the sharp electronic transition of ytterbium in the NIR. Here, we have developed anion exchange procedures with usage of different chemical compounds and studied optical properties in visible and near-infrared ranges of obtained nanocrystals.

This research was supported by RFBR Grant(s) # The work was supported by the Russian Science Foundation (21-73-10131)

WeR9-p40 10:00-13:30

Role of kinetics in spontaneous segregation of group III elements in arsenide nanowires

N.V. Sibirev[1], Y.S. Berdnikov[1,2], I.V. Shtrom [1], R.R. Reznik[1,1], E.V. Ubuivovk[1,2], G.E. Cirlin[2]; [1]St. Petersburg State Univ.; [2]Alferov Univ., Russia

A model of spontaneous formation of the radial heterostructure in arsenide nanowire in single process is proposed. Good agreement of theory and experiment was demonstrated for (In,Ga)As nanowires. This could be considered as an alternative approach to formation of core-shell nanowire heterostructure.

WeR9-p41 10:00-13:30

Luminescent oxide nanoparticles for security applications

D.V. Mamonova[1], A.A. Kalinichev[2] , I.E. Kolesnikov[2], V.A. Medvedev[1], M.D. Mikhailov[3]; [1]Chemical Inst., St. Petersburg State Univ. ; [2]Center for Optical and Laser Materials Research, St. Petersburg State Univ.; [3]Graduate School of Physics and Materials Technology, Peter the Great St. Petersburg Polytechnic Univ., Russia

We report the synthesis of fluorescent markers based on YVO4:Er3+, Tm3+, Nd3+ and the implantation of the markers into a steel plate by laser processing. We demonstrate that the luminescent properties of the particles can be used for creating an ID spectral code based on the energy transfer between different ions.

WeR9-p42 10:00-13:30

Optical properties of the TlBr(0.46)I(0.54)-AgI and TlCl(0.67)Br(0.33)-AgI system crystals

D.D. Salimgareev, A.E. Lvov, A.A. Yuzhakova, V.M. Kondrashin, A.S. Korsakov, L.V. Zhukova; Ural Federal Univ. named after the first President of Russia B. N. Yeltsin, Russia

The present work is devoted to the synthesis of the TlBr0.46I0.54 – AgI and TlCl0.67Br0.33 – AgI systems optical nanoceramics and the study of their optical properties. The spectral transmission range was determined, and the refractive indices at the wavelength of the short-wavelength absorption edge and the carbon dioxide laser (10.6 μm) were calculated.

WeR9-p43 10:00-13:30

Pseudomagnetic excitonic brightening via shear strain in monoatomic transition metal dichalcogenide

H.Y. Hwang[1], S.H. Lee[2], H. Lee[2], Y.D. Jho[2]; [1]Univ. Oxford, United Kingdom; [2]GIST, South Korea

We experimentally demonstrate a drastic photoluminescence enhancement (reduction) in WSe2 (MoSe2) monolayers under pseudomagnetic out-of-plane shear strain. The shear strain-induced spin-state mixing at K valley is associated with brightening of dark exciton in the WSe2 and darkening of bright exciton in the MoSe2.

WeR9-p44 10:00-13:30

Two approaches to two-stage growth of GaP nanowires

Y. Berdnikov[1,2], V.V. Fedorov[1], N.V. Sibirev[2], A.D. Bolshakov[1], S.V. Fedina[1], G.A. Sapunov[1], L.N. Dvoretckaia[1], I.S. Mukhin[1]; [1]Alferov Univ.; [2]St. Petersburg State Univ., Russia

We compare the two approaches to growth of self-catalyzed GaP nanowires, which both allow independent control of the length and diameter. The first approach assumes reduction of growth temperature by 20C and halving of the phosphorus flux at the second stage of the growth with respect to the first stage. Within the second one only gallium flux was varied.

WeR9-p45 10:00-13:30

Optical Methods for Controlling the $CaSO_4 \cdot 2H_2O$ Crystallization Process in the Presence of a Seed

A.E. Kovalenko, P.A. Kekin, A.N. Morozov, I.A. Pochitalkina, K.I. Popov; Mendeleev Univ. of Chemical Technology of Russia (MUCTR), Russia

Analytical control the solid phase parameters using dynamic light scattering, optical microscopy, transmission and scanning electron microscopy was used to establish CaSO4·2H2O heterogeneous crystallization mechanism. It is shown that in reagents solutions the total content of dispersed impurities is determined by the substance and solvent contamination degree. Initial reagents solutions purification using membranes provides a decrease in the impurities content.

WeR9-p46 10:00-13:30

Investigation of obtaining ZnSe nanopowders by means of a fiber ytterbium laser

V.V. Osipov[1], V.V. Platonov[1], E.V. Thikhonov[1], V.V. Lisenkov[1,2]; [1]Inst. of Electrophysics UB RAS; [2]Inst. of New Materials and Technologies, Ural Federal Univ. named after the first President of Russia B.N Yeltsin, Russia

The production of ZnSe nanopowder using radiation of an ytterbium fiber laser has been studied. With an average radiation power of 300 W and a pulse duration of 120 μs, the productivity of nanopowder obtaining was 100 g/h. The nanopowder contains weakly agglomerated particles with an average size of 18 nm, having cubic (40 wt.%) and hexagonal (60 wt.%) phase.

This research was supported by RFBR Grant(s) # The work was performed as part of State Task No. AAAA - A 19-119020790031-5, was supported in part by RFBR Grant No. 20-08-00054 A

WeR9-p47 10:00-13:30

Investigation of the resistance to ionizing radiation of optical products based on the AgBr-AgI system crystals

A.A. Yuzhakova, D.D. Salimgareev, A.E. Lvov, P.V. Pestereva, I.V. Yuzhakov, A.S. Korsakov, L.V. Zhukova; Ural Federal Univ. named after the first President of Russia B. N. Yeltsin, Russia

The photo- and radiation resistance of optical windows and fibers based on the AgBr–AgI system crystals has been studied. The greatest optical loss during irradiation with ultraviolet for 530 min does not exceed 40% in the entire transmission range. The transmission spectra show the resistance of fibers to electron irradiation with doses up to 400 kGy.

WeR9-p48 10:00-13:30

Low-cost magnetic Fe alloy based THz polarization filters in EVA matrix

D.M. Ezhov, E.S. Savelyev, A.I. Olekhnovich, V.N. Cherepanov; Tomsk State Univ., Russia

We present the dependence of the concentration of magnetic driven 5BDSR alloy of THz filters in EVA matrix, on absorption and reflection properties in the extended THz range of 0.2-2 THz. Transmittance dependence on particles concentration and orientation was studied using a custom-made THz-TDS spectrometer. The extinction coefficient of up to 20 was obtained using 15 mass.% of 5BDSR alloy.

WeR9-p49 08:00-13:30

Quantum engineering of bright-dark optical states of resonantly interacting rare earth ions with nanolocal Stark effect

K.K. Pukhov[1], S.K. Sekatskii[2]; [1]Prokhorov General Physics Inst. RAS, Russia; [2]Swiss Federal Inst. of Technology (EPFL), and Univ. of Lausanne, Switzerland

We discuss the possibility to exploit nanolocal Stark effect, caused in crystals doped with rare earth ions by strong inhomogeneous electric fields of sharp Scanning Probe Microscope tip, to engineer the dark – bright states of these resonantly interacting ions. Their energies and decay (decoherence) rates can be strongly influenced by such fields opening new possibilities to quantum information processing.

WeR9-p50 10:00-13:30

Fluorescent nanostructures for targeted biological visualization

E.A. Mordovina, D.V. Tsyupka, A.A. Bakal, A.M. Abramova, O.A. Goryacheva, I.Yu. Goryacheva; Saratov State Univ., Russia

The fluorescent properties of products obtained by the hydrothermal treatment of organic raw materials are of great interest. The use of folic acid as a precursor for fluorescent nanostructures opens up the possibility of targeted imaging. This work shows a one-step scheme for the synthesis of fluorescent nanostructures from folic acid and citrates.

WeR9-p51 10:00-13:30

Modeling the formation of self-catalyzed GaAs and GaP nanowires

A.A. Koryakin; St. Petersburg State Univ., Russia

The growth mechanism of monolayer on the top facet of Ga-catalyzed GaAs and GaP nanowires is investigated. Within the framework of a theoretical model, the maximal monolayer coverage due to the material in the catalyst droplet, the nanowire growth rate and the group V content in the droplet, depending on the growth conditions, are found.

WeR9-p52 10:00-13:30

Optical properties of a hybrid films of J-aggregates and aluminum oxide formed on an island Ag film

I.I. Nikitin, R.D. Nabiullina, L.N. Borodina, A.A. Starovoytov, I.A. Gladskikh; ITMO Univ., Russia

The synthesis technique of nanoporous aluminum oxide on an island silver film has been developed. Such a structure was coated with J-aggregates and optical properties were studied for it. The transfer of optical excitation energy from oxygen vacancies of aluminum oxide to J-aggregates was observed.

This research was supported by RFBR Grant(s) # RPMA grant of School of Physics and Engineering of ITMO University; Russian Science Foundation (Project 21-72-10098)

WeR9-p53 10:00-13:30

Optical properties of spinel based glass-ceramics of the ZnO-Al_2O_3-Ga_2O_3-SiO_2 system doped with Co^{2+} ions

I.V. Glazunov[1], A.M. Malyarevich[1], K.V. Yumashev[1], O.S. Dymshits[2], I.P. Alekseeva[2], A.A. Zhilin[2]; [1]Center for Optical Materials and Technologies, Belarusian National Technical Univ., Belarus; [2]Vavilov State Optical Inst., Russia

Transparent glass-ceramics containing Co2+:Zn(Al,Ga)2O4 nanocrystals were studied. Absorption band of Co2+ ions in the material is shifted to longer wavelengths as compared with glass-ceramics without Ga2O3 addition. Absorption saturation at 1.54 μm was observed and its characteristics (absorption recovery time, ground-state and excited-state absorption cross-sections) were measured. The developed glass-ceramics are promising as saturable absorbers for 1.6 μm erbium lasers.

WeR9-p54 10:00-13:30

High-speed video recording of liquid melt spraying during ablation of the Y_2O_3 target using a fiber ytterbium laser

V.V. Osipov[1], G.S. Evtushenko[3], V.V. Platonov[1], E.V. Thikhonov[1], M.V. Kremenetskii[1], N.A. Vasnev[2], P.I. Gembukh[2], M.V. Trigub[2]; [1]Inst. of Electrophysics UB RAS; [2]Inst. of Atmospheric Optics SB RAS; [3]Federal Research Centre for Projects Evaluation and Consulting Services, Russia

A video shooting of liquid melt splashing during the ablation of Nd:Y2O3 target with the ytterbium fiber laser was made. The use of a CuBr laser-based laser monitor made it possible to eliminate the bright glow of the laser torch in the images and observe the splashing of droplets. The melt splashes out in separate jets, but sometimes in drops.

This research was supported by RFBR Grant(s) # The work was performed as part of State Task № AAAA—A19-119020790031-5, was supported in part by RFBR Grant № 20-08-00054 A

WeR9-p55 10:00-13:30

Synthesis and properties of luminescent carbon nanostructures/SiO_2 composites

Yu.A. Podkolodnaya, A.A. Kokorina, I.Yu. Goryacheva; Saratov State Univ., Russia

We have developed a method for the synthesis of carbon nanostructures/SiO2 composite nanoparticles. The obtained composites have luminescent properties, colloidal stability, and are promising as markers for immunochemical analysis.

This research was supported by RFBR Grant(s) # Russian Science Foundation (grant 20-13-00195)

WeR9-p56 10:00-13:30

Quantum dots for control the concentrations of anthracycline antibiotics

O.A. Goryacheva, D.D. Drozd, T.S. Ponamareva; Chemistry Inst., Department of General and Inorganic Chemistry, Saratov State Univ., Russia

Quantum dots (QDs) can be an optimal material for creating systems for determining the residual concentration of anthracycline antibiotics in blood, urine and tissues to optimize the dosage of chemotherapy drugs. The selection of the optimal composition of the structure and surface of QDs allows to achieve the best energy transfer and, as a result, the most reliable analytical system.

WeR9-p57 10:00-13:30

Phase composition study of the AgBr-AgI-TlBr-TlI system for the infrared materials creation

D.D. Salimgareev, A.E. Lvov, A.A. Yuzhakova, D.A. Belousov, A.S. Korsakov, L.V. Zhukova; Ural Federal Univ. named after the first President of Russia B. N. Yeltsin, Russia

AgBr – AgI – TlBr – TlI has been studied. Inside cross section concentration regions are marked, where both single crystals and optical nanoceramics can be synthesized. In the obtained regions, single crystals of various compositions, as well as optical nanoceramics transparent in the infrared and terahertz ranges, were synthesized.

WeR9-p58 10:00-13:30

Using the steepness of the localized surface plasmon resonance phase response for highly sensitive detection of molecular binding events

J.P. Cuanalo-Fernández[1], S. Mansurova[1], A. Reyes-Coronado[2], M.B. De-la-Mora-Mojica[3], N. Korneev[1], I. Cosme-Bolaños[1], J.A. Urrutia-Anguiano[2], S.F. Guerra-Hernández[1],R. Ramos-García[1]; [1]Dep. Óptica, INAOE; [2]Dep. Física, Facultad de Ciencias, UNAM, Ciudad de México; [3]Dep. micro y nanotecnologías, Inst. de Ciencias Aplicadas y Tecnología, UNAM, Ciudad de México, México

This study demonstrated the capabilities of method which uses the steepness of the localized surface plasmon resonance phase response for sensing of molecular binding event.

WeR9-p59 10:00-13:30

The modeling of the “dry” foam laser probing

A.V. Pantyukov, E.A. Isaeva, A.A. Isaeva, D.A. Zimnyakov; Yuri Gagarin State Technical Univ. of Saratov, Russia

A software package for constructing the structure of "dry" foams and foam-like materials was developed. The possibility of the evaluation of the cell morphology is realized. This knowledge is necessary to determine the system stability and its internal dynamics. The limits of developed software application were also analyzed.

This research was supported by RFBR Grant(s) # The research is supported by grant of the Russian Science Foundation (project № 21-79-00051)

WeR9-p60 10:00-13:30

Laser-induced optical chirality in planar plasmonic nanostructures

D.R. Dadadzhanov[1], N.A. Toropov[1,2], A.A. Starovoytov[1], R.A. Zakoldaev[1], G. Alexan[1], A.A. Gladskikh[1], T.A. Vartanyan[1], I.A. Gladskikh[1]; [1]ITMO Univ., Russia; [2]Univ. of Exeter, UK

Optical chirality in plasmon nanostructures on the dielectric substrate prepared by laser treatment was shown. The influence of circularly polarized light on the plasmon nanostructures is manifested in the increase of the magnitude of CD intensity. It can be attributed to modification of ensemble from achiral to chiral due to spectral hole burning effect of left-handed shape nanostructures.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Science Foundation (Project 21-72-10098)

WeR9-p61 10:00-13:30

Electro-optical properties of modulators based on nematic LC composites with quantum dots

I.S. Chekulaev[1], A.D. Kurilov[1,2], R.N. Kucherov[2], A.A. Belyaev[1], V.V. Osipova[3], Y.G. Galyametdinov[3], V.V. Belyaev[1,4], D.N. Chausov[1,2]; [1]Education & Science Lab for Theoretical & Applied Nanotechnology, Moscow Region State University; [2]Biophotonics Center, Prokhorov General Physics Inst. RAS; [3]Department of Chemistry, Kazan National Research Technological Univ.; [4]RUDN Univ., Russia

Effect of CdSe:Mn quantum dots (QD) on the dielectric, electro-optical, and rheological parameters of the ZhK-1289 LC mixture has been studied. The influence of the CdSe:Mn concentration on phase transitions, fluorescence intensity and, as a consequence, the changes in the electro-optical properties of the composite, has been investigated.

WeR9-p62 10:00-13:30

Anisotropic Rhodium nanoparticles for ultraviolet biomolecule sensing

R.K. Soni; Department of Physics, Indian Inst. of Technology Delhi, India

Rhodium nanocubes and tripod-star nanoparticles have been synthesized by the polyol reduction method and their plasmonic properties. The absorption spectra displayed a plasmonic peak at 278, 326, and 292 nm for nanocubes, concave nanocubes, and tripods. The Rh NPs substrates prepared by self-assembly show a femtomolar detection limit of detection for adenine molecules under ultraviolet excitation at 325 nm.

WeR9-p63 10:00-13:30

Effect of ultrasonic treatment for oxide ceramics preparation with improved luminescent properties

D. Valiev, O. Khasanov, S. Stepanov, E. Dvilis, V. Paygin; School of Advanced Manufacturing Technology, National Research Tomsk Polytechnic Univ., Russia

In the present work, treatment by intense ultrasonic was used during dry pressing of an YSZ and YAG:Ce3+ nano- and micro-powder. The effect of the ultrasonic treatment on the structural and luminescent performances of oxide ceramics obtained by conventional sintering of the pressed compacts was studied.

This research was supported by RFBR Grant(s) # This work was funded by Russian Science Foundation No. 21-73-10100

WeR9-p64 10:00-13:30

Manganese concentration effect on spectral properties of lithium-zinc-germanate glass-ceramics

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

The luminescent properties of lithium-zinc-germanate glass-ceramics doped with different manganese contents have been investigated. Luminescence spectra contain two bands at 670 and 535 nm corresponding to Mn4+ and Mn2+ ions. Concentration dependence of the luminescence lifetime is presented. The maximum lifetime of red luminescence is 1.39 ms for 0.05 mol.% MnO2.

WeR9-p65 10:00-13:30

Synthesis and properties of fluorescent folate modified polymer nanoparticles

D.V. Tsyupka, E.A. Mordovina, A.A. Bakal, A.M. Abramova, I.Yu. Goryacheva; Saratov State Univ., Russia

In the last decade, great scientific interest has been focused on the development of folic acid (FA) modified nanomaterials, which are highly specific for interaction with folate cell receptors. The FA modification of nanoparticles is a complex process requiring additional purification steps. Therefore, the promising direction is the synthesis of fluorescence labels in one stage with uses the hydrothermal synthesis.

This research was supported by RFBR Grant(s) # The work supported by Russian Science foundation (project 20-13-00195)

WeR9-p66 10:00-13:30

Non-reactive metal nanoparticles embedded in an organic matrix

O.V. Molodtsova[1,2], I.M. Aristova[3], D.V. Potorochin[1,2,4], S.V. Babenkov[1,5], I.I. Khodos[6], S.L. Molodtsov[2,4,7], M. Vorokhta[8], T. Skála[8], V.Y. Aristov[1,3]; [1]Deutsches Elektronen-Synchrotron DESY, Germany; [2]ITMO Univ., Russia; [3]Inst. of Solid State Physics RAS, Russia; [4]Inst. für Experimentelle Physik, Freiberg, Germany; [5]Inst. für Physik, Johannes Gutenberg-Univ., Germany; [6]Inst. of Microelectronics Technology and High-Purity Materials RAS, Russia; [7]European XFEL GmbH, Germany; [8]Charles Univ., Faculty of Mathematics and Physics, Czech Republic

The structure and morphology of nanocomposites created by nanoparticles of non-reactive metals (e.g. gold, silver), which self-assemble in/on a thin organic film of partially fluorinated copper phthalocyanine FxCuPc (x=0; 4) depending on the amount of deposited metal, were studied in ultrahigh vacuum conditions using measurements HR-TEM and HR-PES. This work was supported by the RFBR (grant no. 20-02-00489).

This research was supported by RFBR Grant(s) # RFBR grant no. 20-02-00489

WeR9-p67 10:00-13:30

Study of In-$CuPcF_4$ nanocomposite by millisecond dynamic XPS and traditional PES and TEM

O.V. Molodtsova[1,2], I.M. Aristova[3], S.V. Babenkov[1,4], I.I. Khodos[5], D.V. Potorochin[1,2,6], S.L. Molodtsov[2,6,7], V.Y. Aristov[1,3]; [1]Deutsches Elektronen-Synchrotron DESY, Germany; [2]ITMO Univ., Russia; [3]Inst. of Solid-State Physics RAS, Russia; [4]LIDYL, CEA Saclay, France; [5]Inst. of Microelectronics Technology and High-Purity Materials RAS, Russia; [6]Inst. für Experimentelle Physik, Germany; [7]European XFEL GmbH, Germany

The electronic structure and morphology of nanocomposites created by indium nanoparticles, which self-assemble in a wide-gap CuPcF4 organic semiconductor matrix depending on the amount of deposited metal, were fabricated in situ and investigated using the dynamic-XPS method. This work was supported by the Russian Foundation for Basic Research (grant no. 20-02-00489).

This research was supported by RFBR Grant(s) # RFBR grant no. 20-02-00489

WeR9-p68 10:00-13:30

Anomalous changes in the band gap of ZnO during the oxidation of zinc nanoparticles

N.B. Leonov, M.D. Komissarov, T.A. Vartanyan; Laboratory of Surface Photophysics, Center of Information Optical Technologies, ITMO Univ., Russia

Granulated zinc metal films on fused quartz and sapphire supports were obtained via pulsed laser deposition and then oxidized in air. We found that the properties of the formed ZnO nanostructured film depend on the oxidation temperature and the nature of the film support in the following complicated way.

WeR9-p69 10:00-13:30

Effect of copper doping on the optical and electronic properties of highly ordered TiO_2 nanotubes

A.N. Morozov, A.S. Vasil`ev, Thant Zin Phyo, I.A. Pochitalkina; Mendeleev Univ. of Chemical Technology of Russia, Russia

It was shown that the incorporation of copper into the crystal structure of TiO2 NTs does not lead to a change in the band gap, the value of which for all samples was 3.20 ± 0.05 eV. At the same time, as the copper content increases the absorption of light in the UV-Vis range increases.

This research was supported by RFBR Grant(s) # RSF №19-73-00192

WeR9-p70 10:00-13:30

MBE growth and optical properties of InAs quantum dots in Si

V. Lendyashova[1], V. Talalaev[2], D. Mokhov[1], G. Cilrin[1], R. Reznik[2]; [1]Alferov Univ.; [2]St. Petersburg State Univ., Russia

Fabrication of nanocomposite material consisting of III–V quantum dots (QDs) embedded in Si sustained special attention over years. In this work, we present the formation of InAs QD in Si matrix by molecular beam epitaxy and the study of optical properties. Photoluminescence study of 0.2 ML thicknesses InAs quantum dots revealed emission in 1.6 μm region.

This research was supported by RFBR Grant(s) # St. Petersburg State University No. 75746688., Ministry of Science and Higher Education of the Russian Federation (0791-2020-0003)

WeR9-p71 10:00-13:30

Effective charge transfer within 2D layered nanostructures of PbSe-MoS_2 colloidal nanoplatelets

I.D. Skurlov, P.S. Parfenov, A.V. Sokolova, D.A. Tatarinov, A.A. Babaev, M.A. Baranov, A.P. Litvin; ITMO Univ., Russia

We report the creation of layered 2D PbSe-MoS2 nanostructures which demostrate efficient electron transfer from PbSe nanoplatelet to MoS2 nanoplatelet. Results of the work show that ultrathin layers of transition metal dichalcogenides sensitized by 2D lead chalcogenide nanostructures can be effectively used in photodetectors with a spectral sensitivity extended to the near-IR range.

This research was supported by RFBR Grant(s) # 20-32-90208

WeR9-p72 10:00-13:30

Colloidal magnetic photonic crystals: synthesis and modification

A.S. Drozdov[1,2], Y.A. Andreeva[2]; [1]MIPT, Russia; [2]ITMO Univ., Russia

We have developed a new synthetic procedure of biocompatible magnetic clusters sized from 40 to 660 nm and narrow size distribution under mild conditions. Reflectance spectra of the synthesized colloidal suspensions showed magnetic field-dependent behavior and acted as colloidal magnetic photonic crystals. The surface of the synthesized particles was modified by in situ polymerization of dopamine derivatives.

This research was supported by RFBR Grant(s) # RNF 20-73-0001

WeR9-p73 10:00-13:30

The effect of light quenching in the hybrid film InP/InAsP/InP- [QD CdSe/ZnS-TOPO]

A.I. Khrebtov[1], A.S. Kulagina[1], V.V. Danilov[2]; [1]St. Petersburg Academic Univ.; [2]St. Petersburg State Transport Univ., Russia

The effect of light quenching in the hybrid film InP/InAsP/InP–[CdSe/ZnS-TOPO QD] is analyzed taking into account the significant increase in the luminescence intensity observed in such a system as compared to an array of isolated nanowires. We assume that Auger relaxation can be suppressed due to multistage nonradiative excitation transfer in the hybrid structure.

WeR9-p74 10:00-13:30

Synthesis of a hybrid material based on aerogel and organic phosphor using supercritical technologies

A. Lebedev, E. Suslova, K. Kazmina, A. Khomyakov, M. Zykova, O. Petrova, R. Avetisov, N. Menshutina, I. Avetissov; Mendeleev Univ. of Chemical Technology, Russia

A new luminescent hybrid material based on inorganic aerogel has been fabricated by direct synthesis from boron acid and 8-hydroxyquinolinol within the aerogel porous structure during its supercritical drying. The influence of boron ion amount on the luminescent, physical and structural characteristics of material were investigated. Analysis of photoluminescence spectra showed luminescence peak at wavelength of 513 nm.

This research was supported by RFBR Grant(s) # This research was financially supported by the Ministry of Science and Higher Education of Russian Federation, by the project FSSM-2020-0003

WeR9-p75 10:00-13:30

Plasmon structures on gold surface induced by femtosecond laser radiation

A.V. Tcibulnikova[1], A.A. Khankaev[1], V.V. Bryukhanov[1], I.G. Samusev[1], I.I. Lyatun[1], V.A. Slezhkin[2]; [1]REC "Fundamental and applied photonics. Nanophotonics", Immanuel Kant Baltic Federal Univ.; [2]Kaliningrad State Technical Univ., Russia

The method of femtosecond laser structuring of the gold surface is presented in order to study the morphological features of the formed structures, as well as the plasmonic-optical properties.

WeR9-p76 10:00-13:30

Diffraction and selective properties of one-dimensional and two-dimensional periodic structures in a wide range of angles of incidence

P.P. Sokolov, N.D. Vorzobova; Faculty of Photonics, ITMO Univ., Russia

The diffraction and selective properties of various types of periodic nanostructures in promising photopolymer materials at radiation incidence in a wide range of angles are presented for the creation on their basis of effective deflectors and laser beam splitters, as well as diffractive elements for solar energy.

WeR9-p77 10:00-13:30

Synthesis of silver iodide and copper oxide nanowires in nanoporous glasses for photocatalytic water splitting

P.A. Bezrukov, A.I. Sidorov, N.V. Nikonorov; ITMO Univ., Russia

Methods of silver iodide and copper oxide nanowires in nanoporous glasses synthesis consist in electrolysis of metal salts in nanoporous glasses with interconnecting pores, with the following iodizing or oxidizing of metal nanowires. It is shown that silver iodide nanowires possess luminescence in visible spectral range and phase transition. The synthesized nanocomposites can be used for photocatalytic water splitting.

This research was supported by RFBR Grant(s) # Grant of Russian Science Foundation (research project No. 20-19-00559)

WeR9-p78 10:00-13:30

Investigation of the characteristics of a microresonator with carbon nanotubes deposited on its surface

I.K. Gorelov[1], A.A. Mkrtchan[2], A.E. Shitikov[1], V.E. Lobanov[1], I.A. Bilenko[1]; [1]Russian Quantum Center; [2]Skolkovo Inst. of Science and Technology, Russia

Nonlinearity of carbon nanotubes significantly exceeds nonlinearity of the materials of crystal. Deposition of carbon nanotubes to the surface of the microresonator may enhance its nonlinearity. In this paper, the characteristics of high-quality factor microresonators with whispering gallery modes with single walled carbon nanotubes deposited on the surface are experimentally investigated.

R10: Nonlinear and Quantum Photonics in Waveguide Systems

WeR10-p01 15:00-18:30

Limitations and perspectives of Raman dissipative solitons phosphosilicate-fiber based source

D.S. Kharenko[1,2], A.E. Bednyakova[2]; [1]Inst. of Automation and Electrometry SB RAS; [2]Novosibirsk State Univ., Russia

Parameters of Raman dissipative solitons generated in an external phosphosilicate fiber cavity have been optimized experimentally and numerically. Larger net dispersion leads to a higher SRS threshold. Simulation shows 5-nJ high-quality pulses compressed to 300 fs.

WeR10-p02 15:00-18:30

Accounting for microbends in determining induced birefringence in a ring fiber-optic resonator

D.G. Gilev[1,2], P.M. Valiushina[2], V.A. Maksimenko[2,3], V.V. Krishtop[1,2,3]; [1]Perm Scientific-Industrial Instrument Making Company; [2]Perm State Univ.; [3]Perm National Research Polytechnic Univ., Russia

It is proposed to take into account the microbends of an optical fiber for induced birefringence finding in a ring resonator. It is shown that, due to the small bending radius at the coupling regions, the contribution from these regions to the total change in the optical length is comparable with the contribution of the main part of the resonator.

WeR10-p03 15:00-18:30

The role of the longitudinal component of electric field for evanescent fiber-optic sensors

M.A. Abelmas[1], O.V. Ivanov[2]; [1]Ulyanovsk State Technical Univ.; [2]Ulyanovsk Branch of Kotel'nikov Inst. of Radio Engineering and Electronics RAS, Russia

The role of the longitudinal electric field component in the evanescent fiber sensors is studied. Numerical methods are used to calculate the power transmission coefficient of two parallel optical fibers with taking into account the longitudinal component of the field. It is demonstrated that the contribution of the longitudinal component of the field is significant for evanescent fiber sensors.

WeR10-p04 15:00-18:30

The role of leaking modes on dynamic range of amplitude and phase electro-optic light modulators

V.S. Gerasimenko, N.D. Gerasimenko, V.M. Petrov; ITMO Univ., Russia

The leaking modes is a limitation factor of dynamic range of the electro-optic modulators. The leaking modes at the output port of a MZM contains 10-15% of the main waveguide mode power for the open state (when it is closed about all the power leaks), so even after a Frensel reflection the crosstalk can reach 0,1-1% of the input power.

WeR10-p05 15:00-18:30

Optical frequency comb in optoelectronic oscillator with delay line and microresonator

V.V. Kulagin[1,2,3], V.V. Valuev[3,4], S.M. Kontorov[5], V.N. Kornienko[2], D.A. Prokhorov[3], V.A. Cherepenin[2]; [1]Lomonosov Moscow State Univ.; [2]Kotelnikov Inst. of Radioengineering and Electronics RAS; [3]National Research Nuclear Univ. MEPhI; [4]Research Centre "Module"; [5]Skolkovo Inst. of Science and Technology, Russia

New method for generating optical frequency comb in optoelectronic oscillator is proposed and investigated. The scheme advantages are easy control of all comb parameters by changing laser frequency, average frequency of microwave in-loop filter, and amplitudes of signals applied to modulator arms. System parameters were examined using numerical modeling. The study was supported by RFBR, projects 19-29-06108 and 20-07-00768.

This research was supported by RFBR Grant(s) # The study was supported by RFBR, projects 19-29-06108 and 20-07-00768

WeR10-p06 15:00-18:30

Cladding-pumped fiber coupler studies by COMSOL multiphysics

E. Elsts[1], J. Grube[1], A. Supe[2], S. Spolitis[2], K. Zakis[2], S. Olonkins[3], A. Udalcovs[2], R. Murnieks[2], U. Senkans[2], D. Prigunovs[2,3], L. Gegere[2,3], K. Draguns[4], O. Ozolins[2], V. Bobrovs[2]; [1]Inst. of Solid State Physics, Univ. of Latvia; [2]Inst. of Telecommunications, Riga Technical Univ.; [3]AFFOC Solutions; [4]Inst. of Atomic Physics and Spectroscopy, Univ. of Latvia, Latvia

Our paper gives an overview on the simulation model for signal and pump radiation coupler applicable in realization of cladding-pumped fiber optical amplifiers developed in the COMSOL environment. Simulation results of this specialty coupler demonstrates that highest pumping efficiency is obtained in models with electromagnetic mode numbers 5 - 14, when pumping and signal fibers formed 10º angle between them.

WeR10-p07 15:00-18:30

Integration of QKD in existing WDM optical networks: spectral methods of suppressing noise in the O-band

A.N. Klimov[1], A.V. Borisova[2], B.D. Garmaev[1], A.S. Sidelnikova[1]; [1]Lomonosov Moscow State Univ., Quantum Technology Centre; [2]JSC InfoTeCS, Russia

The experimental research results of the performance of spectral filters and multiplexers that can be used for integrating QKD into existing DWDM networks are presented. An optimal combination of optical components has been found for filtering a quantum channel located in the O-band to suppress noise caused by classical signal scattering in fiber optic communication lines.

WeR10-p08 15:00-18:30

Theoretical analysis of quantum noise suppression of light in bismuth-modified tellurite fibers

A.A. Sorokin[1], V.V. Dorofeev[1,2], G. Leuchs[1,3]; [1]Inst. of Applied Physics RAS, Russia; [2]G.G. Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia; [3]Max Planck Inst. for the Science of Light, Germany

Optical sources of squeezed quantum light are required for various ultraprecise measurements. For fiber-based Kerr squeezing technologies, silica fibers are widely used. Here an alternative fiber made of highly-nonlinear bismuth-modified tellurite glass is considered. We performed quantum dynamical simulations and analytical estimations and showed the possibility of attaining high quantum noise suppression up to -15 dB.

This research was supported by RFBR Grant(s) # 19-29-11032, 20-03-00874

WeR10-p09 15:00-18:30

Electrically-controllable integrated-optic beam splitters for homodine detection of vacuume field

E.A. Vashukevich[1], T.Yu. Golubeva[1], V.M. Petrov[2]; [1]St-Petersburg State Univ.; [2]ITMO Univ., Russia

The theory and experiment of a quantum noise generator based on integrated optical beam splitters is presented.

WeR10-p10 15:00-18:30

Parametric gain in the fiber with periodically varying dispersion

L.A. Melnikov, Yu.A. Mazhirina; Yuri Gagarin State Technical Univ. of Saratov, Russia

Modulation instability in the fiber with dispersion modulation and associated parametric amplification is investigated. It has been confirmed that in such fibers modulation instability is observed even in the case of positive dispersion. The prospect of using the fiber with large nonlinearity and periodic dispersion for parametric amplification with an expanded gain band due to parametric resonances is shown.

This research was supported by RFBR Grant(s) # 19-52-45012

WeR10-p11 15:00-18:30

Fiber-optic elements spectroscopy against Trojan-horse attack in 1500-2000 nm range

B.A. Nasedkin, D.A. Tolochko, I.M. Filipov, V.V. Chistyakov, A.O. Ismagilov, F.D. Kiselev, A.N. Tcypkin, V.I. Egorov; ITMO Univ., Russia

In our work, we investigated loss of fiber-optic elements for 1500-2000 nm range and find that for 1800-2000 nm elements lost their properties which are usually used against quantum hacking.

WeR10-p12 15:00-18:30

The effect of spontaneous noise in the probe radiation on the reflectogram form in distributed fibre sensing systems

N.I. Kalmykov[1,2], D.A. Kovalenko[1], I.A. Lobach[1,2], S.I. Kablukov[1,2]; [1]Inst. of Automation and Electrometry SB RAS; [2]Novosibirsk State Univ., Russia

In the paper the effect of spontaneous emission in pulsed probe radiation on the distortions of reflectograms in a distributed temperature sensor is investigated. The spontaneous emission generated in the erbium-doped amplifier can reach up to 50% of the total power. This leads to distortions of the reflectograms and, accordingly, thermograms. Spectral filtration of probe radiation reduces these distortions.

This research was supported by RFBR Grant(s) # No. AAAA-A19-119112990054-4

WeR10-p13 15:00-18:30

Analysis of materials in technological assembly processes of semiconductor devices

A.V. Kamarchuk, A.I. Marchenko; D.A. Bauman, Russian Univ., Russia

Research of materials used in assembly operations of installation of semiconductor crystals. Structural strength analysis for different technological profiles. Investigation of defects in materials after assembly operations that affect the technical characteristics and strength of the device.

WeR10-p14 15:00-18:30

Quantum optics of polyatomic ensembles in a waveguide

A.S. Kuraptsev, H. Meng; Peter the Great St. Petersburg Polytechnic Univ., Inst. of Electronics and Telecommunications, Russia

We study many-body cooperative effects in an ensemble of point impurity atoms located in a waveguide, such as single-photon superradiance, subradiance and light trapping. We show that in the case of single-mode waveguide, the time of radiation trapping exponentially increases with an increase of the size of atomic medium, which indicates the Anderson localization of light.

WeR10-p15 15:00-18:30

Light interaction with individual impurity atoms in a waveguide

A.S. Kuraptsev, K.A. Barantsev, A.N. Litvinov, G.V. Voloshin, Hui Meng, I.M. Sokolov; Inst. of Electronics and Telecommunications, Peter the Great St. Petersburg Polytechnic Univ., Russia

We study the interaction of quasi-resonant light with point impurity atoms embedded into transparent solid dielectric in a waveguide focusing our attention on the case when interatomic separations are much larger that the wavelength of light. We demonstrate the effect of incomplete spontaneous decay of a single excited atom in a waveguide and extremely long-range dipole-dipole interaction between different atoms.

WeR10-p16 15:00-18:30

Pseudoscalar bosons interactions possible investigation via soliton fissionin dispersion oscillating fibers

K.S. Gochelashvili[1], S.V. Erin[2], M.Yu. Salganski[3], A.A. Sysoliatin[1]; [1]Prokhorov General Physics Inst.; [2]NRC «Kurchatov inst.» – IHEP; [3]IHPS RAN, Russia

A unique feature of quantum sensors is the ability to overcome the standard quantum limit. This possibility is based on the use of quantum effects as entanglement, quantum freezing and etc. The possibility of photon conversion into pseudoscalar bosons in dispersion oscillating fibers is considered. Such a phenomen may take place via nonlinear effects in optical fibers with oscillating dispersion.

WeR10-p17 15:00-18:30

Resonant scattering in wurtzite semiconductors

L.E. Semenova; Prokhorov General Physics Inst. RAS, Russia

The Raman scattering of light under excitation near the An=2 and Bn=1 exciton levels in ZnS and the hyper-Raman scattering near two-photon resonance with the An=2 and Bn=2 exciton levels in ZnO were theoretically investigated, taking into account the influence of the complex top valence band.

WeR10-p18 15:00-18:30

RF amplitude and phase control of coherent light by electrodes of travelling waves

V.S. Gerasimenko, N.D. Gerasimenko, V.M. Petrov; [1]ITMO Univ., Russia

This research discusses the influence of the parameters of the traveling wave electrodes on the efficiency of radiation control. It was demonstrated that for more efficient collinear interaction, it is necessary to use electrodes of a travelling wave with a refractive index close to the refractive index of the optical waveguide.

WeR10-p19 15:00-18:30

Weak measurements with adjustable strength

S.D. Manko, D.N. Frolovtsev, S.A. Magnitskiy; Lomonosov Moscow State Univ., Russia

The method for weak measurements with an adjustable strength is proposed and implemented on an IBM quantum computer. The relationship between the strength, the qubit disturbance and the accuracy of the measurement are investigated.

WeR10-p20 15:00-18:30

Cooperative sensitization of trace Tm ions in Yb doped fluorophosphate glass

E. Kolobkova[1,2], P.A. Apanasevich[3], I. Khodasevich[3], A. Grabtchikov[3,1]; [1]ITMO Univ.; [2]St. Petersburg State Inst. of Technology, Russia; [3]Stepanov Inst. of Physics, Belarus

We report results on cooperative sensitization of impurity Tm ions in glass doped by Yb ions. Our experimental data point to the conclusion, that cooperative sensitization observed earlier for traditional concentrations of some wt. % occurs also for the low trace concentration of Tm ions and their up-conversion luminescence can demonstrate the existence of Yb dimers.

This research was supported by RFBR Grant(s) # by Russian Science Foundation (19-13-00343) and by the Belorussian State Program for scientific investigations "Photonics and microelectronics for innovations" (task 1.2)

WeR10-p21 15:00-18:30

Measurement of laser radiation parameters by speckle interferometry

S.M. Kobtsev; Novosibirsk State Univ., Russia

The article discusses the possibilities of simplified measurement of the key parameters of laser radiation on the basis of speckle interferometry and machine learning methods. It is demonstrated that the corresponding device may be designed as a compact and inexpensive laser accessory capable of replacing the entire conventional set of laboratory measurement equipment.

WeR10-p22 15:00-18:30

Nuclear terms temperature drift rate for NV center ground state Hamiltonian

S.V. Bolshedvorskii[1,2], V.V. Soshenko[1,2], V.V. Vorobyov[3], O.R. Rubinas[1,2,4], I.S. Cojocaru[1,2,5], V.N. Sorokin[1,2], A.N. Smolyaninov[1], A.V. Akimov[6,2,5]; [1]Spin Sensor Technology, Russia; [2]Lebedev Physical Inst. RAS, Russia; [3]3rd Inst. of Physics, IQST and Centre for Applied Quantum Technologies, Univ. of Stuttgart, Germany; [4]Moscow Inst. of Physics and Technology, Russia; [5]Russian Quantum Center, Russia; [6]Texas A&M Univ., USA

In our work, we investigate the temperature-dependent shift in the 14N nuclear spin associated with the hyperfine splitting of the NV center.

This research was supported by RFBR Grant(s) # RSF #21-42-04407

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

High power lasers: solid state, gas and hybrid III

Location: Stenberg 1 Room, floor 3. 09:00-11:00

ThR2-15 09:00-09:30

Formation of radiation divergence on the THL-100 laser system *(Invited paper)*

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

Results of radiation divergence research on THL-100 hybrid laser system are presented and the basic problems are discussed.

ThR2-16 09:30-10:00

The progress on the OPCPA front end for SEL-100PW laser facility *(Invited paper)*

Yi Xu[1], X Wang[1], X. Lu[1], Ya. Li[1], Yu. Peng[1], X. Liang[1], Yu. Leng[1,2], R. Li[1,2,3]; [1]State Key Lab. of High Field Laser Physics and CAS Center for Excellence in Ultra-intense Laser Science, Shanghai Inst. of Optics and Fine Mechanics (SIOM); [2]Center of Materials Science and Optoelectronics Engineering, Univ. of Chinese Academy of Sciences; [3]CAS Center for Excellence in Ultra-intense Laser Science, China

We report the recent progress on the front-end developed for the 100PW- class laser in the Station of Extreme Light (SEL-100PW). After the compressor, we obtained a pulse duration of 13.4fs. As the compression efficiency reached 67%, this OPCPA front-end could potentially support a peak power of 263 TW

ThR2-17 10:00-10:30

Adaptive optics for aberration correction in PW lasers *(Invited paper)*

A.V. Kudryashov, V.V. Samarkin, M.A. Sadovsky; Inst. of Geosphere Dynamics (IDG RAS), Russia

Wide-aperture adaptive systems created to correct for aberrations and improve the focusing on the target. Bimorph deformable mirrors with sizes of 320 and 410 mm were developed, where the initial surface shapes after alignment were 1 and 1.5 μm. The use of an adaptive system with 320-mm-deformable mirror in 4.2-PW Ti:Sa laser provided intensity 1.1x10E23 W/cm2 on the target

This research was supported by RFBR Grant(s) # the grant No. 20-69-46064 of the Russian Science Foundation

ThR2-18 10:30-10:45

KDP crystal is a medium for temporal self-compression of high-energy near IR femtosecond pulses

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

KDP crystal can be used for simultaneous spectrum broadening and temporal self-compression of high power near infrared femtosecond laser pulses.

This research was supported by RFBR Grant(s) # 20-21-00123

ThR2-19 10:45-11:00

All-fiber chirped-pulse amplification system generating 50 MW peak power 400 fs pulses at 1026 nm

K.K. Bobkov[1], D.S. Lipatov[2], M.Yu. Salganskiy[2], A.N. Guryanov[2], M.E. Likhachev[1]; [1]Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center RAS; [2]Devyatykh Inst. of Chemistry of High Purity Substances RAS, Russia

We demonstrate an all-fiber chirped-pulse amplification system. A specially designed triple-cladding fiber allowed to stretch 6ps 1026nm pulses from master oscillator to ~500ps. These pulses were amplified in a newly-developed extra-highly-Yb-doped large-mode area fiber up to ~10W average power and then compressed in a transmission grating compressor down to 400fs duration with resulted in a record-high 50MW peak power.

– Break –

High power lasers: solid state, gas and hybrid IV

Location: Stenberg 1 Room, floor 3. 11:30-13:15

ThR2-20 11:30-12:00

Formation of low-coherence laser beams in dense mixtures of solid-state microparticles and liquids *(Invited paper)*

O.A. Burdukova[1,2], V.A. Petukhov[1], M.A. Semenov[1], Yu.V. Senatsky[1]; [1]Lebedev Physics Inst. RAS; [2]Sechenov First Moscow State Medical Univ., Russia.

Low-coherence lasers with intra-cavity diffusers based on slurry-like dense mixtures of crystal or glass microparticles and immersion liquids are proposed.

This research was supported by RFBR Grant(s) # #18-02-00285; #19-02-00344.

ThR2-21 12:00-12:15

Optimization of a laser-plasma -based hard X-ray source for absorption spectroscopy of warm dense matter

A.S. Martynenko[1,2], S.A. Pikuz[1,3], I.Yu. Skobelev[1,3], S.N. Ryazantsev[1,3], C. Baird[4], N. Booth[5], L. Doehl[4], P. Durey[4], A. Ya. Faenov[1,6], D. Farley[4], R. Kodama[6,7], K. Lancaster[4], P. Mckenna[8], C.D. Murphy[4], C. Spindloe[5], T.A. Pikuz[1,6], N. Woolsey[4]; [1]Joint Inst. for High Temperatures RAS, Russia; [2]Plasma Physics Department, GSI Helmholtzzentrum fur Schwerionenforschung, Germany; [3]National Research Nuclear Univ. MEPhI, Russia; [4]York Plasma Inst., Department of Physics, Univ. of York, UK; [5]Central Laser Facility, STFC Rutherford Appleton Laboratory, UK; [6]Open and Transdisciplinary Research Initiative, Osaka Univ., Japan; [7]Inst. of Laser Engineering, Osaka Univ., Japan; [8]Department of Physics, SUPA, Univ. of Strathclyde, UK

Low-Z materials such as aluminium and silicon can be used as X-ray backlighting in a hard X-ray range 2-6 Å (2-6 keV). Photorecombination continuum emission of solid-density plasma may create a featureless spectral continuum of high intensity for use in for example x-ray absorption spectroscopy studies of warm dense matter.

ThR2-22 12:15-12:30

Development of laser method for studying temperature distributions in active elements of high average power laser amplifiers

A.O. Konovalova[1,2], G.V. Kuptsov[1,3], V.A. Petrov[1,3], V.V. Petrov[1,2,3], A.V. Laptev[1]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State National Research Univ.; [3]Novosibirsk State Technical Univ., Russia

This work is devoted to the method for studying temperature distribution in solid-state active elements of high average power laser amplifiers. Temperature distribution in an active element of the cryogenically-cooled diode-pumped laser amplifier with high average power were investigated and analyzed. The investigation was carried out for various pump beam diameters and repetition rates 500 and 1000 Hz.

This research was supported by RFBR Grant(s) # RFBR project 20-02-00529

ThR2-23 12:30-12:45

Optical properties of ceramics made of silver halide solid solutions doped with rare-earth elements

E.A. Korsakova[1], A.N. Orlov[2], D.D. Salimgareev[1], A.E. Lvov[1], V.A. Shitov[2], A.A. Yuzhakova[1], A.S. Korsakov[1], L.V. Zhukova[1], V.V. Osipov[2]; [1]Ural Federal Univ. named after the first President of Russia B. N. Yeltsin; [2]Inst. of Electrophysics UB RAS, Russia

In this study, we investigated optical characteristics of transparent ceramics based on silver halide solid solutions doped with rare-earth elements such as neodymium and ytterbium. The results show that such materials can be used for creating the sources of coherent radiation in the mid-IR region.

ThR2-24 12:45-13:00

Polarizing active large-mode area quasi-Bragg fiber with microstructured core

S.S. Aleshkina, T.A. Kashaykina, M.M. Bubnov, M.E. Likhachev; Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center, FORC RAS, Russia

In the present work we proposed design of polarizing double-clad active large-mode-area fiber. It is intended for operation near 1.064 μm, has mode field diameter ~ 30 μm and clad diameter of 125 μm. Polarizing properties are achieved by differential gain between slow-polarization-state of the fundamental mode as compared to all other modes (including fast-polarization-state of the fundamental mode).

This research was supported by RFBR Grant(s) # RSF 21-19-00528

ThR2-25 13:00-13:15

Stroke analysis of piezocomb stack-array deformable mirrors

V.V. Toporovsky[1], A.V. Kudryashov[1,2], V.V. Samarkin[1], A.A. Panich[3], A.I. Sokallo[3], A.Yu. Malykhin[3]; [1]Inst. of Geosphere Dynamics RAS; [2]Moscow Polytechnic Univ.; [3]Inst. of High Technologies and Piezotechnics, Southern Federal Univ., Russia

We provided mathematical simulation and lab experiments for piezocombs with 2*2 and 4*4 mm actuators to investigate the relation between effective area and stroke of these control elements. Two techniques of electrical wiring were used: thin-film and individual electrical contacting.

R8: Nonlinear Photonics: Fundamentals and Applications

Nonlinear phenomena in fibers I

Location: Pudovkin Room, floor 3. 09:00-11:00

ThR8-31 09:00-09:30

Exotic nonlinear optical effects in multimode fibers *(Invited paper)*

M. Ferraro[1], F. Mangini[1,2], M. Zitelli[1], S. Wabnitz[1]; [1]Sapienza Univ. of Rome, Italy; [2]Univ. of Brescia, Italy

We experimentally and theoretically studied femtosecond laser pulse propagation with powers slightly below the breakdown threshold. In this regime, nonlinear absorption strongly affects spatio-temporal beam dynamics, and several exotic nonlinear optical effects are observed.

ThR8-32 09:30-09:45

Multicore fibers with interacting cores for coherently combined high-power laser systems

A.V. Andrianov[1], N.A. Kalinin[1], E.A. Anashkina[1], A.A. Balakin[1], S.A. Skobelev[1], G. Leuchs[1,2], A.G. Litvak[1]; [1]Inst. of Applied Physics RAS, Russia; [2]Max Planck Inst. for the Science of Light, Germany

We demonstrate experimentally and numerically that in the multicore fiber with a square array of cores the out-of-phase supermode, which is stable at high power, can steadily propagate and can be coherently combined at the output with high efficiency. In numerical modeling 70 MW peak power is demonstrated by using tapered active multicore fiber with an 11x11 array of cores.

ThR8-33 09:45-10:00

Kerr frequency combs of axial-azimuthal modes in SNAP fiber resonator

A. Yu. Kolesnikova, S. V. Suchkov, I. D. Vatnik; Novosibirsk State Univ., Russia

We investigate nonlinear mode interaction in the cylindrical microresonator with nanoscale radius variation. We derive a model which describes the interplay between azimuthal modes and study the nonlinear dynamics of axial-azimuthal modes. Using a properly designed radius longitudinal profile, we obtain broadband generation of stable low-repetition-rate frequency combs based on axial-azimuthal modes.

ThR8-34 10:00-10:15

Ultrashort pulse Raman conversion 1.03→3.9 μm in a gas-filled revolver hollow-core silica fiber

A.V. Gladyshev, A.F. Kosolapov, A.N. Kolyadin, I.A. Bufetov; Dianov Fiber Optics Research Center, Prokhorov General Physics Inst. RAS, Russia

Efficient generation at 3.9 micron is demonstrated via Raman conversion of 1.03-micron ultrashort laser pulses in a gas-filled hollow-core silica fiber.

ThR8-35 10:15-10:30

Phase-sensitive amplification in modulation instability sidebands

P.A. Mavrin[1], A.A.Sysoliatin[2], A.I.Koniuhov[1]; [1]Saratov State Univ., Russia; [2]Prokhorov General Physics Inst., Russia

We show that dispersion oscillating fiber (DOF) can be used for phase-sensitive amplification (PSA) in a wide range of resonant frequencies. The gain depends both on the modulation phase of the fiber dispersion and individual phases of interacting waves. DOF can be used for phase-sensitive amplification and signal squeezing in high-order modulation instability sidebands.

ThR8-36 10:30-11:00

New regimes of pulse evolution in a fiber laser with semiconductor optical amplifier *(Invited paper)*

D. Khudozhitkova[1], A. Bednyakova[1], A. Kokhanovskiy[1], S.K. Turitsyn[2]; [1]Novosibirsk State Univ., Russia; [2]Aston Inst. of Photonic Technologies, Aston Univ., UK

We exploit nonlinear properties of semiconductor optical amplifier (SOA) to manipulate spectral characteristics of fiber laser. We demonstrate that the interplay involving nonlinear dynamics in the laser cavity and SOA allows to control the wavelength of the generating pulses, shifting it from red to blue side of the spectrum depending on the width of the tunable intracavity filter.

This research was supported by RFBR Grant(s) # 21-42-04401

– Break –

Nonlinear phenomena in fibers II

Location: Pudovkin Room, floor 3. 11:30-12:45

ThR8-37 11:30-12:00

Phase-space topology of fiber four-wave mixing *(Invited paper)*

A. Sheveleva[1], P. Colman[1], John M. Dudley[2], Christophe Finot[1]; [1]Lab. Interdisciplinaire CARNOT Bourgogne, Univ. de Bourgogne-Franche-Comté-CNRS; [2]Inst. FEMTO-ST, Univ. de Bourgogne Franche-Comté CNRS, France

We propose and experimentally demonstrate a new experimental testbed enabling the study and control of ideal four-wave mixing interactions in optics. Two approaches are used to reveal the phase-space topology. The first is based on iterated initial conditions in a short fiber segment. The second relies on an experimental dataset that is then processed and analyzed by a neural network.

ThR8-38 12:00-12:15

Demonstration of 20 Gbaud PAM-4 spectrum-sliced signal transmission over WDM network

L. Skladova[1,2], R. Murnieks[1,2], A. Ostrovskis[1,2], V. Bobrovs[1], S. Spolitis[1]; [1]Inst. of Telecommunications of Riga Technical Univ.; [2]Communication Technologies Research Center Riga Technical Univ., Latvia

In this work, we illustrate how higher-order modulation format PAM-4 in combination with the proposed spectrum-slicing technique enhances achievable data rate up to 20 Gbaud without substituting existing transceiver elements with those having larger electrical bandwidth.

ThR8-39 12:15-12:30

Recent advances in Dispersive Fourier Transform technique

S. Hamdi, A. Sheveleva, A. Coillet, P. Grelu, P. Colman; ICB Laboratory, Univ. de Bourgogne-Franche-Comté, France

The seminal Dispersive Fourier Transform technique suffers from a few shortcomings, such as its incapacity to distinguish between temporal jitter and frequency shifts. Taking as example the evolution of soliton molecules in an ultrafast fiber ring laser cavity, we present how additional parameters such as pulse's chirp, jitter, and instantaneous frequency shifts can now be extracted from the DFT experiment.

ThR8-40 12:30-12:45

Reduced set of descriptors for experimental analysis of nonlinear optics phenomena

A. Sheveleva[1], Ch. Finot[1], P. Colman[1]; [1]Lab. Interdiciplinaire Carnot de Bourgogne, UMR CNRS60303, Univ. de Bourgogne-Franche Comté, Dijon, France

We investigate how Dynamic Modes Decomposition and other similar dimension reduction procedures allow identifying the dominant features regulating the dynamics of nonlinear fiber ring cavity lasers. In particular, experimental measurements can be accurately described using only a few well-chosen parameters. In turn, a simpler description of complex phenomena could result in a better understanding of them, hence a better control.

R9: Optical Nanomaterials

Optical nanomaterials II

Location: Deyneka Room, floor 2. 15:00-16:40

ThR9-08 15:00-15:20

MBE growth and properties of AlGaAs nanowires with InGaAs quantum dots on silicon

R.R. Reznik[1], I.V. Ilkiv[1], K.P. Kotlyar[2], V.O. Gridchin[1,2], E.V. Ubyivovk[1], N.S. Dragunova[2], N.V. Kryzhanovskaya[2], N. Akopian[4], G.E. Cirlin[1-3]; [1]St. Petersburg State Univ., Russia; [2]Alferov Univ., Russia; [3]Inst. for Analytical Instrumentation RAS, Russia; [4]Department of Photonics Engineering, Technical Univ. of Denmark, Denmark

AlGaAs nanowires with InGaAs quantum dots were grown on silicon by molecular-beam epitaxy under different growth conditions for the first time. The results of physical properties studies showed that by changing the quantum dots growth time, the ratio of III materials fluxes and the growth temperature it is possible to control the size and composition of quantum dots.

ThR9-09 15:20-15:40

Droplet contact angle controlling the morphology and crystal phase of GaAs and GaP nanowires

V.G. Dubrovskii[1], N.V. Sibirev[1], V.V. Fedorov[2], L.N. Dvoretckaia[2], D.A. Kirilenko[3], I.S. Mukhin[2], A. Ghukasyan[4], N.I. Goktas[4], R.R. LaPierre[4]; [1]Faculty of Physics, St. Petersburg State Univ.; [2]Nanotechnology Research and Education Centre, Alferov Univ.; [3]Ioffe Inst., Russia; [4]Department of Engineering Physics, McMaster Univ., Canada

We show that twinning superlattice Te-doped GaAs nanowires are formed only when the droplet contact angle is above 130 deg, and that pure wurtzite, 500 nm long sections in self-catalyzed GaP nanowires are obtained in the stage of Ga droplet consumption when the contact angle is within the range from 105 deg to 95 deg.

ThR9-10 15:40-16:00

Microspherical lithography for selective epitaxy

L.N. Dvoretckaia[1], A.M. Mozharov[2], V.V. Fedorov[1], M.S. Gavrilov[1], I.S. Mukhin[1]; [1]Alferov Univ.; [2]St. Petersburg State Univ., Russia

The effect of focusing with microspheric lenses during the photolithography process is recently studied intensively due to the wide range of applications of this method. This paper presents the results of nanostructuring the silicon surface using photolithography on the microspheric lenses and etching silicon in nanoholes. The possibility of epitaxial selective synthesis of semiconductor nanostructures A3B5 on silicon is demonstrated.

ThR9-11 16:00-16:20

Growth of III-V nanowires by molecular beam epitaxy: the role of material exchange with the substrate

N.V. Sibirev, V.G. Dubrovskii; St. Petersburg State Univ., Russia

Growth theory of III-V nanowires fabricated by molecular beam epitaxy is developed to reveal the role of the substrate which can be either unpatterned or masked with an inert SiOx layer. Axial and radial growths of nanowires are described in both cases, converging to the asymptotic stage which is independent of the substrate due to the shadowing effect.

ThR9-12 16:20-16:40

Core-shell InGaN Nanowires: MBE growth and properties

V.O. Gridchin[1,3], R.R. Reznik[1,3], K.P. Kotlyar[1,3], V.V. Lendyashova[1,4], A. S. Dragunova[1,5], D.A. Kirilenko[4], N.V. Kryzhanovskaya[1,5], G.E. Cirlin[1,4]; [1]Alferov Univ.; [2]IAI RAS; [3]St.-Petersburg State Univ.; [4]Ioffe Inst.;[5]HSE Univ., Russia

The influence of the growth temperature on physical properties of InGaN nanowires are considered. The growth condition for synthesis of core-shell InGaN nanowires with the chemical composition within the miscibility gap are determined. This work can be beneficial for the development of the growth model of spontaneously formed core-shell NWs and creation micro LEDs on Si substrates.

R1: Solid State Lasers

ThR1-p01 10:00-13:30

Optical spectroscopy of the Er^{3+} ion in BaY_2F_8 crystal and YSAG ceramics

A.V. Astrakhantseva[1], A.A. Shavelev[1], V. Tarala[2], V. Lapin[2], S.V. Kuznetsov[3], A.S. Nizamutdinov[1]; [1]Inst. of Physics, Kazan Federal Univ.; [2]North-Caucasus Federal Univ.; [3]Prokhorov General Physics Inst. RAS, Russia

We report about luminescent properties of Er3+ ions in disordered matrices of yttrium scandium aluminum garnet (YSAG) ceramics and fluoride crystal BaY2F8.

ThR1-p02 10:00-13:30

Growth of large Cr^{3+}:$LiCaAlF_6$ crystals for tunable wavelength laser sources

A.A. Shakirov[1], A.A. Shavelev[1], A.S. Nizamutdinov[1], R.D. Aglyamov[1,2], A.K. Naumov[1], M.A. Marisov[1], O.A. Morozov[1,2], V.V. Semashko[2]; [1]Inst. of Physics, Kazan Federal Univ.; [2]Zavoisky Physical-Technical Inst., FRC Kazan Scientific Center RAS, Russia

Growing Cr3+ doped LiCaAlF6 crystals long up to 100 mm and in diameter up to 10 mm by Bridgman technique is reported. The grown crystals had light scattering. This defect was corrected by annealing in a fluorinated atmosphere.

ThR1-p03 10:00-13:30

Polarized optical spectroscopy of monoclinic Dy:$KY(WO_4)_2$ crystal for potential use in yellow lasers

S. Slimi[1], P. Loiko[2], R.M. Solé[1], M. Aguiló[1], F. Díaz[1], P. Camy[2], X. Mateos[1]; [1]FiCMA-FiCNA-EMaS, Univ. Rovira i Virgili (URV), Spain; [2]Centre de Recherche sur les Ions, les Matériaux et la Photonique, UMR6252 CEA-CNRS-ENSICAEN, Univ. de Caen Normandie, France

Monoclinic 1 at.% Dy:KY(WO4)2 crystal was grown by the top seeded solution growth slow-cooling method. Polarized absorption and luminescence spectra, and the luminescence decay were studied with a focus on yellow emission (~574 nm, the 4F9/2 → 6H13/2 transition). Dy:KY(WO4)2 is a promising gain material for yellow lasers.

ThR1-p04 10:00-13:30

0.6 J/ 3 ns 946 nm Nd:YAG laser

A.F. Kornev[1], A.S. Kovyarov[2], V.P. Pokrovskiy[1], R.V. Balmashnov[1]; [1]"Lasers & Optical Systems" Co. Ltd., Russia; [2]Aston Univ., UK

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

ThR1-p05 10:00-13:30

Femtosecond laser complex for control of micromachining processes of thin-film coatings

R.V. Chkalov, D.A. Kochuev, A.S. Chernikov, K.S. Khorkov; Vladimir State Univ., Russia

The possibilities of increasing the efficiency of technological processes of femtosecond laser micro-processing of materials due to the introduction of control algorithms and information exchange of elements of devices of the telecommunication network of the hardware complex are presented. The result of laser processing thin films samples at various operating parameters is shown.

ThR1-p06 10:00-13:30

Mode-locking in a YAG:Cr^{4+} solid-state laser gyroscope

Yu.Yu. Broslavets[1,2], A.A. Fomichev[1,2], E.A. Polukeev[1,2], V.G. Semenov[1,2], D.M. Ambartsumyan[1], V.P. Surovtseva[1]; [1]Moscow Inst. of Physics and Technology (National Research Univ.); [2]JSC "Lasex", Russia

This paper presents a YAG:Cr4+ solid-state laser gyroscope in which mode locking is used to improve accuracy. Mode locking makes it possible to reduce the competition of counterpropagating waves, in addition, it reduces the spectral width of the longitudinal modes. Analysis of the influence of mode locking on the characteristics of a laser gyroscope is carried out.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Foundation for Basic Research, project no. 20-07-00962 A

ThR1-p07 10:00-13:30

Thallium halides based IR gradient crystals and optical fibers development

M.S. Kuznetsov[1], K.S. Zaramenskikh[1], G.V. Polyakova[1], M.V. Morozov[1], A.Yu. Demina[1], S.M. Pilyushko[1], L.N. Butvina[1,2], L.D. Iskhakova[2]; [1]"Giredmet" Federal State Research and Development Inst. of Rare Metal Industry, JSC; [2]Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center, Russia

Using the solid-state diffusion method, gradient crystals of thallium halides were obtained with both an increasing refractive index to the center and a decreasing one, which corresponds to scattering and focusing lenses. Optical fiber extrusion was tested, experimental samples of gradient light guides made of thallium halides with a diameter of 1 mm were obtained.

ThR1-p08 10:00-13:30

The effect of laser frequency drift on the response of Phase-sensitive Optical Time-domain Reflectometer

D.M. Bengalskii[1], D.R. Kharasov[1,2], E.A. Fomiryakov[1,3], S.P. Nikitin[1], O.E. Nanii[1,3], V.N. Treshchikov[1]; [1]T8 Sensor LLC; [2]Moscow Inst. of Physics and Technology (National Research Univ.); [3]Lomonosov Moscow State Univ., Russia

We present numerical simulations of the Phase-sensitive Optical Reflectometer which response is affected by the laser optical frequency drift. The signals demonstrate random phase-jumps. Corresponding phase noise spectra approximated by a combination of white noise determined by the laser linewidth and flicker phase noise determined by the laser optical frequency drift rate.

ThR1-p09 10:00-13:30

Characterization of perspective active medium based on mixed crystals Ce^{3+}:$LiCaxSr(1-x)AlF_6$

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

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

ThR1-p10 10:00-13:30

Tb^{3+}-GeSbGaSe glass-ceramics for creation of mid-IR radiation sources

A.I. Filatov, L.A. Ketkova, T.V. Kotereva, V.S. Shiryaev; Inst. Chem. High-Purity Substances RAS, Russia

An enhancement of mid-IR photoluminescence in glass-ceramics based on Tb3+-doped Ge33Sb3Ga4Se60 glass with nucleated and grown micro- and nanosized GeSe crystals is reported. Depending on the heat treatment temperature of the glass, an increase in luminescence by a factor of 1.5–4 is achieved. The mechanisms of luminescence enhancement and the influence of optical scattering losses are discussed.

This research was supported by RFBR Grant(s) # Agreement 16-11-2021/52 with Nizhny Novgorod Research and Educational Center

ThR1-p11 10:00-13:30

Numerical simulation of an ultrafast Tm-doped fibre laser with third-order dispersion compensation

A.I. Voronets[1], V.S. Voropaev[1], A.I. Donodin[2], V.V. Dvoyrin[2], M.K. Tarabrin[1,3], V.A. Lazarev[1]; [1]Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical Univ., Russia; [2]Aston Inst. of Photonics Technologies, Aston Univ., UK; [3]Lebedev Physical Inst. RAS, Russia

Tm-doped fibre laser with intracavity third-order dispersion compensation is developed by using fibers with a high concentration of germanium oxide in the core. The numerically simulated pulses have a smooth symmetrical shape and following characteristics: time FWHM of 2 ps, spectral FWHM of 28 nm, 50 MHz repetition rate, average power of 2.5 mW, pulse energy of 48 pJ.

ThR1-p12 10:00-13:30

Advantages of YLF host over YAG in power scaling of ytterbium-based cryogenic lasers

M. Kellert[1], U. Demirbas[1,4], J. Thesinga[1], S. Reuter[1], A. Yakovlev[1], F.X. Kärtner[1,2,3], M. Pergament[1]; [1]CFEL/DESY, Germany; [2]Physics Dept., Univ. of Hamburg, Germany; [3]The Hamburg Centre for Ultrafast Imaging, Germany; [4]Dept. of Electrical and Electronics Engineering, Antalya Bilim Univ., Turkey

Detailed spectroscopic, lasing and thermal-lens measurements carried out with Yb:YAG and Yb:YLF under almost identical conditions to demonstrate, that YLF host has several advantages over YAG for the development of ultrafast laser and amplifier systems at cryogenic temperatures.

ThR1-p13 10:00-13:30

Sensitivity of distributed acoustic sensor based on Sagnac interferometer

T.V. Choban[1], A.A. Zhirnov[1,2], K.V. Stepanov[1], R.I. Khan[1], K.I. Koshelev[1], A.B. Pnev[1], V.E. Karasik[1]; [1]Bauman Moscow State Technical Univ.; [2]Kotelnikov Inst. of Radioengineering and Electronics RAS, Russia

We report on a study of sensitivity distribution over the loop of a Sagnac interferometer, which is one of the most important characteristics of distributed acoustic sensors, applied for long perimeters, pipelines, and railways security and monitoring. In result of numerical simulation we demonstrate that sensitivity has harmonic dependence on position and frequency of the disturbance.

ThR1-p14 10:00-13:30

Magneto-optical Faraday effect in polycrystalline ZnSe and Cr:ZnSe

R. Shahin[1], A.P. Savikin[1], O.V. Martynova[1], S.V. Kurashkin[1,2]; [1]Nizhny Novgorod State Univ., Russia; [2]Inst. of Chemistry of High-Purity Substances of the RAS, Russia

The values of the Verdet constant at 632.8 nm in Cr:ZnSe and undoped ZnSe were obtained. It was shown that the Verdet constant in zinc selenide does not depend on crystallite size. The experimentally determined maximum value of the Verdet constant for Cr:ZnSe was 226.5 rad/(T·m), which is more than two times higher than the corresponding value for ZnSe.

ThR1-p15 10:00-13:30

1-kHz nanosecond DPSS conductive cooling Nd:YAG laser for femtosecond pulses amplification

V.P. Mitrokhin, E.S. Safronova, A.D. Savvin, A.E. Dormidonov; Dukhov Automatics Research Inst., Russia

A nanosecond diode-pumped Nd:YAG laser with pulse repetition rate up to 1 kHz without liquid cooling of the of the active media has been demonstrated. The laser provided the following parameters: pulse width 8 ns (FWHM), pulse energy 10 mJ at 1064 nm and up to 4 mJ at 532 nm.

ThR1-p16 10:00-13:30

Gas tubine vibration monitoring via fiber optic sensor

T.V. Choban[1], A.A. Zhirnov[1,2], K.V. Stepanov[1], S.G. Sazonkin[1], S.V. Tikhomirov[3], A.B. Pnev[1], A.O. Novikov[1], D.A. Yagodnikov[1], C. Svelto[4]; [1]Bauman Moscow State Technical Univ.; [2]Kotelnikov Inst. of Radioengineering and Electronics of RAS; [3]All-Russia Research Inst. of Optophysical Measurements, Russia; [4]DEIB, Politecnico di Milano, Italy

We report on a study of vibration measurements of a gas turbine via fiber optic sensor based on a Mach-Zehnder interferometer. The experiment allows controlling the rotation frequency and detecting acoustic signals from some defects in construction. Phase unwrapping scheme of fiber interferometer and spectrogram analysis provide the measurement information.

ThR1-p17 10:00-13:30

Lutetium-yttrium aluminum garnet doped with chromium - perspective ceramic material for saturable absorbers

V.V. Balashov[1], L.Yu. Zakharov[1], A.Yu. Kanaev[2], A.L. Koromyslov[3], S.M. Kozlova[1], K.V. Lopukhin[1], I.M. Tupitsyn[3], E.A. Cheshev[3]; [1]Kotelnikov's IRE RAS ; [2]SLPG 'Raduga', FSE; [3]Lebedev Physical Inst. RAS, Russia

Optical transmission spectra for annealed and non-annealed samples of LuYAG:Cr4+ ceramics, shrinkage curves, grain sizes dependence on sintering temperature and composition of samples were measured. Based on these results, optimal composition (Lu/Y ratio) and sintering conditions were proposed and discussed.

This research was supported by RFBR Grant(s) # 20-52-00036

ThR1-p18 10:00-13:30

Raman spectroscopy of the bixbyite-type $YScO_3$ crystal fiber

E.A. Dobretsova, O.K. Alimov, S.Ya. Rusanov, V.V. Kashin, S.A. Kutovoi, V.I. Vlasov, D.A. Guryev, V.S. Tsvetkov, V.B. Tsvetkov; GPI RAS, Russia

The bixbyite-type YScO3 crystals have been grown in the form of a fiber. The micro-Raman spectrum of the YScO3 crystal fiber has been recorded in the range of 120 to 660 cm-1 at room temperature and studied with the use of the group-theoretical analysis.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Science Foundation under Grants No. 22-22-00968

ThR1-p19 10:00-13:30

The influence of Sc^{3+} ions on fluorescence lifetime of Yb^{3+} in Yb- doped yttrium scandium aluminum garnet (Yb:YSAG) ceramics

V.Yu. Zhmykhov[1], E.A. Dobretsova[1], Yu.N. Pyrkov[1], M.S. Nikova[2], I.S. Chikulina[2], V.A. Tarala[2], D.S. Vakalov[2], S.V. Kuznetsov[1], V.S. Tsvetkov[1], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Scientific and Laboratory Complex Clean Room, North Caucasus Federal Univ., Russia

We present the luminescence radiative lifetime data of Yb3+ in Yb-doped yttrium scandium aluminum garnet (Yb:YSAG) ceramics. The results show that the Yb3+ lifetime changes significantly with content of Sc3+ ion in Yb:YSAG and depends on the crystallography position occupied by Sc3+. The ceramics with the highest Sc3+ content in octahedral position has longer luminescence radiative lifetimes.

This research was supported by RFBR Grant(s) # Grant of the President of the Russian Federation, grant №MK-72.2022.1.2

ThR1-p20 10:00-13:30

The influence of Er^{3+} ions on fluorescence lifetimes of Er^{3+} in single crystals of BaF_2 - SrF_2 - ErF_3 solid solutions

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We present the data of luminescence radiative lifetime of Er3+ in single crystals of BaF2 – SrF2 – ErF3 solid solutions. The results show that the lifetime of Er3+ depends significantly on content of Er3+ ion in the single crystals. Increasing Er3+ concentration from 0.1 to 20 mol.% leads to decreasing the lifetimes of 4I13/2 level.

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ThR1-p21 10:00-13:30

Fe^{2+}:$ZnAl_2O_4$-based transparent glass-ceramics: tailoring iron absorption at ~2 μm

K. Eremeev[1,2], O. Dymshits[1], I. Alekseeva[1], A. Khubetsov[1], M. Tsenter[1], S. Zapalova[1], A. Braud[2], P. Loiko[2], A. Zhilin[3] ; [1]Vavilov State Optical Inst., Russia; [2]CIMAP, UMR6252 CEA-CNRS-ENSICAEN, France; [3]Efremov Inst. of Electrophysical Apparatus, Russia

Transparent glass-ceramics of the zinc aluminosilicate system based on Fe2+-doped ZnAl2O4 gahnite nanosized (5-16 nm) crystals are developed in different redox conditions. Their structure and spectroscopic properties are studied. The glass-ceramics are promising as saturable absorbers for lasers operating at ~2 μm.

ThR1-p22 10:00-13:30

Development of laser elements with non-linear distribution of active ions

V.A. Petrov[1,2], G.V. Kuptsov[1,2], V.V. Petrov[1,2,3], A.V. Laptev[1], E.V. Stroganova[4]; [1]Inst. of Laser Physics SB RAS; [2]Novosibirsk State Technical Univ.; [3]Novosibirsk State National Research Univ.; [4]Kuban State Univ., Russia

An approach associated with the use of active media with a non-uniform dopant ions concentration distribution is proposed to increase the pulse energy level in high power laser amplifier parameters. The optimal profiles of the laser-active ions gradient distribution in the amplifying medium were determined. A crystal sample was grown in which the activator concentration changes with ratio 1-2 at.%/mm.

This research was supported by RFBR Grant(s) # RFBR project 20-02-00529

ThR1-p23 10:00-13:30

2 um KYW:Tm,Ho laser with transverse diode pumping for passive Q-switching

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The KYW:Tm,Ho laser operating at 2056 nm with 15 mJ and 25 ns pulse is used to study saturable absorption of PbS quantum-dot-doped silicate glasses. Various heat treatment conditions was used to prepare a series of saturable absorber samples having 1st exciton maximum around 2 um.

ThR1-p24 10:00-13:30

Demonstrating wavelength tuning in Er^{3+}-doped fluoride fibre amplifier at 2.789 μm with nanosecond pulses

P. Ray[1], N.B. Chichkov[1], A. Yadav[1], S. Cozic[2], F. Joulain[2], U. Hinze[3,4], S. Poulain[2], E.U. Rafailov[1]; [1]Aston Inst. of Photonic Technologies, Aston Univ., UK; [2]Le Verre Fluor´e, France; [3]Inst. of Quantum Optics, Leibniz Univ. at Hannover, Germany; [4]Laser nanoFab GmbH, Germany

We demonstrate wavelength tunability of over 100 nm in Er3+-doped fluoride fibre amplifier operating at wavelengths centered around 2.8 μm. With nanosecond pulses generated from an optical parametric oscillator, we achieved over 20 dB gain and maximum optical peak powers of more than 7 kW.

ThR1-p25 10:00-13:30

Oscillation dynamics of a synchronously pumped $BaWO_4$ Raman laser on combined vibrational modes

D.P. Tereshchenko[1], E.A. Peganov[2], A.G. Papashvili[1], E.V. Shashkov[1], S.N. Smetanin[1]; [1]Prokhorov General Physics Inst. RAS; [2]National Univ. of Science and Technology MISiS, Russia

Multiwavelength oscillation dynamics of a synchronously pumped BaWO4 Raman laser on combined (925+332cm–1) vibrational modes is experimentally investigated. Picosecond pulse shapes and positions were simultaneously measured for all the output radiation Stokes components depending on detuning of the Raman laser cavity length.

This research was supported by RFBR Grant(s) # The research was supported by Russian Science Foundation – project No 22-22-00708

ThR1-p26 10:00-13:30

Finding the route of laying the optical cable using a coherent reflectometer

A.V. Podnikolenko[1], E.I. Andreeva[1], D.P. Andreev[2]; [1]The Bonch-Bruevich Saint-Petersburg State Univ. of Telecommunications, Russia; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

A technique for searching for a damaged optical cable using the optical coherent reflectometer and vibration action has been developed and tested under the conditions of an operating facility.

ThR1-p27 10:00-13:30

Numerical investigation of a double arms pump impact in the fiber optical parametric oscillator

V.D. Efremov[1], D.S. Kharenko[1,2]; [1]Inst. of Automatic and Electronic SB RAS; [2]Novosibirsk State Univ., Russia

Numerical simulation of a fiber optical parametric oscillator with double arms pump was performed in a wide range of parameters. The use of double arms with photonic-crystal fiber and synchronous pump leads to an increase in the energy of parametric pulses and, when pumps aimed at various points of phase synchronism, to generate pulses previously unavailable in conventional scheme.

This research was supported by RFBR Grant(s) # Russian Science Foundation (Grant No. 21-72-30024)

ThR1-p28 10:00-13:30

Narrow linewidth lasing in Nd:YVO_4 disk laser with two-mirror cavity with M-type degenerate configuration

D.A. Guryev, V.V. Kashin, D.A. Nikolaev, V.B. Tsvetkov; Prokhorov General Physics Inst. RAS, Russia

Single-frequency lasing was realized in continuous-wave TEM00 Nd:YVO4 disk laser with the two-mirror plane-spherical resonator. The laser cavity had a degenerate M-type configuration without any intracavity wavelength selectors. Spectral, energy and spatial characteristics of the laser output were studied. Also, the reasons of single-frequency lasing existence were proposed.

This research was supported by RFBR Grant(s) # The reported study was funded by RFBR, project number 19-32-90248

ThR1-p29 10:00-13:30

Double wavelength laser source for a pulsed holography

V.V. Sementin, E.E. Popov, A.P. Pogoda, V.M. Petrov, A.S. Boreysho; Baltic State Technical Univ. "VOENMEH" named after D.F. Ustinov; ITMO Univ., Russia

The laser source with dual wavelengths, with tunable distance between them simultaneously generating is demonstrated. The possibility of using it for a two wavelength holography is shown. Dual wavelengths at 890.7 nm and 906.7 nm provides measured accuracy of 3d surface profile at 25 μm.

ThR1-p30 10:00-13:30

Terahertz plasmon in narrow gap HgTe/CdHgTe quantum well heterostructures

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We have calculated 2D terahertz plasmon energy spectra in HgTe/CdHgTe quantum wells with different electron concentrations and taking into account spatial dispersion of electron polarizability and interaction plasmon with the optical phonons. Plasmon absorption spectra were found. For nonequillibrium holes we calculated the probabilities to recombine via the plasmon emission and found the threshold hole concentrations for the plasmon amplification.

ThR1-p31 10:00-13:30

Efficient Double-Lyot Spectral Filtering for Mode-Locked Tm-doped all-PM Fiber Laser

Y.Zh. Ososkov[1], A.M. Khegai[1], A.A. Mkrtchyan[2], Y.G. Gladush[2], A.G. Nasibulin[2,3], A.S. Vakhrushev[1], K.E. Riumkin[1], A.V. Kharakhordin[1], S.V. Alyshev[1], E.G. Firstova[1], S.V. Firstov[1], A.N. Guryanov[4], M.A. Melkumov[1]; [1]Prokhorov General Physics Inst. RAS, Dianov Fiber Optics Research Center, Russia; [2]Skolkovo Inst. of Science and Technology, Russia; [3]Department of Chemistry and Materials Science, Aalto Univ., Finland; [4]Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

We report on the first demonstration of the mode-locked Tm-doped all-PM fiber laser with two fiber Lyot filters embedded into the ring resonator. This approach allows us to efficiently tune the central wavelength of laser generation to ~1855 nm as well as to adjust spectrum width for required pulse duration.

ThR1-p32 10:00-13:30

Setup for acoustic sensitivity measurements of fiber optic cables based on weak FBGs

A.A. Zhirnov[1,2], R.I. Khan[1], K.I. Koshelev[1], K.V. Stepanov[1], T.V. Choban[1], A.O. Chernutsky[1], A.B. Pnev[1], A.I. Lopunov[2], O.V. Butov[2]; [1]Bauman Moscow State Technical Univ.; [2]Kotelnikov Inst. of Radioengineering and Electronics RAS, Russia

We report on a study of a new scheme for acoustic sensitivity measurements of fiber optic cables. It uses a Fizeau interferometer scheme with weak fiber Bragg gratings as a mirrors. It's advantage is the absence of interferometer reference arm which exclude noise influence on it and on other parts of scheme.

ThR1-p33 10:00-13:30

Compensation of wavelength instability in Φ-OTDR with weak fiber Bragg gratings

T.V. Choban[1], A.A. Zhirnov[1,2], K.V. Stepanov[1], R.I. Khan[1], A.B. Pnev[1], C. Svelto[3], A.I. Lopunov[2], O.V. Butov[2]; [1]Bauman Moscow State Technical Univ.; [2] Kotelnikov Inst. of Radioengineering and Electronics of RAS, Russia; [3]DEIB, Politecnico di Milano, Italy

We propose a scheme of ϕ-OTDR, which includes irregularly arranged weak fiber Bragg gratings (wFBG) in sensing fiber for laser wavelength instability measurement and compensation. In a scheme with 4 pairs of wFBG, wavelength shift is measured with 16 times higher resolution, which allows reducing the effect of laser instability on ϕ-OTDR accuracy.

ThR1-p34 10:00-13:30

Upconversion luminescence dynamics heavily doped $LiYxYb(1-x)F_4$ crystals activated with Tm^{3+} ions

A.R. Khadiev[1], O.G. Goriev[1], B.N. Kazakov[1], B.L. Safiullin[1], S.L. Korableva[1], O.A. Morozov[1], V.V. Semashko[1,2]; [1]Kazan Federal Univ.; [2]Kazan E. K. Zavoisky Physical-Technical Inst., Russia

Novel z-scan like approach applied to investigation of upconversion processes in heavily doped LiYF4:Yb crystals activated with Tm3+ ions. The article is devoted to study of population mechanisms of the high energy levels (1D2, 1I6) of thulium ions.

ThR1-p35 10:00-13:30

Fluorochlorohafnate glasses with OH-groups reduced content doped by Tm^{3+}, Er^{3+} - promising mid-IR laser medium

A.V. Popov[1], L.V. Moiseeva[1], S.Kh. Batygov[1], M.N. Brekhovskikh[2]; [1]Prokhorov General Physics Inst. RAS; [2]Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia

Fluorochlorohafnate glasses with different BaF2/BaCl2 ratios in the glass batch was synthesized according to a specially developed technique for BaCl2 purification through melt chlorination and a glass preparation procedure that considerably reduce the OH-groups concentration and chlorine vaporization rate. The fluorescence spectra and luminescence decay kinetics of Er3+ and Tm3+ doped these glasses have been studied.

ThR1-p36 10:00-13:30

Optimal compositions and durability of the promising $Yb,Li:ZnWO_4$ laser crystal

K.A. Subbotin[1,2], A.I. Titov[1,2], S.K. Pavlov[2,1], P.A. Volkov[3], V.V. Sanina[1], D.A. Lis[1], O.N. Lis[1], Y.I. Zimina[2], K.V. Kuleshova[2], Y.S. Didenko[2], E.V. Zharikov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Mendeleyev Univ. of Chemical Technology of Russia; [3]NRC "Kurchatov Inst." - IREA Shared Knowledge Center, Russia

The series of Yb, Li: ZnWO4 laser crystals was grown by Czochralski. Actual Yb and Li concentrations in the crystals were determined and the segregation coefficients of the dopants were calculated. The influence of Yb and Li contents onto crystals durability was studied and the optimal compositions have been revealed providing the best mechanical strength.

ThR1-p37 10:00-13:30

Growth, structure and spectroscopy of a novel molybdate laser crystal - $Tm:MgMoO_4$

K.A. Subbotin[1,2], A.I. Titov[1,2], Y.S. Didenko[2], Gh.Z. Elabedine[3], P.A. Loiko[4], R. Maria Solé[3], M. Aguiló[3], F. Díaz[3], P. Camy[4], X. Mateos[3]; [1]Prokhorov General Physics Inst. RAS; [2]Mendeleev Univ. of Chemical Technology of Russia, Russia; [3]Univ. Rovira i Virgili (URV), FiCMA-FiCNA, Spain; [4]Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR6252 CEA-CNRS-ENSICAEN, Univ. de Caen Normandie, France

Thulium-doped magnesium molybdate crystal (Tm:MgMoO4) was grown by the Czochralski method. It belongs to the monoclinic class (sp. gr. C2/m). Its spectroscopic properties are studied. Tm:MgMoO4 exhibits broad and smooth emission spectrum extending beyond 2 μm (3F4 → 3H6 transition) and a long lifetime of the 3F4 state (1.90 ms) making it promising for broadly tunable and mode-locked lasers.

ThR1-p38 10:00-13:30

Dispersion of principal refractive indices of monoclinic $MgWO_4$ laser host crystal

K.A. Subbotin[1,2], Y.I. Zimina[2], K.V. Kuleshova[2], Y.S. Didenko[2], A.I. Titov[1,2], D.A. Lis[1], P.A. Loiko[3]; [1]Prokhorov General Physics Inst. RAS, Russia; [2]Mendeleev Univ. of Chemical Technology of Russia, Russia; [3]Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, France

MgWO4 is a promising laser host crystal. MgWO4 is monoclinic and optically biaxial. We have studied the dispersion of its principal refractive indices, np < nm < ng, in the spectral range of 0.53 – 1.06 μm. MgWO4 possesses high refractive index and a strong natural birefringence. np = 1.981, nm = 2.016 and ng = 2.167 at ~1.06 μm.

ThR1-p39 10:00-13:30

Growth, thermal conductivity and spectroscopic properties of Nd:$MgMoO_4$ laser crystal

K.A. Subbotin[1,2], Y.S. Didenko[2], P.A. Popov[3], A.I. Titov[1,2], D.A. Lis[1], S.K. Pavlov[1,2], Y.I. Zimina[2], K.V. Kuleshova[2]; [1]Prokhorov General Physics Inst. RAS; [2]Mendeleev Univ. of Chemical Technology of Russia; [3]Petrovsky Bryansk State Univ., Russia

The series of Nd:MgMoO4 crystals was grown by the Czochralski method from the charges underwent the special physical treatments. Complex of polarized optical spectroscopic studies was performed. The actual Nd concentrations in the crystals and the unit cell parameters were measured. The peculiarities of the crystals growth process and of the measured properties are discussed.

ThR1-p40 10:00-13:30

Single-frequency ring fibre laser with random distributed feedback based on artificial Rayleigh reflector

M.I. Skvortsov, S.R. Abdullina, A.A. Wolf, A.V. Dostovalov, S.A. Babin; Inst. of Automation and Electrometry SB RAS, Russia

We present a single-frequency erbium fiber laser in ring cavity configuration with distributed feedback in random structure produced by a femtosecond laser writing. Single-frequency operation is observed over the entire range of output powers. At the highest output power, 7 mW, the linewidth does not exceed 0,7 kHz.

This research was supported by RFBR Grant(s) # Gratn of Russian Science Foundation (21-72-30024)

ThR1-p41 10:00-13:30

Fe:ZnSe laser with pumping by a diode side-pumped Er:YAG laser

Ya.K. Skasyrsky, M.R. Butaev, Yu.K. Korostelin, V.I. Kozlovsky, S.O. Leonov, M.P. Frolov; Lebedev Physical Inst. RAS, Russia

We demonstrate the performance of a Fe+2:ZnSe laser pumped by radiation of a diode side-pumped Er:YAG laser. The Fe:ZnSe laser produced 53 mJ of output energy at a pulse duration of 300 μs and a central wavelength of 4.2 μm with a slope efficiency of 42% with respect to absorbed pump energy. We have reached 0.5 W of average power.

ThR1-p42 10:00-13:30

Influence of the secondary-energy transfer on the efficiency of the few-mode ytterbium-erbium fiber amplifier

F.R. Iakupov[1,2], M.A. Chernikov[2], A.I. Baranov[1,2]; [1]Moscow Inst. of Physics and Technology (National Research Univ,); [2]NTO-"IRE-Polus", Russia

In this work an experimental and theoretical study of the processes occurring in the ytterbium-erbium doped fiber amplifier has been carried out. Among them are up-conversion, energy-transfer, amplified spontaneous-emission and secondary energy-transfer.

ThR1-p43 10:00-13:30

A new approach to donor-acceptor energy transfer modelling in rare-earth-doped media using the rate equations

A.S. Yasukevich[1], N.V. Gusakova[2], N.V. Kuleshov[1]; [1]Centre for Optical Materials and Technologies, Belarusian National Technical Univ., Belarus; [2]Norwegian Univ. of Science and Technology, Norway

A generalisation of rate equations simulating donor-acceptor energy transfer and describing the time evolution of donors' and acceptors' luminescence power is proposed. These equations were supplemented by a time-dependent probability of the direct static disordered donor-acceptor energy transfer. A clear physical interpretation of the terms in the equations describing the various stages of the D-A energy transfer is given.

ThR1-p44 10:00-13:30

CW and Q-switch laser of ZrO_2 -Y_2O_3 -Ho_2O_3 crystals

S.A. Artemov[1], E.A. Artemov[2], E.E. Lomonova[2], V. Pankratov[3], P.A. Ryabochkina[1], N.V. Sidorova[1]; [1]National Research Ogarev Mordovia State Univ.; [2]Prokhorov General Physics Inst. RAS, Russia; [3]Inst. of Solid State Physics, Univ. of Latvia, Latvia

The energy and time characteristics of CW and Q-switched two-micron lasing at the 5I7→5I8 transition of Ho3+ ions in ZrO2-Y2O3-Ho2O3 crystals under resonance pumping to the 5I7 level CW Tm: LiYF4 laser were investigated. Mechanisms for the occurrence of burnouts on the faces of active elements ZrO2-Y2O3-Ho2O3 at high laser energy densities have been proposed.

This research was supported by RFBR Grant(s) # 18-29-20039

ThR1-p45 10:00-13:30

Temperature stabilization of an Er:fiber-based femtosecond frequency comb

A.A. Filonov[1], V.S. Pivtsov[1,2], S.A. Farnosov[1], N.A. Koliada[1,3]; [1]Inst. of Laser Physics; [2]Novosibirsk State Technical Univ.; [3]Inst. of Automation and Electrometry SB RAS, Russia

An effect of temperature changes of a Er:fiber-based femtosecond frequency comb on the parameters of its offset frequency f0 is determined. A system for thermal stabilization of air inside the frequency comb has been implemented. This led to a significant decrease in the drift of the amplitude and frequency of the signal f0 in the free regime of operation.

This research was supported by RFBR Grant(s) # The studies were supported by Ministry of Science and Higher Education of the Russian Federation (№ 121033100064-9)

ThR1-p46 10:00-13:30

Diode-Pumped 2128-nm Laser Based on Degenerate Intracavity OPO in KTP Crystal

I.V. Smirnov[1,2], P.G. Zverev[1,2], A.A. Sirotkin[2]; [1]National Research Univ. "Moscow Power Engineering Institute"; [2]Prokhorov General Physics Inst. RAS, Russia

Side-diode-pumped YAG:Nd3+ laser with intracavity optical parametric oscillator in KTP crystal with collinear phase matching at wavelength of 2128 nm and slope efficiency of 2.5% was developed and tested as pump source for ZnSe:Cr2+ laser.

ThR1-p47 10:00-13:30

Preparation of high-purity Ga -Ge -Te -I system glasses for MIR photonics

A.P. Velmuzhov, M.V. Sukhanov; IChHPS RAS, Russia

Methods for high purity Ga-Ge-Te-I system glasses preparation have been developed, including the chemical transport of non-volatile components of the charge. Glass samples with an oxygen impurity content at the level of 1 ppb(wt) were obtained. The samples are high transparent in the spectral range of 5-15 μm.

This research was supported by RFBR Grant(s) # Russian Science Foundation grant No. 21-73-10104

ThR1-p48 10:00-13:30

Thermo-optic properties of orthorhombic Cr^{3+}:$BeAl_6O_{10}$ laser crystal

K.V. Yumashev[1], V.I. Goman[2], L.K. Pavlovski[2], E.V. Vilejshikova[1], A.V. Yukhnouskaya[1], A.M. Malyarevich[1]; [1]Center for Optical Materials and Technologies, Belarusian National Technical Univ., Belarus; [2]Inst. of Improvement of Professional Skills and Staff Retraining on New Directions of Engineering, Technology and Economy, Belarusian National Technical Univ., Belarus

Thermo-optic coefficients of chromium-doped beryllium hexaaluminate Cr:BeAl6O10 laser crystal were investigated for different light polarizations in the spectral range of 0.1 – 1.1 μm. Thermal expansion of Cr:BeAl6O10 crystal were studied. Thermo-optic coefficients at emission wavelength of 0.83 μm were obtained to be (dn/dT)p = 6.4, (dn/dT)m = 5.0, and (dn/dT)g = 5.6 (10-6 K-1).

ThR1-p49 10:00-13:30

Spectral broadening compensation in 35 ps Nd:YAG regenerative amplifier

V.V. Koval[1], E.A. Viktorov[1], R.V. Balmashnov[2], Yu.V. Katsev[2], A.F. Kornev[2]; [1]ITMO Univ.; [2]«Lasers & Optical Systems» Co. Ltd., Russia

We report on a technique of spectral broadening compensation in 35 ps Nd:YAG regenerative amplifier based on the implementation of X-cut KTP Pockels cell. At ~5 mJ output energy the spectrum width was 0.1 nm compared to 0.3 nm that was with X-cut RTP Pockels cell.

ThR1-p50 10:00-13:30

Spectroscopy properties of Dy^{3+} doped CaF_2 single crystals and CaF_2-SrF_2 solid solution

S.N. Ushakov[1,2], M.A. Uslamina[2], K.N. Nishev[2], P.P. Fedorov[1], S.V. Kuznetsov[1], V.S. Tsarev[2], A.V. Sudin[2], V.P. Mishkin[2], Y.A. Udina[2]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Mordovia State Univ., Russia

Samples of CaF2:Dy3+ crystals and CaF2-SrF2:Dy3+ solid solution was obtained by the Bridgman-Stockbarger method. Using the Judd-Ofelt analysis, intensity parameters were obtained. On their basis, integral luminescence cross sections, radiative lifetimes, and luminescence branching coefficients in the IR-region are calculated. Using the correspondence method, the luminescence spectra of the 6H13/2 -> 6H15/2 transition were obtained.

ThR1-p51 10:00-13:30

3 mJ 6 ns 100 Hz 1047 nm Nd:YLF laser with transform-limited pulses

A.F. Kornev[1], A.M. Makarov[1,2], Yu.V. Katsev[1], V.V. Koval[1,2], E.A. Viktorov[2]; [1]«Lasers & Optical Systems» Co. Ltd.; [2]ITMO Univ., Russia

We developed a diode-end-pumped 1047 nm Nd:YLF laser based on a regenerative amplifier which produces 3 mJ 6 ns transform-limited pulses at 100 Hz with high beam quality. The laser has a compact design and demonstrates excellent long-term stability of the output pulse.

ThR1-p52 10:00-13:30

Output power and pulse duration dependence of a saturable absorber mode-locked Yb:KGW laser on output coupling efficiency

P.J. Park, J.Y. Song, S.Y. Lee, D.Y. Kim, K.J. Yee; Chungnam Nat'l Univ., Korea

We report on a diode-pumped saturable-absorber mode-locked Yb:KGW laser, which generates 92 fs pulses at a center wavelength of 1030 nm with an average power of 4.2 W at a repetition rate of 62.7 MHz when the output coupling was 20%. Output coupler with different efficiencies were tested with regards to the output power and the pulse duration.

ThR1-p53 10:00-13:30

Cr:ZnSe and Cr:Zn(1-x)Mn(x)Se (x ≈ 0.05, 0.1, 0.2, 0.3) single crystals mid-IR spectral and laser properties

A. Riha[1], H. Jelinková[1], M.E. Doroshenko[2], M. Jelinek[1], M. Nemec[1], J. Sulc[1], D. Vyhlidal[1], M. Cech[1], N.O. Kovalenko[3]; [1]FNSPE, Czech Technical Univ. in Prague, Czech Republic; [2]Laser Materials and Technology Research Center, GPI RAS, Russia; [3]Inst. for Single Crystals, NAS of Ukraine, Ukraine

Cr2+ ions spectral and laser characteristics temperature dependence of two Cr:ZnSe and four Cr:Zn(1-x)Mn(x)Se (x ≈ 0.05, 0.1, 0.2, and 0.3) single crystal samples is compared and reported for ~1.73 μm laser excitation. Maximal slope efficiency of ~44% at 78 K with pulse repetition rate of 1 Hz and pulse duration of ~140 ns was demonstrated.

ThR1-p54 10:00-13:30

Tunable nanosecond NV-diamond laser

A.D. Savvin[1], V.P. Mitrokhin[1], E. Lipatov[2], V. Vins[3], A.E. Dormidonov[1]; [1]Dukhov Automatics Research Inst.; [2]National Research Tomsk State Univ.; [3]LLC VELMAN[4]3, Russia

Nanosecond laser at NV− centers in diamond sample pumped by pulsed 532-nm laser is presented. The laser pulses have a spectrum width of 20 nm at the central wavelength that can be tuned in the range 700-750 nm. The output pulses energy is around 10 uJ.

ThR1-p55 10:00-13:30

Efficient 2-μm laser oscillation of Tm:KLuW mini-slabs with Brewster's angle cut faces

S.M. Vatnik[1], I.A. Vedin[1], M.D. Kolker[1], S.I. Trashkeev[1], P.A. Statsenko[1], A.A. Pavlyuk[2]; [1]Inst. of Laser Physics; [2]Inst. of Inorganic Chemistry, Russia

We report on highly-efficient room-temperature lasing in 5at.%Tm:KLu(WO4)2 mini-slabs side-pumped by a 35W diode bar. QCW (duty cycle ~14%) output power of 1.47 W at 1908 nm has been demonstrated with optical and slope efficiencies being of 33 and 43% respectively.

ThR1-p56 10:00-13:30

On the inverse problem of photocount statistics

P.P. Gostev, S.A. Magnitskiy, A.S. Chirkin; Lomonosov Moscow State Univ., Russia

The report considers the features of the inverse problem of photocount statistics. A recurrence solution method for finite photocount distributions and a stability criterion for the problem solution for infinite distributions are proposed and discussed.

ThR1-p57 12:00-12:15

High-purity Ga(x)Ge(40-x)S(60) and Ga(x)Sb(40-x)S(60) glasses as promising materials for laser optics

A.P. Velmuzhov, M.V. Sukhanov, B.S. Stepanov, S.V. Mishinov, L.A. Ketkova; IChPS RAS, Russia

New methods for preparation high-purity glasses of Ga-Ge-S and Ga-Sb-S systems with a low content of hydrogen, oxygen impurities and heterogeneous inclusions have been developed. A comprehensive study of the glasses properties has been carried out. The optimal compositions of glasses for use in fiber optics have been determined.

ThR1-p58 10:00-13:30

Superconducting single-photon detector design optimization

I.A. Stepanov[1,2], V.A. Zheltikov[1,2], E.V. Sergeev[1,2], A.S. Baburin[1,2], S.S. Avdeev[1,2], A.O. Melekhina[2], I.A. Ryzhikov[2,3], I.A. Rodionov[1,2]; [1]Dukhov Automatics Research Inst.; [2]FMN Lab., Bauman Moscow State Technical Univ.; [3]Inst. for Theoretical and Applied Electromagnetics RAS, Russia

A new SNSPD topology is proposed, in which, according to the simulation results, the least current crowding effect is observed, which makes it the most preferable for the creation of an SNSPD with a high quantum efficiency and a low dark count rate.

ThR1-p59 10:00-13:30

Analysis of the structure and impurity composition of synthetic HPHT diamonds in the process of laser-induced surface transformation

V.F. Lebedev[1,2], A.V. Koliadin[3]; [1]ITMO Univ.; [2]St. Petersburg State Univ. of Aerospace Instrumentation; [3]LLC "New Diamond Technology", Russia

The analysis of the spectra of laser-induced plasma in the study of multi-sector HPHT diamond plates doped with nitrogen and boron was performed. A degree of surface graphitization was found depending on the crystallographic orientation, the type of doping element, and the degree of doping. It is possible to identify atomic structures, including impurity ones, with different chemical bond strengths.

ThR1-p60 10:00-13:30

Variable envelope shape and width hybrid pulse-burst laser source

V.A. Kamynin, A.I. Trikshev, B.D. Ovcharenko, V.Kh. Bagdasarov, T.V. Dolmatov, V.V. Bukin, V.B. Tsvetkov, S.V. Garnov; Prokhorov General Physics Inst. RAS, Russia

The simple hybrid laser pulse-burst source is presented. The ability to manage pulse burst envelope shape and width was demonstrated. Intra-burst pulses duration and energies were 25 ps and 1.5 mJ, respectively.

This research was supported by RFBR Grant(s) # Ministry of Science and Higher Education of Russian Federation grant № 075-15-2020-912

R4: Laser Beam Control

ThR4-p01 10:00-13:30

Numerical investigation of dynamic coherent beam combining in turbulent atmosphere with taking into account the double-pass delay

M.V. Volkov[1,2], O.A. Kuzikov[1], F.A. Starikov[1,2]; [1]Institute of Laser Physics Research, RFNC - VNIIEF; [2]Sarov Physical and Technical Inst. of National Research Nuclear Univ. MEPhI, Russia

Numerical investigation of dynamic coherent beam combining of 7 channel laser radiation and its focusing on the remote target in turbulent medium has been carried out using the stochastic parallel gradient algorithm with the double-pass delay taken into account. Beam combining efficiency has been explored under various ratios between the phasing system frequency and Greenwood frequency.

ThR4-p02 10:00-13:30

Infrared laser imaging based on up-conversion luminescence of SrF_2:RE (RE = Er, Tm, Yb, Ho)

S.V. Gushchin[1], S.V. Kuznetsov[2], A.A. Lyapin[1], V.Yu. Proydakova[2], P.A. Ryabochkina[1], P.P. Fedorov[2], M.V. Chernov[1]; [1]National Research Mordovia State Univ.; [2]Prokhorov General Physics Inst. RAS, Russia

In the present paper, the up-conversion luminescence (UCL) of fluoride phosphors was investigated. Upon laser excitation at 1532, 1645 and 1940 nm UCL of SrF2:RE (RE = Er, Tm, Yb, Ho) phosphors in the visible and near-infrared spectral region were recorded. Calculated chromaticity coordinates and color temperatures showed that SrF2:RE phosphors are characterized by the yellow-green and red-orange UCL.

ThR4-p03 10:00-13:30

Experimental study of beam propagation by transverse-mode locking

E.A. Cheshev, A.L. Koromyslov, I.M Tupitsyn; Lebedev Physical Inst. RAS, Russia

It was experimentally shown that under the condition of the frequency degeneracy of the cavity modes and narrow diode end-pumping, narrowing of the lasing beam is observed at a distance equal to the length of the cavity from the output mirror.

This research was supported by RFBR Grant(s) # This study is supported by RFBR and BRFBR under the grant No. 20-52-00036

ThR4-p04 10:00-13:30

Spatial chirp of the collimated single-cycle THz pulse

A.O. Nabilkova, M.V. Melnik, A.N. Tsypkin; ITMO Univ., Russia

In this work the results of simulation of single- and multi-cycle THz pulse collimation are shown. The field distribution of single-cycle pulse was compared with multi-cycle pulse under the same conditions. Spatial chirp was observed for a single-cycle pulse – on-axis spectrum is blue-shifted in comparison with the initial spectrum of quasi-point source, whereas off-axis spectrum is narrower and red-shifted.

This research was supported by RFBR Grant(s) # 22-22-20059

ThR4-p05 10:00-13:30

Demonstration of Ka-band mm-wave ARoF signal transmission

A. Ostrovskis[1,2], K. Rubuls[2], T. Salgals[1,2], L. Skladova[1,2], V. Bobrovs[1], S. Spolitis[1,2]; [1]Inst. of Telecommunications, Riga Technical Univ., [2]Communication Technologies Research Center, Riga Technical Univ., Latvia

This research paper demonstrates results on the experimental photonically assisted mm-wave analog radio-over-fiber (ARoF) transmission through 20 km single mode fiber (SMF) and 5 m wireless. Performance of the system is analyzed at several Ka-band frequencies, applicable for 5G deployment.

ThR4-p06 10:00-13:30

Effect of air bubble on liquid crystal alignment

H.L. Margaryan[1], N.H. Hakobyan[1], V.K. Abrahamyan[1], G.M. Stepanyan[1], V.V. Belyaev[2, 3], M.V. Ermakova[2], V.I. Mashchenko[2], V.A. Zhachkin[2], N.V. Tabirian[4]; [1]Yerevan State Univ., Armenia; [2]Moscow Region State Univ.; [3]RUDN Univ., Russia, [4]BEAM Co., USA

The oriented liquid crystal (LC) cells have a uniform appearance without applying voltage. But when a voltage is applied a mosaic LC texture with sections of different orientations is observed. An accidental air bubble appeared at the LC cell making can improve LC alignment while moving. The bubble's surface tension is comparable with the LC surface anchoring.

This research was supported by RFBR Grant(s) # Invetigation is fullfilled under partial support of a grant of Russian Science Foundation (project No. 20-19-00201) and and Science Committee of RA, project №20DP-2H02

ThR4-p07 10:00-13:30

Classification of acoustic influences using trace pattern recognition

I.A. Barantsov, E.O. Garin, A.O. Chernutsky, R.O. Khan, A.B. Pnev; Bauman Moscow State Technical Univ., Russia

We present method for processing and recognizing human walking by analyzing acoustic waves recorded with distributed fiber-optic sensor systems based on phase-sensitive optical time domain reflectometer (Φ-OTDR). The primary processing is performed by a bandpass filter, then the filtered data go to the classifier block based on a convolutional neural network (CNN). The accuracy of the classifier is 98%.

ThR4-p08 10:00-13:30

Design of space based telescope with variable beam direction for quantum communication link

A.S. Bobe[1], V.M. Polyakov[2], S.G. Alekseev[3]; [1]ITMO Univ., Russia, [2]GK "R-AERO" ltd Co, Russia, [3]Voxtellar, Singapore

The optical system of a satellite based telescope was designed. The resulting module has a variable output parallel beam angle and a near diffraction limited performance in the range of motion.

ThR4-p09 10:00-13:30

Development of a shutter -type laser radiation modulator

V.V. Davydov[1,2], S.A. Rodin[3], B.K. Reznikov[3], V.Yu. Rud[2,4], V.I. Dudkin[3]; [1]Peter the Great Saint Petersburg Polytechnical Univ.; [2]All Russian Research Inst. of Phytopathology; [3]The Bonch-Bruevich Saint-Petersburg State Univ. of Telecommunications; [4]Ioffe Physico-Technical Inst. RAS, Russia

The article justify the necessity of using shutter-type modulators to create laser radiation with required parameters in fiber-optic systems. We have developed a shutter-type modulator design. It has no fundamental limitations on the power of laser radiation, has a simple construction and higher protection against interference. The results of the operation of the modulator for different modes are presented.

ThR4-p10 10:00-13:30

A single-scan PM-fibers polarization axes study

M.E. Belokrylov[1], Yu.A. Konstantinov[1], A.I. Krivosheev[1], A.T. Turov[2], K.V. Stepanov[3], E.O. Garin[3], A.B. Pnev[3], A.A. Fotiadi[4,5,6]; [1]Perm Federal Research Center of the Ural Branch of the RAS; [2]Perm National Research Polytechnic Univ.; [3]Bauman Moscow State Technical Univ.; [4]Ulyanovsk State Univ.; [5]Ioffe Physical-Technical Inst. RAS, Russia; [6]Univ. of Mons, Belgium

We propose optical scheme for single-pulse reflectometry of anisotropic optical fibers. In application with Brillouin analyzer this scheme was used for birefringence measurements of the Panda-type fiber. With phi-OTDR device, it allowed to increase a number of key parameters.

ThR4-p11 10:00-13:30

Some features of photodetectors based on $CuIn_5Te_8$

R.V. Davydov[1], V.Yu. Rud[2,3], I.V. Bondar[4], I.M. Gureeva[1], V.V. Krasnoshchekov[1], M.S. Mazing[1], K.J. Smirnov[5]; [1]Peter the Great St.Petersburg Polytechnical Univ.; [2]Ioffe Inst. RAS; [3]All Russian Research Inst. of Phytopathology, Russia; [4]Belorussian State Univ. of Informations Science and Radioelectronics, Belarus; [5]Bonch-Bruevich St. Petersburg State Univ. of Telecommunications, Russia

Studied bulk CuIn5Te8 single crystals are grown by directed crystallization of near-stoichiometric melt. Photosensitive structures are fabricated, and photosensitivity spectra in natural and linear polarized light are obtained. We noted the possibility of achieving broadband photosensitivity under the illumination of the barrier side of these crystals. We establish some features of broadband photosensitivity of such detectors for laser radiation.

ThR4-p12 10:00-13:30

The effect of binary phosphids of the $ZnGeP_2$ single-crystal on the dispersion of the refraction index and the absorption coefficient in mid-IR and terahertz ranges of wavelengths

M.M. Zinoviev[1,2], N.N. Yudin[1,2], A.I. Gribenyukov[3], S.N. Podzyvalov[1], V.V. Dyomin[1], M.M. Kulesh[1], E.S. Slyunko[1]; [1]National Research Tomsk State Univ.; [2]Inst. of Applied Physics RAS; [3]Inst. of Atmospheric Optics SB RAS, Russia

It is shown that the presence of volume inclusions in the ZnGeP2 singlecrystal leads to an increase in the reflection coefficient in the region of 12.5 μm.

This research was supported by RFBR Grant(s) # This research was funded by the Ministry of Science and Higher Education of the Russian Federation (V.E. Zuev Institute of Atmospheric Optics of Siberian Branch of the Russian Academy of Sciences)

ThR4-p13 10:00-13:30

Investigation of the dependence of the dispersion properties of an optical fiber on temperature changes

O.V. Kolmogorov, A.R. Kasimova, S.S. Donchenko, D.V. Prokhorov; FSUE VNIIFTRI, Russia

Report presents the results of a study of changes in chromatic dispersion in an optical fiber depending on temperature in spectral range 1520 to 1570 nm. The result of measurement of difference in the delay of a 50 km long fiber in the temperature range from 10°C to 20°C is about 0.5 ns, which is essential for time signal transfer.

This research was supported by RFBR Grant(s) # RFBR 11023 mk

ThR4-p14 10:00-13:30

Reset-free stabilization of a fiber-optic Mach-Zehnder interferometer using optical frequency shifters for low-noise microwave photonic links

V.V. Lebedev[1], A.V. Varlamov[1], P.M. Agruzov[1], I.V. Ilichev[1], M.V. Parfenov[1,2], A.V. Shamrai[1]; [1]Ioffe Inst.; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

A novel operating point stabilization method for fiber-optic Mach-Zehnder interferometers using optical frequency shifters is experimentally demonstrated. The method is based on placing optical frequency shifters in arms of an interferometer and is potentially capable of continuous reset-free compensation of an unbounded phase drift with rates up to hundreds radians per millisecond.

ThR4-p15 10:00-13:30

Reset-free stabilization of a fiber-optic Mach-Zehnder interferometer using optical frequency shifters for low-noise microwave photonic links

V.V. Lebedev[1], A.V. Varlamov[1] , P.M. Agruzov[1], I.V. Ilichev[1], M.V. Parfenov[1,2], A.V. Shamrai[1]; [1]Ioffe Inst.; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

A novel operating point stabilization method for fiber-optic Mach-Zehnder interferometers using optical frequency shifters is experimentally demonstrated. The method is based on placing optical frequency shifters in arms of an interferometer and is potentially capable of continuous reset-free compensation of an unbounded phase drift with rates up to hundreds radians per millisecond.

ThR4-p16 10:00-13:30

Polymer luminescent films for visualization of large-aperture infrared laser beams

M.V. Chernov[1,2], A.A. Lyapin[1,2], A.M. Kuzmin[2]; [1]PhotonTechSystem; [2]MRSU, Russia

In this work, effective polymer visualizers have been developed. The area of the visualizer was more than 1500 cm2. The spectral range of operation was 0.75-2.1 μm. The polymer base and large dimensions allows the visualizers to be used when setting up laser rangefinders and special equipment in various weather conditions.

ThR4-p17 10:00-13:30

An optical method for studying a magnetic track using speckles of the structure of scattered laser radiation

S.E. Logunov[1,2], V.V. Davydov[2,3], S.S. Makeev[2], I.M. Gureeva[2]; [1]Bonch-Bruevich St. Petersburg State Univ. of Telecommunications; [2]Peter the Great St. Petersburg Polytechnical Univ.; [3]All Russian Research Inst. of Phytopathology, Russia

A new optical method for detecting a magnetic track from a moving magnetic object using speckle structures from scattered laser radiation on nanoparticles of a ferromagnetic fluid is proposed. An experimental setup for its implementation has been developed. A study was made of changes in the parameters of the magnetic field in the magnetic track.

ThR4-p18 09:00-09:30

Development of effective ways to implement coherent addition of a multichannel fiber laser.

S.G. Garanin[1], N.A. Zaretsky[1], T.I. Kozlova[1], M.I. Konovaltsov[1], A.V. Kopalkin[1], O.L. Techko[1], S.V. Khokhlov[1], V.S. Tsykin[1], I.N. Chervyakov[1], G.N. Kachalin[2], N.M. Rakcheev[2], S.V. Tyutin[2]; [1]Russian Federal Nuclear Center All-Russian Research Inst. of Experimental Physics; [2]Lomonosov Moscow State Univ., Russia

The purpose of our work is to obtain the best quality of coherent addition when using a system of separation, amplification and reduction of optical channels of a fiber laser. To do this, two tasks were solved: alignment of the lengths of optical channels and automatic reduction of channels to one axis.

ThR4-p19 10:00-13:30

Developing and analysis of the TlBr(0.46)I(0.54)-AgI and TlCl(0.67)Br(0.33)-AgI systems phase diagrams

D.D. Salimgareev, A.E. Lvov, A.A. Yuzhakova, A.S. Korsakov, L.V. Zhukova, D.V. Shatunova; Ural Federal Univ. named after the first President of Russia B. N. Yeltsin, Russia

This study of the TlBr0.46I0.54–AgI and TlCl0.67Br0.33 – AgI systems phase diagrams. In the TlBr0.46I0.54 – AgI system, the crystals and nanoceramics synthesis is possible in the concentration range from 0 to 43 mol. % AgI in TlBr0.46I0.54. Also for the TlCl0.67Br0.33 – AgI system synthesis is possible in the range from 0 to 30 mol. % AgI in TlCl0.67Br0.33.

ThR4-p20 10:00-13:30

Laser beam quality M2 factor measurement: transport-of-intensity approach potential

I.V. Gritsenko[1], M.S. Kovalev[1,2]; G.K. Krasin[1]; [1]Lebedev Physical Inst.; [2]Bauman Moscow State Technical Univ., Russia

A simple method based on a solution of the transport-of-intensity equation for laser beam quality M2 factor measurement is presented. Demonstrated experimental results prove that the approach is valid. Reconstruction of the other laser beam spatial parameters is presented, namely: radius, waist position, Rayleigh length, angular divergence and quality parameter.

ThR4-p21 10:00-13:30

Parallel-gap resistance microwelding for deformable mirror manufacturing

V.V. Toporovsky[1,2], A.A. Skvortsov[2], A.V. Kudryashov[1,2], V.V. Samarkin[1], A.L. Rukosuev[1], J.V. Sheldakova[1]; [1]Inst. of Geosphere Dynamics RAS; [2]Moscow Polytechnic Univ., Russia

Creation of reliable electrical connection on piezoceramic disk in bimorph deformable mirror is very important and challenging task, especially for small-aperture piezoelectric wavefront correctors. We propose to use parallel-gap resistance microwelding as an effective tool to achieve a good quality of bonding between wire and piezodisk surface and to increase tensile strength of contact in the Ag-Cu (silver-copper) system

ThR4-p22 10:00-13:30

Single photon detectors for QKD

O. Stroh-Vasenev; Laser Components Germany GmbH, Germany

R8: Nonlinear Photonics: Fundamentals and Applications

ThR8-p01 15:00-18:30

Optical properties of optically dense medium of alkali atoms having a nonzero temperature under conditions of coherent population trapping resonance detected by the Ramsey method

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

A mathematical model of the interaction of bichromatic pulsed laser radiation with an optically dense medium of alkali atoms at a nonzero temperature is constructed. A numerical scheme for solving the obtained integro-differential equations is proposed. The results of the solution are analyzed for the dependence of the shape and shifts of the obtained two-photon resonances on temperature.

ThR8-p02 15:00-18:30

Direction-depending ultrashort pulses dynamics In dispersion distributed fibers

A.D. Zverev[1], V.A. Kamynin[1], A.A. Sysoliatin[1], I.S. Panyaev[2], P.A. Itrin[2], D.A. Korobko[2], V.A. Ribenek[2], I.O. Zolotovskii[2], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Kapitsa Scientific Technological Research Inst., Ulyanovsk State Univ., Russia

We demonstrated the realization of different pulse bursts from dispersion distributed fibers depending on the propagation direction and input power. At an average output power level of about 6 mW, it was able to achieve 2 subpicosecond pulses while irradiation injected into the small core side opposite to 3 subpicosecond pulses in case of larger core injection.

This research was supported by RFBR Grant(s) # This work was supported by the Ministry of Science and Higher Education of Russian Federation (grant № 075-15-2020-912) and carried out on the basis of the World-Class Research Center «Photonics»

ThR8-p03 15:00-18:30

Nonlinear dynamics in twisted multicore fibers with PT-symmetry

I.S. Chekhovskoy[1], S.V. Suchkov[1], O.V. Shtyrina[1], S. Wabnitz[1,2], M.P. Fedoruk[1]; [1]Novosibirsk State Univ. Russia; [2]Dipartimento di Ingegneria dell'Informazione, Elettronica e Telecomunicazioni, Sapienza Univ. of Rome, Italy

Linear and nonlinear modes of PT-symmetric multicore fibers twisted around the central axis are studied. We determine the spectral properties of such systems and show that the presence of a central core and twist can significantly change the mode structure, as well as the PT-symmetry breaking threshold. We also construct stationary nonlinear modes and investigate their stability.

ThR8-p04 15:00-18:30

Comparison of methods for calculating thermal frequency shifts in integrated Si_3N_4 microresonators

V.I. Pavlov[1,3], N.P. Khatyrev[1], N.M. Kondratiev[2], I.A. Bilenko[2,3]; [1]Russian Metrological Inst. of Technical Physics and Radio Engineering; [2]Russian Quantum Center; [3]Faculty of Physics, Lomonosov Moscow State Univ., Russia

Heating is inevitable effect in crystaline and integrated whispering gallery mode microresonators, as they usually accumulate high power inside. In this work different methods of thermomechanical processes modeling in such systems are studied.

This research was supported by RFBR Grant(s) # The work was supported by Russian Science Foundation (project 22-22-00872)

ThR8-p05 15:00-18:30

Laser regime analysis using Lyapunov exponents

V.A. Razukov[1], L.A. Melnikov[1], P.V. Kuptsov[2]; [1]Yuri Gagarin State Technical Univ. of Saratov; [2]Kotelnikov Inst. of Radio-Engineering and Electronics RAS, Saratov Branch, Russia

We use Lyapunov charts method for a single-mode, Raman, SBS and fiber lasers and fiber microcavities. Computed regime maps allow us to characterize spatio-temporal properties of established mode and predict the behavior of the electromagnetic field in the laser system, knowing how a specific instability in the cavity depends on the parameters of the given system.

ThR8-p06 15:00-18:30

Influence of inelastic collisions on the efficiency of optical pumping of alkali atoms in a gas cell

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

We study the polarization of the total momentum of alkali atoms in a gas cell with a buffer gas pumped by single-frequency circularly polarized laser radiation. We take into account the motion of atoms and collisions that preserve the spin of the nucleus during the chaotization of the moment of the outer electron shell, the full hyperfine and Zeeman structure.

This research was supported by RFBR Grant(s) # 19-29-10004

ThR8-p07 15:00-18:30

Determination of optical absorption and scattering coefficients of LBO and PPLN crystals

A.K. Vorobyov[1], A.Yu. Ostapiv[1], I.V. Gryshenko[1,2], A.V. Konyashkin[2], O.A. Ryabushkin[2]; [1]Moscow Inst. of Physics and Technology (National Research Univ.); [2]Kotelnikov Inst. of Radioengineering and Electronics RAS, Fryazino Branch, Russia

The measurements of optical absorption and scattering coefficients of nonlinear-optical crystals lithium triborate LiB3O5 (LBO) and periodically poled lithium niobate LiNbO3 (PPLN) are presented. The absorption and scattering coefficients of LBO at 532 nm and 1070 nm and PPLN at 3050 nm were determined using piezoelectric resonance laser calorimetry. The scattering coefficients were also measured using the integrating spheres.

ThR8-p08 15:00-18:30

Investigation of amplified spontaneous emission broadband sources based on C and L-band Er-doped fibers

I.O. Orekhov[1], S.G. Sazonkin[1], L.K. Denisov[1], K.V. Stepanov[1], A.A. Zhirnov[1,2], A.B. Pnev[1], V.E. Karasik[1]; [1]Bauman Moscow State Technical Univ.; [2]Kotelnikov Inst. of Radioengineering and Electronics RAS, Russia

In this article, we compare various schemes for constructing a broadband source with amplified spontaneous emission (ASE), for subsequent use as a master source for a distributed temperature monitoring system on Bragg gratings.

ThR8-p09 15:00-18:30

A neural network method for the BFS extraction

A.I. Krivosheev[1], Yu.A. Konstantinov[1], V.V. Krishtop[2], A.T. Turov[2], F.L. Barkov[1], A.A. Zhirnov[3], E.O.Garin[3], A.B. Pnev[3]; [1]Perm Federal Research Center of the Ural Branch of the RAS; [2]Perm National Research Polytechnic Univ.; [3]Bauman Moscow State Technical Univ.,Russia

We present a method for increasing the accuracy of determining the Brillouin frequency shift in a fiber strain sensor. A neural network which using the results obtained from other methods as input data. The result is an additional 10% accuracy increasing at low SNR values (about 5 dB).

ThR8-p10 15:00-18:30

Laser-induced damage of $ZnGeP_2$ nonlinear crystals at 2,091 mkm depending on the post growth processing technology and laser radiation parameters

N.N. Yudin[1], O.L. Antipov[2], A.I. Gribenyukov[3], I.D. Eranov[2], S.N. Podzyvalov[1], M.M. Zinoviev[1], M.M. Kulesh[1], E.S. Slyunko[1]; [1] National Research Tomsk State Univ.; [2]Inst. of Applied Physics RAS; [3]Inst. of Monitoring of Climatic and Ecological System, Russia

An increase in the threshold energy density of laser radiation by a factor of 1.5 – 3 at λ = 2,091 mkm is revealed with a decrease in the crystal ZnGeP2 temperature from zero to –60 °C. It has been shown that the volume concentration of dislocations in ZnGeP2 has a significant effect on LIDT.

This research was supported by RFBR Grant(s) # This study was supported by the Tomsk State University

ThR8-p11 15:00-18:30

Kerr comb generation efficiency in microresonators and optimal pumping regime

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

The increase of pump-to-comb conversion efficiency is a crucial problem for Kerr frequency comb generation in optical microresonators. We present a careful optimization of the setup parameters, such as pump power and coupling coefficient, for the best performance, showing the global maximum and discuss its attainability.

ThR8-p12 15:00-18:30

One step beyond the RWA: a way to obtain precise polarization spectra without having to consider high-frequency density matrix fluctuations

A.G. Antipov[1], N.I. Matveeva[1], N.S. Pulkin[1,2], S.V. Savelyeva[2], S.V. Uvarova[1], V.I. Yakovleva[1]; [1]St. Petersburg State Univ.; [2]ITMO Univ., Russia

The method to improve the traditional rotating wave approximation in solving density matrix equation is proposed. We use the additional transformation to obtain more close approach to an exact solution than the usual rotating wave approximation. The proposed method is illustrated by the example of a two-level system driven by a polychromatic field.

ThR8-p13 15:00-18:30

Numerical simulation of nonlinear photoionization of metal microparticles

A.A. Sergeev[1,2], S.V. Ivakin[1,2], P.Yu. Serdobintsev[3], A.S. Boreysho[1,2]; [1]Baltic State Technical Univ. "Voenmeh" named after D.F. Ustinov; [2]Laser Systems ltd.; [3]St Petersburg State Univ., Russia

The paper presents the model of a multiphoton ionization of micron-sized metal particles as a process of cascade transitions of electrons through a discrete system of energy levels.

ThR8-p14 15:00-18:30

New methods of visualization of THz fields

S. Bodrov[1,2], A. Murzanev[1], Y. Sergeev[1,2], A. Korytin[1], A. Stepanov[1], O. Chefonov[3], A. Ovchinnikov[3], M. Agranat[3]; [1]Inst. of Applied Physics RAS; [2]Univ. of Nizhny Novgorod; [3]Joint Inst. for High Temperatures RAS, Russia

A commercial CCD matrix can be used for measuring THz fields of the order of MV/cm due to the generation of carriers in the process of silicon ionization. Secondly, irradiation of graphene with THz radiation with fields on the order of hundreds of kilovolts per centimeter leads to the appearance of optical emission recorded by a CCD matrix.

ThR8-p15 15:00-18:30

Development of photonic crystal fibers for the Terahertz spectral range

A.A. Yuzhakova[1], D.D. Salimgareev[1], A.E. Lvov[1], D.V. Shatunova[1], A.S. Korsakov[1], L.V. Zhukova[1]; Ural Federal Univ. named after the first President of Russia B. N. Yeltsin, Russia

The work is devoted to the development of photonic-crystal fibers based on metal halide, transparent in the terahertz spectral range. Simulation of PCF structures was performed, the energy density, attenuation constant in the cross section and the mode field area were determined.

This research was supported by RFBR Grant(s) # The reported study was funded by RFBR according to the research project № 20-32-90021

ThR8-p16 15:00-18:30

Boosting MIR to THz conversion with tight focusing

I.A. Nikolaeva[1,2], D.E. Shipilo[1,2], N.A. Panov[1,2], O.G. Kosareva[1,2]; [1]Faculty of Physics, Lomonosov Moscow State Univ.; [2]Lebedev Physical Inst. RAS, Russia

3D + time numerical simulations of terahertz (THz) generation in two-color femtosecond filament with the optimal phase between the optical harmonics reveal the non-monotonic dependence of the THz energy on the central wavelength of fundamental harmonic pulse. Tight focusing boosts up the conversion efficiency for the MIR pump thus making the THz energy increase monotonically with the wavelength.

ThR8-p17 15:00-18:30

The comparison of OFC generation techniques for fiber optical WDM networks

I. Lyashuk[1], R. Murnieks[1,2], L. Skladova[1,2], S. Spolitis[1,2], V. Bobrovs[1]; [1]Inst. of Telecommunications of Riga Technical Univ.; [2]Communication Technologies Research Center Riga Technical Univ., Latvia

The improvement of wavelength-division multiplexing capabilities have received attention due to the growing demand for higher data for Internet. One of the most promising solutions to improve the spectral and power efficiency of these networks is to substitute laser arrays with optical frequency comb (OFC) generators. This article compares three perspective OFC technologies for channel carrier generation in telecommunication applications.

This research was supported by RFBR Grant(s) # This research was funded by the European Regional Development Fund postdoctoral research project No. 1.1.1.2/VIAA/4/20/659 (COMBSYS) and by the European Social Fund within project No. 8.2.2.0/20/I/008

ThR8-p18 15:00-18:30

Bell-shaped refractive index profiles for the multimode fibers

V.M. Gololobov, P.S. Anisimov, V.V. Zemlyakov, J. Gao; Russian Research Inst. Huawei Technologies Co. Ltd., Russia

Consider bell-shaped functions as potentially new refractive index profile of the fiber with low differential mode group delay. The Fermi-Dirac distribution and Cycloid functions are shown to provide twice or more the fiber-optic bandwidth compared to the conventional quasi-parabolic GRIN. The effect of refractive index fluctuations on the performance of these profiles is analyzed.

ThR8-p19 15:00-18:30

Implementation and verification of the versatile method for optical microresonators dispersion characteristics measurement

N.Yu. Dmitriev[1,2], A.S. Voloshin[3], N.M. Kondratiev[1], V.E. Lobanov[1], K.N. Min'kov[1], A.E. Shitikov[1], E.A. Lonshakov[1], I.A. Bilenko[1,4]; [1]Russian Quantum Center; [2]Moscow Inst. of Physics and Technology, Russia; [3]Swiss Federal Inst. of Technology Lausanne, Switzerland; [4]Faculty of Physics, Lomonosov Moscow State Univ., Russia

A novel approach for optical microresonators dispersive characteristics measuring is implemented and verified. The considered method is based on the application of Mach- Zehnder interferometer and can be used for any wavelength range and any type of microresonator featuring free spectral range till THz.

ThR8-p20 15:00-18:30

Supercontinuum generation In fiber amplifiers and its partial amplification

I.V. Zhluktova, A.D. Zverev, S.A. Filatova, V.A. Kamynin, A.A. Sysoliatin, V.B. Tsvetkov; Prokhorov General Physics Inst. RAS, Russia

The supercontinuum generation in the wavelength range 1000-2400 nm in silica-based fibers with output power 340 mW is presented. Spectral and temporal irradiation conversions in three different fiber amplifiers (erbium-doped, thulium-doped and holmium-doped fiber amplifier) have been investigated.

This research was supported by RFBR Grant(s) # RFBR №075-15-2020-912

ThR8-p21 15:00-18:30

Bifurcations and multiple-period soliton pulsations in Mamyshev oscillator

E. Kuprikov[1], A. Perepelov[1], A. Kokhanovskiy[1], I.A. Bednyakova[1], S. Turitsyn[1,2]; [1]Division of Laser Physics and Innovative Technologies, Novosibirsk State Univ., Russia; [2]Aston Inst. of Photonic Technologies, Aston Univ., UK

We numerically examined multiple-period pulsation of the soliton parameters in a Mamyshev oscillator. We observed that the period of pulsation can be controlled by the spectral distance between the filters. The pulse energy fluctuations ranged from 2 to 47% of the maximum value.

This research was supported by RFBR Grant(s) # This work was supported by Russian Science Foundation (17-72-30006)

ThR8-p22 15:00-18:30

Laser pulse shaping at third harmonic generation process

I.V. Kuzmin, S.Yu. Mironov, M.A. Martyanov, A.K. Potemkin; Federal Research Center Inst. of Applied Physics RAS, Russia

A new approach to generating triangular and cone-shaped laser pulses in UV region is proposed. It is based on third harmonic generation process at collinear interaction of 3D ellipsoidal and cylindrical chirped laser pulses in a nonlinear crystal.

ThR8-p23 15:00-18:30

Propagation effects for optically generated unipolar sub-terahertz pulses

A.L. Novokovskaya, S.A. Sychugin, M.I. Bakunov; Univ. of Nizhny Novgorod, Russia

A complex propagation dynamics of unipolar sub-terahertz pulses generated by intense femtosecond laser pulses in electro-optic crystals is revealed by using a specially developed semi-analytical approach. The unipolar pulse becomes quasi-unipolar after some distance, which depends on its transverse size, and then bipolar. These findings are important for an experimental observation of the unipolar pulses and their practical use.

ThR8-p24 15:00-18:30

Neural network for direct and inverse nonlinear Fourier transform

E.V. Sedov[1,2], I.S. Chekhovskoy[2], J.E. Prilepsky[1], S.K. Turitsyn[1,2]; [1]Aston Univ., UK; [2]Novosibirsk State Univ., Russia

With the ever-increasing demand for the capacity of optical links, the possibility to constructively exploit nonlinear effects in fibre-optic systems using the nonlinear Fourier transform (NFT) has recently become the subject of research. We propose a neural network framework feasible to predict the continuous NFT spectrum of optical signals and to perform the inverse NFT for modulation of the signal.

ThR8-p25 15:00-18:30

Lowering threshold of parametric generation by matching optical lengths of pump resonators and OPO

K.V. Vorontsov[1], S.G. Garanin[1], N.A. Egorov[1], N.G. Zakharov[1,2], R.A. Zorin[1,2], V.B. Kolomeets[1], V.I. Lazarenko[1,2], A.S. Nadezhin[1], G.N. Nomakonov[1], K.A. Tulyakov[1,2,3], Y.N. Frolov[1]; [1]Russian Federal Nuclear Center - All-Russian Scientific Research Inst. of Experimental Physics (RFNC-VNIIEF); [2]Lobachevsky State Univ. of Nizhny Novgorod - National Research Univ.; [3]Branch of Lomonosov Moscow State Univ. in Sarov, Russia

The results of computational and experimental studies of a doubly resonant OPO based on a nonlinear ZnGeP2 crystal generating radiation in the range from 3.5 to 5.0 μm are presented, which demonstrate an approximately 1.5-fold decrease in the parametric generation threshold when the optical lengths of the pump laser resonator and the OPO are matched.

ThR8-p26 15:00-18:30

Measurement of optical absorption coefficient of lithium triborate under the high-power CW laser radiation with Pierce oscillator circuit

K.V. Zotov[1], I.V. Grischenko[1,2], O.A. Ryabushkin[2]; [1]Moscow Inst. of Physics and Technology (State Univ.); [2]Kotelnikov Inst. of Radioengineering and Electronics RAS (Fryazino Branch), Russia

We introduced a method for optical absorption of nonlinear optical crystals measurement based on a piezoelectric resonance laser calorimetry. Nonlinear crystal is used as a frequency selective element in a feedback loop of RF oscillator circuit. Proposed method was used to measure optical absorption coefficient of litihium triborate crystal under high-power cw laser radiation.

ThR8-p27 15:00-18:30

High-power photodetectors based on InGaAs/InGaAsP/InP heterostructures

N.N. Bragin[1], V.N. Svetogorov[1], Yu.L. Ryaboshtan[1], A.A. Marmalyuk[1], A.V. Ivanov[1], M.A. Ladugin[1], A.S. Semenov[2]; [1]Stel'makh R&D Inst. "Polyus"; [2]Peoples Friendship Univ. of Russia (RUDN Univ.), Russia

A UTC photodetector based on InGaAs/ InGaAsP/ InP heterostructures grown by MOCVD is demonstrated. A model of the band diagram of the photodetector is proposed. Energy barriers that reduce the rate of hole removal from the absorbing layer are shown. A solution to reduce these barriers and increase the holes velocity is proposed.

ThR8-p28 15:00-18:30

Periodically poled ferroelectric crystals and thin films for frequency conversion and diffractive optical elements

V.Ya. Shur[1], A.R. Akhmatkhanov[1], M.A. Chuvakova[1], A.A. Esin[1], O.L. Antipov[2], A.A. Boyko[3], D.B. Kolker[3], V.S. Pavelyev[4]; [1]Inst. of Natural Sciences and Mathematics, Ural Federal Univ.; [2]Inst. of Applied Physics RAS; [3]Novosibirsk State Univ.; [4]Samara Univ., Russia

We present the recent achievements in periodical poling by domain engineering in single crystals of lithium niobate, lithium tantalate and potassium titanyl phosphate for creation of nonlinear frequency converters and tunable diffractive optical elements. The submicron periodical poling was realized in thin films. The promising applications of bulk waveguides created in nonlinear crystals by femtosecond laser irradiation are discussed.

This research was supported by RFBR Grant(s) # 18-29-20077-мк

ThR8-p29 15:00-18:30

Reconstruction of NLC director deformation using a combination of aberration self-action and polarization microscopy methods

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

The processes of light-induced orientation at oblique light incidence on a dye-doped nematic liquid crystal are studied with the simultaneous use of aberrational self-action and polarization microscopy. Each method has features associated with the geometry of light propagation in an NLC, and their combination significantly expands the possibilities of reconstructing the light-induced profile of the nonlinear phase shift.

ThR8-p30 15:00-18:30

Raman frequency conversion of spectrally tunable laser radiation on coherently driven molecular vibrations in high-pressure hydrogen

R. Chulkov[1,2], V. Zhaunerchyk[3]; [1]The FREIA Lab, Department of Physics and Astronomy, Uppsala Univ., Sweden; [2]Inst. of Physics NASB, Belarus; [3]Department of Physics, Univ. of Gothenburg, Sweden

A narrowband pulsed light source for gas-phase molecule spectroscopy utilizes resonant 4-wave mixing of the dye laser, injection-seeded Nd:YAG laser, and Raman shifted sidebands in high-pressure hydrogen. Spectrally tunable Stokes and anti-Stokes generation from ultraviolet down to mid-infrared regions is demonstrated. Effects of tuning range broadening and conversion efficiency increase are discussed in terms of developed numerical model.

ThR8-p31 15:00-18:30

Influence of the defects of multilayer interference antireflection coating based on oxides on the laser-induced damage threshold of $ZnGeP_2$ single crystal

M.M. Zinoviev, N.N. Yudin, S.N. Podzyvalov, E.S. Slyunko, N.A. Yudin, M.M. Kulesh, National Research Tomsk State Univ., Russia

The effect of the defect structure and the parameters of antireflection interference coatings based on alternating layers of Nb2O5/Al2O3 and Nb2O5/SiO2 layers on the laser-induced damage threshold of ZGP crystals under the action of Ho:YAG laser radiation at a wavelength of 2.097 μm was determined.Coating deposition was carried out using the ion-beam sputtering method.

This research was supported by RFBR Grant(s) # This research was funded by the Ministry of Science and Higher Education of the Russian Federation (V.E. Zuev Institute of Atmospheric Optics of Siberian Branch of the Russian Academy of Sciences)

ThR8-p32 15:00-18:30

Efficient frequency doubling of soliton self-frequency shifted ultrashort pulses

A. Koviarov, D. Stoliarov, D. Galiakhmetova, E. Rafailov; Aston Inst. of Photonic Technologies, Aston Univ., UK

We present the design and performance of robust and reliable ultrafast laser system with 1675nm and 837 nm wavelengths for multi-photon bioimaging. The laser system is based on femtosecond Er3+ fiber laser with further soliton self-frequency shift and frequency doubling stages. Both signals will be used for nonlinear imaging which allows getting additional information for extracting contrast from unstained tissue.

ThR8-p33 15:00-18:30

Entangled optical solitons in liquid crystals

A.V. Kondakova, T.F. Kamalov; Moscow Region State Univ., Russia

We consider optical 1D envelope solitons in nematic liquid crystal. The main purpose of this article is to show that a special stochastic representation of quantum mechanics can be used to simulate real entangled systems and applied in the creation of new technologies in the field of quantum computing.

ThR8-p34 15:00-18:30

Cr^{2+}:CdSe laser with moving active element

N. Zacharov[1,2], R. Zorin[1], V. Lazarenko[1,2], E. Saltykov[1,2], A. Lobanova[1,2,3], A. Marugin[2], V. Garyutkin[1], G. Mischenko[1], M. Volkov[1], F. Starikov[1]; [1]Russian Federal Nuclear Center - All-Russian Scientific Research Institute of Experimental Physics RFNC-VNIIEF); [2]Branch of Lomonosov Moscow State Univ. in Sarov; [3]Lobachevsky Nizhniy Novgorod State Univ., Russia

In the present work, we overcome the barrier of the emission power of Cr:CdSe laser radiation generation, which is associated with the thermal effects that occur in the crystal. It was possible to increase the emission power by removing the active element from the pump area.

ThR8-p35 15:00-18:30

THz detection in GaSe:S crystals at telecom wavelength

O.N. Shevchenko[1,3], N.A. Nikolaev[1,3], K.A. Kokh[2], [1]Inst. of Automation & Electrometry SB RAS, [2]Inst. of Geology & Mineralogy SB RAS, [3]Novosibirsk State Univ., Russia

Ga50%Se(50-x)%Sx% crystals (where x takes values of 0, 1.5, 6, 8, 11) strobed by 1.55 μm femtosecond pulses were studied as an electrooptic detector of terahertz waves. The refractive index of the crystals at 1.55 μm and THz wavelength was measured. Based on this data and THz detection efficiency, the electrooptical coefficients were estimated.

ThR8-p36 15:00-18:30

Carrier dynamics in the barrier region of InGaN/GaN quantum well heterostructure

T. Aggarwal, A. Udai, S. Ganguly, D. Saha; Indian Inst. of Technology Bombay, India

The study of carrier and photon dynamics in these quantum-confined structures is essential to understand the recombination and capture mechanisms in the active region. We have studied the carrier dynamics in the barrier region of InGaN/GaN quantum well heterostructure. The study is manifested by the ultrafast pump-probe spectroscopy technique.

ThR8-p37 15:00-18:30

Decay of induced absorption in $La(0.05)Gd(0.95)VO_4$ crystal in visible spectral region

D.S. Chunaev, S.B. Kravtsov, P.G. Zverev; Prokhorov General Physics Inst. RAS, Russia

Induced absorption in La0.05Gd0.95VO4 crystal under two-photon interband excitation by picosecond laser radiation at 523.5 nm was investigated. Temporal behavior of absorption revealed short and long decay stages and their dependence on initial value.

ThR8-p38 15:00-18:30

Single- and Multi-soliton generation in ANDi-laser with tunable spectral filtration

A. Kokhanovskiy, K. Serebrennikov; Division of Laser Physics and Innovative Technologies, Novosibirsk State Univ., Russia

We investigated the influence of spectral filtration inside all-normal dispersion (ANDi) fiber mode-locked laser on dissipative soliton formation. Central wavelength of the spectral filter significantly influences on pulse regime: single or multi-soliton. Depending on matching between net spectral losses of the laser cavity and filter spectral profile it is possible to generate from 1 to 3 solitons inside optical bunch.

ThR8-p39 15:00-18:30

Role of optical feedback in formation of radiation properties of a Raman fiber laser with randomly distributed feedback well above generation threshold

O.A. Gorbunov[1,2], I.D. Vatnik[1,2], S.V. Smirnov[1], D.V. Churkin[1]; [1]Novosibirsk State Univ.; [2]Inst. of Automation and Electrometry SB RAS, Russia

Nonlinear effects are known to govern spectral properties of Raman fiber laser radiation well above the generation threshold, and the role of randomly distributed feedback in random fiber lasers is expected to be negligible. We numerically study spectral properties of a random fiber laser and a corresponding fiber amplifier with no feedback and emphasize the importance of Rayleigh backscattering.

This research was supported by RFBR Grant(s) # Russian Science Foundation, project # 19-12-00318-P

ThR8-p40 15:00-18:30

Features of transmission of terahertz radiation by a nonlinear Fabry-Perot interferometer

A. Gendrina, S. Kozlov; International Laboratory of Femtosecond Optics and Femtotechnologies, ITMO Univ., Russia

Transmission of the Fabry-Perot interferometer with nonlinear media can be bistable. In this work the numerical results show that bistable transmission of nonlinear Fabry-Perot interferometer in terahertz spectral range is achievable already when thickness of the nonlinear media is comparable to radiation wavelength.

ThR8-p41 15:00-18:30

Self-starting fiber mode-locked laser assisted with DDQN algorithm

A. Kokhanovskiy, K. Serebrennikov, A. Shevelev, E. Kuprikov; Division of Laser Physics and Innovative Technologies, Novosibirsk State Univ., Russia

Here, we investigate the performance of Double-Deep Q-learning (DDQL) algorithm for designing self-starting fiber laser. Fiber mode-locked laser based on nonlinear polarization effect was chosen as an experimental platform. We show that the proposed algorithm is capable to learn non-trivial hysteresis dynamics inside the laser in order to achieve stable soliton generation.

ThR8-p42 15:00-18:30

Noncritical phase-matched THz generation in GUHP molecular crystal

A.S. Sinko[1,2], I.A. Ozheredov[1,2], P.M. Solyankin[2], V.L. Manomenova[3], E.B. Rudneva[3], N.N. Kozlova[3], A.E. Voloshin[3], A.P. Shkurinov[1,2]; [1]Lomonosov Moscow State Univ.; [2]ILIT RAS - Branch of FSRC "Crystallography and Photonics" RAS; [3]Shubnikov Inst. of Crystallography of FSRC "Crystallography and Photonics" RAS, Russia

A narrow-band coherent terahertz radiation source based on a semi-organic molecular crystal GUHP is presented. The unique resonant spectral features of the transmission in the terahertz frequency range make it possible to achieve the duration of generated THz pulses up to ~300 ps at a temperature of 10 K with a stable oscillation frequency of the electromagnetic field.

This research was supported by RFBR Grant(s) # 20-32-90234, 18-29-20104

ThR8-p43 15:00-18:30

Third harmonic generation in a medium with combined nonlinear response

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

We present theoretical investigation of third harmonic generation in a medium with combined quadratic and cubic nonlinear response under the condition of frequency doubling at big phase mismatching. It is based on using of the multiscale method. This investigation, supported by computer simulation results, shows very high frequency conversion efficiency.

ThR8-p44 15:00-18:30

Distributed acoustic sensing over 146 km using phase-sensitive optical time-domain reflectometer assisted by bidirectional distributed Raman amplifier

D.R. Kharasov[1,2], E.A. Fomiryakov[1,3], D.M. Bengalskii[1], S.P. Nikitin[1], O.E. Nanii[1,3], V.N. Treshchikov[1]; [1]T8 Sensor LLC; [2]Moscow Inst. of Physics and Technology (National Research Univ.); [3]Lomonosov Moscow State Univ., Russia

We demonstrate the operation of a distributed acoustic sensor (DAS) based on a phase-sensitive optical time-domain reflectometer assisted by a bidirectional distributed Raman amplifier over a distance of 146 km without blind zones.

ThR8-p45 15:00-18:30

Second harmonic generation with half-order periodically poled $LiNbO_3$ crystal

E.D. Cherotchenko[1], V.Yu. Mylnikov[1], K.A. Fedorova[2], D.A. Mikhailov[1], V.A. Kuznetsov[3], V.V. Dudelev[1], D.V. Chistyakov[1], S.N. Losev[1], N.S. Averkiev[1], E.U. Rafailov[4], G.S. Sokolovskii[1]; [1]Ioffe Inst., Russia; [2]Technische Hochschule Mittelhessen Univ. of Applied Sciences, Germany; [3]PPML "239", St. Petersburg, Russia; [4]Aston Univ., UK

We study two different mechanisms of the second harmonic generation in a periodically poled nonlinear crystal.

ThR8-p46 15:00-18:30

Optical parametric oscillations and second harmonic generation of repetitively-pulsed radiation of a fiber-laser pumped Tm^{3+}:YAP laser in a fan-out periodically poled MgO:$LiNbO_3$ crystal

O.L. Antipov[1,2], D.B. Kolker[3], A.A. Dobrynin[1,2], A.G. Zav'yalov[1,2], Yu.A. Getmanovskiy[1,4], V.V. Sharkov[1,2], M.A. Chuvakova[5], A.R. Akhmathanov[5], V.Ya. Shur[5]; [1]Inst. of Applied Physics RAS; [2]Nizhny Novgorod State Univ.; [3]Novosibirsk State Univ.; [4]Nizhny Novgorod State Technical Univ.; [5]Ural Federal Univ., Russia

Nonlinear optical frequency conversions of the repetitively-pulsed radiation of a 1941 nm Tm3+:YAP laser pumped by a CW 1670-nm fiber laser were studied. Both the mid-infrared optical parametric oscillation (OPO) and second harmonic generation (SHG) were obtained in the same periodically poled MgO:LiNbO3 crystal with a fan-out grating design by tuning the grating period and the crystal temperature.

This research was supported by RFBR Grant(s) # Ministry of Education and Science of the Russian Federation (projects №0030-2021-0012 and №FSUS 2020-0036)

ThR8-p47 15:00-18:30

Turbulent state switching in mode-locked fiber lasers

Z.Z. He, X.W. Shu; Wuhan National Laboratory for Optoelectronics and School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China

Our simulations demonstrate the switching of stable mode-locking, turbulent, and laminar in a nonlinear polarization rotation mode-locked fiber laser by tuning the polarization controller, which advances the understanding of turbulence in the framework of the complex Ginzburg-Landau equation.

ThR8-p48 15:00-18:30

Investigation of the effect of laser-induced plasma parameters on surface heating

A.V. Kharkova, D.A. Kochuev, A.A. Voznesenskaya, K.S. Khorkov; [1]Vladimir State Univ. named after A.G. and N.G. Stoletovs, Russia

In this work, we studied the heating of an AISI 304 wafer in the laser-plasma femtosecond ablation mode. The results of measuring the temperature of heating of the sample surface under the action of laser radiation in the point mode of exposure to laser radiation and in scanning with a beam at a constant number of acting pulses are presenting.

ThR8-p49 15:00-18:30

$BaMgF_4$ whispering-gallery-mode crystal resonator with high Q-factor

K.N. Min'kov[1], A.E Shitikov[1], A.N. Danilin[1,2]; [1]Russian Quantum Center; [2]Faculty of Physics, Lomonosov Moscow State Univ., Russia

For the first time, we report on a Q-factor of 1.2×107 in crystalline z-cut BaMgF4 optical microresonators at 1550 nm wavelength.

ThR8-p50 15:00-18:30

Self-stopping of light in two-level homogeneous medium

R.M. Arkhipov[1,2], M.V. Arkhipov[1], I. Babushkin[3], N.N. Rosanov[1,2]; [1]St.Petersburg State Univ.; [2]Ioffe Inst., Russia; [3]Inst. of Quantum Optics, Leibniz Univ. Hannover and Cluster of Excellence PhoenixD (Photonics, Optics, and Engineering—Innovation across Disciplines), Germany

We show theoretically that single-cycle light pulse can be self-stopped in two-level homogeneous resonant medium thus forming a novel type of structure- light- matter oscillon.

ThR8-p51 15:00-18:30

Light beam transformation upon deformation of liquid crystal film with free surface

S.A. Shvetsov[1,2], G.A. Voronin[2,3], A.V. Emelyanenko[1], A.S. Zolot'ko[2]; [1]Lomonosov Moscow State Univ., Russia; [2]Lebedev Physical Inst., Russia; [3]Moscow Inst. of Physics and Technology, Russia

We report the self-induced beam mode conversion in the nematic liquid crystal film with a free surface. It was found that thermal gradient field formed by light absorption induces the axially symmetric deformation in liquid crystal, with serves as phase plate for optical vortex formation.

This research was supported by RFBR Grant(s) # 19-53-26007, 21-53-50008

ThR8-p52 15:00-18:30

Emission of electrons from a metal tip irradiated by femtosecond IR lasers at wavelengths of 800 and 1240 nm

A.V. Ovchinnikov[1], O.V. Chefonov[1], M.B. Agranat[1], N.A. Abramovskii[2,3], S.B. Bodrov[2,3], A.M. Kiselev[2], A.A. Murzanev[2], A.V. Romashkin[2], A.N. Stepanov[2]; [1]Joint Inst. for High Temperatures RAS; [2]Inst. of Applied Physics RAS; [3]Lobachevsky State Univ. of Nizhny Novgorod, Russia

The results of comparative studies of the photoemission of electrons from a metal needle, obtained on two lasers using femtosecond laser radiation at two wavelengths of 800 and 1240 nm, are presented. The possibility of obtaining electron bunches with a charge of tens of picocoulombs in a single laser pulse is demonstrated.

ThR8-p53 15:00-18:30

Waveguiding via transformation optics

M.S. Elizarov, A. Fratalocchi; King Abdullah Univ. of Science and Technology, Saudi Arabia

We demonstrate subwavelength waveguiding device based on the artificial material with ultra-high refractive index. Material is engineered through the deformation of reflective substrate via transformation optics approach which allows to achieve arbitrary refractive index distribution.

7th International A.M. Prokhorov Symposium on Biophotonics

TECHNICAL PROGRAM

7TH INTERNATIONAL A. M. PROKHOROV SYMPOSIUM ON BIOPHOTONICS
PLENARY SESSION

Location: Piedmonte room, floor 3

13:45–14:00 **Opening and welcome remarks**

14:00–14:45 **Valentin Gapontsev, ideas implementation. Prospects for fiber lasers**
N. N. Evtikhiev
"IRE-Polus" Ltd., National Research Nuclear University "MEPhI", Russia

14:45–15:30 **Biodegradable containers for drug delivery to tumours**
A. V. Zvyagin
MQ Photonics Centre, Faculty of Science and Engineering, Macquarie University, Sydney, Australia

16:00–16:45 **New opportunities for nanobiotechnology based on ultrasensitive methods of physical measurements**
P. I. Nikitin
Prokhorov General Physics Institute of RAS, Russia

16:45–17:30 **Multimodal photonic exploration of early embryonic development**
I. V. Larina
Baylor College of Medicine, USA

Section A. Advanced laser medical systems and technologies

Advanced laser medical systems and technologies I

Location: Petrov Vodkin 3 Room, floor 2. 09:00-11:00

TuSYA-01 09:00-09:30

Mechanisms of short wavelength light - biological tissue interaction *(Invited paper)*

I.A. Abushkin[1], V.M. Chudnovsky[2], M.A. Guzev[3], A.E. Anchugova[4,5], M.Y. Galiulin[5]; [1]Center for Medical Laser Technologies; [2] Ilyichev Pacific Oceanological Inst.; [3]Inst. of Applied Mathematics; [4]Chelyabinsk State Univ.; [5]South Ural State Medical Univ., Russia

The processes of formation and transfer of heat from exposure to short-wave infrared light - 1.5, 1.9 and (1.5 + 1.9) μm were studied in physiological solution, donor blood, and during interstitial thermotherapy of rabbit liver in vivo. Heat transfer corresponded to forced convection caused by boiling at the end of the fiber.

TuSYA-02 09:30-10:00

Comparative study of the endovenous laser coagulation with 1.47 and 1.94 μm clinical effiscacy *(Invited paper)*

V.Yu. Bogachev[1,2], K.A. Kaperiz[2], V.P. Minaev[3]; [1]Pirogov Russian National Research Medical Univ.; [2]The First Phlebological Center; [3]IRE-Polus Ltd, Russia

Studies have shown that EVLT with a wavelength of λ= 1.94 μm is accompanied by significantly less intraoperative pain syndrome and the risk of skin hyperpigmentation in the target vein projection. A lower penetration depth at wavelength λ= 1.94 μm reduces the risk of thermal damage to the nerve trunks near the target vein.

TuSYA-03 10:00-10:30

Prospects of automating the process of endovasal laser coagulation with using the visualization of the venous bed *(Invited paper)*

P.A. Ryabochkina[1], A.N. Belyaev[1], A.A. Artemov[1], A.D. Taratynova[1], A.A. Lyapin[1], S.A. Khrushchalina[1], S.V. Kostin[1], D.V. Pyanzin[1], A.V. Spirin[1], A.N. Chaldyshkin[1], D.N. Artemyev[2]; [1]National Research Mordovia State Univ.; [2]Samara National Research Univ., Russia

The scheme of the hardware and software complex which will be used at the clinical practice during EVLC operation for the treatment of varicose vein minimized postoperative complication.

This research was supported by RFBR Grant(s) # 18-29-20,039

TuSYA-04 10:30-10:45

Evaluation of vascularization parameters of experimental tumors of different morphogenesis

K.G. Pavlova[1,2], A.A. Kurnikov[1], D.A. Khochenkov[3], Yu.A. Khochenkova[3], A.A. Glyavina[1,2], 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]Blokhin National Medical Research Center of Oncology, Russia

Using OA and DOS the comparison of vascular structure and oxygenation of renal (SN-12C) and colon (Colo320, HCT116) cancer models was carried out. High vascularity was found for Colo320 and SN-12C as compared to HCT116. For Colo320 the presence of extended hemoglobin-containing structures was revealed, as well as a significantly decreased level of oxygenation.

This research was supported by RFBR Grant(s) # 21-15-00032

TuSYA-05 10:45-11:00

The use of femtosecond laser pulses for controlled laser-assisted hatching of fresh and frozen/thawed mammalian embryos

I.V. Ilina[1], M.A. Filatov[2], D.S. Korshunova[2], Y.Y. Silaeva[3], D.S. Sitnikov[1]; [1]JIHT RAS; [2]Center for Precision Genome Editing and Genetic Technologies for Biomedicine, IGB RAS; [3]Core Facility Centre, IGB RAS, Russia

Femtosecond laser pulses were applied for the microsurgery of mammalian embryos at the late stages of preimplantation development. An artificial opening in the outer envelope of mouse blastocysts was created and promoted hatching to start immediately through the hole formed. Laser exposure parameters were optimized to perform delicate laser-assisted hatching either on fresh or frozen/thawed mammalian embryos.

– Break –

Advanced laser medical systems and technologies II

Location: Petrov Vodkin 3 Room, floor 2. 11:30-13:45

TuSYA-06 11:30-12:00

Laser engineering of biological tissue and microbial systems *(Invited paper)*

N.V. Minaev, Inst. of Photon Technologies, FSRC "Crystallography and Photonics" RAS, Russia

The report presents the results related to developing laser additive technologies for use in regenerative medicine in tissue engineering and microbiology. The results of developing approaches to form tissue engineering structures based on biocompatible and bioresorbable polymeric materials and the research results on the development of laser-induced bioprinting of living cells, cell aggregates, and microorganisms are presented.

This research was supported by RFBR Grant(s) # Russian Science Foundation 20-14-00286

TuSYA-07 12:00-12:30

Surgery guidance in urology using optical spectroscopy *(Invited paper)*

P.S. Tseregorodtseva[1], K.E. Buiankin[1,2] , B.P. Yakimov[1,2,3], A.A. Kamalov[2], G.S. Budylin[1,2,4], D.A. Davydov[1,2], E.A. Shirshin[1,2]; [1]Faculty of Physics, Lomonosov Moscow State Univ.; [2]Medical Research and Education Center, Lomonosov Moscow State Univ.; [3]World-Class Research Center "Digital Biodesign and Personalized Healthcare", Sechenov First Moscow State Medical Univ.; [4]Inst. of Spectroscopy RAS, Russia

Diffuse reflectance spectroscopy and imaging are increasingly being used in surgical guidance for tumor margin detection during endoscopic operations. In this work, using optical phantoms mimicking normal and pathological bladder tissues, the accuracy of tumor margin detection using single-fiber diffuse reflectance spectroscopy and spatial frequency domain imaging was evaluated.

TuSYA-08 12:30-12:45

Pro- and anti-inflammatory genes expression during the healing of biological tissues after exposure to 2-micron laser radiation

S.A. Filatova[1], M.S. Kopyeva[1,2], V.A. Kamynin[1], A.V. Lokhonina[3], M.S. Fomina[4], P.V. Novokreshchenov[5], I.M. Pushkar[5], V.V. Astashov[5], T.K. Fatkhudinov[3,4], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Faculty of Science, Peoples Friendship Univ.; [3]Histology Department, Peoples Friendship Univ. of Russia; [4]Department of Growth and Development, Science Research Inst. of Human Morphology; [5]Human Anatomy Department, Peoples Friendship Univ. of Russia, Russia

We present the results on the expression of pro- and anti-inflammatory genes during the healing process of mice's muscle and skin tissues after exposure to continuous-wave laser radiation of an all-fiber holmium laser at a wavelength of 2.1 μm with different powers.

This research was supported by RFBR Grant(s) # Ministry of Science and Higher Education of Russian Federation (grant № 075-15-2020-912)

TuSYA-09 12:45-13:00

Thermal effect of femtosecond laser pulses in terms of laser-assisted hatching procedure on mammalian embryos

D.S. Sitnikov, I.V. Ilina, A.A. Pronkin; Joint Inst. of High Temperatures RAS, Russia

An assessment of thermal effects of femtosecond laser pulses during microsurgical procedures on embryos is performed. Issues of nonlinear absorption of laser pulses in aqueous medium are of crucial significance, as well as issues of subsequent heat transfer. Temperature evolution in the center of focused laser beam is presented from femtosecond to millisecond time scales.

TuSYA-10 13:00-13:15

Study of hemo- and lympho-dynamics in the healing process of laser wound on mouse skin

M.S. Kopyeva[1,2], S.A. Filatova[1], E.A. Tatarchenko[2], V.A. Kamynin[1], V.V. Astashov[2], T.K. Chekhlova[2], V.B. Tsvetkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Peoples' Friendship Univ. of Russia, RUDN Univ., Russia

This work presents a study of hemo- and limpho- microcirculation in mouse skin before and after exposure to laser radiation, as well as studying changes in microcirculation in the healing process of the wound using laser Doppler flowmetry. The continuous-wave (CW) radiation was induced using an all-fiber holmium (Ho) laser with a wavelength of 2.1 μm.

TuSYA-11 13:15-13:30

Device for goniometric measurement of diffusely reflected light from the surfaces of biological tissues

A.V. Smirnov[1], N.V. Kovalenko[1,2], O.A. Ryabushkin[1,2]; [1]Moscow Inst. of Physics and Technology, Russia; [2]Fryazino branch of Kotelnikov Inst. of Radio-Engineering and Electronics, Russia

The biological tissue surface can be studied through analysis of diffuse reflected radiation. The experimental setup is introduced in this work to conduct the measurements and prove existing mathematical model.

TuSYA-12 13:30-13:45

Dual-wavelengths copper vapour laser technologyfor eyelid intradermal melanocytic nevi treatment.

I.V. Ponomarev[1], S.B. Topchy[1], L.D. Shakina[2], A.E. Pushkareva[3]; [1]Lebedev Physical Inst. RAS; [2]National Medical Research Center of Children Health; [3]ITMO Univ., Russia

Intradermal melanocytic benign eyelid nevus of Miescher occupied eyelid ciliary edge gives rise the poor blinking and vision limitation.Copper vapour laser provides complete elimination of eyelid nevus without side effects due to the high absorption by melanin and oxyhemoglobin.

Section B. Laser interaction with cells and tissues: clinical imaging and spectroscopy

Laser interaction with cells and tissues: clinical imaging and spectroscopy I

Location: Petrov Vodkin 1 Room, floor 2. 09:00-11:00

TuSYB-01 09:00-09:30

Light sheet flow cytometry: study of polyelectrolyte microcapsules in whole blood *(Invited paper)*

D.N. Bratashov[1], O.A. Sindeeva[2], O.A. Mayorova[1], R.A. Verkhovskii[1], A.V. Ermakov[1,3], O.V. Grishin[1], I.O. Kozhevnikov[1], M.A. Makarkin[1], E.S. Prikhozhdenko[1]; [1]Saratov State Univ.; [2]Skolkovo Inst. of Technology; [3]Sechenov Medical State Univ., Russia

Lightsheet-based flow cytometry system with the ability of measuring in the whole undiluted blood and magnetic separation of objects of interest was developed. It was used to investigate how the magnetic targeting of polyelectrolyte microcapsules influenced by the concentration of magnetic nanoparticles, microcapsule size and flow speed in the vessel.

TuSYB-02 09:30-10:00

Biophotonics for point-of-care diagnostics: noninvasive sensing and imaging of the skin physiological parameters *(Invited paper)*

D.A. Davydov[1,4], G.S. Budylin[1,2,3], N.Z. Zlobina[1,2,3], A.V. Baev[4], B.P. Yakimov[1,3,4], E.A. Shirshin[1,3,4]; [1]Medical Research and Education Center, Lomonosov Moscow State Univ.; [2]Inst. of Spectroscopy RAS; [3]World-Class Research Center "Digital Biodesign and Personalized Healthcare", Sechenov First Moscow State Medical Univ.; [4]Faculty of Physics, Lomonosov Moscow State Univ., Russia

In this work the possibility of determining the physiological parameters of the skin: water concentration and dermis thickness, was studied by diffuse reflectance spectroscopy. Effects of water concentration and dermal thickness changes on skin optical properties have been studied experimentally and using numerical Monte-Carlo simulation. The obtained experimental dependences are confirmed both by the simulation results and experimentally by ultrasonography.

This research was supported by RFBR Grant(s) # This work was supported by the grant of the Russian Science Foundation (grant No. 22-25-00864)

TuSYB-03 10:00-10:30

Novel approaches in 3D live cell microscopy *(Invited paper)*

H. Schneckenburger[1], V. Richter[1], M. Rank[2], A. Heinrich[2]; [1]Inst. of Applied Research; [2]Center for Optical Technologies (ZOT), Aalen Univ., Germany

Microscopy methods for 3D live cell imaging including various techniques, challenges and restrictions are described. Novel devices for application of these methods in combination with 3D printed optics are presented and discussed.

TuSYB-04 10:30-10:45

Raman and fluorescence lifetime imaging of cellular carotenoids distribution in algae

A.N. Semenov, E. Protasova, Eu. Parshina, K. Chekanov, T.A. Fedorenko, D.N. Ahaev, E.S. Lobakova, Eu.G. Maksimov; M.V. Lomonosov Moscow State Univ., Russia

The results of the complex multimodal optical study utilizing Raman and fluorescence lifetime imaging of the spatial distribution of carotenoids in the cells of algae Haematococcus pluvialis and Bracteacoccus aggregatus are presented.

This research was supported by RFBR Grant(s) # Russian Scientific Foundation grant № 22-25-00183

TuSYB-05 10:45-11:00

Intraoperative video-fluorescent diagnostics of pituitary adenomas during tumor resection

E.I. Kozlikina[1,2], K.T. Efendiev[1,2], A.Y. Grigoriev[3,4], O.Y. Bogdanova[3], I.S. Trifonov[3], V.V. Krylov[3], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. of the RAS, Russia; [2]National Research Nuclear Univ. MEPhI, Russia; [3]Federal State Budgetary Educational Inst. of Higher Education "Evdokimov Moscow State Univ. of Medicine and Dentistry", Russia; [4]The National Medical Research Centre for Endocrinology, Russia

For the first time, Ce6 photosensitizer and two-channel video-fluorescence system were used for fluorescence-guided resection of pituitary adenomas. The study involved three patients. Recorded during resection data showed a high level of Ce6 accumulation in pituitary adenoma tissues that helped achieve a high degree of tumor /resection.

– Break –

Laser interaction with cells and tissues: clinical imaging and spectroscopy II

Location: Petrov Vodkin 1 Room, floor 2. 11:30-13:30

TuSYB-06 11:30-12:00

Noninvasive glioblastoma diagnosis using spectral methods and machine learning *(Invited paper)*

O. Cherkasova[1,2], M. Konnikova[2,3], E. Dizer[4], A. Mankova[3], D. Vrazhnov[5,6], Yu. Kistenev[6], Y. Peng[6], A. Shkurinov[2,3]; [1]Inst. of Laser Physics SB RAS, Russia; [2]Inst. on Laser and Information Technologies - Branch of the Federal Scientific Research Centre "Crystallography and Photonics" RAS, Russia; [3]Lomonosov Moscow State Univ., Russia; [4]National Research Nuclear Univ. "MEPhI", Russia; [5]Inst. of Atmospheric Optics, Siberian Branch of the RAS, Russia; [6]Tomsk State Univ., Russia; [7]Univ. of Shanghai for Science and Technology, R. P. China.

Terahertz, Infrared, and Raman spectra of mouse blood serum were studied in the dynamics of U87 glioblastoma development. Machine learning methods were used to identify the most informative frequencies associated with glioma molecular markers and verify the separability of the groups under study.

This research was supported by RFBR Grant(s) # The work was supported by the RFBR (project № 19-52-55004), by the Government of the Russian Federation (Agreement No. 075-15-2021-615 of 04 June 2021)

TuSYB-07 12:00-12:30

Medical applications of laser photoacoustic spectroscopy *(Invited paper)*

Yu. Kistenev[1], A. Borisov[1], V.V. Prishepa[1], V. Skiba1, E. Schnayder[1], G. Rasponin[1], D. Makashev[1], I.K. Lednev[1,2]; [1]Tomsk State Univ., Russia; [2]Univ. at Albany, SUNY, USA

The report is devoted to medical diagnostics implementations through the chemical-composition-based and pattern-recognition-based analysis of breath air using laser photoacoustic spectroscopy combined with machine learning.

This research was supported by RFBR Grant(s) # The research was carried out with the support of a grant under the Decree of the Government of the Russian Federation No. 220 of 09 April 2010 (Agreement No. 075-15-2021-615 of 04 June 2021)

TuSYB-08 12:30-12:45

Intraoperative video-fluorescence navigation by PpIX and tissue saturation measurement during surgical resection of gastric malignant tumor

D.M Kustov[1], D.V. Yakovlev[1,2], A.S. Moskalev[1], E.I Kozlikina[1,3], W. Blondel[4], C. Daul[4], V.V. Levkin[5], S.S. Kharnas[5], A.A. Shiryaev[5], M.V. Loshchenov[1,3], N.A. Kalyagina[1,3], V.B. Loschenov[1,3]; [1]Prokhorov General Physics Inst. RAS; [2]Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS; [3]National Research Nuclear Univ. MEPhI, Russia; [4]Univ. de Lorraine, France; [5]Sechenov First Moscow State Medical Univ., Russia

Fluorescence visualization of pathologies is a popular form of endoscopic diagnostics in medicine. Interest in fluorescence optical visualization consists in providing information on the fluorescent signal spatial distribution by the photosensitizer fluorescence, which has a selective accumulation in tumor. Together with this, the determination of tissue saturation makes possible to assess of blood supply to anastomosis during surgical operation.

This research was supported by RFBR Grant(s) # 21-58-15005

TuSYB-09 12:45-13:00

The skin evanescent Fourier spectroscopy in vivo by extruded nanostructured silver halide fibers

L.N. Butvina[1], A.L. Butvina[1], V.D. Bitzoev[2]; [1]Prochorov General Physics Inst. RAS, Dianov Fiber Optics Research Center; [2]Mosgorzdrav, Russia

The evanescent Fourier spectroscopy of the skin in the finger print of biomolecules (600-4000 cm-1) using new extruded nanostructured fibers from silver halides were demonstrated. The quantitative molecular analysis of cellular components of the upper layers of the skin under different laser and light illumination were measured.

TuSYB-10 13:00-13:15

On the scattering phase function of the infinitesimal scattering volume of turbid biological media

D.A. Rogatkin, A.P. Tarasov; Lab. of Medical and Physics Research, Moscow Regional Research and Clinical Inst. "MONIKI" named after M.F. Vladimirsky, Russia

In the light transport theory, the scattering phase function (SPF) is commonly considered as independent on the absorption coefficient of a turbid medium. In this study for biological turbid media, we propose an approach to analytically derive SPF. It is shown that SPF for the infinitesimal scattering volume can depend on both scattering and absorption coefficient.

TuSYB-11 13:15-13:30

Infrared radiation transfer simulation of a two-layer bio-tissue based on the Bethe-Salpeter equation

V.L. Kuzmin[1], Yu.A. Zhavoronkov[2], S.V. Ul'yanov[2], A.Yu. Valkov[1,2]; [1]Peter the Great St. Petersburg Polytechnic Univ.; [2]St. Petersburg State Univ., Russia

We present results of Monte Carlo simulations of the infrared radiation backscattering from the "skull-brain" system based on the Bethe-Salpeter equation. Our original procedure for detecting backscattered photons gives a significant reduction in the computation time. We also modify the inverse transform procedure in the Monte Carlo method by explicitly considering radiation decay due to absorption in each scattering order.

– Lunch Break –

Laser interaction with cells and tissues: clinical imaging and spectroscopy III

Location: Petrov Vodkin 1 Room, floor 2. 15:00-16:30

TuSYB-12 15:00-15:30

Spectroscopic detection of pigments in tissues: correlation with tissue aging and cancer development *(Invited paper)*

L.M. Oliveira[1,2], T.M. Gonçalves[1], A.R. Botelho[1], I.S. Martins[2], H.F. Silva[2], I. Carneiro[3], S. Carvalho[3], R. Henrique[3], V.V. Tuchin[4]; [1]Physics Department, Polytechnic of Porto – School of Engineering (ISEP), Portugal; [2]Center of Innovation in Engineering and Industrial Technology, ISEP, Portugal; [3]Department of Pathology and Cancer Biology and Epigenetics Group, Portuguese Oncology Inst. of Porto, Portugal; [4]Science Medical Center, Saratov State Univ., Russia

Melanin and lipofuscin contents in tissues can be retrieved from their absorption spectrum. Analyzing various tissues between 200 and 1000 nm, it was found that the rabbit pancreas had similar contents of these pigments due to the aging process, while in the human kidney 83% of the melanin in the normal tissue was converted into lipofuscin in the cancer tissue.

This research was supported by RFBR Grant(s) # VVT was supported by the RF Government grant 075-15-2021-615

TuSYB-13 15:30-16:00

Calibration problem in laser ektacytometry of red blood cells *(Invited paper)*

S.Yu. Nikitin; Physics Faculty, Lomonosov Moscow State Univ., Russia

Problem of measuring red blood cell deformability by laser diffractometry in a shear flow (ektacytometry) is considered. A calibration equation is obtained that connects the geometric parameters of the isointensity line of the diffraction pattern with the level of light intensity on this line. A simplified algorithm for measuring the spread of red blood cell in deformability is proposed.

TuSYB-14 16:00-16:15

Digital diaphanoscopy data processing for differentiation of maxillary sinus pathologies

E.O. Bryanskaya[1], V.V. Dremin[1,2], I.N. Novikova[1], Yu.O. Nikolaeva[3], V.G. Pil'nikov[3], A.V. Bakotina[3], A.Y. Ovchinnikov[3], D.N. Panchenkov[3], A.V. Baranov[4], V.G. Artyushenko[5], A.V. Dunaev[1]; [1]R&D Center of Biomedical Photonics, Orel State Univ., Russia; [2]College of Engineering and Physical Sciences, Aston Univ., UK; [3]Yevdokimov Moscow State Univ. of Medicine and Dentistry; [4]Skobelkin State Scientific Center of Laser Medicine FMBA, Russia; [5]Art Photonics GmbH, Germany

The paper presents the results of the use of the digital diaphanoscopy method to detect the pathology of the maxillary sinuses with the participation of conditionally healthy volunteers and patients with various types of pathological changes, confirmed by CT results. The results sinuses state classifying based on a quantitative assessment of the registered scattering patterns of light are also presented.

This research was supported by RFBR Grant(s) # The reported study was funded by RFBR according to the research project № 20-32-90147

TuSYB-15 16:15-16:30

Near-Infrared and diffuse reflectance spectroscopy of ex vivo and in vivo cutaneous melanin - pigmented neoplasia

V.S. Mircheva[1], P.P. Troyanova[2], I.N. Terziev[2], Yu.A. Khristoforova[3], I.A. Bratchenko[3], L.A. Bratchenko[3], Ts.I. Genova[1], E. Borisova[1,4]; [1]Inst. of Electronics, BAS, Bulgaria; [2]Univ. Hospital "Tzaritza Yoanna – ISUL", Bulgaria; [3]Samara National Research Univ., Russia; [4]Research National Saratov State Univ., Russia

In the current study are investigated pigmented skin neoplasia - benign, dysplastic and malignant ones using Near- Infrared fluorescence technique and diffuse – reflectance spectroscopy in order to make them easier to distinguish.

Section C. Photonics and nanobiotechnology

Photonics and nanobiotechnology I

Location: Petrov Vodkin 2 Room, floor 2. 09:00-11:00

TuSYC-01 09:00-09:30

Detection of the receptor-binding domain of the SARS-CoV-2 spike glycoprotein using surface-enhanced Raman scattering *(Invited paper)*

A.K. Sarychev; Inst. for Theoretical and Applied Electrodynamics RAS, Russia

Label-free SERS recording of the receptor-binding domain of SARS-CoV-2 S-glycoprotein is proposed, which allows sensing characteristic protein Raman spectra at the concentrations sufficient for ultrasensitive detection of viral protein antigens.

This research was supported by RFBR Grant(s) # 20-21-00080

TuSYC-02 09:30-10:00

Gap-enhanced Raman tags: fabrication, optical properties, applications in biosensing and bioimaging *(Invited paper)*

B.N. Khlebtsov; Inst. of Biochemistry and Physiology of Plants and Microorganisms, Saratov Scientific Centre RAS, Russia

Gap-enhanced Raman tags (GERTs) are new emerging probes of the surface-enhanced Raman spectroscopy (SERS) that have found promising analytical and bioimaging applications. In this talk, we discuss recent progress in the synthesis, experimental studies of optical properties, and biomedical applications of novel GERTs fabricated with common plasmonic metal – gold (Au).

TuSYC-03 10:00-10:30

SERS-active substrates based on Au/Ag-decorated silicon nanostructures for the rapid detection of biomolecules *(Invited paper)*

L.A. Osminkina; Lomonosov Moscow State Univ., Russia

Surface-enhanced Raman scattering (SERS) has proven itself to successfully detect different biomolecules. Silicon nanostructures are attractive objects for creating sensitive sensors due to the simplicity of their preparation methods and silicon surface tailorability. We propose a new method for producing SERS-active substrates based on Au/Ag-decorated silicon nanostructures for the rapid label-free detection of bilirubin, pyocyanin and different proteins.

TuSYC-04 10:30-10:45

Using the SERS method and machine learning technology to detect the influenza A virus.

A.T. Tabarov[1], V.V. Vitkin[1], D.M. Danilenko[2], O.V. Andreeva[1], A.A. Shemanaeva[1], E.E. Popov[1], A.A. Dobroslavin[1], V.V. Kurikova[1], O.B. Kuznetsova[1]; [1]ITMO Univ.; [2]Smorodintsev Research Inst. of Influenza, Russia

The worldwide pandemic demonstrates the need to develop new methods for the respiratory viral diseases' diagnosis, which should be fast and accurate. Surface-enhanced Raman spectroscopy (SERS) can be one of such methods. Our work demonstrates the possibility of using SERS technology and machine learning for fast and accurate detection of the influenza A virus in a biological sample.

TuSYC-05 10:45-11:00

Gold nanolabels for SERS imaging excitable by red lasers

V.O. Svinko, A.I. Shevchuk, A. N. Smirnov, V.V. Sharoiko, E.V. Solovyeva; Inst. of Chemistry, St. Petersburg State Univ., Russia

The work is aimed to the design of plasmonic tags, having the most effective SERS signal upon the excitation by red lasers. Gold nanostars were synthesized to be used as a plasmonic core, covered by polymer shell containing Cyanine 5.5 and functionalized by folic acid as a model delivery vector. The obtained tags were tested on PANC-1 cell line.

This research was supported by RFBR Grant(s) # The work is supported by Saint-Petersburg State University, project № 92350587.

– Break –

Photonics and nanobiotechnology II

Location: Petrov Vodkin 2 Room, floor 2. 11:30-13:30

TuSYC-06 11:30-12:00

Combination of nanostructured materials and photonic tools for biomedical applications *(Invited paper)*

D.A. Gorin; Skolkovo Inst. of Science and Technology, Russia

The photonic tools, as well as acoustic tools, can be used for in vivo navigation, visualization, and activation of a new type of multifunctional nanostructured particles. 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.

This research was supported by RFBR Grant(s) # 19-53-80047 БРИКС_т

TuSYC-07 12:00-12:30

Gene and small molecule delivery in vivo using novel nanoparticle-based systems *(Invited paper)*

M.P. Nikitin[1,2]; [1]Moscow Inst. of Physics and Technology; [2]Sirius Univ. of Science and Technology, Russia

Therapies based on co-delivery of drugs and nucleic acids have outstanding potential. Nanoparticles are a promising class of delivery vehicles due to their ability to simultaneously transport a great range and amount of payloads. Here, we demonstrate the possibility of adapting the properties of nanoparticles of various classes to deliver a wide range of therapeutic cargo for biomedical applications.

This research was supported by RFBR Grant(s) # the Russian Science Foundation grant #21-14-00269 , the Ministry of Science and Higher Education of the Russian Federation: agreement #075-03-2021-095, project 0714-2020-0004

TuSYC-08 12:30-12:45

The use of dielectric nanoparticles doped with rare-earth ions to increase the thermal effect of laser radiation of various wavelengths on biological tissues

S.A. Khrushchalina, I.A. Yurlov, P.A. Ryabochkina, V.P. Ageev, O.N. Kulikov, V.I. Shlyapkina, M.N. Tremasov, M.N. Zharkov, A.N. Belyaev, O.S. Bushukina; National Research Ogarev Mordovia State Univ., Russia

The paper presents the results of in-vivo experiments on the non-contact effect of laser radiation with different wavelengths on the skin of rats pre-coated with nanoparticles doped with rare-earth ions. We carried out a comparative assessment of the degree of damage to biological tissues after non-contact exposure to laser radiation with and without preliminary coating with nanoparticles.

This research was supported by RFBR Grant(s) # This work is financially supported by a grant from the President of the Russian Federation (MK-5500.2021.1.2)

TuSYC-09 12:45-13:00

Dual pH and oxygen sensor for application in FLIM-PLIM imaging

A.I. Solomatina, P.S. Chelushkin; Inst. of Chemistry, St. Petersburg State Univ., Russia

Simultaneous multiple sensing of physiologically relevant characteristics of biological samples remains a challenging issue in bioimaging. Herein we describe a new strategy and present the first example of dual pH/O2 lifetime sensor based on covalent conjugation of fluorescein (pH) and orthometalated iridium complex (O2) to human serum albumin (HSA) and demonstrate its applicability in FLIM-PLIM microscopic experiments.

TuSYC-10 13:00-13:30

Construction of optical and electrochemical biosensors by circular permutation of enzymes. *(Invited paper)*

K. Alexandrov; CSIRO-QUT Synthetic Biology Alliance, Queensland Univ. of Technology, Australia

Here we present an approach for the construction of fully integrated but modular biosensors with optical and electrochemical outputs. This is achieved by designing allosterically regulated circular permutated variants of enzymes such as PQQ-glucose dehydrogenase (PQQ-GDH) and NanoLuc luciferase.

– Lunch Break –

Photonics and nanobiotechnology III

Location: Petrov Vodkin 2 Room, floor 2. 15:00-17:00

TuSYC-11 15:00-15:30

Application of fluorescent nanoparticles in bioanalysis *(Invited paper)*

I.Yu. Goryacheva, A.A. Kokorina, E.A. Mordovina, D.V. Tsyupka, D.D. Drozd, T.S. Ponomaryeva, O.A. Goryacheva; Saratov State Univ., Russia

Fluorescent nanoparticles, first of all quantum dots, modified carbon-based and gold nanostructures present a perspective tool for fast and high-throughput signal enhancement and detection. Analysis in format Point-Of-Care or multisample readers allow to provide a basis for researcher or routine analysis. Future perspectives are related to the sensitivity improvement of conjugation protocols and assay schemes, application of non-incubation homogeneous formats.

This research was supported by RFBR Grant(s) # The work was supported by Russian Science foundation (project 20-13-00195).

TuSYC-12 15:30-16:00

Real-time detection of molecular markers in complex biological matrices *(Invited paper)*

A.V. Orlov; Prokhorov General Physics Inst. RAS, Russia

High-sensitive analytical systems have been developed based on interferometric optical and electronic magnetic registration of biolabels on 2-D, 2.5-D and 3-D solid phases. Real-time detection of a wide range of key biological markers (both high- and low-molecular-weight substances) has been demonstrated. The possibility of their direct registration in complex matrices has been shown.

TuSYC-13 16:00-16:30

QDs as a sensor of intra-endosomal microenvironment changes *(Invited paper)*

E.S. Kornilova[1,2,3], I.K. Litvinov[1], A.V. Salova[1], T.N. Belyaeva[1]; [1]Inst. of Cytology RAS; [2]Peter the Great St. Petersburg Polytechnic Univ.; [3]St. Petersburg State Univ., Russia

Fluorescent semiconductor nanocrystals Quantum Dots (QDs), due to long fluorescence lifetime attract attention as promising markers to follow endocytosis in live cells. We have studied the influence of such components of intra-endosomal medium, as hydrogen and peroxide as well as K+, Na+ and Ca2+ ions, on QDs lifetime. We conclude that QDs may manifest complicated changes in endosomal microenvironment.

This research was supported by RFBR Grant(s) # Russian Foundation for Basic Research, number No 20-04-00927.

TuSYC-14 16:30-16:45

An increase in luminescence brightness of Nd^{3+}: LaF_3 nanoparticles, synthesized by hydrothermal microwave method promising for NIR bioimaging

A.V. Popov[1], E.O. Orlovskaya[1], A.T. Shaidulin[1,2], E.E. Timofeeva[1], S.G. Fedorenko[3], Yu.V. Orlovskii[1,4]; [1]Prokhorov General Physics Inst. RAS; [2]Mendeleev Univ. of Chemical Technology of Russia; [3]Voevodsky Inst. of Chemical Kinetics and Combustion SB RAS, Russia; [4]Inst. of Physics, Univ. of Tartu, Estonia

By transferring the initial Nd3+: LaF3 nanoparticles synthesized by hydrothermal microwave treatment, from aqueous colloidal solutions to DMSO, the possibility of increasing the luminescence brightness in the near IR spectral range is shown.

TuSYC-15 16:45-17:00

Study of biodistribution and accumulation of nanoparticles in a tumor using various detection techniques

E.N. Mochalova[1,2], A.G. Burenin[1], M.V. Veremyeva[1], A.M. Skirda[1], B.G. Gorshkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Sirius Univ. of Science and Technology, Russia

Nanoparticles offer a variety of potentially effective solutions for the development of agents for targeted therapy and early diagnosis of cancer. Here we studied the biodistribution and tumor uptake of a wide range of nanoparticles to achieve their proper in vivo performance using a number of techniques such as optical imaging, ICP-OES, and magnetic particle quantification method.

This research was supported by RFBR Grant(s) # Russian Science Foundation grant No. 21-12-00407

Section A. Advanced laser medical systems and technologies

TuSYA-p01 15:00-18:30

Helicobacter pylori breath test by the Raman spectroscopy gas analyzer

E.E. Popov[1], A.V. Polishchuk[1], I.K. Chubchenko[2], O.B. Kuznetsova[1], V.V. Vitkin[1]; [1]ITMO Univ,; [2]Mendeleyev Inst. for Metrology (VNIIM), Russia

The features of the Helicobacter pylori pathogen diagnosis in the human gastrointestinal tract using Raman spectroscopy are described. The estimation of the Raman gas analyzer resolution was conducted. Experimental measurement of a gas mixture with a known composition has been carried out.

TuSYA-p02 15:00-18:30

δ13C measurements in a human exhalation

E.E. Popov[1], A.V. Polishchuk[1], I.K. Chubchenko[2], K.M. Grigorenko[1], A.V. Kovalev[1]; [1]ITMO Univ.; [2]Mendeleyev Inst. for Metrology (VNIIM), Russia

The ratio of stable 13C/12C carbon isotopes in the exhaled human breath was measured and compared to a standard value of reference material. Extended uncertainty of measurements was calculated. The factors influencing the measurement's uncertainty in the Raman spectroscopy analysis of the gas mixture's quantitative composition were determined.

TuSYA-p03 15:00-18:30

Laser mass spectrometry of volatile organic compounds for diagnostics of kidney damage

A.B. Bukharina[1], A.V. Pento[1], V.V. Iakovlev[2], O.L. Morozova[2]; [1]Prokhorov General Physics Inst. RAS, [2]Sechenov First Moscow State Medical Univ., Russia

A method of laser mass spectrometric express analysis of volatile organic compounds (VOC) without sample preparation is proposed. VUV radiation of laser plasma is used for VOCs ionization. The method was applied for early diagnostics of kidney damage in children with congenital uropathy.

TuSYA-p04 15:00-18:30

Study of the effect of dissection of biological tissues by 3 microns laser radiation

O.V. Tikhonevich[1], A.A. Sirotkin[1], N.E. Gorbatova[2], G.P. Kuzmin[1], Y.L. Kalachev[1]; [1]Prokhorov General Physics Inst. RAS; [2]Inst. of Emergency Children's Surgery and Traumatology, Russia

The results of exposure to laser radiation at a wavelength of 3 microns were studied and its parameters were determined for ablative destruction of surface tissues and dissection of tissue structures.

TuSYA-p05 15:00-18:30

Evaluation of the photoplethysmographic waveform by Monte Carlo simulation of light transport

D.G. Lapitan[1], A.P. Tarasov[1,2]; [1]Moscow Regional Research and Clinical Inst. (MONIKI) named after M.F. Vladimirsky; [2]Federal Research Scientific Center "Crystallography and Photonics" RAS, Russia

The photoplethysmographic waveform was modeled for different source-detector distances using the Monte Carlo technique. For this, a three-layer optical model of the skin for reflection was developed. It was found that the pulse wave is most pronounced for the distance of 6 mm.

This research was supported by RFBR Grant(s) # Russian Science Foundation (project No. 21-75-00037)

TuSYA-p06 15:00-18:30

Fluorescence visualization of superficial bladder cancer at TUR

M. Loshchenov[1,2], A. Seregin[3,4], N. Kalyagina[1,2], A. Borodkin[1]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPhI; [3]Botkin City Clinical Hospital of the Department of Health of Moscow; [4]Russian Medical Academy of Continuous Professional Education of the Ministry of Health of the Russian Federation, Russia

The study demonstrates the possibilities of video-fluorescence diagnostics with laser excitation at 635 nm at bladder TUR. The main tumor foci were resected, and then a fluorescence analysis of the tumor borders was performed. Small fluorescent tumor foci, not seen by cystoscopy in white light, were detected and the diagnostic fluorescence contrast was measured to quantify 5-ALA in tissues

TuSYA-p07 15:00-18:30

Laser radiation at a wavelength of 525 nm used for controlled hemostasis.

O.V. Tikhonevich[1], A.A. Sirotkin[1] , N.E. Gorbatova[2], D.A. Safin[2], Y.L. Kalachev[1], G.P. Kuzmin[1]; [1]Prokhorov General Physics Inst. RAS; [2]Inst. of Emergency Children's Surgery and Traumatology, Russia

The results of exposure to laser radiation at a wavelength of 525 nm were studied and its parameters were determined for laser radiation to effectively stop bleeding.

Section C. Photonics and nanobiotechnology

TuSYC-p01 15:00-18:30

Hybrid nanostructures based on InGaN nanowires with deposited Ag NPs-SiOx for visible emission range

T.M. Shugabaev[1], V.O. Gridchin[1,2], K.P. Kotlyar[1], A.S. Dragunova[1], A.S. Kulagina[3], G.E. Cirlin[1-3]; [1]St. Petersburg Academic Univ.; [2]St. Petersburg State Univ.; [3]Ioffe Inst., Russia

InGaN nanowires were synthesized by molecular beam epitaxy. The colloidal method was used to synthesize silver NPs coated with SiOx layers of different thicknesses. The dependence of the PL response of the InGaN-Ag-SiOx hybrid structure on the thickness of the SiOx layer has been studied for the first time.

This research was supported by RFBR Grant(s) # RSF grant (project № 19-7230010)

TuSYC-p02 15:00-18:30

Two-stage method for comparing the lengths of optical fibers using OFDR

I.R. Drozdov[1], K.A. Ovcinnikov[1,2], E.S. Boychuk[1,3], V.V. Krishtop[1,2,3]; [1]Perm Scientific-Industrial Instrument Making Company; [2]Perm State Univ.; [3]Perm National Research Polytechnic Univ., Russia

The paper proposes a two-stage method for comparing the lengths of optical fibers using the optical frequency domain reflectometry. The method was applied for comparing of of two fibers lengths.

TuSYC-p03 15:00-18:30

Modeling of local field enhancement and laser heating effects in iron oxide nanoparticles

D.V. Pominova[1,2], I.D. Romanishkin[1], A.V. Ryabova[1,2], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPHI, Russia

In this work, we have carried out theoretical modeling of heating of iron oxide nanoparticles under the action of laser radiation, modeling of scattering and absorption of exciting laser radiation on iron oxide nanoparticles and their dimers, as well as local field enhancement near individual iron oxide nanoparticles and between two nanoparticles of different sizes forming a dimer.

This research was supported by RFBR Grant(s) # The Russian Foundation for Basic Research grant 21-52-12030 NNIO_a

TuSYC-p04 15:00-18:30

Optical characterization of small-molecule—protein conjugates for development of express high-sensitive immunosensors based on magnetic biolabels

J.A. Malkerov[1], S.L. Znoyko[1], A.V. Pushkarev[1], N.N. Orlova[1], A.I. Nikitin[2], G.M. Sorokin[3], B.G. Gorshkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Volga branch of MADI; [3]Chuvash State Univ., Russia

Conjugates of ochratoxin A (OTA) with a carrier protein – bovine serum albumin – were characterized in terms of kinetics of their interaction with monoclonal antibodies against OTA. Spectral interferometric methods were used for label-free characterization in a real-time mode. An express sensitive method was developed for on-site OTA detection in food based on electronic registration of magnetic biolabels.

TuSYC-p05 15:00-18:30

Changes in the optical properties of plant tissues with cyclic temperature changes

E.A. Trefilova[1], T.K. Karpova[1], N.V. Kovalenko[1,2], O.A. Ryabushkin[1,2]; [1]Moscow Inst. of Physics and Technology; [2]Fryazino branch of Kotelnikov Inst. of Radio-Engineering and Electronics, Russia

Using the method of movable integrating spheres, the optical properties of the raw and freezing-unfreezing potato flesh were investigated. The significant effect of this process on both optical scattering and absorption is shown.

TuSYC-p06 15:00-18:30

Raman spectroscopy of the interaction of carbon-coated iron nanoparticles with proteins

V.A. Mozhaeva, E.I. Nagaev, T.A. Matveeva, E.A. Mol'kova, R.M. Sarimov, K.A. Prokhorov; [1]Biophotonics Center, Prokhorov General Physics Inst. RAS, Russia

Here, using Raman spectroscopy, the interaction of graphene-coated iron nanoparticles (G-Fe NPs) with the protein immunoglobulin G (IgG) is studied. Two additional peaks in the spectrum reflecting the interaction of G-Fe NPs with IgG were found for their solution. The amplitude of the found peaks decreases with change in pH to 4, which is below the IgG isoelectric point.

This research was supported by RFBR Grant(s) # 22-22-00951

TuSYC-p07 15:00-18:30

Internal reference method for the study of upconversion luminescence of nanoparticle suspensions

S.A. Burikov[1]; A.A. Fedyanina[1]; K.A. Laptinskiy[2]; T.A. Dolenko[1]; [1]Department of Physics, Lomonosov Moscow State Univ.; [2]Skobeltsyn Inst. of Nuclear Physics, Lomonosov Moscow State Univ., Russia

This paper presents new internal reference method for studying upconversion luminescence of nanoparticle suspensions. Idea of method is based on simultaneous excitation of luminescence of suspensions of upconversion nanoparticles and Raman scattering of medium. For this, signal and idler beams of optical parametric oscillator were used. Method allows to eliminate the influence of instability of excitation intensity on the results.

TuSYC-p08 15:00-18:30

Effect of high-power pulses of terahertz radiation on normal and tumor cell lines of the human brain

D.S. Sitnikov[1], I.V. Ilina[1], V.A. Revkova[2], S.A. Gurova[3], M.A. Konoplyannikov[2,4], V.A. Kalsin[2], V.P. Baklaushev[2]; [1]Joint Inst. for High Temperatures RAS; [2]Federal Research and Clinical Center of Specialized Medical Care and Medical Technologies of FMBA of Russia; [3]National Research Nuclear Univ. MEPhI, Obninsk Inst. for Nuclear Power Engineering; [4]Inst. for Regenerative Medicine, Sechenov Univ., Russia

A study was made of the impact of high-power pulses of THz radiation (0.1-3 THz) on cells of normal and tumor lines of the human brain. The formation of H2AX histone phosphorylation foci in cells under the influence of THz pulses was studied, taking into account the phase of the cell cycle.

This research was supported by RFBR Grant(s) # 19-02-00762

TuSYC-p09 15:00-18:30

Synthesis of polymer-coated metal-organic frameworks for gene delivery

A.A. Sizikov[1], E.V. Kalita[1], R.O. Melikov[1], A.V. Gopanenko[2], V.R. Cherkasov[1,3]; [1]Moscow Inst. of Physics and Technology, Russia; [2]Sirius Univ. of Science and Technology, Russia; [3]Prokhorov General Physics Inst. RAS, Russia

In vivo delivery of genes of interest is an ongoing challenging task. We performed optimization of synthesis of metal-organic frameworks with magnetic core to improve their ability to be nucleic acid carriers. We varied synthesis parameters to investigate their impact on DNA-binding capacity and on the ability of nanoparticles to be a vehicle for in vitro transfection.

This research was supported by RFBR Grant(s) # Russian Science Foundation grant # 21-14-00269, the Ministry of Science and Higher Education of the Russian Federation: agreements # 075-00958-2105 and 075-03-2021-095, project 0714-2020-0004

TuSYC-p10 15:00-18:30

Optimization of Au-based nanoparticle-beacon system for biomedical applications

A.A. Kotov[1], A.V. Gopanenko[2], B.G. Gorshkov[3], M.P. Nikitin[1,2]; [1]Moscow Inst of Physics and Technology; [2]Sirius Univ. of Science and Technology; [3]Prokhorov General Physics Inst. RAS, Russia

In this study, we explored new sensing oligos for a recently developed nanoparticle-beacon (NB) system, aiming to expand the set of NB that could be used to detect several clinically relevant targets in the format of lateral flow assay (LFA). We expanded the set of oligos exploited as sensors in the NB and applied them in different assays.

This research was supported by RFBR Grant(s) # 075-00958-2105, 075-03-2021-095, 0714-2020-0004

TuSYC-p11 15:00-18:30

Electrophoretic mobility of gold nanoparticles by electrophoretic light scattering method

E. Savchenko, O. Tkach, Peter the Great St. Petersburg Polytechnic Univ., Russia

In this research we describe principles of electrophoretic light scattering method and results on measuring electrophoretic mobility of gold nanoparticles depending on the concentration of the solution.

This research was supported by RFBR Grant(s) # This research was funded by RSF, grant number No 21-72-20029.

TuSYC-p12 15:00-18:30

Label-free method for screening antibodies against thyroxin

S.L. Znoyko, V.A. Bragina, J.A. Malkerov, B.G. Gorshkov; Prokhorov General Physics Inst. RAS, Russia

A label-free optical method is presented for screening antibodies against free thyroxine. The method features real-time monitoring of antigen-antibody interactions. The single-used sensor chip is a commonly available microscope glass cover slip. The benefits of the developed method include controllable in real time immobilization of virtually any biotinylated antigen/antibody on universal biotinylated chips due to the used biotin-streptavidin bond.

This research was supported by RFBR Grant(s) # 21-12-00407

TuSYC-p13 15:00-18:30

Continuous variable measurement-device-independent quantum communication scheme based on subcarrier waves

M. Fadeev[1,2], R. Goncharov[1], S. Smirnov[1], V. Chistyakov[1]; [1]ITMO Univ., [2]SMARTS-Quanttelecom LLC., Russia

In this work, we combine the achievements in terms of coherent detection based on the subcarrier wave method and measurement-device-independent approach. For such a scheme we provide a proof-of-principle experiment

TuSYC-p14 15:00-18:30

Evaluation of the influence of the contribution of laser-induced plasma in the synthesis of nanoparticles

A.V. Kharkova, D.A. Kochuev, K.S. Khorkov; Vladimir State Univ., Russia

A method of femtosecond laser synthesis of aluminum oxide nanoparticles has been developing. As a result of ablation of the material, the formation of a laser-induced plasma plume was observed. The influence of the energy contribution of the plasma plume on the process of ablation of nanoparticles is estimating.

TuSYC-p15 15:00-18:30

Development and characterization of a label-free method for detection of folic acid

D.O. Novichikhin[1,2], S.L. Znoyko[1], N.N. Orlova[1,3], F.A. Zavalko[3], B.G. Gorshkov[1]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPhI; [3]Moscow Inst. of Physics and Technology, Russia

Rapid inexpensive tests with single-used consumables for determination of folic acid are highly demanded in medicine. In this study, we propose and demonstrate a method of label-free detection of folic acid based on the spectral-correlation interferometry approach. The proposed method exhibits subnanomolar limit of detection and a wide dynamic range that covers clinically relevant concentrations of folic acid in humans.

TuSYC-p16 15:00-18:30

Fluorescence anisotropy of FAD in water-propylene glycol solutions under excitationby picosecond laser pulses at 355 nm

I.A. Gorbunova[1], M.K. Danilova[1], I.A. Gradusov[2], D.M. Beltukova[1] , V.P. Belik[1], O.S. Vasyutinskii[1]; [1]Ioffe Physical Technical Inst.; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia

The experimental study of fluorescence anisotropy decay of FAD in water-propylene glycol solutions under excitation by picosecond laser pulses at 355 nm was carried out. Initial anisotropies and rotational diffusion times were determined from experimental data by fit. The determined relationship between the rotational diffusion times and solvent viscosity was compared with that in water-methanol solutions

TuSYC-p17 15:00-18:30

Phase edges detection in the presence of noise based on transport-of-intensity equation

I.V. Gritsenko[1], M.S. Kovalev[1,2]; [1]Lebedev Physical Inst.; [2]Bauman Moscow State Technical Univ., Russia

A method for phase edges detection is presented. This approach allows to retrieve phase of a light wave from the intensity measurement in multiple planes using transport-of-intensity equation. Then edges detection implemented via ridding of noise-induced artefacts.

TuSYC-p18 15:00-18:30

Anti-Stokes fluorescence excitation as a method for investigation of protein-protein interactions on example of cyanobacterial phycobiliproteins

E.A. Protasova, D.V. Zlenko, E.A. Slutskaya, E.G. Maksimov; Lomonosov Moscow State Univ., Russia

Phycobiliproteins are highly fluorescent components of the photosynthetic apparatus of cyanobacteria and red algae. This work shows the possibility of anti-Stokes fluorescence excitation of phycobiliproteins through the single-photon hot-band mechanism. Selective excitation of low-energy chromophores in phycobiliproteins-containing light-harvesting complex reveals features of interactions between pigments in a complex with orange carotenoid protein.

TuSYC-p19 15:00-18:30

Controlled surface topology for tunable kinetics of biomolecular interactions monitored with a label-free optical biosensor for detection of cardiac markers

A.V. Orlov, S.V. Miziev, N.V. Guteneva; Prokhorov General Physics Inst. RAS, Russia

The present research shows that the same functional coating applied onto surfaces of different topology produces materials that have different kinetic properties of interaction with the target. Direct optical monitoring of interactions was implemented using an original label-free detector. The approach was demonstrated during development of a sensitive analytical system for simultaneous express determination of several cardiomarkers.

TuSYC-p20 15:00-18:30

Optical label-free method for characterization of kinetics of antibodies to SARS-CoV-2

V.A. Bragina[1], A.V. Pushkarev[1], A.V. Orlov[1], S.L. Znoyko[1], D.O. Novichikhin[1,2], N.V. Guteneva[1], A.M. Skirda[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPhI, Russia

In this work, an optical label-free method is developed for measurements and characterization of kinetics of antibodies to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in real time. The proposed method employs inexpensive and widely available consumables compatible with various chemical interfaces. It is promising for assessment the kinetics of humoral response to SARS-CoV-2 infection or postvaccination.

TuSYC-p21 15:00-18:30

DIY plasma system for PDMS labs-on-a-chip

V.D. Khudyshkin, D.S. Andreyev; X-BIO Inst., Univ. of Tyumen, Russia

We present a low-cost DIY plasma activation system suitable for irreversible bonding PDMS to PDMS or glass substrates and changing the surface properties of materials.

Section B. Laser interaction with cells and tissues: clinical imaging and spectroscopy

Laser interaction with cells and tissues: clinical imaging and spectroscopy IV

Location: Petrov Vodkin 1 Room, floor 2. 09:00-11:00

WeSYB-16 09:00-09:30

Spectral approaches for depth analysis in diffuse optical diagnostics modalities *(Invited paper)*

M. Kirillin[1], D. Kurakina[1], A. Khilov[1], V. Perekatova[1], A. Getmanskaya[1,2], V. Shishkova[1,2], M. Shakhova[1,3], A. Orlova[1], A. Malygina[3], A. Mironycheva[1,3], I. Shlivko[3], S. Gamayunov[1,4], N. Orlinskaya[3], I. Turchin[1], E. Sergeeva[1]; [1]Inst. of Applied Physics RAS; [2]Lobachevsky State Univ. of Nizhny Novgorod; [3]Privolzhsky Research Medical Univ.; [4]Nizhny Novgorod Regional Oncological Hospital, Russia

Strong dispersion of biotissue optical properties in visible and NIR ranges determines difference in probing depths in optical diagnostics modalities thus allowing to control probing depth by the choice of the wavelength range. The paper discusses spectral dependence of the probing depth and the accuracy of oxygen saturation reconstruction in diffuse reflectance spectroscopy and reviews dual-wavelength approach in fluorescence imaging.

WeSYB-17 09:30-10:00

Raman-LIBS for tumor tissue imaging and cells detection *(Invited paper)*

Qingyu Lin, Yixiang Duan; Research Center of Analytical Instrumentation, School of Mechanical Engineering, Sichuan Univ., China

With cancer seriously hampering the increasing life expectancy of people, developing an instantly diagnostic method has become an urgent objective. we developed Raman-LIBS method for tumor tissues recognition and cancer cells detection.

WeSYB-18 10:00-10:30

Physical aspects and possibilities of laser drug delivery *(Invited paper)*

A.V. Belikov, Y.V. Fedorova, S.N. Smirnov, A.D. Kozlova; ITMO Univ., Russia

The features of active laser delivery of modern chlorin-containing photosensitizing drugs under the nail plate and skin are discussed. The mechanisms and optimal parameters for microporation and active laser delivery of drugs were determined.

This research was supported by RFBR Grant(s) # The research was supported by Russian Science Foundation (project No. 22-25-00468)

WeSYB-19 10:30-10:45

An ex vivo study of the impact of mid-infrared laser on ocular tissues

YU.N. Yusef[1], D.V. Petrachkov[1], E.N. Korobov[1], L. Alharki[1], I.M. Belousova[2], A.P. Zhevlakov[2], A.S. Narivonchik[2]; [1]Dept. Innovation Vitreoretinal Technology, Research Inst. of Eye Diseases; [2]Vavilov State Optical Inst., Russia

We are searching for the most suitable laser radiation, which will allow to make thin cuts on the retina with high accuracy, minimal damage to surrounding tissues. As the first wavelength we chose 3.0 μm. The retina, choroid and sclera of pig eyes were used. The impact of laser radiation on eye tissues was assessed using a scanning electron microscope.

WeSYB-20 10:45-11:00

Anisotropic relaxation in NADH excited state studied by polarized pump-probe spectroscopy in water-1,2-propandiol solutions

I.A. Gorbunova[1], D.A. Volkov[1], M.E. Sasin[1], D.V. Yashkov[2], Y. Wang[3], S. Zhang[3], O.S. Vasutinskii[1]; [1]Ioffe Inst., Russia; [2]Peter the Great St. Petersburg Polytechnic Univ., Russia; [3]State Key Lab. of Magnetic Resonance and Atomic and Molecular Physics, China

Energy transfer processes in NADH excited states in water-1,2-propandiol solutions has been studied using polarization-sensitive pump–probe technique. Fast picosecond anisotropic vibrational relaxation in NADH was observed at the first time that was shown to be due to the rotation of the molecular transition dipole moment in the course of fast rearrangement of NADH nuclear configuration.

– Break –

Laser interaction with cells and tissues: clinical imaging and spectroscopy V

Location: Petrov Vodkin 1 Room, floor 2. 11:30-13:30

WeSYB-21 11:30-12:00

Simultaneous measurement of fluorescent and magnetic resonance 3D images *(Invited paper)*

I.D. Solovyev[1], N.I. Kazachkina[1], V.V. Zherdeva[1], I.G. Meerovich[1], D.K. Tuchina[1,2], A.A. Bogdanov Jr.[1,3], V.V. Tuchin[1,2,4], A.P. Savitsky[1]; [1]Bach Inst. of Biochemistry, Federal Research Centre "Fundamentals of Biotechnology" RAS; [2]Saratov State Univ., Russia; [3]Univ. of Massachusetts Medical School, Radiology, USA; [4]Inst. of Precision Mechanics and Control RAS, Russia

The combination of magnetic resonance and fluorescence imaging will allow tying molecular events to their location in the body. The optical clearing is the major strategy for increasing the depth of light penetration into essentially non-transparent turbid environments such as biological tissues, which decreases the multiple scattering of light.

This research was supported by RFBR Grant(s) # The study was supported by the Ministry of Science and Higher Education of the Russian Federation (grant no. 14.W03.31.0023)

WeSYB-22 12:00-12:30

Evaluation of OCA diffusivity in tissues through diffuse reflection spectroscopy *(Invited paper)*

I.S. Martins[1], M.R. Pinheiro[2], H.F. Silva[1], V.V. Tuchin[3], L.M. Oliveira[1,2]; [1]Center of Innovation in Engineering and Industrial Technology, ISEP, Portugal; [2]Polytechnic of Porto – School of Engineering (ISEP), Portugal; [3]Science Medical Center, Saratov State Univ., Russia

The diffusion properties of water and optical clearing agents in a tissue are usually evaluated ex vivo. Using both collimated transmittance and diffuse reflectance kinetic measurements, the diffusion properties of water and propylene glycol were evaluated in muscle. The properties obtained by both methods presented a deviation of 0.8%, a result that opens the possibility for in vivo evaluation.

This research was supported by RFBR Grant(s) # VVT was supported by the RF MSHE grant 13.2251.21.0009

WeSYB-23 12:30-13:00

Osmotically-induced strain in biological tissues during optical clearing: dependence on agent type and concentration *(Invited paper)*

Yu.M. Alexandrovskaya[1], O.I. Baum[1], A.A. Sovetsvky[2], A.L. Matveyev[2], L.A. Matveev[2], V.Y. Zaitsev[2]; [1]Inst. of Photon Technologies, FSRC "Crystallography and Photonics" RAS; [2]Inst. of Applied Physics RAS, Russia

We apply phase-sensitive Optical Coherence Elastography (OCE) to evaluate and analyze spatially-resolved strain fields in porous biological tissues during their optical clearing. Particular examples of optical clearing agents diffusion in cartilage, eye tissues and liver are considered.

WeSYB-24 13:00-13:15

Recognising the cellular composition of brain tumours

Yu.S. Maklygina[1], A.S. Skobeltsin[1,2], I.D. Romanishkin[1], D.S. Farrakhova[1], L. Bezdetnaya[3,4], V.B. Loschenov[1,2]; [1] Prokhorov General Physics Inst. RAS; [2]Inst. of Engineering Physics for Biomedicine, National Research Nuclear Univ. MEPhI; [3]Centre de Recherche en Automatique de Nancy, CNRS, Univ. de Lorraine, France; [4]Inst. de Cancérologie de Lorraine, France

Due to their different metabolism, cells of different phenotypes that make up tumour tissue are able to accumulate photosensitizer in different ways, allowing physical methods to give a picture of the composition of tumour tissue.

This research was supported by RFBR Grant(s) # The reported study was funded by RFBR according to the research project No. 21-52-15025 and partly by IEA (International Emerging Action) CNRS grant 00534.

WeSYB-25 13:15-13:30

Laser microsurgery and fusion of multicellular spheroids for studying regeneration

N.V. Kosheleva[1,2,3,4], Y.M. Efremov[2,2], B.S. Shavkuta[3], I.M. Zurina[3,4], A.I. Shpichka[1,2,3], I.V. Ilina[5], I.N. Saburina[4], X.-J. Liang[1,6], P.S. Timashev[2,3,7,8]; [1]Lab. of Clinical Smart Nanotechnology, Sechenov Univ., Russia; [2]World-Class Research Center "Digital Biodesign and Personalized Healthcare," Sechenov Univ., Russia; [3]Inst. for Regenerative Medicine, Sechenov Univ., Russia; [4]FSBSI Inst. of General Pathology and Pathophysiology, Russia; [5]Joint Inst. for High Temperatures RAS, Russia; [6]National Center for Nanoscience and Technology, China; [7]Department of Polymers and Composites, Semenov Federal Research Center for Chemical Physics RAS, Russia; [8]Lomonosov Moscow State Univ., Russia

Analysis of multicellular spheroids regeneration and fusion process was obtained. The energy of laser pulses of microdissection for softer spheroids was less than for stiff, softer spheroids fused 1 day faster than stiff. Reparative processes after microdissection occurred gradually over seven days. Cell spheroids fusion is not entirely captured with the models based on the coalescence of liquid drops.

This research was supported by RFBR Grant(s) # Research at Sechenov University was funded by the Ministry of Science and Higher Education of the Russian Federation (№. 075-15-2021-596, spheroids); by the RFBR (№ 20-04-60063, cells)

– Lunch Break –

Laser interaction with cells and tissues: clinical imaging and spectroscopy VI

Location: Petrov Vodkin 1 Room, floor 2. 15:00-17:00

WeSYB-26 15:00-15:30

Evaluation of optical clearing potential of natural oils and gels *(Invited paper)*

H.F. Silva[1], D.S. Teixeira[2], I.S. Martins[1] , V.V. Tuchin[3] , L.M. Oliveira[1,2]; [1]Center of Innovation in Engineering and Industrial Technology, ISEP, Portugal; [2]Physics Department, Polytechnic of Porto – School of Engineering (ISEP), Portugal; [3]Science Medical Center, Saratov State Univ., Russia

Various liquids have been used to study the increase of tissue transparency. Some were found beneficial, while others presented poor clearing efficiency. In this study the clearing potential of some oils and gels was evaluated. The clearing efficiency of electronic cigarette liquid and almond oil was good, while cinnamon and anise oils turned the tissues opaquer to light transmittance.

This research was supported by RFBR Grant(s) # VVT was supported by the RF Government grant 075-15-2021-615

WeSYB-27 15:30-16:00

Nanoparticles fabricated by laser ablation and fragmentation of nano- and microstructured silicon: perspectives in optical bioimaging and photohyperthermia *(Invited paper)*

S.V. Zabotnov[1], V.Yu. Nesterov[1], O.I. Sokolovskaya[1], D.V. Shuleiko[1], L.A. Golovan[1], P.K. Kashkarov[1], A.V. Khilov[1,2], D.A. Kurakina[2], P.D. Agrba[1,3], E.A. Sergeeva[1,2], M.Yu. Kirillin[2,3]; [1]Lomonosov Moscow State Univ.; [2]Inst. of Applied Physics RAS; [3]Lobachevsky State Univ. of Nizhny Novgorod, Russia

Pulsed laser ablation and fragmentation of porous silicon, silicon nanowires and silicon microparticles in water and ethanol allowed to fabricate crystalline silicon nanoparticles with mean sizes 25 – 200 nm. Such particles are promising both in fluorescence and scattering bioimaging techniques and in photohyperthermia of tumors.

This research was supported by RFBR Grant(s) # the Russian Science Foundation, Grant #19-12-00192

WeSYB-28 16:00-16:15

Fluorescence evaluation of tissue samples from skin collagen-related diseases

Ts.I. Genova[1], E.G. Borisova[1,2], I.P. Angelov[1,3], P.P. Troyanova[4], I.N. Terziev[4]; [1]Inst. of Electropnics BAS, Bulgaria; [2]National Research Saratov State Univ., Russia; [3]Inst. of Organic Chemistry with Center of Phytochemistry, BAS, Bulgaria; [4]Univ. Hospital "Tzaritza Yoanna – ISUL", Bulgaria

We have implemented excitation-emission matrices for fluorescence assessment of tissue samples from degenerative skin diseases. Those measurements are part of a proof of concept study for the development of a new technique for noninvasive optical diagnostic of degenerative skin diseases.

WeSYB-29 16:15-16:30

Filtering Raman spectral features of glial tumor sites based on biochemical correlates

T.A. Savelieva[1,2], I.D. Romanishkin[2], A.V. Orlov[1], A.V. Kosyrkova[3], S.V. Shugaj[3], S.A. Goryajnov[3], D.A. Golbin[3], V.B. Loschenov[1,2]; [1]National Research Nuclear Univ. MEPhI; [2]Prokhorov General Physics Inst. RAS; [3]Burdenko National Medical Research Center of Neurosurgery, Russia

Raman spectroscopy is a sensitive and fast tool to differentiate glial tumor and normal tissues during surgery. The structure of Raman spectra motivated us to implement the feature selection technique, based on statistically significant differences between the groups. Finally they were matched to the main biochemical components of the studied tissues.

This research was supported by RFBR Grant(s) # This work was supported by a Ministry of Science and Higher Education of the Russian Federation (agreement 075-15-2021-1343, October 4, 2021)

WeSYB-30 16:30-16:45

Detection of Influenza A and B viruses by Raman spectroscopy

A.T. Tabarov[1], V.V. Vitkin[1], D.M. Danilenko[2], O.V. Andreeva[1], A.A. Shemanaeva[1], E.E. Popov[1], A.A. Dobroslavin[1], V.V. Kurikova[1], O.B. Kuznetsova[1]; [1]ITMO Univ.; [2]Smorodintsev Research Inst. of Influenza, Russia

The large-scale outbreaks of various respiratory viral diseases have occurred several times over the past decades. Optical spectroscopy, with Raman scattering spectroscopy in particular, can serve as an alternative approach to the diagnosis of respiratory viral diseases. The paper demonstrates the possibility of using machine learning technology for the detection and differentiation of various viruses.

WeSYB-31 16:45-17:00

Optical percutaneous needle biopsy to differentiate liver cancer from normal parenchyma

E.V. Potapova[1], E.A. Zherebtsov[1,2], V.V. Dremin[1,3], K.Y. Kandurova[1], V.V. Shupletsov[1], A.V. Mamoshin[1,4], A.V. Dunaev[1]; [1]Research & Development Center of Biomedical Photonics, Orel State Univ., Russia; [2]Optoelectronics and Measurement Techniques unit, Univ. of Oulu, Finland; [3]College of Engineering and Physical Sciences, Aston Univ., UK; [4]Orel Regional Clinical Hospital, Russia

This work presents results of optical percutaneous needle biopsy to differentiate liver cancer from normal parenchyma in vivo and in situ measurements by two developed optical biopsy systems – fluorescence and diffuse reflectance spectroscopy, and fluorescence lifetime one. The accuracy characteristics of optical systems are shown, technology development prospects are described.

Section C. Photonics and nanobiotechnology

Photonics and nanobiotechnology IV

Location: Petrov Vodkin 2 Room, floor 2. 09:00-11:00

WeSYC-16 09:00-09:30

Brillouin imaging: past, present and future. *(Invited paper)*

I. Kabakova; School of Mathematical and Physical Sciences, the Univ. of Technology Sydney, Australia

In this talk I will introduce imaging technology based on Brillouin light scattering for mapping micromechanical properties in tissues, cells and biomaterials. Additionally, I will review recent progress, remaining challenges and future directions in this fascinating field of research.

WeSYC-17 09:30-10:00

Macroscopic time- and spectrally resolved fluorescence imaging *(Invited paper)*

V. Shcheslavskiy[1,2], M. Shirmanova[2], J. Lagarto[3,4], F.S. Pavone[3,4,5], R. Cicchi[3,4], W. Becker[1]; [1]Becker&Hickl GmbH, Germany; [2]Privolzhsky Research Medical Univ., Russia ; [3]National Inst. of Optics, National Research Council (INO-CNR), Italy; [4]European Lab. for Non-linear Spectroscopy (LENS), Italy; [5]Univ. of Florence, Italy

Fluorescence Lifetime Imaging is an optical technique that delivers not only structural, but also molecular specific information about the samples. When it is enhanced with spectral resolution, it becomes even more powerful. This presentation describes a multimodal approach to study biological samples on a macroscale using combined spectroscopic and fluorescence time-resolved methods.

This research was supported by RFBR Grant(s) # RSF: 22-29-01198; 20-65-46018

WeSYC-18 10:00-10:30

How chemotherapy affects microviscosity? *(Invited paper)*

M. Shirmanova[1], L. Shimolina[1,2], A. Gulin[3], N. Ignatova[1], I. Druzhkova[1], A. Khlynova[1], M. Lukina[1], L. Snopova[1], M.K. Kuimova[4], E. Zagaynova[2]; [1]Privolzhsky Research Medical Univ.; [2]Lobachevsky State Univ.; [3]Semenov Inst. of Chemical Physics RAS, Russia; [4]Imperial College London, UK

The plasma membrane of cells is a semi-permeable barrier between the cell and its environment, crucial for cellular homeostasis and survival. In our studies using fluorescence lifetime imaging microscopy (FLIM) and fluorescent molecular rotors we have investigated, in vitro and in vivo, the effects of chemotherapy on membrane viscosity and determined its role in the development of chemoresistance.

This research was supported by RFBR Grant(s) # RSF, Project No. 20-14-00111

WeSYC-19 10:30-10:45

Targeted silver nanoparticles for cancer phototherapy and diagnostics

P.A. Kotelnikova, V.O. Shipunova, S.M. Deyev, A.V. Zvyagin; Shemyakin – Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

To obtain targeted nanoagents for phototherapy, we have synthesized silver nanoparticles of various shapes, including spheres, nanorods, nanoprisms, and nanowires. We have developed a number of methods for modifying and stabilizing nanoparticles with polymers and recombinant proteins that can selectively bind cancer cells. We have demonstrated the possibility of silver nanoparticle application as photosensitizers using various light sources.

This research was supported by RFBR Grant(s) # RFBR 20-34-90029, Russian Science Foundation 21-74-30106

WeSYC-20 10:45-11:00

Immunoglobulin -based hybrid targeted nanoagents for in vitro and in vivo multimodal imaging

A.V. Lunin[1], E.S. Korenkov[1], T. Sadan[2], R. Popovtzer[2], E.N. Mochalova[1,3,4], V.R. Cherkasov[1,4]; [1]Moscow Inst. of Physics and Technology, MIPT, Russia; [2]Faculty of Engineering and the Inst. of Nanotechnology and Advanced Materials, Bar-Ilan Univ., Israel; [3]Sirius Univ. of Science and Technology, Russia; [4]Prokhorov General Physics Inst. RAS, Russia

Nanomedicine constantly broadens horizons of modern therapy and diagnostics. However, imaging nanoagents are of especial interest. Here, we report on novel, facile, and sustainable way to fabricate targeted multimodal imaging nanoparticles. Specifically, we synthesize nanoparticles using immunoglobulins and introduce nanoparticles of different nature into immunoglobulin-based matrix. We demonstrate applicability of the nanoparticles both in vitro and in vivo.

This research was supported by RFBR Grant(s) # #19-515-06010, # 19-515-06010

– Break –

Photonics and nanobiotechnology V

Location: Petrov Vodkin 2 Room, floor 2. 11:30-13:15

WeSYC-21 11:30-12:00

Optoacoustic measurement of nanoparticle degradation in physiological media *(Invited paper)*

I.V. Zelepukin[1,2], A.V. Zvyagin[2,3,4], S.M. Deyev[1,2,3]; [1]National Research Nuclear Univ. "MEPhI"; [2]Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS; [3]Sechenov First Moscow State Medical Univ., Russia; [4]Macquarie Univ., Australia

Here we present method of optoacoustic detection of inorganic nanoparticle degradation. Using optoacoustics we measured kinetics of silicon nanoparticle degradation in various buffers and conditions. It allows to find first known nanoparticle coating with outstanding ability to accelerate silicon material dissolution in buffers.

WeSYC-22 12:00-12:30

Light-activated polymer nanoparticles for image-guided breast cancer treatment *(Invited paper)*

V.O. Shipunova[1], A.A. Sizikov[1], V.R. Cherkasov[1,2]; [1]Moscow Inst. of Physics and Technology; [2]Prokhorov General Physics Inst. RAS, Russia

This report presents a series of works devoted to the creation of biocompatible polymer nanostructures for the therapy and diagnostics of cancer.

This research was supported by RFBR Grant(s) # Ministry of Science and Higher Education of the Russian Federation: agreements # 075-00958-2105 and 075-03-2021-095, project 0714-2020-0004

WeSYC-23 12:30-12:45

Biocompatible with animal cells composite material based on borosiloxane and fullerenes with light-induced bacteriostatic properties

D.E. Burmistrov, M.E. Astashev, A.V. Simakin, R.M. Sarimov, A.D. Kurilov, D.N. Chausov, S.V. Gudkov; Prokhorov General Physics Inst. RAS, Russia

Borosiloxane-fullerene C60 nanocomposites containing various concentrations of fullerene molecules were created. The resulting composite material is capable of self-healing structure. The composite material exhibits photoinduced bacteriostatic properties and is capable of attaching bacterial cells to itself. At the same time, the nanocomposite is biocompatible with mammalian cells; the surface of the nanocomposite is suitable for the colonization of eukaryotic cells.

WeSYC-24 12:45-13:00

Phosphorescent Ir(III) oxygen sensors for bioimaging

I.S. Kritchenkov[1], A.I. Solomatina[1], P.S. Chelushkin[1], M.V. Shirmanova[2], E.S. Kornilova[3], A. Rueck[4], S.P. Tunik[1]; [1]Inst. of Chemistry, St. Petersburg State Univ.; [2]Inst. of Experimental Oncology and Biomedical Technologies, Privolzhsky Research Medical Univ.; [3]Inst. of Cytology RAS, Russia; [4]Core Facility Confocal and Multiphoton Microscopy, Ulm Univ., Germany

This work is devoted to the design, synthesis and implementation of novel iridium(III) O2 sensors in bioimaging.

WeSYC-25 13:00-13:15

Imaging flow cytometry for investigation of extracellular vesicles-magnetic nanoparticles interactions for liquid biopsy

V.A. Bragina[1], S.L. Znoyko[1], N.V. Guteneva[1], V.R. Cherkasov[1], D.O. Novichikhin[1,2], A.G. Burenin[1]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPhI, Russia

A novel approach was developed for investigation of interactions between extracellular vesicles (EVs) and magnetic nanoparticles (MNPs). It combines high-resolution imaging flow cytometry (IFC) with fluorescently labeled MNP conjugates. The IFC data verified the optimality of parameters (the amount of MNP conjugates per test, incubation time) for the efficient of magnetic immunochromatographic assay for liquid biopsy EV quantification.

– Break –

Photonics and nanobiotechnology VI

Location: Petrov Vodkin 2 Room, floor 2. 15:00-16:45

WeSYC-26 15:00-15:30

Surface-enhanced Raman scattering from 1D-3D plasmonic Au nanoparticles:the fourth-power law revisited *(Invited paper)*

N.G. Khlebtsov[1,2], B.N. Khlebtsov[1], A.M. Buroc[1], V.A. Khanadeev[1]; [1]Inst. of Biochemistry and Physiology of Plants and Microorganisms, Saratov Scientific Centre RAS; [2]Saratov State Univ., Russia

The electromagnetic theory predicts the four-power scaling of the average SERS enhancement factor as a function of the local field. However, the existing experimental data do not confirm such theoretical predictions. We discuss a reexamination study using well-defined experimental models obtained by controllable etching of Au nanorods, nanotriangles, and nanostars, functionalized with Raman reporters, together with COMSOL and T-matrix simulations.

WeSYC-27 15:30-16:00

Peculiarities of photoluminescence decay for molecules near plasmonic nanostructures *(Invited paper)*

S.M. Safarian[1], Y.V. Rostovtsev[2], V.P. Drachev[1]; [1]Center for Engineering Physics, Skolkovo Inst. of Science and Technology, Russia; [2]Department of Physics, Univ. of North Texas, USA

Plasmonic nanostructures used in the photoluminescence biomolecules monitoring result in bi-exponential decay and affect emitted photon statistics.

WeSYC-28 16:00-16:15

Mode switching of the low-frequency oscillationsof the tobacco mosaic virus when the temperature of its aqueous suspension changes

A.F. Bunkin[1], M.A. Davydov[1], A.N. Fedorov[1], M.V. Arkhipenko[2], V.B. Oshurko[1,2], S.M. Pershin[1]; [1]Prokhorov General Physics Inst. RAS; [2]Faculty of Biology, Moscow State Univ.; [3]Moscow State Technological Univ. STANKIN, Russia

A stimulated low-frequency Raman scattering radiation in suspension of the tobacco mosaic virus with frequencies 31.17 and 43.5 GHz was observed. The virus concentration was varied in the range of about 1012 and 2.0 × 1012 cm–3. The high sensitivity Raman spectrum to the suspension temperature was observed also.

This research was supported by RFBR Grant(s) # 20-02-00172 and Russian Science Foundation (project no. 22-22-001).

WeSYC-29 16:15-16:30

Plasmon resonances of the multilayer nanoparticle

I.A. Pavlichenko; Univ. of Nizhny Novgorod, Russia

Based on the hydrodynamic approach, a physical model of the plasmon response of a spherical metal-dielectric-metal nanoparticle interacting with laser radiation is developed. The frequency dependences of the maximum value of the local field are calculated, and it has been shown that spatial dispersion can have a noticeable effect on the magnitude and position of the main resonance maximum.

WeSYC-30 16:30-16:45

Rapid and easy-to-use method for optimization of lateral flow assay with magnetic separation

A.V. Pushkarev, D.O. Novichikhin, E.N. Mochalova, A.V. Orlov; Prokhorov General Physics Inst. RAS, Russia

Rapid and easy-to-use method has been developed for accurate determining the optimal parameters of a lateral flow assay having a stage of magnetic separation. The method is based on the spectral correlation interferometry joined with a mathematical model describing such test systems. The method demonstrates high correlation with experimental data and can be used without specialized software.

Section D. Photodynamic processes in biology and medicine

Photodynamic processes in biology and medicine I

Location: Petrov Vodkin 3 Room, floor 2. 09:15-11:00

WeSYD-01 09:15-09:45

Absorption spectra of dissolved oxygen molecules in aerated solvents. A review of laser activation experiments *(Invited paper)*

A.A. Krasnovsky, A.S. Benditkis, A.S. Kozlov; Federal Research Center of Biotechnology RAS, Russia

Oxygen activation by laser radiation at 400 – 1300 nm has been studied in aerated organic solvents using chemical trapping and phosphorescence of singlet oxygen under ambient conditions. As a result, the absorption spectra of dissolved oxygen and molar absorption coefficients corresponding to the oxygen absorption peaks have been measured. The biomedical importance of these data will be discussed.

This research was supported by RFBR Grant(s) # No 19-04-00331

WeSYD-02 09:45-10:15

Multifunctional photosensitizer based theranostic agents for imaging-guided photodynamic therapy of cancer *(Invited paper)*

H. Abrahamse; Laser Research Centre, Faculty of Health Sciences, Univ. of Johannesburg, South Africa

We highlight the recent progress in the development of PS-based multifunctional theranostic agents for biomedical applications in multimodal imaging combined with PDT.

WeSYD-03 10:15-10:45

Nano- and picosecond dynamics of excited states of biological coenzymes *(Invited paper)*

O.S. Vasyutinskii; Ioffe Inst. RAS, Russia

The lecture presents the results of experimental and theoretical studies of anisotropic relaxation and energy transfer in excited states of biological coenzymes NADH and FAD in solutions under excitation with pico- and femtosecond laser pulses. Time-resolved transient polarization-modulation and fluorescence anisotropy signals were recorded and analyzed by means of the methods developed by the authors.

WeSYD-04 10:45-11:00

Dependence of Radachlorin fluorescence lifetime on solution pH and localization in Hela cells

A.V. Belashov[1], A.A. Zhikhoreva[1], T.N.Belyaeva[2], I.K. Litvinov[2], A.V. Salova[2], E. S. Kornilova[2], I.V. Semenova[1], O.S. Vasyutinskii[1]; [1]Ioffe Inst.; [2]Inst. of Cytology RAS, Russia

Variations of Radachlorin fluorescence lifetime with pH in PBS solutions have been studied. As shown, an increase in pH resulted in the fluorescence lifetime rise. FLIM-assisted experiments on Radachlorin fluorescence lifetimes in living HeLa cells demonstrated dependence of the lifetime on intracellular localization of Radachlorin molecules. Recorded variations of Radachlorin fluorescence lifetime within intracellular area were about 15-20%.

– Break –

Photodynamic processes in biology and medicine II

Location: Petrov Vodkin 3 Room, floor 2. 11:30-13:30

WeSYD-05 11:30-12:00

Photodynamic theranostics of central lung cancer: capabilities of early diagnosis and minimally invasive therapy *(Invited paper)*

G.V. Papayan[1,2], A.L. Akopov[1]; [1]The Pavlov First Saint Petersburg State Medical Univ.; [2]Almazov National Medical Research Centre, Russia

Bronchoscopic fluorescent diagnostics enable to reveal tumor changes in bronchi mucosa at early stages, and a developed PDT technique performed under fluorescent control helps achieve personalized treatment. Further progress will be determined by the development of new photosensitizers, which should be characterized by a high absorption band in NIR-area.

WeSYD-06 12:00-12:30

Phototoxicity induced in living HeLa cells by focused femtosecond laser pulses: a data-driven approach *(Invited paper)*

B. Talone[1], M. Bazzarelli[2], A. Schirato[1,3], F. Dello Vicario[2], D. Viola[1], E. Jacchetti[4], M. Bregonzio[2], M.T. Raimondi[4], G. Cerullo[1,5], D. Polli[1,5]; [1]Department of Physics, Politecnico di Milano; [2]3rdPlace SRL; [3]Inst. Italiano di Tecnologia; [4]Department of Chemistry, Materials and Chemical Engineering 'G. Natta', Politecnico di Milano; [5]Inst. di Fotonica e Nanotecnologie (IFN), Consiglio Nazionale delle Ricerche (CNR), Italy

We experimentally characterized the survival rate of HeLa cells to sub-200-fs laser pulses at 1040 nm and 80-MHz repetition rate for nonlinear microscopy applications. A data-driven approach could derive the mechanisms of damage as a function of laser power and pixel dwell time in two different light exposure modalities, deepening the photothermal damage with thermodynamic considerations.

WeSYD-07 12:30-13:00

The concept of multimodal prevention and treatment of new coronavirus infection COVID-19 by drug photosensitizers and photodynamic therapy on their basis. *(Invited paper)*

S.D. Nikonov[1,4], V.B. Loktev[2], V.A. Svyatchenko[2], A.P. Mayorov[3], D.A. Bredikhin[1,4]; [1]Novosibirsk State Univ.; [2]State Research Center of Virology and Biotechnology "Vector" Rospotrebnadzor; [3]Inst. of Laser Physics SB RAS; [4]Novosibirsk Scientific Research Inst. of Tuberculosis, Russia

A study of antiviral low-dose photodynamic therapy with pharmacopoeial photosensitizers in the form of methylene blue and chloride E6 (Radachlorin) solutions in vitro demonstrated complete inactivation of SARS-CoV-2 in suspension and protection of Vero E6 cells even 3.5 hours after their infection with coronavirus at concentrations of photosensitizers 100-1000 times lower than the recommended pharmacopoeial forms of these drugs.

WeSYD-08 13:00-13:15

Synthesis of core-shell ternary quantum dots -porphyrin conjugates and its photodynamic therapy application

O.S. Oluwafemi; Department of Chemical Sciences (formerly Applied Chemistry), Univ. of Johannesburg; Centre for Nanomaterials Science Research, Univ. of Johannesburg, South Africa

Porphyrins are photosensitisers used in photodynamic therapy (PDT). However, their limited absorption and aggregation in an aqueous medium affect their effectiveness in PDT. In this presentation, the synthesis of ternary quantum dots (QDs) and their conjugation to porphyrin as an efficient way to overcome photosensitizer shortcoming will be discussed.

WeSYD-09 13:15-13:30

Synthesis and spectroscopic studies of nanostructures based on upconversion nanoparticles coated with a photosensitizer for photodynamic therapy with infrared excitation

D.V. Pominova[1,2], V.Y. Proydakova[1], I.D. Romanishkin[1], A.V. Ryabova[1,2], S.V. Kuznetsov[1], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPHI, Russia

In this work, we studied the processes of energy transfer from upconversion nanoparticles to photosensitizer molecules. The possibility of photodynamic therapy with infrared excitation using synthesized nanostructures has been demonstrated.

– Lunch Break –

Photodynamic processes in biology and medicine III

Location: Petrov Vodkin 3 Room, floor 2. 15:00-16:30

WeSYD-10 15:00-15:30

Ultrafast relaxations and singlet oxygen generation in solutions of C_{60} in n-methylpyrrolidone *(Invited paper)*

I.M. Kislyakov[1], V.M. Kiselev[2], J. Wang[1];[1]Shanghai Inst. of Optics and Fine Mechanics, CAS, China;[2]Vavilov State Optical Inst., Russia

Photodynamic processes related to the transfer of photoexcitation energy were studied in air-saturated solutions of C60 in NMP. Both excited state kinetics and the efficiency of singlet oxygen photosensibilization are traced. A large quantum yield of the latter which weakly depends on the solution aging was found in the broad range excitation spectrum from UV to the red.

WeSYD-11 15:30-15:45

Photodiagnostics and photodynamic treatment of glioblastoma stem cells with porphyrins and phthalocyanines

L.B. Zaharieva[1,2], D.S. Kyurkchiev[4], K.D. Tumangelova-Yuzeir[4], E.I. Ivanova-Todorova[4], I.A. Angelov[1,5], Ts.I. Genova[1], B.B. Kolev[1], A.I. Gisbrecht[1], L.A. Avramov[1], O.V. Semyachkina-Glushkovskaya[3], P.A. Karazapryanov[6], K.Ts. Minkin[6], E.G. Borisova[1,7]; [1]Inst. of Electronics, BAS, Bulgaria; [2]Sofia Univ., Bulgaria; [3]Saratov State Univ., Russia; [4]Medical Univ. of Sofia, Bulgaria; [5]Inst. of Organic Chemistry with Center of Phytochemistry, BAS Bulgaria; [6]Univ. Hospital "St. Ivan Rilski", Bulgaria; [7]Research National Saratov State Univ., Russia

Investigations into efficacy and mechanisms of impact in photodynamic treatment (PDT) with different photosensitizers, based on porphyrins and phthalocyanines, on stem cells cultures isolated from human glioblastoma were carried out.

WeSYD-12 15:45-16:00

Photodynamic action of polycationic synthetic bacteriochlorin against human lung cancer cells

E.A. Kogan[1], G.A. Meerovich[2,3], S.Sh. Karshieva[4], E.V. Akhlyustina[3], E.A. Makarova[5], N.V. Zharkov[1], I.P. Angelov[6,7], V.B. Loschenov[2,3]; [1]Sechenov First Moscow State Medical Univ.; [2]Prokhorov General Physics Inst. RAS; [3]National Research Nuclear Univ. "MEPHI"; [4]Blokhin National Medical Research Center of Oncology; [5]Organic Intermediates and Dyes Inst., Russia; [6]Inst. of Organic Chemistry with Centre of Phytochemistry; [7]Inst. of Electronics, Bulgaria

The aim of this work is to evaluate the photodynamic effectiveness of photosensitizers based on polycationic derivatives of synthetic bacteriochlorin on human lung cancer cells A549. The results obtained show that these photosensitizers effectively bind to these cells and have very high phototoxicity and low "dark" cytotoxicity

This research was supported by RFBR Grant(s) # 20-52-18008

WeSYD-13 16:00-16:15

Photodynamic therapy for malignant brain tumors

E.I. Kozlikina[1,2], I.S. Trifonov[3], V.V. Krylov[3], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPhI; [3]Evdokimov Moscow State Univ. of Medicine and Dentistry, Russia

This study presents first results of PDT patients with high grade gliomas in Russian Federation. PDT remains a promising therapeutic approach that requires further study in HGGs to analyze median survival rate. Photodynamic techniques such as photodynamic diagnosis (PDD), fluorescence-guided tumor resection (FGR) and photodynamic therapy (PDT) are currently undergoing intensive clinical investigations as adjuvant treatment for malignant brain tumors

WeSYD-14 16:15-16:30

Photodynamic therapy with 5-ALA induced PpIX effect on macrophages polarization

A.V. Ryabova[1,2], D.V. Pominova[1,2], A.S. Skobeltcin[1,2], I.D. Romanishkin[1], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPHI, Russia

In this work, we have carried out the assessment of changes in the polarization of macrophages in response to photodynamic treatment according to the changes in the fluorescence lifetime of respiratory chain enzymes. The analysis of the time-resolved fluorescence of metabolic signatures and PpIX makes it possible to determine the cell metabolism types.

This research was supported by RFBR Grant(s) # 20-02-00928

Section B. Laser interaction with cells and tissues: clinical imaging and spectroscopy

Laser interaction with cells and tissues: clinical imaging and spectroscopy VII

Location: Petrov Vodkin 1 Room, floor 2. 09:00-11:00

ThSYB-32 09:00-09:30

Morphological changes of red blood cell trapped in laser tweezers *(Invited paper)*

P.B. Ermolinskiy, A.E. Lugovtsov, A.V. Priezzhev; Lomonosov Moscow State Univ., Russia

The aim of this work was to study the effect of a highly focused laser beam on a red blood cell (RBC) trapped by laser tweezers. The changes of RBC shape in the laser trap were found for different laser beam powers. The results are important for understanding the mechanisms of interaction of laser beams with live cells.

This research was supported by RFBR Grant(s) # This work was supported by the Russian Scientific Foundation (Grant No. 20-45-08004).

ThSYB-33 09:30-10:00

3D scaffolds biodegradation in vivo tracking: current state and prospects *(Invited paper)*

P.S. Timashev; Inst. for Regenerative Medicine, Sechenov Univ.; World-Class Research Center "Digital Biodesign and Personalized Healthcare"; Lomonosov Moscow State Univ., Russia

There is an urgent need to develop strategies for real-time and non-invasively monitoring in vivo degradation. Fluorescence-related imaging, optical coherence tomography, computed tomography, and THz spectroscopy and imaging can be used to achieve this task. We consider the most novel and our own works in the area of in vivo biodegradation and perspectives of the use of the mentioned techniques.

ThSYB-34 10:00-10:30

Comparison of strain ultrasound elastography with compression optical coherence elastography for breast cancer characterization *(Invited paper)*

E.V. Gubarkova[1], A.A. Sovetsky[2], D.A. Vorontsov[3], P.A. Buday[3], M.A. Sirotkina[1], A.A. Plekhanov[1], A.L. Matveyev[2], L.A. Matveev[2], A.Y. Vorontsov[3], V.Y. Zaitsev[2], N.D. Gladkova[1]; [1]Privolzhsky Research Medical Univ.; [2]IAP RAS; [3]Nizhny Novgorod Regional Oncologic Hospital, Russia

The aim of this study is compare the results of ultrasound strain elastography with compression optical coherence elastography (C-OCE) in breast cancer assessment and to evaluate factors that can affect the results of the two elastography techniques. C-OCE has novel capabilities due to its ability to locally control pressure on the tissue and obtain local stress-strain curves.

ThSYB-35 10:30-10:45

Image-guided drug delivery to hair follicles in topical PUVA therapy

Yu.I. Svenskaya[1], E.E. Talnikova[2], E.A. Genina[1], D.A. Gorin[3], G.B. Sukhorukov[4], V.V. Tuchin[1]; [1]Saratov State Univ; [2]Saratov State Medical Univ.; [3]Skolkovo Inst. of Science and Technology, Russia; [4]Queen Mary Univ. of London, UK

Transdermal administration of therapeutic molecules via skin appendages has gained great scientific interest, especially concerning delivery to specific targeted regions and the reduction of systemic toxicity. Here, a novel effective approach towards intrafollicular delivery of psoralen drug is proposed. The impactful effect of topical Psoralen-UVA therapy via targeting to hair follicles is demonstrated in healthy volunteers and a vitiligo patient.

This research was supported by RFBR Grant(s) # The research was supported by RSF (17-73-20172)

ThSYB-36 10:45-11:00

Local atraumatic fixation of the intestinal wall in the real-time artefact-free structural and angiographic transserous OCT imaging

M.G. Ryabkov[1], M.A. Sizov[2], P.A. Shilyagin[3], P.V. Peretyagin[1], E.L. Bederina[1], A.A. Moiseev[3], G.V. Gelikonov[3], N.D. Gladkova[1], E.B. Kiseleva[1]; [1]Privolzhsky Research Medical Univ.; [2]City Clinical Hospital No.30, Nizhny Novgorod; [3]Inst. of Applied Physics RAS, Russia

We develop a method for atraumatic fixation of the intestinal wall to obtain real-time artefact-free structural and angiographic Optical Coherence Tomography images. A special vacuum cap was designed and tested on the wall of the small intestine of minipigs. As a result, the number of motion artifacts in images compared to manual fixation was reduced from 84% to 8%.

This research was supported by RFBR Grant(s) # The study was funded by RSF, grant #19-75-10096.

– Break –

Laser interaction with cells and tissues: clinical imaging and spectroscopy VIII

Location: Petrov Vodkin 1 Room, floor 2. 11:30-14:00

ThSYB-37 11:30-12:00

Rate and degree of platelets aggregation in cardiovascular diseases: studies by light scattering technique *(Invited paper)*

A.E. Lugovtsov, D.A. Umerenkov, P.B. Ermolinskiy, A.V. Priezzhev; Lomonosov Moscow State Univ., Russia

The aim of this work was to measure parameters of platelet aggregation in patients with arterial hypertension and type 2 diabetes mellitus using light scattering technique. The degree and rate of platelets aggregation in patients with these diseases are increased compared to those in healthy people.

ThSYB-38 12:00-12:30

RBC interaction with endothelial cells: study using laser tweezers technique *(Invited paper)*

A.V. Priezzhev[1], P.B. Ermolinskiy[1], A.E. Lugovtsov[1], O.N. Scheglovitova[2]; [1]Lomonosov Moscow State Univ.; [2]Gamaleya National Research Center for Epidemiology and Microbiology, Russia

The aim of this work was to measure the force of interaction between individual red blood cells and endothelial cells using laser tweezers. The changes in the cells interaction forces were found dependent of the content of fibrinogen and other activators in environmental medium. The results are important for understanding the mechanisms of interaction of RBC with vascular endothelium.

ThSYB-39 12:30-13:00

Strain-estimation-based OCT angiography *(Invited paper)*

A.A. Zykov, A.L. Matveyev, L.A. Matveev, D.V. Shabanov, V.Y. Zaitsev; Inst. of Applied Physics RAS, Russia

Optical Coherence Angiography (OCA) discriminates own erythrocytes' motions against the surrounding "solid" tissue. We present a new OCA principle based on local interframe strain estimation. Compared with high-pass filtering of temporal speckle variability, strain-based OCA shows higher tolerance to artifacts induced by strong inhomogeneous strains, which is very promising for realization of contact-mode OCA for practical applications on patients.

ThSYB-40 13:00-13:15

Numerical simulations of phase-amplitude compensation of masking strain-induced motions of scatterers in contact-mode optical coherence angiography

A.A. Zykov, A.L. Matveyev, L.A. Matveev, V.Y. Zaitsev; Inst. of Applied Physics RAS, Russia

Visualization of microvasculature in Optical Coherence Angiography (OCA) is based on discrimination of erythrocytes motion against the surrounding motionless tissue. In practice, surrounding tissue is never still; therefore its motion must be compensated before flow detection. We present a deformation compensation technique for contact-mode OCA in case of big strains when phase-only compensation is insufficient and phase-amplitude compensation is required.

ThSYB-41 13:15-13:30

Fluorescence lifetime measurements for kidney ischemia monitoring in minimally invasive surgery

E.A. Zherebtsov[1,2], S.V. Popov[3], R.G. Guseinov[3], V.V. Shupletsov[1], K.Y. Kandurova[1], V.V. Perepelitsa[3], I.N. Orlov[3], A.S. Katunin[3], E.V. Potapova[1], A.V. Mamoshin[1], A.V. Dunaev[1]; [1]Research & Development Center of Biomedical Photonics, Orel State Univ., Russia; [2]Optoelectronics and Measurement Techniques Unit, Univ. of Oulu, Finland; [3]St. Luka Clinical Hospital, Department of Urology, Russia

The paper demonstrates the results of the application of fluorescent and diffuse reflectance measurements in laparoscopic renal surgeries during warm ischemia. The experimental setup and results of the combined use of optical modalities for cellular metabolism and tissue saturation assessment are described.

– Lunch Break –

Laser interaction with cells and tissues: clinical imaging and spectroscopy IX

Location: Petrov Vodkin 1 Room, floor 2. 15:00-16:15

ThSYB-42 15:00-15:30

Morphological and functional assessment of tumor and non-tumor tissue under therapy using multimodal OCT *(Invited paper)*

M.A. Sirotkina[1], E.V. Gubarkova[1], A.L. Potapov[1], A.A. Moiseev[3], S.S. Kuznetsov[2], E.S. Sedova[2], E.V. Grebenkina[2], S.V. Gamayunov[2], N.D. Gladkova[1]; [1]Privolzhsky Research Medical Univ.; [2]Nizhny Novgorod Regional Oncologic Hospital; [3]Inst. of Applied Physics RAS, Russia

The aim of this study is compare the early (within 24 hours) blood vessels reaction to photodynamic therapy (PDT) by optical coherence angiography (OCA) in case of tumor (basal cell carcinoma) and inflammation lesions (lichen sclerosus). It was shown that the microvascular damages was the primary reaction to PDT. The dynamic of reaction was universal for tumor and inflammation lesions.

ThSYB-43 15:30-16:00

Model of a Photosensitizer for Photodynamic Therapy Based on Upconversion Nanoparticles *(Invited paper)*

V.I. Kochubey[1], I.Yu. Yanina[1,2]; [1]Inst. of Physics, Saratov State Univ.; [2]Lab. of Laser Molecular Imaging and Machine Learning, National Research Tomsk State Univ., Russia

Stable surface coating of the upconversion nanoparticles with human serum albumin (HSA) was carried out to cross-link the photodynamic dye with the particles.

ThSYB-44 16:00-16:15

Iridium cyclometalated complexes as pH probes: synthesis, photophysics, computational study, and cellular imaging

A.I. Solomatina, D.O. Kozina, V.V. Porsev, S.P. Tunik; Inst. of Chemistry, St. Petersburg State Univ., Russia

We report a series of iridium(III) cyclometalated complexes [Ir(N^C)2(X^X)] bearing pH-responsive groups. The compounds were synthesized in good to moderate yields and characterized by mass-spectrometry, NMR-spectroscopy, and XRD analysis. The compounds demonstrate luminescence in solution and pH-dependent photophysical characteristics. Two of the complexes, which display pH-response in a physiologically relevant range in aqueous media, were applied for cellular bioimaging.

Section C. Photonics and nanobiotechnology

Photonics and nanobiotechnology VII

Location: Petrov Vodkin 2 Room, floor 2. 09:00-10:45

ThSYC-32 09:00-09:30

Laser synthesis of colloidal nanomaterials for biomedicine *(Invited paper)*

A.A. Popov; Inst. for Physics and Engineering in Biomedicine, National Research Nuclear Univ. MEPhI, Russia

Pulsed laser ablation in liquids is a “green” physical technique for NPs synthesis, which offers an exceptional purity level of the nanomaterials. Here we present our recent results in synthesis of various inorganic nanomaterials by methods of pulsed laser ablation in liquids for biomedical applications.

This research was supported by RFBR Grant(s) # Russian Science Foundation project no. 19-72-30012

ThSYC-33 09:30-10:00

Modeling of nanoparticles formation process due to pulsed laser ablation in liquids *(Invited paper)*

D.S. Ivanov[1,2], S.M. Klimentov[2], I.N. Zavestovskaya[1], A. Popov[2], P. Shahov[2], A.V. Kabashin[2]; [1]Lebedev Physical Inst. RAS; [2]MEPhI, Inst. of Engineering Physics for Biomedicine, Russia

In this work, we investigate the mechanism of NPs generation in liquids as a function of the pulse duration, the indecent fluence, and the irradiation regime (single- multi-pulse). For that purpose we applied the combined atomistic-continuum model to simulate ultrashort laser pulse interaction with gold sample under water layer confinement.

ThSYC-34 10:00-10:15

Terbium oxide nanoparticle synthesis and the effect of oxidation of nanoparticles on the properties of laser-induced breakdown of aquous colloids

I.V. Baimler, A.V. Simakin, S.V. Gudkov; Prokhorov General Physics Inst. RAS, Russia

The research focuses on the synthesis of Tb nanoparticles with different oxidation degrees by laser ablation in various liquid media. The influence of the oxidation of nanoparticles on the physical and chemical processes during laser-induced breakdown is discussed.

ThSYC-35 10:15-10:30

Laser influence on biopolymer media with carbon nanoparticles for biomedical applications

A.Yu. Gerasimenko[1,2], A.V. Kuksin[1]; [1]Inst. of Biomedical Systems, National Research Univ. of Electronic Technology; [2]Inst. for Bionic Technologies and Engineering, Sechenov First Moscow State Medical Univ., Russia

Laser technology for fabricating composite structures based on biopolymers with single-walled carbon nanotubes has been developed. The structures are intended to recovery of cardiovascular tissues. This is evidenced by the results of the atomic-molecular structure, electrical conductivity studies and biocompatibility. The composites were fabricated due to the phase transition of an aqueous dispersion under the influence of pulsed laser radiation.

ThSYC-36 10:30-10:45

Study of the effect of laser pulse duration in the ultraviolet spectral range on fibroblasts

Y.M. Hamdan[1], E.I. Madirov[1], M.A. Marisov[1], N.I. Shamsutdinov[1], P.V. Zelenikhin[1], A.S. Nizamutdinov[1], A.A. Buglak[2], T.A. Telegina[3]; [1]Kazan Federal Univ.; [2]St. Petersburg State Univ.; [3]Bach Inst. of Biochemistry, Research Center of Biotechnology RAS, Russia

Report the different pulse duration of UVB laser radiation cytotoxic effect on human skin fibroblasts.

This research was supported by RFBR Grant(s) # Russian Science Foundation (RSF)

–Break –

Photonics and nanobiotechnology VIII

Location: Petrov Vodkin 2 Room, floor 2. 11:30-13:30

ThSYC-37 11:30-11:45

Preparation of luminescent nanothermometers based europium(III) complexes embedded in latex nanoparticles

K.M. Kuznetsov, J.R. Shakirova, V.A. Baigildin, S.P. Tunik; St. Petersburg State Univ., Russia

Temperature sensing at macro- and nanoscale levels is one of the challenging tasks in bioimaging. Herein we present the synthesis of a series of thermosensitive europium complexes and an approach to the preparation of luminescent thermosensitive nanospecies containing these complexes, which keep intact europium centered emission and temperature sensitivity in physiological media without crosstalk with other environmental stimuli.

This research was supported by RFBR Grant(s) # 19-13-00132

ThSYC-38 11:45-12:00

Polymer-bound pH-responsive iridium(III) complex as a potential probe in Phosphorescent Lifetime Imaging

Ju. Shakirova, V.A. Baigildin, A.I. Solomatina, S.P. Tunik; St. Petersburg State Univ., Russia

Herein we present the synthesis of the phosphorescent iridium(III) complex with emission lifetime response to variations in pH in the physiologically important range as a potential probe for in vitro/in vivo imaging in PLIM mode. To prevent the oxygen quenching of the phosphorescence and interaction with the biological environment the probe was covalently bonded to biocompatible N-vinylformamide-N-Vinylpyrrolidone block copolymer.

ThSYC-39 12:00-12:15

Physical background of Nd^{3+}, Yb^{3+}:YF_3 temperature sensors for biomedical applications

M.S Pudovkin; Inst. of Physics, Kazan Federal Univ., Russia

The studied Nd3+, Yb3+: YF3 nanoparticles demonstrated high (0.01 K-1) temperature sensitivity in the physiological temperature range. The mechanism of temperature sensitivity includes phonon-assisted energy transfer processes between doping ions, as well as lattice distortion due to thermal expansion phenomenon.

WeSYC-40 12:15-12:30

Down- conversion $LiYF_4$:Tm^{3+}, Yb^{3+} phosphors for optical temperature sensing

A.K. Ginkel, A. R. Khadiev, E.O. Volkova, O.A. Morozov, S.L. Korableva, M.S. Pudovkin; Inst. of Physics, Kazan Federal Univ., Russia

Down-conversion luminescence has been demonstrated in Tm3+ - Yb3+ co-doped LiYF4 upon the 688-nm excitation of Tm3+. For the sake of temperature sensing, luminescence decay time of Tm3+ and luminescent intensity ratios were taken as temperature dependent parameters. The maximum sensitivities were 0.33 μs/K for LiYF4:Tm3+(0,5%),Yb3+(60%) sample.

ThSYC-41 12:30-12:45

Laser-induced switching of the biological activity of phosphonates

D.V. Pankin[1], I.E. Kolesnikov[1], A.G. Pilip[2], A.Egorova[2,3], A.A. Manshina[4]; [1]Center for Optical and Laser Materials Research, St. Petersburg State Univ.; [2]St. Petersburg Federal Research Center RAS, Scientific Research Centre for Ecological Safety RAS; [3]St. Petersburg State Inst. of Technology (Technical Univ.); [4]Inst. of Chemistry, St. Petersburg State Univ., Russia

Butyrylcholinesterase inhibition and its change as a result of laser irradiation are demonstrated for the first time for a series of newly synthesized phosphorylated arylaminomalonates and phosphorus functionalized thiazolotriazoles. The effect of compounds structures on butyrylcholinesterase inhibition and its laser-activated change is revealed experimentally and confirmed by molecular dynamics and docking modelling.

This research was supported by RFBR Grant(s) # This work was supported by RSF project 22-13-00082 and funds within the state assignment of Ministry of Education and Science of the Russian Federation for 2022-2024 (No. FFZF-2022-0012)

ThSYC-42 12:45-13:00

OCT study of cataract simulation in the lens of a porcine eye

E.M. Kasianenko, Y.M. Alexandrovskaya, O.I. Baum; Inst. Photonic Technologies of Federal Scientific Research Centre "Crystallography and Photonics" RAS, Russia

An OCT study of the laser-induced dynamics of the deformation response of the lens structure during cataract modelling using peroxide and formalin at two wavelengths 1,44 and 1,56 μm is presented.

This research was supported by RFBR Grant(s) # No. 20-02-00486a

ThSYC-43 13:00-13:15

The influence of microenvironmental and molecular conformational effects on quantum yield in NADH and FAD in water-alcohol solutions.

I.A. Gorbunova, M.K. Danilova, M.E. Sasin, O.S. Vasutinskii; Ioffe Inst., Russia

We studied quantum yield in biological coenzymes NADH and FAD in water-alcohol solutions. The analysis of the experimental results obtained allowed to separate the factors that influence on the fluorescence quenching in FAD and NADH: the role of molecular conformations in non-radiative relaxation processes in excited states, and solution viscosity and polarity.

ThSYC-44 13:15-13:30

Anti-breast cancer nanorobots for magnetic hyperthermia in vitro and in vivo

M.V. Lomova[1], P.A. Demina[1], Y.I. Svenskaya[1], A.A. Abalymov[1], R.A. Anisimov[1], V.A. Kildisheva[1], A.E. Kalinova[2], A.A. Serdobintsev[2], A.V. Sadovnikov[2], D.V. Voronin[1]; [1]Science Medical Centre, Saratov State Univ.; [2]Inst. of Physics, Saratov State Univ., Russia

The effectiveness of magnetic hyperthermia at high and low frequencies of alternating and constant magnetic fields is determined by the accumulation of drug carriers in the target organ. Adressable delivery of drugs can also be carried out through the usage of magnetic nanorobots.

This research was supported by RFBR Grant(s) # The study was supported by a grant from the Russian Science Foundation (project No. 19-73-10123).

– Lunch Break –

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Photonics and nanobiotechnology IX

Location: Petrov Vodkin 2 Room, floor 2. 15:00-16:30

ThSYC-45 15:00-15:15

The unified approach to simulate absorption spectra of photosynthetic pigments: the combination of artificial intelligence and stochastic theory of optical response

V.A. Kurkov[1], D.D. Chesalin[2], A.P. Razjivin[3], A.A. Ashikhmin[4], R.Y. Pishchalnikov[2]; [1]Moscow Inst. of Physics and Technology (National Research Univ.); [2]Prokhorov General Physics Inst. RAS; [3]Pushchino Scientific Center for Biological Research RAS, Inst. of Basic Biological Problems RAS; [4]Lomonosov Moscow State Univ., Belozersky Research Inst. of Physico-Chemical Biology, Russia

Electronic optical spectra of photosynthetic pigments such as chlorophylls, bacteriochlorophylls, and carotenoids are characterized by the presence of a phonon wing of varying degrees of intensities. Differential evolution - the multiparametric optimizer and the stochastic theory were used together to simulate absorption profiles of pigments and to fit experimental data.

This research was supported by RFBR Grant(s) # RSF # 22-21-00905

ThSYC-46 15:15-15:30

The role of overtones of effective vibronic frequencies in modeling of the linear optical response of carotenoids

D.D. Chesalin[1], E.G. Maksimov[2], R.Y. Pishchalnikov[1]; [1]Prokhorov General Physics Inst. RAS; [2]Lomonosov Moscow State Univ., Department of Biophysics, Faculty of Biology, Russia

Absorption spectra of carotenoids (lutein and zeaxanthin) in two solvents (acetone and methanol) were simulated applying the multimode stochastic theory. Adding overtones of ν1 and ν2 vibronic mode (vibrations of single and double carbon bonds in the carbon chain) to the spectral density allowed obtaining good agreement between the experimental and calculated data in all combinations of carotenoids and solvents.

This research was supported by RFBR Grant(s) # RSF # 22-21-00905, https://rscf.ru/en/project/22-21-00905/

ThSYC-47 15:30-15:45

Molecular dynamics simulation of structural evolution in crystal and amorphous alloys under ultrafast laser irradiation

D. Iabbaden[1], C. Fusco[2], J. Amodeo[2], F. Garrelie[1], JP. Colombier[1]; [1]Univ Lyon, UJM-Saint-Etienne, CNRS, Inst. of Optics Graduate School, Lab. Hubert Curien; [2]Univ Lyon, INSA Lyon, CNRS, MATEIS, UMR5510, France

The main originality of this work is to investigate the ultrafast phenomena and the subsequent structural modifications triggered by femtosecond laser pulses (< 100 fs). In this context, classical molecular dynamics approach is proposed. The challenge is to capture solid-solid phase transformations in both amorphous and crystal matrices.

ThSYC-48 15:45-16:00

Use of evolutionary neural networks to design robust and scalable flat-optics on flexible substrates.

M. Makarenko, Q. Wang, A. Burguete-Lopez, F. Getman, A. Fratalocchi; PRIMALIGHT, Faculty of Electrical Engineering; Applied Mathematics and Computational Science, King Abdullah Univ. of Science and Technology, Saudi Arabia

One of the current challenges in flat-optics is obtaining designs that can withstand the fabrication errors of the manufacturing techniques. We present an inverse design platform that enables the fast design of flexible flat-optics that maintain high performance under deformations. We realize flexible polarizers that maintain a polarization efficiency of 80% over 200nm bandwidths under large mechanical deformations.

ThSYC-49 16:00-16:30

The highly disordered anisotropic media approach to diagnose cancer *(Invited paper)*

T. Gric[1,2,3], E.U. Rafailov[2]; [1]Department of Electronic Systems, Vilnius Gediminas Technical Univ., Lithuania; [2]Aston Inst. of Photonic Technologies, Aston Univ. UK; [3]Semiconductor Physics Inst., Center for Physical Sciences and Technology, Vilnius, Lithuania

We treat biological tissues as the highly disordered anisotropic media by utilizing effective medium approximation. The former allows to account for the system response analytically with no needs of human intervention aiming to detect cancer.

Section D. Photodynamic processes in biology and medicine

Photodynamic processes in biology and medicine IV

Location: Petrov Vodkin 3 Room, floor 2. 09:00-11:00

ThSYD-15 09:00-09:30

Localized and enhanced photodynamic processes through microsphere-assisted microscopy *(Invited paper*

I.S. Ruzankina[1,2], A. Mermoul[1,2], G. Ferrini[1]; [1]1st Interdisciplinary Lab. for Advanced Materials Physics (I-LAMP) and Dept. of Mathematics and Physics, Univ. Cattolica del Sacro Cuore, Italy; [2]Dept. of Chemistry, KU Leuven, Belgium

The principal aim of this work is to give a perspective on the use of a single dielectric microsphere to control light focusing and collection from a substrate, also operating with short laser pulses. The possible advantages in the selective enhancement of surface photodynamic and thermo-mechanical processes on various kinds of substrates are discussed.

ThSYD-16 09:30-10:00

Photodynamic inactivation of influenza virus in biological fluid by fullerene *(Invited paper)*

V.V. Zarubaev[1], I.M. Belousova[2], T.D. Muraviova[2], T.K. Krisko[2], A.M. Starodubtsev[2]; [1]St. Petersburg Pasteur Inst.; [2]Vavilov State Optical Inst., Russia

The purpose of the study was to assess light-mediated virus inactivating properties of fullerene and its effect on the intactness of biological fluids. It was shown that light irradiation in presence of fullerene and oxygen results in complete inactivation of influenza virus in albumin solution.

ThSYD-17 10:00-10:30

Nanostructured and molecular ROS generators for Photo- and Sonodynamic Therapy *(Invited paper)*

A. Dadadzhanova[1], E. Kolesova[1], V. Maslov[1], J. Kost[2], A. Orlova[1]; [1]ITMO Univ., Russia; [2]Ben-Gurion Univ. of the Negev, Israel

Sonodynamic therapy can dramatically enhance the efficiency of non-invasive tumour treatment due to multiple mechanisms initiating cell apoptosis or necrosis under ultrasound action combined with molecule and nanostructured sonosensitizers. Recently, we have demonstrated for the first time the sonodynamic effect of low-intensity 20 kHz ultrasound combined with chlorin e6 on melanoma cells.

This research was supported by RFBR Grant(s) # This work was supported by the Ministry of Science and Higher Education of the Russian Federation, GOSZADANIE No. 2019-1080

ThSYD-18 10:30-10:45

Cell death pathways studied in HMC-1 line after photodynamic treatment with chlorin e6 derivate

D.R. Faizullina[1], T.G. Grishacheva[1], A.S. Trulioff[2], I.V. Kudryavtsev[2], S.V. Shmakov[3], N.N. Petrishchev[1]; [1]Scientific and Educational Inst. of Biomedicine, Pavlov First St. Petersburg State Medical Univ.; [2]Department of Immunology, Inst. of Experimental Medicine; [3]Lab. of Nanobiotechnologies, Alferov Univ., Russia

The cell death mode has been studied in HMC-1 line with flow cytometry after treatment with chlorin e6 derivate Radachlorin used as a photosensitizer. Confocal laser scanning microscopy has been applied to investigate Radachlorin accumulation and distribution. We observed the significant irradiation-dose-dependent difference in apoptosis/necrosis between photodynamic treated HMC-1 line cells and control.

ThSYD-19 10:45-11:00

Photodynamic processes on the surface of copper and copper alloys, causing air sterilization

I.M. Belousova[1], V.M. Kiselev[1], I.V. Bagrov[1], T.D. Murav'eva[1], A.M. Starodubtsev[1], T.K. Krisko[1], O.S. Zhitenev[1], V.V. Zarubaev[2], A.A. Stro[3], I.M. Kislyakov[4]; [1]Vavilov State Optical Inst., Russia; [2]St. Petersburg Research Inst. of Epidemiology and Microbiology named after V.I. Pasteur, Russia; [3]Scientific Research Inst. of Influenza named after A.A. Smorodintsev, Russia; [4]Shanghai Inst. of Optics and Fine Mechanics, China

The developed photodynamic method based on a microporous photocatalytic element made of copper or copper alloy made it possible to completely inactivate influenza viruses in a closed air space and turned out to be promising for the development of equipment for disinfecting and sterilizing air from viruses (influenza, COVID-19 etc.) in enclosed spaces, including medical facilities.

– Break –

Photodynamic processes in biology and medicine V

Location: Petrov Vodkin 3 Room, floor 2. 11:30-13:00

ThSYD-20 11:30-12:00

Colloidal stability and oxidation of shungite carbon nanoparticles in aqueous dispersion mediated by fatty acid *(Invited paper)*

N.N. Rozhkova[1], A.S. Goryunov[2], A.G. Borisova[2], A.A. Kovalchuk[1], S.S. Rozhkov[1]; [1]Inst. of Geology KarRC RAS; [2]Inst. of Biology KarRC RAS, Russia

We studied the interaction of shungite carbon (ShC) nanoparticles and biomolecules using linoleic acid (LA) as an example. The mechanism of interaction of LA with defect-free graphene fragments of ShC is mainly of a hydrophobic nature. Polar sites of nanoparticles can be screened by LA molecules. The results are important for understanding redox effects of ShC on serum albumin.

ThSYD-21 12:00-12:30

Analysis of cells' response to photodynamic treatment with Radachlorin and PpIX by holographic techniques *(Invited paper)*

I.V. Semenova; Ioffe Inst., Russia

An approach is developed for investigation of cellular response to photodynamic treatment by means of digital holographic microscopy and tomography. It allows for noninvasive monitoring of living cell cultures over long time and provides quantitative data on a set of major morphological and optical parameters of cells and their dynamics over time.

ThSYD-22 12:30-13:00

Photoactive Nanomaterials for water remediation and drug delivery *(Invited paper)*

J.M. Nunzi[1,2], S. Atkins[3], A. Chueh[2], T. Barwell[3], L. Seroude[3], A. Laghzizil[4]; [1]Department of Physics, Engineering Physics & Astronomy, Queen's Univ., Kingston K7L3N6; [2]Department of Chemistry, Queen's Univ., Kingston K7L3N6; [3]Department of Biology, Queen's Univ., Kingston, ON, K7L-3N6, Canada; [4]Applied Chemistry of Materials Lab., Mohammed V Univ., Faculty of Sciences, Morocco

Photoactive nanomaterials are investigated for environment protection and sustainability. Azo-benzene polymers self-organize under light into self-structured surface relief gratings. We use them for light triggered drug delivery, which may reduce the damage caused by excess drug released into to the environment. The damage to fresh waters can also be remediated using our newly developed photocatalytic nature-sourced nanomaterials.

This research was supported by RFBR Grant(s) # Natural Sciences and Engineering Research Council of Canada (RGPIN-2020-07016)

ThSYD-23 13:00-13:15

Classification of cell states and lines by machine learning algorithms based on holographic data

A.A. Zhikhoreva[1], A.V. Belashov[1], T.N. Belyaeva[2], A.V. Salova[2], E.S. Kornilova[2], I.V. Semenova[1], O.S. Vasyutinskii[1]; [1]Ioffe Inst.; [2]Inst. of Cytology RAS, Russia

We report the development and validation of machine learning classification algorithms aimed at determination of cell lines and states. Three types of classifiers were used to analyze cellular parameters obtained by digital holographic microscopy. The highest classification accuracy was achieved with the support vector machine learning algorithm. The classification accuracy over 90% was demonstrated.

ThSYD-24 13:15-13:30

Laser osteoperforation in the treatment of the distal tibia osteomyelitis

A.V. Lychagin[1], S.V. Ivannikov[1], N.A. Nabatchikov[1,2], O.D. Podkosov[2]; [1]Sechenov Univ.; [2]Botkin Hospital, Russia

Currently, the treatment of osteomyelitis of the distal tibia remains a hot topic for discussion. Nowadays, the search for an optimal treatment method is relevant. The 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.

– Lunch Break –

Photodynamic processes in biology and medicine VI

Location: Petrov Vodkin 3 Room, floor 2. 15:00-16:45

ThSYD-25 15:00-15:30

Lasers in ophthalmology *(Invited paper)*

YU.N. Yusef, D.V. Petrachkov, E.N. Korobov, L. Alharki; Dept. Innovation Vitreoretinal Technology, Research Inst. of Eye Diseases, Russia

Ophthalmology is one of the first areas of medicine to instantly recognize the potential of lasers. There are great prospects for the use of lasers as a "laser scalpel" for the removal of the vitreous body, precision removal of moorings from the surface of the retina, epiretinal fibrosis, and precision retinotomy.

ThSYD-26 15:30-15:45

Experimental characterization of $BaTiO_3$ microspheres to enhance photodynamic and thermal processes in biology and medicine

I.S. Ruzankina[1,2], G. Ferrini[1]; [1]Interdisciplinary Lab. for Advanced Materials Physics (I-LAMP) and Department of Mathematics and Physics, Univ. Cattolica del Sacro Cuore, Italy; [2]Department of Chemistry, KU Leuven, Belgium

This research is aimed at the experimental characterization of large-size BaTiO3 microspheres as intensity enhancers for photodynamic processes on bio-objects with CW light. As a probe we use the surface Raman signal to quantitatively quantify the intensity enhancement and light gathering capability of the dielectric microspheres. The performances of the microspheres lenses are compared to those of standard microscopy objectives.

This research was supported by RFBR Grant(s) # MIUR - PRIN 2017 (aSTAR project (2017RKWTMY 003)). This work has been partially supported by the Universita` Cattolica del Sacro Cuore through D.3.1 and D.2.2 grants.

ThSYD-27 15:45-16:00

Red and near-infrared photobiomodulation of MSCs metabolism in 3D conditions

P.Y. Bikmulina[1], N.V. Kosheleva[1,2,3,4], A.I. Shpichka[1,2], V.I. Yusupov[5], Yu.A. Rochev[2,6], P.S. Timashev[1,2,7,8]; [1]World-Class Research Center "Digital Biodesign and Personalized Healthcare", Sechenov Univ.; [2]Inst. for Regenerative Medicine, Sechenov Univ.; [3]Lab. of Clinical Smart Nanotechnology, Sechenov Univ.; [4]FSBSI Inst. of General Pathology and Pathophysiology; [5]Inst. of Photon Technologies of FSRC "Crystallography and Photonics" RAS, Russia; [6]National Univ. of Ireland, Ireland; [7]Department of Polymers and Composites, Semenov Federal Research Center for Chemical Physics RAS, Russia; [8]Chemistry Department, Lomonosov Moscow State Univ., Russia

The developing field of tissue engineering and 3D-bioprinting requires novel techniques for the stimulation of cell survival, proliferation and differentiation. Photobiomodulation is a perfect candidate here since it is non-invasive, can permeate highly hydrated structures, and was shown to regulate cell physiology in stress conditions. We analyzed the effects of photobiomodulation for the mesenchymal stromal cells in 3D constructs.

This research was supported by RFBR Grant(s) # The study was supported by the Russian Foundation for Basic Research (№ 20-515-56005, hydrogels) and Russian Science Foundation (№18-15-00401)

ThSYD-28 16:00-16:15

Spectral and kinetic characteristics of promising agents for combined PDT based on YF_3-CeF_3:Tb^{3+} nanoparticles conjugated with Radachlorin by means of polyvinylpyrrolidone

A.I. Khusainova, N.I. Shamsutdinov, P.V. Zelenikhin, E.V. Lukinova, S.L. Korableva, A.S. Nizamutdinov; Inst. of Physics, Kazan Federal Univ., Russia

In this work, we studied the spectral and kinetic characteristics of YF_3-CeF3:Tb3+ (15 %) nanoparticles with Radachlorin and polyvinylpyrrolidone. Strong energy transfer from nanoparticles to Radachlrine is shown. To assess the toxicity, we conducted an MTT tests for A549 cells in the presence of nanoparticles with the Radachlorin.

ThSYD-29 16:15-16:30

Age-dependent changes in the functional activity of astrocytes

E.V. Mitroshina[1], T.A. Mishchenko[1], M.I. Krivonosov[2], M.V. Vedunova[1]; [1]Inst. of Biology and Biomedicine, Lobachevsky State Univ. Nizhny Novgorod; [2]Lab Syst Med Hlth Aging, Lobachevsky State Univ. Nizhny Novgorod, Russia

Age-dependent changes in the functional reorganization of neural networks and astrocytes in aging modeling, expressed in a decrease in the number of connections between cells, were shown.

This research was supported by RFBR Grant(s) # This work was supported by the Center of Excellence «Center of Photonics» funded by the Ministry of Science and Higher Education of the Russian Federation, contract No. 075-15-2020-927

ThSYD-30 16:30-16:45

Advanced NADH/FAD/FMN-FLIM and oxygen PLIM

A. Rueck, N. Naskar, K. Reess, S. Kalinina; Univ. Ulm, Core Facility Optical Microscopy N24, Germany

Fluorescence lifetime imaging (FLIM) of metabolic coenzymes, as NAD(P)H and FAD, is now widely accepted to be one of the most important imaging methods for cell metabolism; different algorithms are investigated to get reproducible results.

Section B. Laser interaction with cells and tissues: clinical imaging and spectroscopy

ThSYB-p01 15:00-18:30

Investigation of a combined absorption-fluorescence-Raman spectroscopy approach to brain tumor tissue differentiation ex vivo

I.D. Romanishkin[1], T.A. Savelieva[1,2], I.Yu. Poletaeva[3], S.V. Shugai[3], S.A. Goryaynov[3], D.A. Golbin[3], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. MEPhI; [3]Burdenko National Medical Research Center of Neurosurgery, Russia

In this work, we used a combined absorption-fluorescence-Raman approach to the optical investigation of brain tissue. The proposed approach allowed taking into account the blood fill, oxygenation, accumulation of fluorescent biomarker, and Raman signal to estimate a degree of malignancy of the tissue.

ThSYB-p02 15:00-18:30

Comparative analysis of TIE imaging and off-axis digital holography for evaluation of cell parameters

A.A. Zhikhoreva[1], A.V. Belashov[1], T.N. Belyaeva[2], A.V. Salova[2], E.S. Kornilova[2], I.V. Semenova[1], O.S.Vasyutinskii[1]; [1]Ioffe Inst.; [2]Inst. of Cytology RAS, Russia

We report comparative analysis of phase imaging of cell specimens performed using transport of intensity equation (TIE) and off-axis digital holography. Optical and morphological parameters of fixed HeLa cells were evaluated from the phase images obtained by these techniques. The accuracy of three TIE solvers under different experimental conditions was estimated by comparison with the data, obtained by holographic microscopy.

ThSYB-p03 15:00-18:30

Combined Monte Carlo and k-Wave simulations of optoacoustic images of blood vessels in tissue-like medium

V.V. Perekatova, A.V. Khilov, D.A. Kurakina, A.A. Getmanskaya, M.Yu. Kirillin; Inst. of Applied Physics RAS, Russia

We simulated set of OA images at dual wavelengths for different vasculature parameters by applying combined Monte Carlo and k-Wave simulations. The obtained set of synthetic OA data revealed high potential as a training set for machine learning technique for blood oxygen saturation mapping based on spectral OA data.

ThSYB-p04 15:00-18:30

Determination of biotissue photodegradation kinetic parameters based on electrical impedance

K.V. Sovin[1], N.V. Kovalenko[1,2], O.A. Ryabushkin[1,2]; [1]Moscow Inst. of Physics and Technology; [2]Fryazino branch of Kotelnikov Inst. of Radio-Engineering and Electronics, Russia

A method for determination of degradation kinetic parameters in laser damage process of biological tissues is proposed. By scattering of laser radiation, homogeneous heating of the sample was created. In this process the temperature dependence of its low-frequency electrical impedance (~1 kHz) was measuring. By processing these kinetics with Arrhenius formulations important parameters of the heating kinetics were obtained.

ThSYB-p05 15:00-18:30

Application and optimization of LCOS spatial light modulator for estimation of optical and physiological parameters of living cells

A.V. Belashov, A.A. Zhikhoreva, I.V. Semenova, O.S. Vasyutinskii; Ioffe Inst. Russia

We report implementation of quantitative phase imaging for evaluation of optical and morphological parameters of living cells using phase-only spatial light modulator. The method accuracy was evaluated under different experimental conditions by comparison with the data, obtained by holographic tomography.

ThSYB-p05 15:00-18:30

The effect of laser radiation on the BSA conformation

E.A. Molkova, V.I. Krasovskii, V.I. Pystovoy; Prokhorov General Physics Inst. RAS, Russia

The effect of laser radiation on the buffer solution of bovine serum albumin (BSA) was studied. In this work, we irradiate aqueous solutions of BSA with a 532 nm laser source with pulse energy 70 μJ and pulse duration 10ns. It has been shown there is a change in the secondary structure of the protein.

ThSYB-p06 15:00-18:30

Homogeneous heating of biological tissues with laser radiation

V.S. Anpilov[1], N.V. Kovalenko[2,3], O.A. Ryabushkin[2,3]; [1]Moscow Engineering Physics Inst.; [2]Moscow Inst. of Physics and Technology; [3]Fryazino branch of Kotelnikov Inst. of Radio-Engineering and Electronics, Russia

In this paper, the heating of biological tissues uniformly illuminated by optical radiation with a penetration depth of the order of the sample size is investigated. The considered method makes it possible to achieve rapid homogeneous heating of the sample volume, as opposed to heating water or air.

ThSYB-p07 15:00-18:30

Frequency-domain lifetime analysis of singlet oxygen luminescence

V.V. Dremin[1,2], E.U. Rafailov[1]; [1]Aston Univ, UK; [2]Orel State Univ, Russia

A system has been developed to measure the intensity and lifetime of singlet oxygen luminescence in the frequency-domain. Test measurements showed the possibility of high-quality analysis of the singlet oxygen concentration in the medium.

ThSYB-p08 15:00-18:30

Light absorption in human tissues for blood flow analysis and diagnostics

E. Nepomnyaschaya, E. Savchenko, I. Kolokolnikov; Peter the Great St. Petersburg Polytechnic Univ., Russia

We suggest to use light absorption methods to realize non-invasive blood flow analysis and diagnostics of liver function based on it. In this research we describe principles of absorbance spectroscopy and results on spectroscopic measurements in medicine.

This research was supported by RFBR Grant(s) # This research was funded by RSF, grant number №21-72-00035. https://rscf.ru/en/project/21-72-00035/.

ThSYB-p09 15:00-18:30

Study of the optical properties of biological tissue depending on temperature

E.A. Gamayunova, V.I. Kochubey; Saratov State Univ., Russia

Measurement of the internal biological tissue temperature is an important parameter for monitoring physiological processes. In our work, we present the results of a study of the optical properties dependence of biological tissues in vitro on temperature changes.

ThSYB-p10 15:00-18:30

Using disk-detector geometry for calculation of optical path length by Monte Carlo simulation of light transport in turbid media

A.P. Tarasov[1,2]; Vladimirsky Moscow Regional Research and Clinical Inst. "MONIKI"; [2]Federal Scientific Research Centre "Crystallography and Photonics" of RAS, Russia

Disk-detector geometry, replacing a conventional square detector with a disk detector, is a technique designed to accelerate Monte Carlo simulations of light transport in turbid media. In this study, we test applicability of using this technique to calculate optical pathlength. It is shown that such calculations are correct, and their accuracy is higher than in the case of square detectors.

Section D. Photodynamic processes in biology and medicine

ThSYD-p01 15:00-18:30

Anisotropic relaxation of Radachlorin photosensitizer in aqueous solution under two-photon excitation

I.A. Gorbunova, M.E. Sasin, A.A. Zhikhoreva, A.V. Belashov, I.V. Semenova, O.S. Vasyutinskii, Ioffe Inst., Russia

The fluorescence decay of Radachlorin photosensitizer in aqueous solution under two-photon excitation by femtosecond laser pulses at 810 nm has been studied. The major fluorescence parameters of the molecule including fluorescence decay time, rotational diffusion time and anisotropy have been determined.

ThSYD-p02 15:00-18:30

Conformational relaxation and molecular oxygen rebinding in alpha and beta subunits within valency hybrids of human hemoglobin

S.V. Lepeshkevich[1], I.V. Sazanovich[2], M.V. Parkhats[1], S.N. Gilevich[3], B.M. Dzhagarov[1]; [1]Stepanov Inst. of Physics NASB, Belarus; [2]Central Laser Facility, Research Complex at Harwell, STFC Rutherford Appleton Lab., UK; [3]Inst. of Bioorganic Chemistry NASB, Belarus

Picosecond to millisecond laser time-resolved transient absorption spectroscopy was used to study O2 rebinding and conformational relaxation following O2 photodissociation in the alpha and beta subunits within human hemoglobin. Oxy-cyanomet valency hybrids were used as models for oxygenated hemoglobin. Significant functional non-equivalence of the alpha and beta subunits in both the geminate O2 rebinding and concomitant structural relaxation was revealed.

ThSYD-p03 15:00-18:30

Efficacy of photoactivated medicinal plant extracts

A.V. Mikulich[1], A.I. Tretyakova[1], R.K. Nahorny[1], N.V. Dudchik[2], O.A. Emeliyanova[2], A.I. Zhabrouskaya[2], A.N. Sobchuk[1], T.S. Ananich[1], L.G. Plavskaya[1], O.N. Dudinova[1], I.A. Leusenka[1], S.V. Yakimchuk[1], V.Yu. Plavskii[1], T.Q. Tien[3], Q.C. Tong[3], Th.-Ph. Nguyen[4]; [1]Inst. of Physics NASB; [2]Scientific Practical Centre of Hygiene, Belarus; [3]IMS, VAST, Vietnam; [4]SEP, Hanoi Univ. of Science and Technology, Vietnam

We present study on spectral-luminescent characteristics medicinal plant extracts (extract from a mixture of flowers of Matricaria chamomilla and Calendula officinalis, Achilléa millefólium herb (commercial name "Rotatit"); preparation from Hypéricum perforátum; preparation from Eucalypti viminalis folia), their ability to generate of singlet oxygen upon photoexcitation and photodynamic effects of extracts on mammalian cell culture and different taxonomic groups of bacteria.

ThSYD-p04 15:00-18:30

Increasing the chlorine E6 concentration in tumor tissues by preliminary laser irradiation

K.T. Efendiev[1,2], P.M. Alekseeva[1,2], A.A. Shiryaev[3], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]Department of Laser Micro-, Nano-, and Biotechnology, Inst. of Engineering Physics for Biomedicine, National Research Nuclear Univ. "MEPhI"; [3]Univ. Clinical Hospital no.1, Levshin Inst. of Cluster Oncology, Sechenov First Moscow State Medical Univ., Ministry of Health of the Russian Federation, Russia

This paper presents a method for increasing the chlorin e6 concentration in tumors. Different dynamics in fluorescence indices were observed in tumors and their border. After preliminary irradiation of tissues, an increase in the fluorescence indices of tumors was observed in 70% of cases. In 60% of cases, a decrease in photosensitizer fluorescence was observed in the tumor border.

ThSYD-p05 15:00-18:30

Oxidation of biopterins under exposure to UV light from LED

D.A. Makarova[1], A.S. Nizamutdinov[1], E.I. Madirov[1], E.V. Lukinova[1], Y.L. Vechtomova[2], A.A. Buglak[3], T.A. Telegina[2]; [1]Inst. of Physics, Kazan Federal Univ.; [2]Bach Inst. of Biochemistry, Research Center of Biotechnology RAS; [3]St. Petersburg State Univ., Russia

Here we report the study of processes of tetrahydrobiopterin oxidation upon irradiation with UV light form LED source. We have detected the dihydropterin dimers formation initiated by UV light.

ThSYD-p06 15:00-18:30

Photobleaching control of chlorin e6 in the cervical tissues by the phototheranostics method

P.M. Alekseeva[1,2], K.T Efendiev[1,2], A.V. Gilyadova[3,4], A.A. Shiryaev[3,4], V.B. Loschenov[1,2]; [1]Prokhorov General Physics Inst. RAS; [2]National Research Nuclear Univ. "MEPhI"; [3]Sechenov First Moscow State Medical Univ., Levshin Inst. of Cluster Oncology, Univ. Clinical Hospital No.1; [4]National Medical Research Center - Treatment and Rehabilitation Center of the Ministry of Health of the Russian Federation, Russia

Photodynamic therapy with intravenous administration of the chlorin e6 shows high efficiency in the treatment of cervical neoplasms with complete eradication of the human papillomavirus. This method can reduce deaths from cervical cancer and preserve fertility in patients. Spectral and video fluorescence diagnostics allows intraoperatively assessing the degree of photosensitizer accumulation and photobleaching and visualizing the boundaries of neoplasms.

ThSYD-p07 15:00-18:30

Photonics of oxygen-saturated microemulsions based on extracts of spruce cone from picea abies for photodynamic therapy

A.V. Tcibulnikova[1], E.S. Zemlyakova[1,2], V.A. Slezhkin[1,2], I.G. Samusev[1], V.V. Bryukhanov[1], D.A. Artamonov[1]; [1]Immanuel Kant Baltic Federal Univ., Russia; [2]Kaliningrad State Technical Univ., Russia.

A spectral study of the microemulsion solution based on Spruce Cone (Picea abies) extract containing of polyphenols and phenolic acids was carried out in the visible and IR spectral regions. The microemulsion solution has an absorption spectrum and luminescence. Based on the time-resolved spectroscopy, the possibility of reactive oxygen species generation in the microemulsion with the extract was proved.

ThSYD-p08 15:00-18:30

Singlet oxygen generation by a pH-responsive photosensitizer based on porphyrin and hydroxyapatite nanoparticles

M.V. Parkhats[1], S.V. Lepeshkevich[1], A.V. Petkevich[2], A.A. Rogachev[2], S.N. Terekhov[1], B.M. Dzhagarov[1]; [1]Stepanov Inst. of Physics NASB; [2]Inst. of Chemistry of New Materials NASB, Belarus

The efficiency of photosensitized singlet oxygen generation was found to be decreased up to 10 times upon the porphyrin-hydroxyapatite complex formation at pH 7.6. The drop of pH to 5.0 leads to increasing in singlet oxygen luminescence. The obtained data indicate that at low pH value the porphyrin is released from the complex and its photodynamic activity is restored.

ThSYD-p09 15:00-18:30

Study of microcirculation parameters using wearable Doppler monitors in pregnant patients with type 1 diabetes mellitus

E. Zharkikh[1], Yu. Loktionova[1], A. Zherebtsova[1], M. Tsyganova[2], A. Tiselko[3], E. Zherebtsov[1,4]; [1]Research and Development Center of Biomedical Photonics, Turgenev Orel State Univ.; [2]St. Petersburg State Univ.; [3]The Research Inst. of Obstetrics, Gynecology and Reproductology named after D.O. Ott, Russia; [4]Optoelectronics and Measurement Techniques, Univ. of Oulu, Finland

The study is devoted to investigating the parameters of blood microcirculation and oxidative metabolism in pregnant women with diabetes mellitus using the new portable devices for monitoring blood microcirculation and metabolic processes. The peculiarities of regulation of microcirculation and tissue metabolic parameters in 1st trimester of pregnancy were investigated in women with diabetes mellitus.

This research was supported by RFBR Grant(s) # The study was supported by the Russian Foundation for Basic Research (research project No. 20-08-01153)

ThSYD-p10 15:00-18:30

Using genetically engineered calcium indicator to identify the role of astrocytes in the development of Alzheimer's disease

M.S. Gavrish, E.V. Mitroshina, M.O. Savyuk, M.V. Vedunova; Inst. of Biology and Biomedicine, Lobachevsky State Univ. of Nizhny Novgorod, Russia

A new calcium sensor has been developed to determine the functional activity of astrocytes in Alzheimer's disease an in vitro modeling

This research was supported by RFBR Grant(s) # This work was supported by the Center of Excellence «Center of Photonics» funded by the Ministry of Science and Higher Education of the Russian Federation, contract No. 075-15-2020-927

The School "Photonic nanomaterials"

Session 1

Thursday, June 23

Location: Deyneka Room, floor 2. 09:00-13:30

ThST1-01 09:00-10:00

Growth modeling of III-V nanowires *(Invited Lecture)*

V.G. Dubrovski; St. Petersburg State Univ., Russia

ThST1-02 10:00-11:00

Molecular beam epitaxy of semiconductor nanostructures *(Invited Lecture)*

G.E. Cirlin; Alferov St. Petersburg National Research Academic Univ. RAS, Russia

ThST1-03 11:30-12:30

Flexible light-emitting devices based on III-V and III-N nanowires encapsulated into polymer matrix *(Invited Lecture)*

I.S. Mukhin; Alferov St. Petersburg National Research Academic Univ. RAS, Russia

ThST1-04 12:30-13:30

III-V hybrid nanostructures on silicon: MBE growth and properties. *(Invited Lecture)*

R.R. Reznik; St. Petersburg State Univ., Russia

Session 2

Thursday, June 23

Location: Deyneka Room, floor 2, floor 3. 15:00-17:00

ThST1-05 15:00-15:20

MBE growth and properties of AlGaAs nanowires with InGaAs quantum dots on silicon

R.R. Reznik; St. Petersburg State Univ., Russia

ThST1-06 15:20-15:40

Droplet contact angle controlling the morphology and crystal phase of GaAs and GaP nanowires

N.G. Sibirev; St. Petersburg State Univ., Russia

ThST1-07 15:40-16:00

Microspherical lithography for selective epitaxy

L. Dvoretckaia; Alferov St. Petersburg National Research Academic Univ. RAS, Russia.

ThST1-08 16:00-16:20

Growth of III-V nanowires by molecular beam epitaxy: the role of material exchange with the substrate

V.G. Dubrovskii; St. Petersburg State Univ., Russia

ThST1-09 16:20-16:40

Core-shell InGaN Nanowires: MBE growth and properties

V. Gridchin; Alferov St. Petersburg National Research Academic Univ. RAS, Russia

The School "X-ray synchrotron and laser research methods in material science"

Session 1

Tuesday, June 21

Location: Deyneka Room, floor 2. 17:30-19:30

TuST2-01 17:30-18:30

Synchrotron x-ray microimaging at storage-ring and XFEL sources of "megascience" *(Invited Lecture)*

T.S. Argunova; Ioffe Inst., Russia

TuST2-02 18:30-19:30

X-ray structural analysis in the study of biopolymer polyelectrolyte materials *(Invited Lecture)*

A.V. Podshivalov; ITMO Univ., Russia

Session 2

Wednesday, June 22

Location: Deyneka Room, floor 2. 17:30-19:30

WeST2-03 17:30-18:30

X-ray resonance reflectometry as a multifunctional synchrotron method for studying magnetic nanofilms *(Invited Lecture)*

S.M. Suturin; Ioffe Inst., Russia

WeST2-04 18:30-19:30

Commensurate and incommensurate superstructures in perovskite-based crystals and nano-heterostructures *(Invited Lecture)*

R.G. Burkovsky; St. Petersburg State Technical Univ., Russia

Session 3

Thursday, June 23

Location: Deyneka Room, floor 2. 17:30-19:30

ThST2-05 17:30-18:30

Biomedical applications of Raman spectroscopy *(Invited Lecture)*

E.E. Popov; ITMO Univ., Russia

ThST2-06 18:30-19:30

Application of some synchrotron-related spectroscopy techniques for studying electronic structure of advanced carbon nanostructures *(Invited Lecture)*

V.V. Shnitov; Ioffe Inst., Russia

Session 4

Friday, June 24

Location: Stenberg 2 Room, floor 3. 09:00-11:00

FrST2-07 09:00-10:00

Free-electron laser as a source of hard X-ray twisted photons *(Invited Lecture)*

D.V. Karlovets; ITMO Univ., Russia

FrST2-08 10:00-11:00

XPS study of halide perovskites electronic structure from core-level to valence band *(Invited Lecture)*

S.A. Khubezhov; ITMO Univ., Russia

A1: Centennial of Prof. Nikolai Basov, Nobel Prize winner (1964)

Location: Stenberg 1 Room, floor 3. 15:00-17:00

ThA1-01 15:00-15:10
Opening of N.G.Basov Round Table
Andrey Ionin; Lebedev Physical Inst. RAS, Russia

ThA1-02 15:10-15:30
N.G. Basov and laboratory (division) of Quantum Radiophysics of LPI of RAS
Igor Kompanets; Lebedev Physical Inst. RAS, Russia

ThA1-03 15:30-15:50
N.G.Basov was the first who organized laser investigations in the USSR
Joseph Zubarev; Lebedev Physical Inst. RAS, Russia

ThA1-04 15:50-16:10
Nd:glass laser for plasma heating: first experiments in Basov's laboratory (1964-1968)
Yurii Senatskii; Lebedev Physical Inst. RAS, Russia

ThA1-05 16:10-16:30
N.G. Basov's disk laser is a universal tool for centuries!
Victor Apollonov; Prokhorov General Physics Inst. RAS, Russia

ThA1-06 16:30-16:50
Basov-Krokhin-Popov diode injection laser has opened a new era of eye-safe environmental sensing by diode-laser-based Lidar: to 100th anniversary of Nikolay Basov
Sergey Pershin; Prokhorov General Physics Inst. RAS, Russia

ThA1-07 16:50-17:00
Friendly work on "DOLPHIN 1", memories of great times and great people
Sergey Bobashev; Ioffe Inst., Russia

ThA1-01 15:00-15:10
Вступительное слово
Ионин Андрей Алексеевич (ФИАН)

ThA1-02 15:10-15:30
Н.Г. Басов и Лаборатория (Отделение) квантовой радиофизики ФИАН
Компанец Игорь Николаевич (ФИАН)

ThA1-03 15:30-15:50
Н.Г.Басов - пионер и организатор лазерных исследований в СССР
Зубарев Иосиф Геннадиевич (ФИАН)

ThA1-04 15:50-16:10
Лазер на неодимовом стекле для нагрева плазмы: первые эксперименты в лаборатории Н.Г. Басова (1964-1968)
Сенатский Юрий Всеволодович (ФИАН)

ThA1-05 16:10-16:30
Дисковый лазер Н.Г.Басова – универсальный лазер на века!
Аполлонов Виктор Викторович (ИОФРАН)

ThA1-06 16:30-16:50
Диодный инжекционный лазер Басова-Крохина-Попова открыл новую эру безопасного для глаз зондирования окружающей среды лидаром на основе диодного лазера: к 100-летию со дня рождения Николая Басова
Першин Сергей Михайлович (ИОФРАН)

ThA1-07 16:50-17:00
Дружная работа на «ДЕЛЬФИНЕ 1», воспоминания о прекрасном времени и прекрасных людях.
Бобашев Сергей Васильевич (ФТИ им. А.Ф. Иоффе РАН)

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AZIMUTH PHOTONICS specializes in the distribution and promotion of leading international manufacturers optoelectronic components on the Russian market. Our company is actively involved in the development new projects with OEMs and research organizations. Our aim is introduction of state-of-the-art technologies and innovative solutions in the field of optoelectronics into production to encourage development and support projects of Russian OEM companies.
We supply optoelectronic components such as X-ray modules, photodiodes, photomultiplier tubes, detectors, CCD/CMOS, IR arrays, IR emitters, scintillation materials, laser diodes and laser modules, DPSS lasers.
We have strong long term relations with manufacturers of optoelectronic components as Cobolt, Omicron-Laserage, Frankfurt Laser Company, Pd-LD, Picoquant, Becker&Hickl, Laser Components GmbH, Thorlabs and many others.

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ETM Photonics is a team that has decided to change the principles of work at the rapidly growing market for the supply of scientific equipment.
We offer the development of technical projects of any complexity from the moment of their initiation to commissioning.
We have experience in scientific research in the field of photonics, so we speak the same language with you.
We are represented in Saint Petersburg and Moscow, work directly with Manufacturers and independently arrange customs clearance of imported products, which guarantees the fulfillment of warranty obligations, speed of delivery, while maintaining an acceptable price.
We are: customer oriented, transparent, open to dialogue, compliant with the laws of Russia and the country of the Supplier.

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B. I. Stepanov Institute of Physics is well-known leader in the field of laser physics, nonlinear optics and laser specroscopy in Belarus with over 60-year history. More than 25 years a lot of attention in the Institute is devoted to development, manufacturing and investigations of diode-pumped solid state lasers. As a result a group of highly qualified scientists, designers and engineers ready for practical realization of different customized diode pumped solid state laser systems was formed. Our own mechanical and optical departments enable manufacturing of lasers with required characteristics in the shortest time periods. One of the main directions of the Institute 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.

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ITMO University (Saint Petersburg) is a national research university, the leading Russian university in the field of information and photonic technologies. The university is the alma mater
of winners of numerous international programming competitions: ACM ICPC (the only seven-
time world champions), Google Code Jam, Facebook Hacker Cup, Yandex Algorithm, Russian
Code Cup, Topcoder Open etc.
Priority research areas:

- IT,
- photonic technologies,
- robotics,
- quantum communication,
- translational medicine,
- urban studies,
- art&science,
- science communication.

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Laser Components LLC is a Russian supplier of components for optoelectronic, laser, navigation and thermal imaging equipment, as well as ready-made solutions for building complex security systems from leading manufacturers in China.
From year to year, we set ourselves the task of providing enterprises, organizations, institutes of high-tech industries with modern components for thermal imaging and laser equipment.
All products are characterized by high reliability, impeccable quality, safety and ease of operation.
Laser Components LLC has a quality management system certificate according to GOST ISO 9001-2001(ISO 9001:2008), as well as GOST RV 0015-002-2012.
Thanks to cooperation with leading enterprises, as well as optical institutes of the Chinese Academy of Sciences, Laser Components supplies large-sized optics with high requirements for material, processing and coating.
The professionalism and multilingualism of the employees of the Laser Components company allows you to quickly contact manufacturers without experiencing language barriers, as well as to carry out quality control directly at the factory itself.
Among our clients are more than 40 organizations that are part of the Rosatom and Rostec state corporations, more than 10 organizations of the rocket and space industry, as well as about 30 research institutes.

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SC «LLS» is the leader of the Optics and Photonics industry in Russia. Resident of ITMO University Technopark, member of the Laser Association. LLS specializes in the manufacturing, supply, integration of laser-optic and fiber-optic equipment.
Head office is located in St. Petersburg. Branch offices and showrooms are located in Moscow, Novosibirsk, Vladivostok, Naberezhnye Chelny and Cherepovets.
LLS offers a wide range of fiber-optic and laser components, including:
Optics and optomechanics;
Instrumentation 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;
Development of laser marking and engraving technologies.

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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.

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LSTECH is a fiber optic passive component manufacturer. Main items are high power components & modules for fiber laser applications, specialized in PM or non-PM high power pump combiners, signal beam combiners, mode field adaptor & clad power stripper, high power endcaps, fused fiber bundles. Also, we provide various specialty fiber optic solutions based on long-term experiences and techniques to fulfill customer requirements. Our Mission is customer satisfaction with high quality products.

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Maiman Electronics LLC specializes in development and manufacturing Laser Diode Drivers. Our main:
SF6XXX – powerful OEM CW compact Laser Diode Driver;
SF8XXX – ultra-compact OEM driver for butterfly Laser Diode;
MBLXXXX – benchtop laser power supply for laboratory applications;
SF6XXX and SF8XXX ultra-compact and highly reliable solutions that can be easily integrated into the customers laser system. This makes Maiman Electronics LLC an important partner for companies across various industries – for example, material processing, medical equipment, laser measurement equipment applications and ect.
Benchtop solution MBLXXXX perfect fits scientific research and laser diode burn-In/life time tests.
Benchtop MBLXXXX has modifications with TEC controllers and laser diode mounts.

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The research and production company Photonic Technology Systems LLC was founded by a group of scientists in 2017 PhotonTechSystems manufactures educational photonics kits, optical table, laminar tabletop workstation, laser beam visualizers, and other high-tech products. Our goal is to integrate the results of scientific and educational activities in the field of photonics and business. PhotonTechSystems are based on the spirit of partnership, continuous development and high quality.

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Photonics Cloud Ltd. is a distributor of optical tables, optomecanics and optics of the largest producers in Southeast Asia. We offer a range of standard sizes of optical tables and produce optical tables of any shape and size according to the customer's specifications. Photonics Cloud produces Laminar boxes for laser systems, Faraday cage and other different equipment. Photonics Cloud supplies to the Russian market laser crystal: Diffusion Bonding Laser Crystals, Nd:YAG Crystals, Nd:YVO4 Crystals, Nd:Ce:YAG Laser Crystals, CTH:YAG Crystals, Er:YAG Crystals, Yb:YAG Crystals, Ti:Sapphire Crystals, Alexandrite Laser Crytstals, BBO Crystals, DKDP (KD*P) Crystals, KTP Crystals, HGTR KTP Crystals, LBO Crystals, BIBO Crystals, ZGP (ZnGeP2) Crystals, KTA Crystals, LiIO3 Crystals, LiNbO3 Crystal and MgO:LiNbO3 Crystals, RTP Crystals, YCOB Crystals, Cr4+:YAG Crystals, Co2+:MgAl2O4 (Co2+:Spinel) Crystals, V3+:YAG Crystals, MgF2 Crystals, YVO4 Crystals, TSAG (Terbium Scandium Aluminium Garnet) Crystals, TGG (Terbium Gallium Garnet) Crystals and others.

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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 components.

Rostox-N Ltd
Production of synthetic sapphire

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ZAO Rostox-N jointly with EZAN (Moscow region, Chernogolovka) designs and manufactures automated crystal growth equipment for growing wide range single crystals by different techniques such as: Czochralski, Stepanov (EFG), Kyropoulos and sublimation growth. We develop crystal growth technologies for sapphire, SiC, crystals for laser applications and for scintillators.
Since 1993, we have been one of the world leaders in the growth and production of single crystal sapphire products: for optical application (protective windows, light guides, lenses), precision sapphire products (plungers, valves, balls, spheres), sapphire for chemical and mechanical applications (tubes, substrates, rods, insulators).

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