17th International Conference

"Laser Optics 2016"

Technical Program

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LASER RADIATION

Saint Petersburg, Russia
June 27 - July 1, 2016

17th International Conference "Laser Optics 2016"

On July 11, 2016, will be the 100th anniversary of the birth of Alexander Mikhailovich Prokhorov. Professor Prokhorov (1916-2002) was one of the founders of laser sciences, a Nobel prize winner, and for many years an Honorary Chair of the Laser Optics Conference. We dedicate the conference to his memory.

Saint Petersburg
2016

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THE 17TH INTERNATIONAL CONFERENCE «LASER OPTICS 2016»

IS TECHNICALLY CO-SPONSORED BY

IEEE Photonics Society

AND HOSTED BY:

Fund for Laser Physics

IPG Photonics Corporation

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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
2016

МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

The Ministry of Education and Science of Russian Federation

St.Petersburg Government

IPG IRE-POLUS

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МИНПРОМТОРГ РОССИИ

The Ministry of Industry and Trade of the Russian Federation

Rozhdestvensky Optical Society

Laser Association

www.photonics.su научно-технический журнал
ФОТОНИКА

«Photonika» Magazine

GPI
Prokhorov General Physics Institute of RAS

RHYTHM OF MACHINERY

«RITM» Magazine

Holiday Inn

Holiday Inn St. Petersburg Moskovskiye Vorota

JUNE 27 - JULY 1, ST. PETERSBURG, RUSSIA

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TOPICS FOR LO`2016

R1. SOLID-STATE LASERS

DPSSL • Ultrafast • Mid-IR • CW and pulsed • Compact sources • Emerging applications • Guided wave lasers • Fiber lasers (excluding high power) • Tunable lasers • Parametric amplifiers

R2. HIGH POWER LASERS

Advances in high-power gas and solid-state lasers • Fundamental issues in high-power laser science • High power laser architectures • Terawatt lasers, including fusion lasers • Novel optical materials for high power applications and systems • Thermal and thermo-optical effects in lasers and their mitigation • CO_2/CO lasers • Iodine lasers • Slab gas lasers • Chemical lasers • Excimer lasers • Extreme-UV light sources • Alkali vapor lasers

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

Quantum-well, wire, dash and dot lasers and devices • MID-IR and Quantum Cascade lasers • Ultrashort pulse lasers • VCSELs, VECSELs and superlattice structures • UV and Visible diode lasers and LEDs • Compact THz sources and applications • Silicon photonics • Optical coherent tomography • Multiphoton imaging • Novel semiconductor-based devices and emerging applications

R4. LASER BEAM CONTROL

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

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 FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, AND GLOBAL NAVIGATION

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

R7. LASERS IN ENVIRONMENTAL MONITORING

Laser remote sensing technologies and methods • Lidar techniques and measurements for atmospheric remote sensing • Oil spill and ocean monitoring • Urban remote sensing • Laser sensing for geology • Remote sensing for agriculture and ecosystems • Space-based lidar for global observations • Laser applications in biophotonics

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Nonlinear optical devices, including microresonators, waveguides, and PT-symmetric systems • Multimode light propagation • Self-focusing, collapse dynamics and applications • Conservative and dissipative optical solitons, oscillons • Vortex solitons and optical angular momentum • Supercontinuum generation • Fiber optics and telecommunications

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. 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

TOPICS FOR LO`2016

S1. 8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

High power fiber lasers for material processing applications • Cutting and welding with kW fiber lasers • Fiber laser cladding, sintering, heat treatment and additive technology • Fiber lasers for automotive applications • Mid power fiber laser applications • Pipe and thick section welding • Marking and engraving • Mid infra-red, 2 to 3 micron fiber lasers, processing including • Cutting and welding of plastics • Visible, UV and ultrafast fiber lasers and applications • Hybrid lasers • Life Sciences, medical, surgical, food production, agricultural pest and herbal control applications of fiber lasers • New materials and parts for fiber lasers: fibers, crystals, glasses, optics, nonlinear elements, etc.

S2. 4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS»

New medical applications and advanced laser medical systems for ophthalmology, dermatology, urology, endoscopic and microsurgery, dentistry, and other specialties autofluorescence and photodynamic diagnosis • Optical coherence tomography and diffuse optical imaging • New developments in non-invasive optical technologies, laser microscopy and spectroscopy of tissues • Optical clearing and light transport in cells and tissues • Laser trapping and manipulation of biological particles • Nonlinear interactions of light and tissues • Speckle phenomena in tissues • Quantification and imaging of cells, blood and lymph flows • Terahertz waves interaction with cells and tissues • Analytical biophotonics • Novel sensing principles, devices and instrumentation for medical diagnostics • Nanomaterials and nanosystems for diagnostics and therapy

MONDAY, 27 JUNE	
11.00-13.40	**PLENARY SESSION** *MOSKOVSKY CONGRESS HALL*
18.00-21.00	**WELCOME RECEPTION** *MOSKOVSKY CONGRESS HALL*

TUESDAY, 28 JUNE					
9.00-11.00		**R1** SOLID-STATE LASERS I ***DEYNEKA*** *P. 20*	**R3** QUANTUM-WELL, WIRE, DASH AND DOT LASERS AND DEVICES ***PETROV-VODKIN 1*** *P. 21*	**R8** NONLINEAR FIBERS AND PHOTONIC CRYSTALS ***PUDOVKIN*** *P. 24*	**R9** OPTICAL NANOMATERIALS I ***STENBERG*** *P. 26*
11.00-11.30	COFFEE BREAK				
11.30-13.30		**R1** SOLID-STATE LASERS II ***DEYNEKA*** *P. 20*	**R3** LASER DYNAMICS AND ULTRASHORT PULSE GENERATION ***PETROV-VODKIN 1*** *P. 21*	**R8** NONLINEAR FIBERS ***PUDOVKIN*** *P. 24*	**R9** OPTICAL NANOMATERIALS II ***STENBERG*** *P. 26*
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION** **R1, R9** ***MOSKOVSKY CONGRESS HALL*** *P. 29*	**R6** LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, AND GLOBAL NAVIGATION I ***DEYNEKA*** *P. 23*	**R3** UV AND VISIBLE DIODE LASERS AND LEDS ***PETROV-VODKIN 1*** *P. 22*	**R8** FIBERS AND FIBER LASERS ***PUDOVKIN*** *P. 25*	**R9** OPTICAL NANOMATERIALS III ***STENBERG*** *P. 27*
17.00-17.30	COFFEE BREAK				
17.30-19.30	**POSTER SESSION** **R1, R9** ***MOSKOVSKY CONGRESS HALL*** *P. 29*	**R6** LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, AND GLOBAL NAVIGATION II ***DEYNEKA*** *P. 23*	**R3** VCSELS AND VECSELS ***PETROV-VODKIN 1*** *P. 22*	**R8** FIBERS AND FIBER LINES ***PUDOVKIN*** *P. 25*	

WEDNESDAY, 29 JUNE					
9.00-11.00	**POSTER SESSION** **R8** ***MOSKOVSKY CONGRESS HALL*** *P. 43*	**R1** SOLID-STATE LASERS III ***STENBERG*** *P. 32*		**R3** NOVEL DEVICES AND EMERGING APPLICATIONS I ***DEYNEKA*** *P. 34*	**R5** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES I ***PUDOVKIN*** *P. 37*
11.00-11.30	COFFEE BREAK				
11.30-13.30	**POSTER SESSION** **R8** ***MOSKOVSKY CONGRESS HALL*** *P. 43*	**R1** SOLID-STATE LASERS IV ***STENBERG*** *P. 32*	**R2** HIGH POWER LASERS I ***PETROV-VODKIN 1*** *P. 33*	**R3** NOVEL DEVICES AND EMERGING APPLICATIONS II ***DEYNEKA*** *P. 34*	**R5** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES II ***PUDOVKIN*** *P. 37*
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION** **R1, R5** ***MOSKOVSKY CONGRESS HALL*** *P. 40*	**R4** LASER BEAM CONTROL I ***STENBERG 2*** *P. 36*	**R2** HIGH POWER LASERS II ***PETROV-VODKIN 1*** *P. 33*	**R3** NOVEL DEVICES AND EMERGING APPLICATIONS III ***DEYNEKA*** *P. 35*	**R7** LASERS IN ENVIRONMENTAL MONITORING I ***PETROV-VODKIN 3*** *P. 38*
17.00-17.30	COFFEE BREAK				
17.30-19.30	**POSTER SESSION** **R1, R5** ***MOSKOVSKY CONGRESS HALL*** *P. 40*	**R4** LASER BEAM CONTROL II ***STENBERG 2*** *P. 36*	**R2** LASER BEAM CONTROL III ***PETROV-VODKIN 1*** *P. 33*	**R3** NOVEL DEVICES AND EMERGING APPLICATIONS IV ***DEYNEKA*** *P. 35*	**R7** LASERS IN ENVIRONMENTAL MONITORING II ***PETROV-VODKIN 3*** *P. 38*
19.40-21.10	**POSTDEADLINE SESSION** ***DEYNEKA***				

MONDAY, 27 JUNE

PLENARY SESSION *MOSKOVSKY CONGRESS HALL*		11.00-13.40
WELCOME RECEPTION *MOSKOVSKY CONGRESS HALL*		18.00-21.00

TUESDAY, 28 JUNE

R10 HARD X-RAY FELS ***RIHTER*** *P. 27*	**S1 PLENARY SESSION** ***PETROV-VODKIN 2+3*** *P. 63*		**S2 PLENARY SESSION** ***LEVINSON*** *P. 73*	9.00-11.00
COFFEE BREAK				11.00-11.30
R10 SOFT X-RAY AND THZ FELS ***RIHTER*** *P. 28*	**S1A** FIBER LASERS AND COMPONENTS I ***PETROV-VODKIN 2*** *P. 64*	**S1B** FIBER LASER TECHNOLOGIES AND EQUIPMENT I ***PETROV-VODKIN 3*** *P. 65*	**S2A** ADVANCED LASER SYSTEMS FOR MEDICAL APPLICATIONS I ***LEVINSON*** *P. 74*	11.30-13.30
LUNCH BREAK				13.30-15.00
R10 SCIENCE AT FELS ***RIHTER*** *P. 28*	**S1A** FIBER LASERS AND COMPONENTS II ***PETROV-VODKIN 2*** *P. 64*	**S1B** FIBER LASER TECHNOLOGIES AND EQUIPMENT II ***PETROV-VODKIN 3*** *P. 65*	**S2A** ADVANCED LASER SYSTEMS FOR MEDICAL APPLICATIONS II ***LEVINSON*** *P. 74*	15.00-17.00
COFFEE BREAK				17.00-17.30
			A3 MEMORIAL SESSION IN HONOUR OF ALEXANDER PROKHOROV (1916-2002) ***LEVINSON***	17.30-19.30

WEDNESDAY, 29 JUNE

S2B CLINICAL OPTICAL IMAGING AND SPECTROSCOPY I ***RIHTER*** *P. 77*	**S1A** FIBER LASERS AND COMPONENTS III ***PETROV-VODKIN 2*** *P. 66*	**S2C** LASER INTERACTION WITH CELLS AND TISSUES I ***LEVINSON*** *P. 79*	**A1** ADVANCED LASER TECHNOLOGY AND EQUIPMENT IN INDUSTRIAL APPLICATIONS ***BRIK***	9.00-11.00
COFFEE BREAK				11.00-11.30
S2B CLINICAL OPTICAL IMAGING AND SPECTROSCOPY II ***RIHTER*** *P. 77*	**S1A** FIBER LASERS AND COMPONENTS IV ***PETROV-VODKIN 2*** *P. 66*	**S2C** LASER INTERACTION WITH CELLS AND TISSUES II ***LEVINSON*** *P. 79*	**A1** ADVANCED LASER TECHNOLOGY AND EQUIPMENT IN INDUSTRIAL APPLICATIONS ***BRIK***	11.30-13.30
LUNCH BREAK				13.30-15.00
R8 NONLINEARITIES FOR OPTICAL AND TERAHERTZ RADIATION ***PUDOVKIN*** *P. 39*	**S1A** FIBER LASERS AND COMPONENTS V ***PETROV-VODKIN 2*** *P. 67*	**S2C** LASER INTERACTION WITH CELLS AND TISSUES III ***LEVINSON*** *P. 80*	**A1** ADVANCED LASER TECHNOLOGY AND EQUIPMENT IN INDUSTRIAL APPLICATIONS ***BRIK***	15.00-17.00
COFFEE BREAK				17.00-17.30
R8 LOCALIZED STRUCTURES OF OPTICAL AND MATTER WAVES ***PUDOVKIN*** *P. 39*				17.30-19.30
POSTDEADLINE SESSION ***DEYNEKA***				19.40-21.10

THURSDAY, 30 JUNE					
9.00-11.00	**POSTER SESSION** **R3, R7** ***MOSKOVSKY CONGRESS HALL*** *P. 55*	**R1** SOLID-STATE LASERS V ***STENBERG*** *P. 46*	**R2** HIGH POWER LASERS IV ***PETROV-VODKIN 1*** *P. 48*	**R4** LASER BEAM CONTROL III ***DEYNEKA*** *P. 49*	**R8** NONLINEAR CAVITIES AND TRAPS ***PUDOVKIN*** *P. 52*
11.00-11.30	COFFEE BREAK				
11.30-13.30	**POSTER SESSION** **R3, R7** ***MOSKOVSKY CONGRESS HALL*** *P. 55*	**R1** SOLID-STATE LASERS VI ***STENBERG*** *P. 46*	**R2** HIGH POWER LASERS V ***PETROV-VODKIN 1*** *P. 48*	**R4** LASER BEAM CONTROL IV ***DEYNEKA*** *P. 49*	**R8** NONLINEAR SURFACES, WAVEGUIDES AND CAVITIES ***PUDOVKIN*** *P. 52*
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION** **R2, R4** ***MOSKOVSKY CONGRESS HALL*** *P. 54*	**R1** SOLID-STATE LASERS VII ***STENBERG*** *P. 47*		**R5** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES III ***DEYNEKA*** *P. 50*	**R8** NONLINEAR FREQUENCY CONVERSION ***PUDOVKIN*** *P. 52*
17.00-17.30	COFFEE BREAK				
17.30-19.30	**POSTER SESSION** **R2, R4** ***MOSKOVSKY CONGRESS HALL*** *P. 54*			**R5** SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES IV ***DEYNEKA*** *P. 50*	**R8** NONLINEARITY OF SOLIDS, GASES AND PLASMAS ***PUDOVKIN*** *P. 53*

FRIDAY, 1 JULY	
10.00-17.00	**A2** NEWLED CONSORTIUM MEETING ***MUNTS***

SIDE-EVENT WORKSHOPS:

A1. Advanced laser technology and equipment in industrial applications

Official Language: Russian
Brik Room, floor 3
June 29, 2016
09:00 - 17:00
Registration: 08:30 – 09:00
Chair: *Nikolay N. Evtikheev, NTO "IRE-Polus", Russia*
Moderator: *Sergey N. Smirnov, Lasertech Ltd., Russia*

A2. NEWLED consortium meeting (by invitation only)

Official Language: English
Munts Room, floor 3
June 30 and July 1, 2016
10:00 - 17:00
Chair: *Edik Rafailov, Aston University, UK*
Sponsor : FP7 NEWLED Project

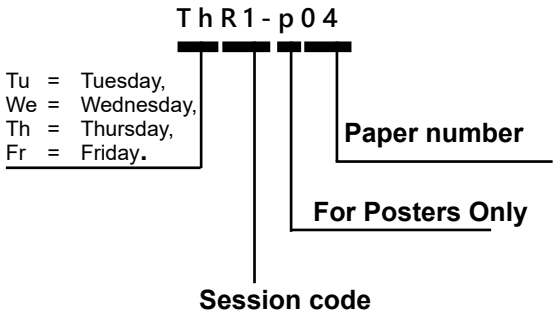
THURSDAY, 30 JUNE					
S1A FIBER LASERS AND COMPONENTS VI ***PETROV-VODKIN 2*** *P. 68*	**S1B** FIBER LASER TECHNOLOGIES AND EQUIPMENT III ***PETROV-VODKIN 3*** *P. 69*	**S2D** PHOTONICS AND NANOBIOTECHNOLOGY II ***LEVINSON*** *P. 82*	**S2E** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE I ***RIHTER*** *P. 84*	**A2** NEWLED CONSORTIUM MEETING ***MUNTS***	9.00-11.00
COFFEE BREAK					11.00-11.30
S1A FIBER LASERS AND COMPONENTS VII ***PETROV-VODKIN 2*** *P. 68*	**R7** LASERS IN ENVIRONMENTAL MONITORING III ***PETROV-VODKIN 3*** *P. 51*	**S2D** PHOTONICS AND NANOBIOTECHNOLOGY III ***LEVINSON*** *P. 82*	**S2E** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE II ***RIHTER*** *P. 84*	**A2** NEWLED CONSORTIUM MEETING ***MUNTS***	11.30-13.30
LUNCH BREAK					13.30-15.00
S1A FIBER LASERS AND COMPONENTS VIII ***PETROV-VODKIN 2*** *P. 69*	**R7** LASERS IN ENVIRONMENTAL MONITORING IV ***PETROV-VODKIN 3*** *P. 51*	**S2D** PHOTONICS AND NANOBIOTECHNOLOGY IV ***LEVINSON*** *P. 83*	**S2E** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE III ***RIHTER*** *P. 85*	**A2** NEWLED CONSORTIUM MEETING ***MUNTS***	15.00-17.00
COFFEE BREAK					17.00-17.30
					17.30-19.30

FRIDAY, 1 JULY	
A2 NEWLED CONSORTIUM MEETING ***MUNTS***	10.00-17.00

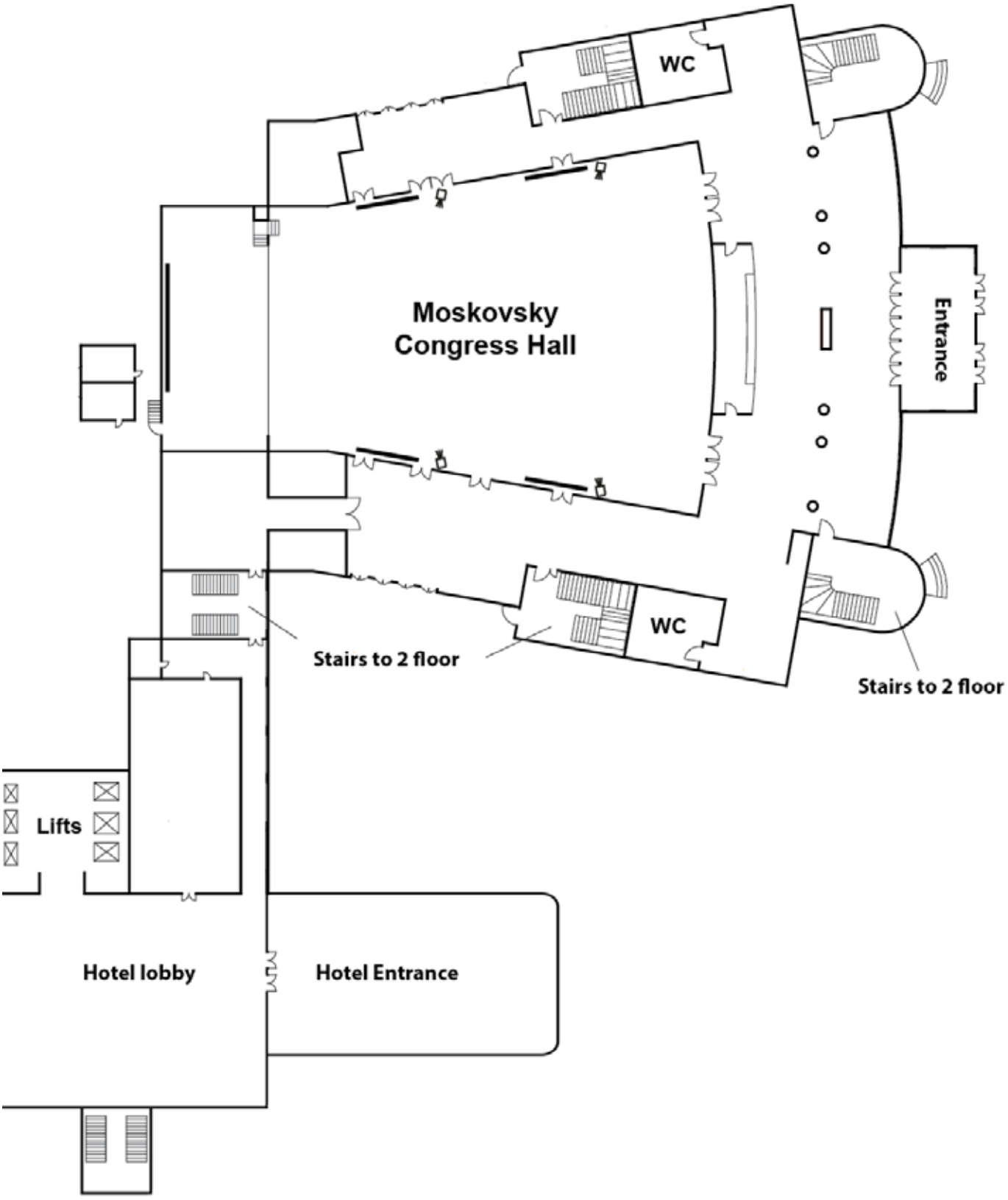
SIDE-EVENT WORKSHOPS:

A3. Memorial Session in Honour of Alexander Prokhorov (1916-2002)

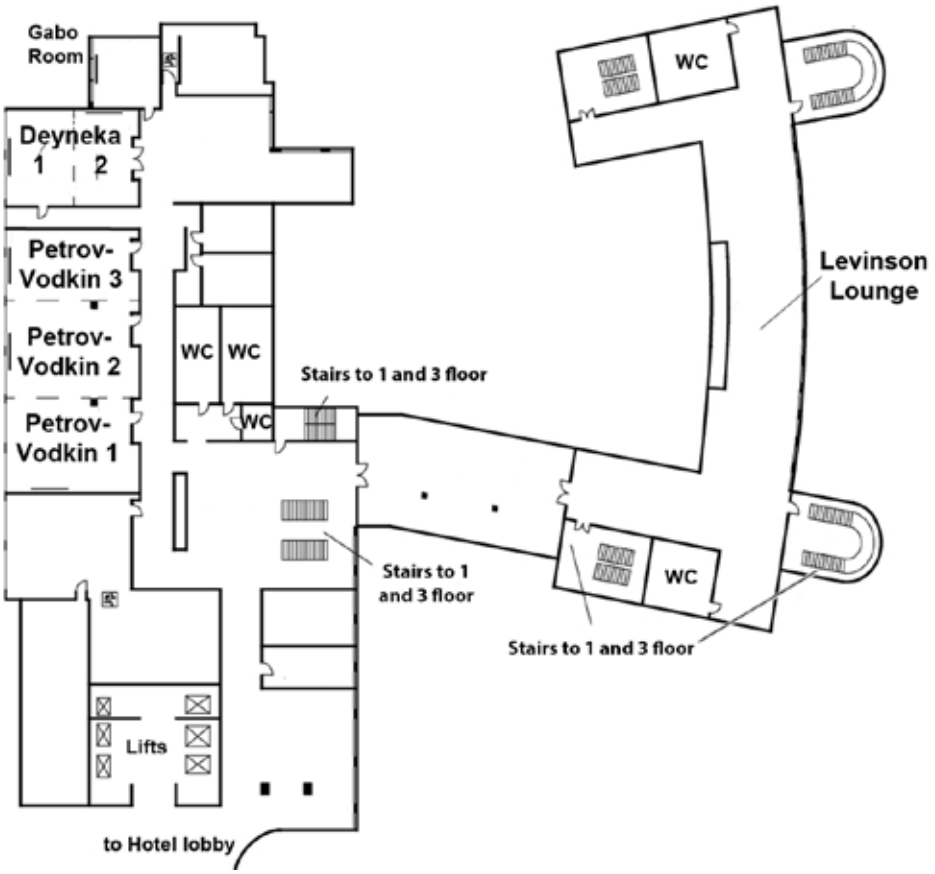
Official Language: Russian
Levinson Hall, floor 2
June 28, 2016
17:30 – 19:00
Chair: *Ivan A. Shcherbakov, Prokhorov General Physics Inst. of RAS, Russia*



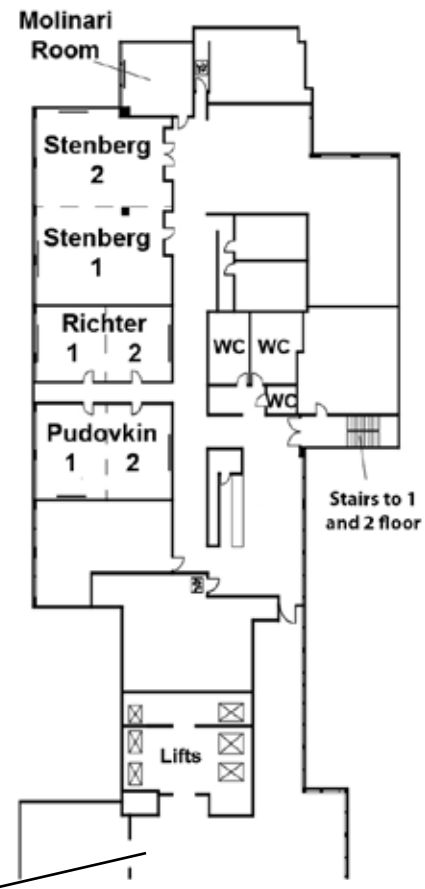
FIRST FLOOR


WC
Moskovsky
Congress Hall
Entrance
WC
Stairs to 2 floor
Stairs to 2 floor
Lifts
Hotel lobby
Hotel Entrance

SECOND FLOOR



THIRD FLOOR



TO MUNTS AND BRIK CONFERENCE ROOMS

PLENARY SESSION

11:00 - 11:20 Opening remarks

3D Laser printing of nanoparticles and living cells

Boris Chichkov

Laser Zentrum Hannover e.V., Germany

11:20-11:55

Laser printing can be used for printing very small and delicate objects like nanoparticles and living cells.
Nowadays, 3D printers can be bought for less than 500 Euro. They are able to print three-dimensional structures from thermoplastic and other materials. Here we report on laser printing of nanoparticles and living cells.
We demonstrate a simple printing method allowing the generation and arrangement of spherical metal and dielectric nanoparticles in a very precise manner. For example, the printed silicon nanoparticles have a predefined size and are characterized by unique optical properties. With sizes in the range of 100-200 nm in diameter they exhibit pronounced electric and magnetic dipole resonances within the visible spectral range. Fabrication, characterization, and applications of the generated nanoparticle arrays will be discussed.
In a series of publications on laser printing of living cells we proved that cells are not harmed by the printing process. The differentiation behavior and potential of laser printed stem cells are not affected. Stem cells can be printed in defined patterns and then differentiated within these patterns towards bone, cartilage or adipose tissue. With specific multi-cellular cell structures, studies of cell-cell and cell-environment interactions can be performed. Furthermore, fibroblast and keratinocyte cells have been printed layer-by-layer to form 3D skin tissue constructs. The skin tissue formation has been proven by visualizing intercellular junctions and verifying their functionality.
The presented laser printing techniques are promising for a wide range of applications in nanophotonics and tissue engineering.

Why we need to replace the transistor, and what would be the newly required material properties?

Eli Yablonovitch

University of California, United States

11:55-12:30

In contemplating the headlong rush toward miniaturization represented by Moore's Law, it is tempting to think only of the progression toward molecular sized components. There is a second aspect of Moore's Law that is sometimes overlooked. Owing to miniaturization, the energy efficiency of information processing has steadily improved. But there is an inefficiency for internal communications in a chip. It is caused by the difference in voltage scale between the wires and the transistor switches. Transistors are thermally activated, leading to a required voltage >>kT/q. Wires are long, and they have a low impedance, allowing them to operate efficiently even at a few millivolts. Thus the main Figure-of-Merit for future transistors is low operating voltage or sensitivity, NOT mobility.
The challenge then is to replace transistors with a new low-voltage switch that is better matched to the wires. I will present the new material quantum level properties, which are being explored by the NSF Science & Technology Center for Energy Efficient Electronics Science.

PLENARY SESSION

Applications of plasmonic and dielectric nanoantennas in nanophotonics

Stefan A. Maier

Imperial College London, UK

12:30-13:05

Optical nanoantennas based on metallic nanostructures enable the controlled focusing of light from the far field to highly confined volumes below the diffraction limit, and furthermore form the basis of implementations of metamaterials and metasurfaces operating in the optical regime of the spectrum.

Upon excitation of the plasmon oscillation, parts of the energy get dissipated via elecron/hole pair formation, leading ultimately to dissipation into phonon modes. Here, we show how the vibrational frequencies of these modes can be controlled on the nanoscale, at the level of an individual nanoantenna. This is achieved via pinning certain parts of the antenna stronger to the substrate, utilizing oxide bar layers. Comprehensive finite element modelling combined with degenerate fs pump probe spectroscopy allows us to determine the ratio of the amplitudes of the underlying vibrational normal mode, demonstrating the tailoring. We believe that this work could be the start of a new avenue for control over electromagnetic - acoustic coupling in optical metasurfaces.

We further demonstrate the mapping of plasmonic hot spots using super-resolution far-field fluorescence spectroscopy, including a de-coupling of enhanced absorption and emission processes. The crucial role of the latter in determining the position of the emitter with respect to the antenna will be elucidated. Finally, we will present applications of dielectric nanoantennas for surface-enhanced spectroscopies, including antennas operating via localized surface phonon-polariton modes.

Wave control with space-time manipulations

Mathias Fink

Institut Langevin, ESPCI Paris Tech, France

13:05-13:40

Time-reversal processing is based on Huygens principles and on wavefield manipulation on spatial boundaries. It provided an elegant way to back propagate a wave field towards its initial source allowing to create, through any complex medium, a wave pattern of any required shape restricted only by diffraction limits.

Here we want to revisit these approaches by introducing another point of view, the one that Loschmidt proposed in his famous argument to create a time-reversal experiment by inversing instantaneously all velocities of the particles in a gas. The extension of this concept to wave will be discussed through the concept of time boundaries manipulation. Experiments, conducted with water waves, validating this approach will be presented. We show that sudden changes of the medium properties generate instant wave sources that emerge instantaneously from the entire space at the time disruption. The time-reversed waves originate from these "Cauchy sources" which are the counterpart of Huygens virtual sources on a time boundary. It allows us to revisit the holographic method and introduce a new approach for wave control in complex media.

In the second part of this talk, we will discussed another approach to manipulate a wave field in reverberating medium by introducing tunable metasurfaces as spatial boundaries and we will emphasize this concept for microwaves.

R1. SOLID-STATE LASERS

Location: Deyneka Room, floor 2, 09:00–11:00

Solid-State Lasers I

Session Chair: Uwe Morgner,
Inst. für Quantenoptik Leibnitz Univ., Germany

TuR1-01 Invited **09:00-09:30**

Generation and amplification of ultrashort mid-infrared pulses

T. Floery[1], V. Shumakova[1], P. Malevich[1], S. Ališauskas[1], G. Andriukaitis[1], A. Voronin[2], A.M. Zheltikov[2,3], A.V. Mitrofanov[2,4], D. Kartashov[5], A. Baltuška[1,6], A. Pugžlys[1,6]; 1 - Vienna Univ. of Technology, Austria, 2 - Lomonosov Moscow State Univ., Russia, 3 - Texas A&M Univ., United States, 4 - Russian Quantum Center, Russia, 5 - Friedrich-Schiller Univ., Germany, 6 - Center for Physical Sciences & Technology, Lithuania

We report on the generation of high-energy few-optical-cycle pulses in mid-infrared spectral region via self-compression in transparent dielectrics and filaments as well as via four wave parametric amplification in gas-filled hollow waveguides.

TuR1-02 **09:30-09:45**

Passively Q-switched 1.55 μm laser performance of Er,Yb:GdAl3(BO3)4 diode-pumped laser

K.N. Gorbachenya[1], V.E. Kisel[1], A.S. Yasukevich[1], S.V. Kurilchik[1,2], V.V. Maltsev[3], N.I. Leonyuk3 , N.V. Kuleshov[1]; 1 - Center for Optical Materials and Technologies, Belarusian National Technical Univ., Belarus, 2 - Inst. of Physics, Kazan Federal Univ., Russia, 3 - Lomonosov Moscow State Univ., Russia

We report diode-pumped passively Q-switched Er,Yb:GdAl3(BO3)4 laser. By using of Co2+:MgAl2O4 crystal as a saturable absorber Q-switched laser pulses with duration of 12 ns and maximum energy of 18.7 μJ at repetition rate of 32 kHz corresponded to the average output power of 0.6 W were obtained at 1550 nm under the continuous-wave pumping.

TuR1-03 **09:45-10:00**

Spectroscopy and laser performance of in-band pumped Er:LLF and Er:YLF crystals

S.V. Kurilchik[1,2], K.N. Gorbachenya[2], V.E. Kisel[2], N.V. Kuleshov[2], A.S. Nizamutdinov[1], S.L. Korableva[1], V.V. Semashko[1]; 1 - Kazan Federal Univ., Russia, 2 - National Technical Univ., Belarus

Spectroscopic properties and continuous-wave laser performance of in-band pumped Er:LiLuF4 and Er:LiYF4 crystals were investigated. For Er:LiLuF4 crystal maximum slope efficiency of 44 % was obtained at 1609 nm wavelength. Er:LiYF4 crystal laser operation was demonstrated for the first time under in-band pumping. Output power of 58 mW and slope efficiency of 21 % at 1606 nm were achieved.

TuR1-04 **10:00-10:15**

Spectroscopic and laser properties of Tm3+ optical centers in BaF2 single crystal and ceramics

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

Individual low temperature (77K) fluorescence spectra of new long-lifetime optical centers of Tm3+ ions in BaF2 single crystal and ceramics at the 2um 3F4-3H6 and 1G4-3H5 transitions are separated. Spectroscopic and laser properties of these centers are investigated.

TuR1-05 **10:15-10:30**

Adaptation of the Er-Yb microchip laser for use in phase-sensitive optical time domain reflectometry

A.A. Zhirnov[1], A.B. Pnev[1], V.E. Karasik[1], K.V. Stepanov[1], D.A. Shelestov[1], M. Norgia[2], A. Pesatori[2], C. Svelto[2]; 1 - SEC «Photonics and IR-Technology», Bauman Moscow State Technical Univ., Russia, 2 - DEIB, Politecnico di Milano, Italy

We report on the experiments related to the Er-Yb microchip laser setup with fiber diode pumping. The main goal is a new radiation source for the use in the phase-sensitive optical time domain reflectometry (ϕ-OTDR) development.

TuR1-06 Invited **10:30-11:00**

Generation of microjoule subcycle pulses in the mid-infrared

A.A. Lanin[1,2], E.A. Stepanov[1,2], A.A. Voronin[1,2], A.B. Fedotov[1,2], A.M. Zheltikov[1,2,3]; 1 - Lomonosov Moscow State Univ., Russia, 2 - Russian Quantum Center, Russia, 3 - Texas A&M Univ., United States

In this work, we fill the existing gap in subcycle lightwave electronics by demonstrating a robust, all-solid-state approach for the generation of microjoule subcycle pulses in the mid-infrared. We have demonstrated an approach for the generation of 20-fs-pulses at 6.8 mkm. Subcycle pulse widths have been achieved due to self-compression dynamics and ultrabroadband phase matching for four waves mixing near the zero-GVD wavelength of GaAs.

- Coffee Break -

Location: Deyneka Room, floor 2, 11:30 – 13:15

Solid-State Lasers II

Session Chair: Maximilian Lederer,
European XFEL GmbH, Germany

TuR1-07 Invited **11:30-12:00**

Broadband ultrafast photonics in graphene

F. Rotermund; Department of Physics & Department of Energy Systems Research, Republic of Korea

Graphene has been widely investigated for a number of broadband photonic applications. In the present talk, recent progress in graphene-based saturable absorbers applicable for ultrafast solid-state lasers and terahertz nonlinear spectroscopy in graphene and graphene-based materials will be presented.

TuR1-08 **12:00-12:15**

Glass-ceramics with Co2+:ZnO nanocrystals: novel saturatable absorber for Er lasers

O.S. Dymshits[1], N.A. Skoptsov[2], V.V. Vitkin[3], A.A. Zhilin[1], D.V. Shemchuk[1], M.Ya. Tsenter[1], P.A. Loiko[2], A.M. Malyarevich[2], K.V. Bogdanov[3], I.V. Glazunov[2], K.V. Yumashev[2]; 1 - NITIOM Vavilov State Optical Inst., Russia, 2 - Belarusian National Technical Univ., Belarus, 3 - ITMO Univ., Russia

Transparent glass-ceramics based on Co2+:ZnO nanocrystals are synthesized in cobalt-doped glasses of the K2O-ZnO-Al2O3-SiO2 system. Passive Q-switching of an Er,Yb:glass laser with 0.37 mJ/100 ns pulses at ~1.54 μm is realized.

TuR1-09 **12:15-12:30**

NIR photoluminescence of Bi+ impurity center in RbY2Cl7 ternary chloride crystal

A.N. Romanov[1], D.N. Vtyurina[1], E.V. Haula[1], D.P. Shashkin[1], M.S. Kouznetsov[2], I.S. Lisitsky[2], N.A. Pimkin[2], V.N. Korchak[1]; 1 - Semenov Inst. of Chemical Physics RAS, 2 - State Scientific-Research and Design Inst. of Rare-Metal Industry «Giredmet», Russia

Intense long-lived NIR photoluminesce, centered at 920 nm was observed from the single crystalline specimens of RbY2Cl7 ternary chloride, containing Bi+ impurity centers. This crystal phase can be crystallized from the stoichiometric Lewis acidic melt, which promotes the formation of Bi+ ion in sufficient concentration.

TuR1-10 **12:30-12:45**

Optical properties and high-efficiency lasing of Nd:YAG and Ho:YAG ceramics

S.M. Vatnik[1], I.A. Vedin[1], V.V. Osipov[2], K.E. Luk'yashin[2], R.N. Maksimov[2], V.I. Solomonov[2], Yu.L. Kopylov[3], I.Sh. Steinberg[4], P.E. Tverdokhleb[4], A.A. Pavlyuk[5]; 1 - Inst. of Laser Physics SB RAS, 2 - Inst. of Electrophysics UB RAS, 3 - Kotel'nikov Inst. of Radio Engineering and Electronics RAS, 4 - Inst. of Automation and Electrometry SB RAS, 5 - Inst. of Inorganic Chemistry SB RAS, Russia

We report on optical properties and high-efficiency lasing of YAG ceramics synthesized at IREE (Fryazino) and IEP (Ekaterinburg). The best slope efficiency is to be 36% for 1% Nd:YAG ceramics and 40% for 1%Ho:YAG ceramics, in the latter case the emission was centered at 2090 nm. Internal losses in domestic ceramics prove to be a few percents per centimeter.

TuR1-11 **12:45-13:00**

The 2-μm waveband laser system based on Tm:YLF and Ho:YAG crystals with diode pumping

C.V. Vorontsov, N.G. Zaharov, S.D. Velikanov, Yu.N. Frolov, A.V. Larionov, G.N. Nomakonov, V.B. Kolomeets; RFNC – VNIIEF, Russia

The experimental investigation results of the continuous-wave Tm:YLF laser based on the one cylindrical active element with the dual end pumping of the laser diode modules are represented. The σ- and π-polarized generation is obtained with the total pumping power up to 185 W.

TuR1-12 **13:00-13:15**

Efficient 10-J pulsed Fe:ZnSe laser at 4100 nm

M.P. Frolov, Yu.V. Korostelin, V.I. Kozlovsky, Yu.P. Podmar'kov, Ya.K. Skasyrsky; Lebedev Physical Inst. RAS, Russia

Energies of over 10 J and efficiencies of over 44% have been demonstrated in single-shot operation of liquid nitrogen cooled single-crystalline Fe:ZnSe laser at 4100-nm wavelength.

TuR1-13 **13:15-13:30**

Multipass pump scheme for passively Q-switched eye-safe Er:YAG DPSSL

V.M. Polyakov, V.A. Buchenkov, A.V. Kovalev, V.V. Vitkin, A.A. Mak; ITMO Univ., Russia

We discuss an efficient Er:YAG DPSSL with passive Q-switch and analyze Er:YAG spectroscopic properties for efficient performance. The multipass pump scheme and multipass lasing scheme are discussed.

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

Location: Petrov-Vodkin 1 Room, floor 2, 09:00 – 11:00

Quantum-well, wire, dash and dot lasers and devices

Session Chair: Grigorii Sokolovskii, Ioffe Inst., Russia

TuR3-01 Invited **09:00-09:30**

Semiconductor laser based optical frequency combs - applications in communications and signal processing

P. Delfyett, S. Bhooplapur, A. Klee, E. Sarailou, K. Bagnell; CREOL, The College of Optics & Photonics, Univ. of Central Florida, United States

Optical frequency combs from mode-locked lasers are developed and used for realizing unique functionality for applications in ultra-wide bandwidth communication and signal processing.

TuR3-02 **09:30-09:45**

Novel approach for transverse mode engineering in edge-emitting semiconductor lasers

N.Yu. Gordeev[1,2,3], A.S. Payusov[1,2,3], Yu.M. Shernyakov[2,3], S.A. Mintairov[2], N.A. Kalyuzhnyy[2], M.M. Kulagina[2], A.E. Zhukov[3], M.V. Maximov[2,3]; 1 - Submicron Heterostructures for Microelectronics, Research Engineering Center RAS, 2 - Ioffe Inst., 3 - St. Petersburg Academic Univ., Russia

We review our novel approach based on coupled large optical cavity (CLOC) structures for effective suppression of high-order transverse modes in edge-emitting lasers with broadened waveguides. We discuss the main principles of the CLOC laser concept and present our recent numerical and experimental results of the laser operation.

TuR3-03 Invited **09:45-10:15**

Wavelength stabilized high-power diode lasers – design, manufacturing and applications

B. Sumpf; Ferdinand-Braun Inst., Germany

Wavelength stabilized high-power diode lasers are requested light sources in the field of laser based sensor systems. They are used as pump lasers for non-linear frequency conversion, e.g. second harmonic generation, to pump solid state fs-laser devices applied for diagnostic purposes in life sciences and they are applied directly as light sources for absorption or Raman spectroscopy. This paper presents recent developments concerning distributed Bragg reflector (DBR) ridge waveguide (RW) diode lasers for vibrational spectroscopy and high brightness DBR-tapered lasers for non-linear optics. The manufacturing and the electro-optical, spectral, and beam parameters of these devices will be presented together with a compact handheld Raman probe using an implemented dualwavelength DBR-RW diode laser for Shifted Excitation Raman Difference Spectroscopy (SERDS).

TuR3-04 **10:15-10:30**

Integrated butt-coupled membrane laser for Indium Phosphide on Silicon platform

V. Pogoretskiy, A. Higuera-Rodriguez, Y. Jiao, J. J.G.M van der Tol, D. Heiss, M. K. Smit; Eindhoven Univ. of Technology, The Netherlands

In this work we present the design and technology development for an integrated butt-coupled membrane laser in the IMOS (Indium Phosphide Membrane on Silicon) platform. Laser is expected to have a small footprint (less than 50 μm2), 1 mA threshold current and a direct modulation frequency of 10 GHz.

TuR3-05 Invited **10:30-11:00**

Modulation response of double tunneling-injection quantum dot lasers

L.V. Asryan; Virginia Polytechnic Inst. and State Univ., United States

The upper limit for the modulation bandwidth in a double tunneling-injection (DTI) quantum dot (QD) laser is discussed. While the maximum bandwidth is the same in DTI and conventional QD lasers, the optimum dc current, at which it is obtained, is lower in a DTI laser. Different factors limiting the modulation bandwidth in a DTI QD laser are also discussed.

- Coffee Break -

Location: Petrov-Vodkin 1 Room, floor 2, 11:30 – 13:30

Laser dynamics and ultrashort pulse generation

Session Chair: Edik Rafailov, Aston Univ., United Kingdom

TuR3-06 Invited **11:30-12:00**

Integrated mode locked laser systems in semiconductor photonic integrated circuits

E. Bente, V. Moskalenko, S. Latkowski, M. Llorens-Revull, K. Williams; Eindhoven Univ. of Technology, Netherlands

The performance of integrated planar waveguide mode locked lasers can be enhanced using the available photonic integration platform technology in indium-phosphide. Extended cavity mode locked oscillators including DBR mirrors and phase modulators can be realized at telecom wavelengths to improve performance and control over the device. Integrated pulse shapers and special amplifiers can be used to improve the output properties further.

TuR3-07 **12:00-12:15**

Mode-locking and Q-switching in 1.06 μm two-sectional QW lasers due to Stark effect

M.S. Buyalo[1,2], I.M. Gadzhiyev[1,2], N.D. Il'inskaya[1], A.A. Usikova[1], V.N. Nevedomskiy[1], A.Yu. Egorov[2], E.L. Portnoi[1]; 1 - Ioffe Inst., 2 - ITMO Univ., Russia

In two section lasers with 3 QWs passive mode-locking and Q-switching are realized. Frequency rate in mode-locking is 75 GHz with time-bandwidth product 0.49. The bleaching mechanism is induced by photocurrent in absorber at high reverse biases.

TuR3-08 Invited **12:15-12:45**

High-energy picosecond optical pulse generation with asymmetric-waveguide diode lasers

E.A. Avrutin[1], B.S. Ryvkin[2,3], J.T. Kostamovaara[2]; 1 - Univ. of York, United Kingdom, 2 - Univ. of Oulu, Finland, 3 - Ioffe Inst., Russia

We report recent progress and discuss important issues in the design of gain-switched and combined gain/Q-switched asymmetric waveguide lasers with a large effective spot size for applications ranging from optical range finding (with a prototype system developed) to nonlinear optics. The role of the active layer material, the waveguide design, and the use of saturable absorber in the cavity are discussed.

TuR3-09 **12:45-13:00**

Laser-thyristors as a source of high-power laser pulses with a pulse width of 1-100 ns

A.A. Podoskin[1], O.S. Soboleva[1], V.V. Zolotarev[1], D.A. Veselov[1], N.A. Pikhtin[1], I.S. Tarasov[1], T.A. Bagaev[2], M.A. Ladugin[2], A.A. Marmalyuk[2], V.A. Simakov[2], S.O. Slipchenko[1]; 1 - Ioffe Inst., 2 - Stel'makh Research and Development Inst. «Polyus», Russia

A low-voltage AlGaAs/GaAs/InGaAs laser-thyristor heterostructure has been fabricated in order to have a compact source of high-power laser pulses at 900nm wavelength. Peak powers/pulse width of 55 W/100 ns and 8 W/10 ns from 200μm aperture and 1W/1ns from 20μm aperture have been demonstrated.

TuR3-10 Invited **13:00-13:30**

Frequency combs from InAs/InP quantum dash based mode-locked lasers for multi-terabit/s data transmission

A. Ramdane[1], V. Panapakkam[1], Q. Gaimard[1], K. Merghem[1], G. Aubin[1], N. Chimot[2], F. Lelarge[2], V. Vujicic[3], A. Anthur[3], R. Zhou[3], L.P. Barry[3], P. Marin[4], J.N. Kemal[4], J. Pfeifle[4], C. Koos[4]; 1 - Laboratory for Photonics, CNRS, France, 2 - III-V Lab, Palaiseau, France, 3 - Dublin City Univ., Ireland, 4 - Karlsruhe Inst. of Technology (KIT), Germany

InAs/ InP quantum dash based mode locked lasers are particularly suited for frequency comb generation. Multi-terabit/s data transmission has been achieved using one single chip.

- Lunch Break -

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

Location: Petrov-Vodkin 1 Room, floor 2, 15:00 – 17:00

UV and visible diode lasers and LEDs

Session Chair: Sergey Ivanov, Ioffe Inst., Russia

TuR3-11 Invited **15:00-15:30**

Dislocations in LD and LED semiconductor heterostructures

A.E. Romanov[1,2], J.S. Speck[3]; 1 - ITMO Univ., Russia, 2 - Ioffe Inst., Russia, 3 - UCSB, United States

We discuss misfit dislocations (MDs) and threading dislocations (TDs) in lattice-mismatched semiconductor heteroepitaxial layers, which are the key structural elements of light-emitting diodes (LEDs) and laser diodes (LDs). Novel approaches to modelling MD formation and TD reduction are considered. The behavior of dislocations in conventional III-V semiconductor compounds as well in polar and semipolar III-nitride heterostructures are reviewed in detail.

TuR3-12 Invited **15:30-16:00**

The most important issues in technology of AlGaInN-based laser diodes and in array

M. Leszczynski; TopGaN and Inst. of High Pressure Physics UNIPRESS, Poland

Depsite the bright commercial future of nitride LDs, there is a number of technological issues which are being solved, and some of them will be discussed in the presentation.

TuR3-13 **16:00-16:15**

Fractional order of poling period for broadly tunable second harmonic generation

K.A. Fedorova[1,2], G.S. Sokolovskii[2], I.O. Bakshaev[3], D.A. Livshits[3], E.A. Rafailov[1]; 1 - Aston Univ., United Kingdom, 2 - Ioffe Inst., Russia, 3 - Innolume GmbH, Germany

We demonstrate the possibility of using a fractional order of poling period of nonlinear crystal waveguides for tunable second harmonic generation. This approach allows for an extension of wavelength coverage in the visible spectral region by frequency doubling in a single nonlinear crystal waveguide.

TuR3-14 Invited **16:15-16:45**

True yellow II-VI/GaAs optically pumped laser structures for microchip laser diode converters

S.V. Sorokin[1], I.V. Sedova[1], S.V. Gronin[1], S.V. Ivanov[1], E.V. Lutsenko[2], A.G. Vainilovich[2], G.P. Yablonskii[2]; 1 - Ioffe Inst., Russia, 2 - Stepanov Inst. of Physics NASB, Belarus

We report on recent progress in developing true-yellow (570-590nm) low-threshold (on for microchip laser diode converters.

TuR3-15 **16:45-17:00**

Infrared, green, and blue-violet pulsed lasers based on semiconductor structures pumped by low-energy electron beam

M.M. Zverev[1], N.A. Gamov[1], E.V. Zhdanova[1], V.B. Studionov[1], I.V. Sedova[2], S.V. Sorokin[2], S.V. Gronin[2], S.V. Ivanov[2], M.A. Ladugin[3], A. Padalitsa[3], A.V. Mazalov[3], V. Kureshov[3], A.A. Marmalyuk[3]; 1 - Moscow Technological Univ. MIREA, 2 - Ioffe Inst., 3 - RDI Polyus, Russia

Ultimate parameters of infrared, visible and blue-violet electron-beam-pumped lasers and laser arrays based on II-VI, III-V and III-N semiconductor heterostructures, obtained at electron energy below ~10keV are discussed.

- Coffee Break -

Location: Petrov-Vodkin 1 Room, floor 2, 17:30 – 19:30

VCSELs and VECSELs

Session Chair: Victor Ustinov, Ioffe Inst., Russia

TuR3-16 Invited **17:30-18:00**

Monolithic high-index contrast grating VCSELs

M. Gebski[1], M. Marciniak[1], M. Dems[1], J.A. Lott[2], T. Czyszanowski[1]; 1 - Lodz Univ. of Technology, Poland, 2 - Technical Univ. Berlin, Germany

A new and radically simplified construction of the vertical-cavity surface-emitting laser (VCSEL) with monolithic high-index contrast grating will be investigated. Instead of hundreds of epitaxial layers as in conventional VCSELs, the proposed design consists of a thin active zone capturing and recombining the carriers positioned between two monolithic cladding layers of p-doped and n-doped material. In these semiconductor lasers the optical feedback is provided by one or two planar monolithic subwavelength gratings etched into the cladding layers on either side of the optical cavity.

TuR3-17 **18:00-18:15**

VCSEL polarization control by rhomboidal selectively-oxidized current aperture

M.A. Bobrov[1], N.A. Maleev[1], S.A. Blokhin[1], A.G. Kuzmenkov[1,2] A.P. Vasil'ev[1,2], A.A. Blokhin[1], M.M. Kulagina[1], Yu.A. Guseva[1], S.I. Troshkov[1], V.M. Ustinov[1,2,3]; 1 - Ioffe Inst., 2 - Submicron Heterostructures for Microelectronics, Research Engineering Center RAS, 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

The new approach for single-mode (SM) VCSEL polarization control based on rhomboidal selectively-oxidized current aperture combined with intracavity contacts is discussed. MBE-grown VCSELs with aperture size of about 2.5 micron demonstrate lasing at 845-852 nm with SM output power exceeds 1.5 mW, SMSR high than 30 dB, and orthogonal polarization suppression ratio high than 20 dB for temperature of 20-80°C.

TuR3-18 Invited **18:15-18:45**

Progress in high-power VECSELs: from material science to applications

M. Guina; Tampere Univ. of Technology, Finland

The presentation is focused on reviewing the major recent steps in the development of VECSEL technology. Emphasis is put on advances concerning power scaling, thermal management, and wavelength coverage. Ultimately, an outline of emerging applications in medicine and atom physics, is presented.

TuR3-19 **18:45-19:00**

1.3 μm InAs quantum dot semiconductor disk laser

S.A. Blokhin[1], M.A. Bobrov[1], A.A. Blokhin[1], A.G. Kuzmenkov[1], A.P. Vasil'ev[1], N.A. Maleev[1], V.V. Dudelev[1], K.K. Soboleva[2], G.S. Sokolovskii[1], A. Rantamäki[3], O. Okhotnikov[3], V.M. Ustinov[1]; 1 - Ioffe Inst., Russia, 2 - Peter the Great St.Petersburg Polytechnic Univ., Russia, 3 - Tampere Univ. of Technology, Finland

We report an InAs/InGaAs quantum dot-based optically pumped vertical-external-cavity surface-emitting laser emitting at 1.3 μm. A fibre-coupled 808 nm laser diode and V-cavity configuration were used. Continuous wave output power over 200 mW is obtained at 7-15°C, which is the highest reported for such type of surface-emitting laser in this wavelength range.

TuR3-20 **19:00-19:15**

A serially-connected two-chip VECSEL for dual-wavelength emission

F. Zhang[1], M. Gaafar[1], C. Möller[1], W. Stolz[1,2], M. Koch[1], A. Rahimi-Iman[1]; 1 - Philipps-Univ. Marburg, Germany, 2 - NAsP III/V GmbH, Germany

We present a compact and flexible cavity design for high intracavity powers in dual-wavelength vertical-external-cavity surface-emitting lasers (VECSELs), by serially connecting two different gain chips in one cavity. Such device generates linearly polarized dual-wavelength emission with up to 640 W intracavity power at 10 nm wavelength spacing, which is tunable via a changing of the cavity angles on the chips. Furthermore, in this cavity, type-I second harmonic generation and sum-frequency generation have been performed in a LiNbO3 crystal.

TuR3-21 **19:15-19:30**

Self-mode-locked semiconductor disk laser

A. Rahimi-Iman[1], M. Gaafar[1], M. Vaupel[1], C. Möller[1], F. Zhang[1], D. Al-Nakdali[1], K. A. Fedorova[2], W. Stolz[1,3], E.U. Rafailov[2], M. Koch[1]; 1- Philipps-Univ. Marburg, Germany, 2 - Aston Univ., United Kingdom, 3 - NAsP III/V GmbH, Germany

In the last decade, vertical-external-cavity surface-emitting lasers (VECSELs) have become promising sources of ultrashort laser pulses. While the mode-locked operation has been strongly relying on costly semiconductor saturable-absorber mirrors for many years, new techniques have been found for pulse formation. Mode-locking VECSELs are nowadays not only achievable by using a variety of saturable absorbers, but also by using a saturable-absorber-free technique referred to as self-mode-locking (SML), which is to be highlighted here.

R6. LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, AND GLOBAL NAVIGATION

Location: Deyneka Room, floor 2, 15:00 – 17:00

Lasers for Satellite Ranging Systems, Space Geodesy, and Global Navigation I

Session Chair: Vladimir P. Vasiliev,
OJSC «RPC «Precision Systems and Instruments», Russia

TuR6-01 Invited **15:00-15:30**

New one-way and two-way precision radio-laser ranging systems to increase the accuracy of global space geodesy and navigation systems

M.A. Sadovnikov, A.A. Chubykin, V.D. Shargorodskiy; OJSC «RPC «Precision Systems and Instruments», Russia

New laser technologies for collecting sub-millimeter accuracy data to promote ephemeris-time support for global navigation and space geodesy are presented. The ways to use laser ranging systems to perform lunar ranging and space debris monitoring are reviewed. Technical specifications of high-accuracy measuring systems are given.

TuR6-02 Invited **15:30-16:00**

High brightness Q-switched Nd:YAG lasers for plasma diagnostics and long distance ranging

A.F. Kornev; ITMO Univ., Russia

Results of developments and studies of high brightness Q-switched Nd:YAG lasers. Output energy of the lasers is up 4 J at 1064 nm, 2.5 J at 532 nm, 1 J at 946 nm, pulse repetition rate up to 330 Hz and beam divergence near to diffraction limited. 6 J@200 Hz and 12 J@300 Hz multichannel laser systems laser were developed.

TuR6-03 Invited **16:00-16:30**

High-energy, high repetition rate regenerative amplifiers at 2 μm

U. Griebner, L. von Grafenstein, M. Bock, T. Elsaesser; Max Born Inst., Germany

Picosecond Ho:YLF regenerative amplifiers near 1 kHz repetition rate are reported. Stable operation regimes are identified, delivering up to 16 mJ picosecond pulses at 2051 nm, with energy fluctuations of the pulse train as low as 1% rms.

TuR6-04 **16:30-16:45**

Russian Lunar Laser Rangefinder with Millimeter Accuracy

I.A. Grechukhin[1], E.A. Grishin[1], O.A. Ivlev[1], A.F. Kornev[2], A.A. Mak[2], M.A. Sadovnikov[1], V.D. Shargorodsky[1]; 1 - OJSC «RPC «Precision Systems and Instruments», 2 - ITMO Univ., Russia

Laser rangefinder being created by JC «RPC «PSI» will allow ranging to retroreflectors installed on the Moon's surface with the millimeter accuracy. Laser transmitter developed by the ITMO University is one of component parts of this rangefinder, which features high power of 250mJ at the wavelength of 532nm, having the pulse duration of 100ps and repetition rate of 200Hz.

TuR6-05 **16:45-17:00**

100 ps 360 mJ 200 Hz Nd:YAG laser for the Lunar Laser Ranging

R.V. Balmashnov, Y.V. Katsev, A.F. Kornev, I.G. Kuchma, D.O. Oborotov; ITMO Univ., Russia

We developed high-power diode-pumped Nd:YAG 1.064 μm laser with pulse duration of 100 ps, energy of 360 mJ, pulse repetition rate of 200 Hz and divergence of laser radiation at the level 1.3 of diffraction limit. 72% efficiency of second harmonic generation of the laser output was obtained.

- Coffee Break -

Location: Deyneka Room, floor 2, 17:30 – 19:30

Lasers for Satellite Ranging Systems, Space Geodesy, and Global Navigation II

Session Chair: Vladimir P. Vasiliev,
OJSC «RPC «Precision Systems and Instruments», Russia

TuR6-06 Invited **17:30-18:00**

Lasers for space debris relocation

B. Greene; Space Environment Research Centre, Australia (will be presented by C. Smith; EOS Space Systems, Australia)

Debris removal systems based on known technologies and proven phenomenology are proposed to allow the required laser characteristics to be determined for each proposed configuration. We show that space debris can be relocated in space using lasers which could be achieved with currently-available technology.

TuR6-07 **18:00-18:15**

System for transmitting energy and information using laser radiation for control of the shape of large space-based antennas

A.S.Boreysho, L.B.Kochin, S.Yu.Strakhov; Baltic State Technical Univ., Russia

The article is devoted to wireless and fiber-optic transmission of laser energy for operation of special actuators and control of the shape of the deformable space-based antenna.

TuR6-08 **18:15-18:30**

SC laser ranging efficiency increase based on the use of picosecond lasers and corner retroreflectors with a double-lobe pattern

M.A. Sadovnikov, A.L. Sokolov, V.D. Shargorodskiy, V.D. Nenadovich, V.V. Murashkin; OJSC «RPC «Precision Systems and Instruments», Russia

This report represents an advanced circular retroreflector system designed for mid-orbit spacecrafts which consists of corner reflectors with the controlled camber of a single dihedral angle for generating a double-lobe pattern and thus compensating for the velocity aberration. It is shown that the circular retroreflector system has a number of advantages over the existing ones.

TuR6-09 **18:30-18:45**

Test data on high-precision laser equipment for synchronization of the time scales of distributed SLR-stations and GLONASS satellite

M.V. Baryshnikov, A.S. Zhabin, S.A. Martynov, M.A. Sadovnikov, A.A. Chubykin, V.D. Shargorodskiy; OJSC «RPC «Precision Systems and Instruments», Russia

This report represents results of high-precision (with the error of no more than 100 ps) comparison between the time scales of distributed SLR-stations using a GLONASS satellite equipped with the retroreflector system and laser pulse photodetector and also provides the guidelines to increase the laser time transfer availability based on the use of a radio laser network.

TuR6-10 **18:45-19:00**

Progress in optical space-based clocks: status, perspectives and applications

A.V. Kovalev, V.M. Polyakov, A.A. Mak; ITMO Univ., Russia

We discuss the recent advantages in creation of optical space-based frequency standards. We observe perspective in the field as well as status of making the laser frequency standard of radio frequency range in ITMO University and recent experiments on launching optical frequency combs in space. The most important applications of space-based optical clocks are overviewed.

TuR6-11 **19:00-19:15**

Multifactor optimization of the CPT miniature quantum frequency standards

K.A. Barantsev, A.N. Litvinov, E.N. Popov, V.M. Petrov; Peter the Great St.Petersburg Polytechnic Univ., Russia

In this work is shown that the form and width of the laser spectrum on the input of the cell significantly affects the quality parameter of the CPT-resonance and, as a consequence, stability of the frequency standard. We analyze two types of signal detecting: the signal of forward passed radiation and the fluorescence signal.

TuR6-12 **19:15-19:30**

Retroreflectors using a birefringent wedge for efficient velocity aberration compensation

V.P. Vasiliev; OJSC «RPC «Precision Systems and Instruments», Russia

Various practical solutions for retroreflectors using a birefringent wedge for efficient velocity aberration compensation are presented, and their experimental verification is provided. The way a turn beam coming from a retroreflector changes its direction using polarizing components provides optical velocity aberration compensation without considerable loss of return signal intensity.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Location: Pudovkin Room, floor 3, 09:00 – 11:00

Nonlinear Fibers and Photonic Crystals

Session Chair: Boris A. Malomed, Tel Aviv Univ., Israel

TuR8-01 Invited **09:00-09:30**

Space-time dynamics of nonlinear multimode fibers

K. Krupa[1], A. Tonello[1], A. Barthélémy[1], V. Couderc[1], B.M. Shalaby[1,2], A. Bendahmane[3], G. Millot[3], S. Wabnitz[4]; 1 - Univ. de Limoges, France, 2 - Tanta Univ., Egypt, 3 - Univ. de Bourgogne Franche-Comté, France, 4 - Univ. Brescia, and INO-CNR, Italy

The spatio-temporal dynamics of multimode waves in optical fibers leads to novel possibilities to shape the frequency and spatial content of laser beams.

TuR8-02 Invited **09:30-10:00**

Microscopic reconfigurable photonic circuits and buffers at the fibre surface

M. Sumetsky[1], A.V. Dmitriev[1], N.A. Toropov[2]; 1 - Aston Univ., United Kingdom, 2 - ITMO Univ., Russia

Recent experimental and theoretical results on microscopic reconfigurable photonic circuits and buffers introduced at the fiber surface are reviewed.

TuR8-03 **10:00-10:15**

Self-pulsating nonlinear systems via dissipative parametric instability

A.M. Perego[1,2], N. Tarasov[1,3,4], D.V. Churkin[1,3,4], S.K. Turitsyn[1,4], K. Staliunas[2,5]; 1 - Aston Inst. of Photonic Technologies, Aston Univ., United Kingdom, 2 - Univ. Politècnica de Catalunya, Spain, 3 - Inst. of Computational Technologies SB RAS, Russia, 4 - Novosibirsk State Univ., Russia, 5 - Inst. Catalana de Recerca i Estudis Avançats, Spain

The recently discovered dissipative parametric instability is presented in the framework of the universal complex Ginzburg-Landau equation. The pattern formation associated with the instability is discussed in connection to the relevant applications in nonlinear photonics especially as a new tool for pulsed lasers design.

TuR8-04 **10:15-10:30**

Generation in visible range using second harmonic of random distributed feedback fiber laser

E.I. Dontsova[1], S.I. Kablukov[1], I.D. Vatnik[1,2], S.A. Babin[1,2]; 1 - Inst. of Automation and Electrometry, 2 - Novosibirsk State Univ., Russia

Frequency doubling of radiation generated by random distributed feedback (RDFB) Raman fiber laser (RFL) in MgO:PPLN crystal is studied experimentally for the first time. Second harmonic generation (SHG) power is compared for conventional and RDFB RFL configurations. The comparison shows, that higher SHG power (more than 100 mW at 654 nm) is generated with RDFB RFLs.

TuR8-05 **10:30-10:45**

Broad green generation using adiabatically chirped chi(2) nonlinear photonic crystals

H.-J. Lee[1], C.-M. Lai[2], W.-S. Tsai[3], A.-H. Kung[4], L.-H. Peng[1]; 1 - National Taiwan Univ., 2 - Ming Chuan Univ., 3 - National Chi Nan Univ., 4 - Academia Sinica and National Tsing Hua Univ., China

Broad green generation from 500 to 565nm was observed on chirped chi(2) nonlinear photonic crystals made of periodically-poled lithium tantalate (PPLT) with single pass up-conversion efficiency ~10%. This was ascribed to simultaneous multi-wavelength SHG and SFG due to nonlinear interaction of (signal, idler) waves in the adiabatically chirped PPLT.

TuR8-06 **10:45-11:00**

Towards three octave-spanning mid-IR supercontinuum generation in chalcogenide fibers with two zero dispersion wavelengths

E.A. Anashkina[1], V.S. Shiryaev[2], G.E. Snopatin[2], A.V. Kim[1]; 1 - Inst. of Applied Physics RAS, 2 - Inst. of Chemistry of High-Purity Substances RAS, Russia

We have numerically demonstrated mid-IR supercontinuum generation spanning more than three octaves in all-solid chalcogenide glass fibers with two zero dispersion wavelengths pumped by 50-pJ femtosecond pulses at 2 microns. We manufactured the proper step-index fibers with As39.4Se55.3Te5.3 core and As39.4S60.6 cladding having various core diameters and theoretically studied wavelength conversion up to 8 microns.

- Coffee Break -

Location: Pudovkin Room, floor 3, 11:30 – 13:30

Nonlinear Fibers

Session Chair: Stefan Wabnitz, Univ. Brescia, and INO-CNR, Italy

TuR8-07 Invited **11:30-12:00**

Statistics of rare events: errors in optical fiber communication systems

I.R. Gabitov[1,2], F. Kueppers[3], M. Shkaryaev[4]; 1 - Skolkovo Inst. of Science and Technology, Russia, 2 - Univ. of Arizona, United States (on leave), 3 - Technische Univ. Darmstadt, Germany, 4 - Iowa State Univ., United States

Statistics of bit-errors in optical fiber systems is studied. Obtained results are verified experimentally.

TuR8-08 Invited **12:00-12:30**

New area of the discrete photonics: the optical flat bands in waveguide arrays with alternating sign of refraction index

A.I. Maimistov; Moscow Inst. of Physics and Technology, National Nuclear Research Univ., Russia

The waveguide bundles and two dimensional waveguide arrays in the case of the electromagnetic wave propagating along the waveguide only are discussed. The waveguide array consists of alternating waveguides of positive and negative refraction indexes. It is shown the features of the spectrum are depended on number of waveguides per cell.

TuR8-09 **12:30-12:45**

Towards generation of multicolor dissipative solitons in telecom range

A.E. Bednyakova[1,2], D.S. Kharenko[3,1], E.V. Podivilov[3,1], M.P. Fedoruk[1,2], A.A. Apolonski[3,4], S.A. Babin[3,1], S.K. Turitsyn[5,1]; 1 - Novosibirsk State Univ., Russia, 2 - Inst. of Computational Technologies SB RAS, Russia, 3 - Inst. of Automation and Electrometry SB RAS, Russia, 4 - Ludwig-Maximilians-Univ. Muenchen and Max-Planck-Inst. fuer Quantenoptik, Germany, 5 - Aston Univ., United Kingdom

All-fiber cavity for synchronous generation of conventional and Raman dissipative solitons in the telecom spectral range is designed. Through extensive numerical modelling we demonstrate 2-wavelength complex with 10 nJ energy and <200 fs duration after compression. A comparison with the experimental results will be presented.

TuR8-10 **12:45-13:00**

Interaction between weak and nonlinear optical waves in fibers in the vicinity of zero-dispersion point

I. Oreshnikov[1], R. Driben[1,2], A.V. Yulin[1]; 1 - ITMO Univ., Russia, 2 - Univ. of Paderborn, Germany

We study interaction of weak dispersive waves with broad class of nonlinear waves including dark solitons and second-order solitons. We show a possibility to control nonlinear waves with weak probe signals, polychromatic frequency conversion of weak dispersive waves, and demonstrate a way to emulate classical optical devices like Fabry-Perot and Bragg resonators.

TuR8-11 **13:00-13:15**

Steering of solitons by resonant dispersive waves

A.V. Yulin; ITMO Univ., Russia

It is shown that the effect of Cherenkov radiation can be inverted and the solitons can be pumped by the synchronous dispersive waves of low intensity. This effect is analogous to the effect of the acceleration of moving charges by resonant electromagnetic waves. The importance of mutual resonant interactions between the solitons and the dispersive waves for supercontinuum generation is discussed.

TuR8-12 **13:15-13:30**

Three-photon spontaneous downconversion in highly nonlinear germania-silica optical fiber waveguides

S.V. Tsvetkov[1], K.G. Katamadze[1,2], N.A. Borshchevskaia[1,2], A.A. Sysolyatin[1], M.V. Fedorov[1], S.P. Kulik[1,2], M.Yu. Salganskii[3], A.S. Belanov[4]; 1 - Prokhorov General Physics Inst. RAS, 2 - Lomonosov Moscow State Univ., 3 - Inst. of Chemistry of High-Purity Substances RAS, 4 - Moscow State Univ. of Information Technologies, Radioengineering and Electronics, Russia

Three-photon spontaneous parametric downconversion (TPSPDC) is a challenging problem in nonlinear quantum optics. A highly doped germania-silica optical fiber is a good candidate for the appropriate nonlinear medium, because of the big interaction length and tight field confinement. A principal condition for TPSPDC is the exact phase-matching between the pump and signal fiber modes.

- Lunch Break -

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Location: Pudovkin Room, floor 3, 15:00 – 17:00

Fibers and Fiber Lasers

Session Chair: Ildar R. Gabitov, Skolkovo Inst. of Science and Technology, Russia

TuR8-13 Invited **15:00-15:30**

Soliton fission and fusion in dispersion oscillating fiber and correlation properties of the pulses

L. Melnikov; Gagarin Saratov State Technical Univ., Saratov Branch of Kotel'nikov Inst. of Radioengineering and Electronics RAS, Russia

Comprehensive solitons dynamics in the fiber with periodically oscillating group velocity dispersion is demonstrated. Soliton fission and recently described solitons fusion are explained using the solitons spectra of inverse scattering problem solution. The fission and fusion occurs when discrete spectral parameters of the solitons demonstrate collisions (anti-crossing) behavior during the pulse propagation along the fiber. The resulting pulses after fission remain coupled and this coupling exists in spite of long temporal or longitudinal distance between the pulses. Possible scenarios of coupling are discussed and correlation properties of the pulses are investigated.

TuR8-14 **15:30-15:45**

Dissipative Faraday instability mode-locking in a Raman fiber laser

N. Tarasov[1,2], A.M. Perego[1,3], D.V. Churkin[1,2,4], K. Staliunas[3,5], S.K. Turitsyn[1,4]; 1 - Aston Univ., United Kingdom, 2 - Inst. of Computational Technologies SB RAS, Russia, 3 - Univ. Politècnica de Catalunya, Spain, 4 - Novosibirsk State Univ., Russia, 5 - Inst. Catalana de Recerca i Estudis Avançats, Spain

There is a new type of parametric instability that was recently theoretically predicted - dissipative Faraday instability. In this work we experimentally demonstrate this new type of instability by successfully achieving mode-locking in a simple configuration. The results not only open the possibilities for novel designs of mode-locked lasers, but extend beyond the field of laser physics.

TuR8-15 **15:45-16:00**

Generation of frequency combs in nonlinear SNAP fiber resonators

S.V. Suchkov[1], M. Sumetsky[2], A.A. Sukhorukov[2]; 1 - Australian National Univ., Australia, 2 - Aston Univ., United Kingdom

We suggest Surface Nanoscale Axial Photonic resonators for generation of frequency combs. We derive model equations, which describe propagation of whispering gallery modes in nonlinear SNAP resonators. Our simulations show that by appropriate variation of fiber radius along the millimeter long SNAP resonator, we can obtain a frequency comb, comparable to frequency combs generated by ring resonators of cm radius.

TuR8-16 **16:00-16:15**

Mid-IR ultrashort Raman solitons and red-shifted dispersive waves in suspended-core tellurite fiber

E.A. Anashkina[1], A.V. Andrianov[1], V.V. Dorofeev[2], A.V. Kim[1]; 1 - Inst. of Applied Physics RAS, 2 - Inst. of Chemistry of High-Purity Substances RAS, Russia

We have demonstrated numerically the possibility to obtain ultrashort laser pulses in the range beyond 4 microns due to soliton self-frequency shift and red-shifted dispersive wave generation in a suspended-core fiber made of specially synthesized high-purity low-loss Te2O3-WO3-La2O3 glass pumped by a standard fs pump laser source at 2 microns.

TuR8-17 **16:15-16:30**

Broadband femtosecond fiber laser with ultrahigh repetition rate in the telecommunication range

A.V. Andrianov[1], V.M. Mylnikov[1,2], M.Yu. Koptev[1], S.V. Muravyev[1], A.V. Kim[1]; 1 - Inst. of Applied Physics RAS, 2- Nizhny Novgorod State Univ., Russia

A new variant of the fiber laser for generation of ultrashort pulse bunches and sequences with repetition rate in the range of 8-260 GHz, which combines a nonlinear amplifying loop mirror and a comb spectral filter for stabilization of the pulse separation, was demonstrated. We showed that a well-ordered and equidistant structure of the pulse sequence is maintained on a nanosecond timescale.

TuR8-18 **16:30-16:45**

Femtosecond pulse propagation in the negative curvature hollow-core revolver fiber

A.A. Krylov, Yu.P. Yatsenko, A.D. Pryamikov, A.F. Kosolapov, A.N. Kolyadin, A.V. Gladyshev, I.A. Bufetov; Fiber Optics Research Center RAS, Russia

For the first time femtosecond pulse propagation has been numerically and experimentally studied in the hollow-core revolver fiber with a non-coupled cylindrical capillaries-based cladding, fabricated for high-power ultra-short pulse delivery in the telecom band near 1.55 μm.

TuR8-19 **16:45-17:00**

Short cavity Brillouin random laser

S.M. Popov[1], O.V. Butov[1], Yu.K. Chamorovsky[1], P. Mégret[2], I.O. Zolotovskii[3], A.A. Fotiadi[2,3,4]; 1 - Inst. of Radio Engineering and Electronics RAS, Russia, 2 - Univ. of Mons, Belgium, 3 - Ulyanovsk State Univ., Russia, 4 - Ioffe Inst., Russia

We report on random lasing realized with 100-m-long Rayleigh fiber fabricated with multiple reflection centers inscribed in the fiber core and uniformly distributed over the fiber length. Extended fluctuation-free fragments in the oscilloscope traces highlight power behavior typical for lasing.

- Coffee Break -

Location: Pudovkin Room, floor 3, 17:30 – 19:30

Fibers and Fiber Lines

Session Chair: Sergey A. Kozlov, ITMO Univ., Russia

TuR8-20 **17:30-17:45**

Differential high-resolution stimulated CW Raman spectroscopy of hydrogen in a hollow-core fiber

P.G. Westergaard, M. Lassen, J.C. Petersen; Danish Fundamental Metrology, Denmark

We demonstrate sensitive high-resolution stimulated Raman measurements of hydrogen using a hollowcore photonic crystal fiber (HC-PCF). The Raman transition is pumped by a narrow linewidth (<50 kHz) 1064 nm fiber CW laser. The probe light is produced by a homebuilt CW optical parametric oscillator (OPO), tunable from around 800 nm to 1300 nm.

TuR8-21 **17:45-18:00**

Optical trigger based on a fiber-coupled liquid crystal

S.I. Trashkeev[1,2], B.N. Nyushkov[1,2], R.V. Galev[1,3], D.B. Kolker[1,2], V.I. Denisov[1]; 1 - Inst. of Laser Physics SB RAS, 2 - Novosibirsk State Univ., 3 - Khristianovich Inst. of Theoretical and Applied Mechanics SB RAS, Russia

Triggering capability of a laser radiation transmission through a fiber-coupled nematic liquid crystal (NLC) was experimentally investigated. This capability arises from light-induced reorientation of NLC molecules that enables self-focusing and self-confinement of propagating laser radiation. It was shown, that triggered optical coupling of two single-mode optical fibers terminated coaxially in NLC can be achieved through a self-induced light guide.

TuR8-22 Invited **18:00-18:30**

On-chip nonlinear generation and quantum tomography of entangled photons

A.A. Sukhorukov; Australian National Univ., Australia

We present the theoretical concepts and experimental results on the generation and characterization of photon-pair states with reconfigurable quantum entanglement in integrated nonlinear photonic structures.

TuR8-23 **18:30-18:45**

One-way quantum key distribution scheme

A.V. Duplinskiy[1,2], V.E. Ustimchik[1,2], Y.V Kurochkin[1]; 1 - Russian Quantum Center, 2 - Moscow Inst. of Physics and Technology, Russia

We report the quantum key distribution (QKD) demonstration over a standard optical singlemod fiber, implementing the BB84 phase-coding protocol via one-way optical scheme. The stabilization technique was developed allowing to maintain continuous QKD with a high bit rate. Stabilization is applied both against polarization and phase drifts, using the feedback system.

TuR8-24 **18:45-19:00**

Testing of quantum key distribution system with real optic-fiber communication line

A.V. Losev, A.V. Miller, A.S. Sokolov, A.A. Kanapin, Y.V. Kurochkin; Russian Quantum Center, Russia

We report the quantum key distribution (QKD) demonstration over a standard optical singlemod fiber, implementing the BB84 phase-coding protocol via two-pass optical scheme. To achieve the results we reported we used self-developed electronics.

TuR8-25 **19:00-19:15**

Development and characteristics measurement of single photon detectors, based on InGaAs/InP avalanche photodiodes, designed for quantum communication lines

S.V. Zaitsev[1], A.V. Miller[2], A.V. Losev[2], V.L. Kurochkin[2], Y.V. Kurochkin[2]; 1 - FemtoVision Company, 2 - Russian Quantum Center, Russia

The detector, which is discussed further, designed for single photon detection of 1550nm wavelength, was developed as part of the project: «Creating a quantum device prototype for secure data transmission». Today the best single photon detectors for practical use in this field are based on avalanche InGaAs/InP photodiodes, which are used in this study. The report contains discussions of the detectors construction, its structural and functional schemes, and certain working features in Geiger mode and free-running mode, with a delay timer after every registered pulse, and without it.

TuR8-26 Invited **19:15-19:45**

The brave new world of ultrafast optics in the mid-infrared

A.V. Mitrofanov[1,2,4,5], A.A. Lanin[1,2], E.A. Stepanov[1,2], A.A. Voronin[1,2], D.A. Sidorov-Biryukov[1,2], S.I. Mitryukovsky[2], A.B. Fedotov[1,2], A. Pugžlys[6], V.Ya. Panchenko[4,5], A. Baltuška[6], A.M. Zheltikov[1,2,3,4]; 1 - Lomonosov Moscow State Univ., Russia, 2 - Russian Quantum Center, Russia, 3 - Texas A&M Univ., United States, 4 - Kurchatov Inst. National Research Center, Russia, 5 - Inst. of Laser and Information Technologies RAS, Russia

Our studies reveal unique properties of midinfrared filaments, where the generation of powerful midinfrared supercontinuum is accompanied by unusual scenarios of optical harmonic generation, giving rise to remarkably broad radiation spectra, stretching from the visible to the mid-infrared. Filamentation-assisted pulse compression in the gas phase is shown to enable the generation of subterawatt few-cycle pulses in the mid-infrared. Generation of few- and even single-cycle midinfrared field waveforms with peak powers ranging from a few megawatts to hundreds of gigawatts has been demonstrated within a broad range of central wavelengths.

R9. OPTICAL NANOMATERIALS

Location: Stenberg Room, floor 3. 09:00 – 11:00

Optical Nanomaterials I

Session Chair: Vladimir G. Dubrovskii, Ioffe Inst., ITMO Univ., Russia

TuR9-00 **08:45-09:00**

Opening remarks from session chairs

V.G. Dubrovskii[1,2], F. Glas[3]; 1 - Ioffe Inst., Russia, 2 - ITMO Univ., Russia, 3 - CNRS Lab for Photonics and Nanostructures, France

TuR9-01 Invited **09:00-09:30**

Interface dynamics and crystal phase switching in GaAs nanowires

F.M. Ross; IBM T. J. Watson Research Center, United States

In order to understand the mechanism that controls crystal phase, we use in situ electron microscopy to image catalytically-grown GaAs nanowires during growth as they are switched between polytypes by varying growth conditions. We find striking differences between the growth dynamics of the two phases, including differences in interface morphology, step flow, and catalyst geometry.

TuR9-02 Invited **09:30-10:00**

Semiconductor nanostructures for lasers and optoelectronics applications

Ch. Jagadish; Australian National Univ., Australia

In this talk I will discuss about the synthesis of nanostructures and their characterization and device fabrication and testing. Role of plasmonic cavities in improving the quantum efficiency of nanostructures will be discussed. Strengths and weaknesses of each of these nanostructures will be presented and future perspective will be provided.

TuR9-03 Invited **10:00-10:30**

Growth of organized III-V nanostructures for quantum technology and energy applications

A. Fontcuberta i Morral, Laboratory of Semiconductor Materials, Inst. of Materials, Ecole Polytechnique Fédérale de LaUnited Statesnne, Switzerland

Nanowires are filamentary crystals with a tailored diameter ranging from few to ~100 nm. The special geometry and reduced dimensions of these nanowires results in interesting optical and electrical properties and provides a great potential for many applications of the XXI century. In this talk we will first review the growth mechanisms of Ga-assisted growth of GaAs nanowires by molecular beam epitaxy. We will follow by elucidating the photonic properties of single nanowires standing and lying on a substrate to show how they can be used for quantum science and technology and energy harvesting applications.

TuR9-04 **10:30-10:45**

Self-catalyzed growth of GaAs nanowires on silicon by HVPE

Zh. Dong[1,2], Ya. André[1,2,3], V. Dubrovskii[4,5], C. Bougerol[6,7], G. Monier[1,2], R. Ramdani[1,2], A. Trassoudaine[1,2,8], Ch. Leroux[9,10], D. Castelluci[1,2], E. Gil[1,2,3]; 1 - Inst. Pascal, France, 2 - CNRS, UMR 660[2], France, 3 - ITMO Univ., Russia, 4 - St. Petersburg Academic Univ., Russia, 5 - Ioffe Inst., Russia, 6 - Univ. Grenoble Alpes, France, 7 - CNRS, Inst. Néel, France, 8 - Univ. d'Auvergne, France, 9 - Univ. du Sud Toulon-Var, France, 10 - CNRS, UMR 624[2], France

We report on the first self-catalyzed growth of GaAs nanowires on patterned and non-patterned silicon (111) wafers by hydride vapor phase epitaxy (HVPE) with a record elongation rate of 30 μm/h. The crystalline structure was analyzed using high resolution transmission electron microscopy (HRTEM). Self-catalyzed growth proceeds under gallium rich conditions at low-temperature (600 °C). Nanowires exhibit cylindrical rod-like shape morphology with a mean diameter of 50 nm and are randomly distributed.

TuR9-05 **10:45-11:00**

MBE growth and optical properties of GaN nanowires on SiC/Si(111) hybrid substrate

R.R. Reznik[1,2], K.P. Kotlyar[2], I.V. Ilkiv[1,2], I.P. Soshnikov[2,3], S.A. Kukushkin[6], A.V. Osipov[6], E.V. Nikitina[2], G.E. Cirlin[1,2,4,5]; 1 - St-Petersburg Academic Univ., 2 - Peter the Great St.Petersburg Polytechnic Univ., 3 - Ioffe Inst., 4 - Inst. for Analytical Instrumentation RAS, 5 - St.Petersburg State Univ., 6 - Inst. of Problems of Mechanical Engineering RAS, Russia

The fundamental possibility of the growth of GaN nanowires by molecular-beam epitaxy on a silicon substrate with nanoscale buffer layer of silicon carbide has been demonstrated for the first time. Morphological and spectral properties of the resulting system have been studied and compared properties of GaN nanowires on silicon substrate.

- Coffee Break -

Location: Stenberg Room, floor 3, 11:30 – 13:30

Optical Nanomaterials II

Session Chair: Frank Glas, CNRS Lab for Photonics and Nanostructures, France

TuR9-06 Invited **11:30-12:00**

Photonic wires and trumpets: an attractive novel platform for quantum optoelectronic devices

J.-M. Gérard, J. Claudon; CEA, Inst. for Nanoscience and Cryogenics, France

Over the last 20 years, major efforts have been devoted to the tailoring of the optical properties of semiconductor emitters using optical microcavities and photonic crystals. INAC has recently introduced photonic wires as a novel platform for quantum optics. We will review recent studies which demonstrate an excellent control over the spontaneous emission of InAs quantum dots (QDs) embedded in vertical single-mode GaAs photonic wires and first applications in the field of quantum optoelectronic devices.

TuR9-07 Invited **12:00-12:30**

Recent progress on patterned Ga-assisted growth of GaAs nanowires for optoelectronic applications

R.R. LaPierre[1], J. Boulanger[1], A. Chia[1], M. Leyden[1], S. Yazdi[2,3], T. Kasama[2], M. Aagesen[4], H. Tavakoli Dastjerdi[1]; 1 - McMaster Univ., Canada, 2 - Technical Univ. of Denmark, Denmark, 3 - Rice Univ., United States, 4 - Gasp Solar ApS, Denmark

A single junction core-shell GaAs nanowire (NW) solar cell on Si (111) substrate is presented. A Ga-assisted vapor-liquid-solid (VLS) growth mechanism was used for the formation of a patterned array of radial p-i-n GaAs NWs encapsulated in AlInP passivation. Novel device fabrication utilizing facet-dependent properties to minimize passivation layer removal for electrical contacting is demonstrated. Thorough electrical characterization and analysis of the cell is reported. The electrostatic potential distribution across the radial p-i-n junction GaAs nanowire is investigated by off-axis electron holography. The results are generally applicable to other nanowire-based optoelectronic devices.

TuR9-08 Invited **12:30-13:00**

Gate-controlled plasmonics in single nanostructures

F. Rossella[1], A. Arcangeli[1], J. Xu [1], D. Ercolani[1], A. Tredicucci[1,2], F. Beltram[1], S. Roddaro[1], L. Sorba[1]; 1 - NEST Scuola Normale Superiore, 2 - Univ. di Pisa, Italy

Nanoplasmonics is emerging as a powerful tool for modern information and communication technologies, as suggested by the recent realization of gate-tunable plasmons in graphene nanostructures. Here we demonstrate that a similar approach can be also very useful for the spatially resolved investigation of fundamental properties of nanostructures. In the present implementation we achieve field-effect control of the plasma resonance in InAs nanowire (NW) devices, detected by scattering-type scanning near-field optical microscopy (s-SNOM) in the mid-infrared region (λ ~ 10.5 μm).

TuR9-09 **13:00-13:15**

Metal mesoscopic contact as a source of plasmons for plasmonic nanocircuitries

A.V. Uskov[1,2], I.V. Smetanin[1], I.E. Protsenko[1], J.B. Khurgin[3], M. Buret[4], A. Bouhelier[4]; 1 - Lebedev Physical Inst., Russia, 2 - ITMO Univ., Russia, 3 - John Hopkins Univ., United States, 4 - Univ. Bourgogne Franche-Comte, France

We show that nanoscale metal contacts (constrictions) can serve as an efficient sources of plasmons for future nanoplasmonic integrated circuits. Electron, passing ballistically through nanoscale contact, can emit plasmons with the probability ~0.1 due to multiple collisions with walls of the constriction.

TuR9-10 **13:15-13:30**

Phase and amplitude modulations of THz waves in carbon-based derivatives

M. Irfan, J.-H. Yim, Y.-D. Jho; Gwangju Inst. of Science and Technology, South Korea

We manipulate the phase and amplitude of terahertz waves emitted from graphitic materials by utilizing doping types, work function offsets, and circular transports.

- Lunch Break -

R9. OPTICAL NANOMATERIALS

Location: Stenberg Room, floor 3, 15:00 – 16:30

Optical Nanomaterials III

Session Chair: Ray LaPierre,
Centre for Emerging Device Technologies, McMaster Univ., Canada

TuR9-11 **15:00-15:15**

High-sensitivity side-coupled symmetric-shaft-shape photonic crystal sensor arrays

Zh. Fu, J. Zhou, L. Huang, F. Sun, H. Tian; Beijing Univ. of Posts and Telecommunications, China

High-sensitive symmetric-shaft-shape photonic crystal sensor arrays (SSPhCSAs) consisting of four cavities side-coupled to a W1 waveguide are designed. The sensitivities of the four sensor units are from 178 to 398 nm/RIU.

TuR9-12 **15:15-15:30**

Laser formation of the metal-carbon islands thin films for optical application

A. Kucherik[1], A. Antipov[1], S. Arakelian[1], S. Kutrovskaya[1], A. Osipov[1], T. Vartanyan[2], A. Povolotckaia[3], A. Povolotskiy[3], A. Manshina[3]; 1 - Stoletov Vladimir State Univ., 2 - ITMO Univ., 3 - St. Petersburg State Univ., Russia

In this work a method for the laser formation of C-Au-Ag clusters and complexes on the surface of an optically transparent media is discussed.

TuR9-13 **15:30-15:45**

Saturation parameters studies of carbon nanotube-based thin-film saturable absorbers for erbium fiber laser mode-locking

A.A. Krylov[1], S.G. Sazonkin[2], N.R. Arutyunyan[3,4], V.V. Grebenyukov[3], A.S. Pozharov[3], D.A. Dvoretskiy[2], A.B. Pnev[2], V.E. Karasik[2], E.D. Obraztsova[3,4], E.M. Dianov[1]; 1 - Fiber Optics Research Center RAS, 2 - Bauman Moscow State Technical Univ., 3 - Prokhorov General Physics Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia

We have experimentally studied saturation behavior of Single-Walled Carbon Nanotube-based saturable absorbers at different temperatures and SWCNT concentrations in the carboxymetylcellulose polymer matrix and related it to the mode-locked erbium-doped fiber laser performance.

TuR9-14 **15:45-16:00**

Ferrofluid as promising magnetically controlled material for optofluidics and microstrutured fiber-based sensing

A.V. Prokofiev[1,2], A.V. Varlamov[1,2], P.M. Agruzov[1], I.V. Pleshakov[1,2], E.E. Bibik[3], S.I. Stepanov[4], A.V. Shamray[1,2]; 1 - Peter the Great St.Petersburg Polytechnic Univ., Russia, 2 - Ioffe Inst., Russia, 3 - St. Petersburg State Inst. of Technology (Technical Univ.), Russia, 4 - CICESE, Mexico

Studies of magneto-optic properties of Fe3O4 ferrofluid (colloidal solution of nanosized particles) in a pulsed and AC magnetic field are reported. It is shown that a microstructured optical fiber with cladding holes filled with ferrofluid is sensitive to the external magnetic field vector and that operating speed of magnetically controlled optofluidic devices can be increased by using a transverse biasing.

TuR9-15 **16:00-16:15**

Novel hybrid materials based on various oxyquinoline organic phosphour complexes and oxyfluoride glass

M.O. Anurova, C.V. Ermolaeva, O.B. Petrova, A.V. Khomyakov, A.A. Akkuzina, R.I. Avetisov, I.Ch. Avetissov; Mendeleev Univ. of Chemical Technology, Russia

Novel luminescent organic-inorganic hybrid materials were synthesized by high temperature reaction between metalorganic phosphors and glass. In the present research we used a lead fluoroborate glass as an inorganic matrix and various luminescent oxyquinoline complexes as organic active agent.

TuR9-16 **16:15-16:30**

Laser correlation spectroscopy and nonlinear magnetooptic response of structures formed by nanoparticles in magnetic fluid

E.K. Nepomniashchaia[1], A.V. Prokofiev[1,2], E.T. Aksenov[1], I.V. Pleshakov[1,2], E.E. Bibik[3], E.N. Velichko[1], Yu.I. Kuzmin[1,2]; 1 - Peter the Great Saint Petersburg Polytechnic Univ., 2 - Ioffe Inst., 3 - St. Petersburg State Inst. of Technology, Russia

Investigations of the agglomeration process in liquid nanostructured materials (magnetic fluids) and its effect on their optical properties are presented.

R10. FREE ELECTRON LASERS

Location: Rihter Room, floor 3, 09:00 – 11:00

Hard X-ray FELs

Session Chair: Wilfried Wurth,
DESY/ Univ. Hamburg, Germany

TuR10-01 Invited **09:30-10:00**

European XFEL: status and research instrumentation

S.L. Molodtsov; European XFEL GmbH, Technische Univ. Bergakademie Freiberg, Germany, ITMO Univ., Russia

The European XFEL is a new international research installation that is currently under construction in Germany. The facility will generate new knowledge in almost all the technical and scientific disciplines that are shaping our daily life. The status and research instruments are described here.

TuR10-02 Invited **10:00-10:30**

Ultrafast pump-probe laser for the European X-ray free-electron laser facility

M. J. Lederer, M. Pergament, M. Kellert, K. Kruse, J. Wang, G. Palmer, L. Wissmann, U. Wegner, M. Emons; European X-Ray Free-Electron Laser-Facility GmbH, Germany

We present a versatile and flexible ultrafast optical laser setup, developed for future experiments at the European XFEL. Like the XFEL, the laser operates in burst-mode, emitting milli-Joule class few-cycle pulses at MHz repetition rates. At its core is an optical parametric amplifier optimized for 800nm emission. We present the design, capabilities, scope of operation and installation schedule.

TuR10-03 Invited **10:30-11:00**

Measurements on 3D spatial distribution, spectral and coherent properties of focused XFEL beam

S.A. Pikuz[1], T.A. Pikuz[1,2], A.Ya. Faenov[1,2], A.N. Mitrofanov[1], T. Matsuoka[2], S. Matsuyama[3], K. Yamauchi[3], N. Ozaki[3], Y. Inubushi[4], M. Yabashi[4,5], K. Tono[4,5], Y. Sato[3], H. Yumoto[4], H. Ohashi[4,5], A.N. Grum-Grzhimailo[6], M. Nishikino[7], T. Kawachi[7], T. Ishikawa[4,5], R. Kodama[2]; 1 - Joint Inst. for High Temperatures RAS, Russia, 2 - Osaka Univ., Japan, 3 - Osaka Univ., Japan, 4 - JASRI/SPring-8, Japan, 5 - RIKEN Harima Inst., Japan, 6 - Lomonosov Moscow State Univ., Russia, 7 - Quantum Beam Science Center JAEA, Japan

Versatile and convenient method to measure in situ the parameters of intense X-ray beams is developed applying photoluminescence LiF crystal detector. The capabilities of the method are demonstrated in the experiments at BL3 SACLA-Spirng8 beam line showing uniquely high sensitivity, dynamic range, and submicron spatial resolution of the detector. It allows to measure the intensity distribution of the beam inside the focal spot and at far field in the same single laser shot, that makes the method attractive for optimization of focusing systems developed at FEL, synchrotron and plasma-based SXLR facilities. The approach to study coherent and spectral properties of X-ray beams based on the analysis of diffraction patterns recorded on LiF films is introduced.

- Coffee Break -

R10. FREE ELECTRON LASERS

Location: Rihter Room, floor 3, 11:30 – 13:15

Soft X-ray and THz FELs

Session Chair: Manfred Helm,
Helmholtz-Zentrum Dresden-Rossendorf, Germany

TuR10-04 Invited **11:30-12:00**

The FERMI free-electron lasers

Luca Giannessi; Elettra-Sincrotrone Trieste S.C.p.A., ENEA C.R. Frascati, Italy

The injection of an external seed to initiate the FEL amplification in a free electron laser is a concept initially introduced to improve the source spectral brightness. In the framework of the 4th generation light sources, FERMI was built with this unique distinguishing feature. We will provide an overview of the main recent developments seeded FEL facility.

TuR10-05 **12:00-12:15**

Tunable ultrafast laser system for seeded XUV FEL

P. Cinquegrana, M.B. Danailov, A. Demidovich, G. Kurdi, I. Nikolov, P. Sigalotti; Elettra – Sincrotrone Trieste, Italy

Description of an ultrafast Ti:Sa based laser system used for seeding an FEL facility and for pump-probe experiments.

TuR10-06 **12:15-12:30**

Temporal characterazation of FEL pulses

R. Ivanov, S. Düsterer, G. Brenner, S. Dziarzhytski; Deutsches Elektronen-Synchrotron DESY, Germany

We used a terahertz (THz) field driven streak camera with capabilities to deliver the pulse duration and the arrival time information with around 10 fs resolution for each single XUV FEL pulse at FLASH. The setup was operated simultaneously with an alternative method to determine the FEL pulse duration based on spectral measurements. A comparison will be shown.

TuR10-07 Invited **12:30-13:00**

Novosibirsk high-power THz FEL facility

N.A. Vinokurov, V.S. Arbuzov, K.N. Chernov, I.V. Davidyuk, E.N. Dementyev, B.A. Dovzhenko, Ya.V. Getmanov, B.A. Knyazev, E.I. Kolobanov, A.A. Kondakov, V.R. Kozak, E.V. Kozyrev, V.V. Kubarev, G.N. Kulipanov, E.A. Kuper, I.V. Kuptsov, G.Ya. Kurkin, S.V. Motygin, V.N. Osipov, V.M. Petrov, L.E. Medvedev, V.K. Ovchar, A.M. Pilan, V.M. Popik, V.V. Repkov, T.V. Salikova, M.A. Scheglov, I.K. Sedlyarov, G.V. Serdobintsev, S.S. Serednyakov, O.A. Shevchenko, A.N. Skrinsky, S.V. Tararyshkin, V.G. Tcheskidov, A.G. Tribendis, P.D. Vobly; Budker Inst. of Nuclear Physics SB RAS, Russia

Novosibirsk free electron laser (FEL) facility contains three FELs operating in the wavelength range 8 – 240 micron at average power up to 0.5 kW and peak power about 1 MW. Radiation users works at 6 user stations performing biological, chemical, physical and medical research.

TuR10-08 **13:00-13:15**

Analytical approximate methods in optimization of optical systems for free-electron lasers

V.V. Kubarev; Budker Inst. of Nuclear Physics RAS, Novosibirsk State Univ., Russia

Analytical approximate methods in optimization of various optical resonators and transport beamlines for free-electron laser (FEL) were presented. Small signal gain, losses, optimal output coupling, and output FEL power are written as simple clear analytical functional of geometrical parameters of the FEL's optical systems.

- Lunch Break -

Location: Rihter Room, floor 3, 15:00 – 17:15

Science at FELs

Session Chair: Sergey Pikuz,
Joint Inst. for High Temperatures RAS, Russia

TuR10-09 Invited **15:00-15:30**

Solid state spectroscopy with THz free electron lasers

M. Helm; Helmholtz-Zentrum Dresden-Rossendorf, Germany

Some applications of infrared and THz free electron lasers in solid state spectroscopy are discussed. In particular, nonlinear experiments on semiconductor quantum well excitons and pump-probe studies on carrier relaxation in graphene are presented.

TuR10-10 Invited **15:30-16:00**

Science frontiers @ FERMI

C. Masciovecchio; Elettra – Sincrotrone Trieste, Italy (will be presented by M. Danailov; Elettra – Sincrotrone Trieste, Italy)

The most recent light sources, extreme ultraviolet (EUV) and X-ray free electron lasers (FELs), have extended tabletop laser experiments to shorter wavelengths, adding element and chemical state specificity by exciting and probing electronic transitions from core levels. Through their unique properties, combining femtosecond X-ray pulses with coherence and enormous peak brightness, the FELs have enabled studies of a broad class of dynamic phenomena in matter that crosses many scientific disciplines and have led to major breakthroughs in the last few years.

TuR10-11 Invited **16:00-16:30**

Time-resolved X-ray spectroscopy with free-electron lasers

W. Wurth; Univ. of Hamburg, DESY Photon Science, Germany

We present the results and prospects for time-resolved photoelectron spectroscopy and time-resolved resonant inelastic X-ray scattering. We discuss on free electron lasers FLASH and European XFEL and their application to X-ray spectroscopy technics.

TuR10-12 Invited **16:30-17:00**

Imaging single cells in a beam of live cyanobacteria with an X-ray laser

G. van der Schot, T. Ekeberg, J. Hajdu; Uppsala Univ., Sweden

Femtosecond diffractive imaging with X-ray free-electron lasers (XFELs) has the potential to achieve sub-nanometer resolution on micron-sized living cells. We developed an injection method that can image millions of living cells per day. We show that it is indeed possible to record scattered signal beyond 4 nm resolution. Detector saturation limited our image reconstructions to 76 nm.

TuR10-13 **17:00-17:15**

Reduction of the graphene oxide films by soft UV irradiation

M.K. Rabchinskii[1], A.T. Dideikin[1], M.V. Baidakova[1,2], V.V. Shnitov[1], I.I. Pronin[1,2], D.A. Kirilenko[1,2], P.N. Brunkov[1,2], J. Walter[3], S.L. Molodtsov[2,3,4]; 1 - Ioffe Inst.,Russia, 2 - ITMO Univ., Russia, 3 - Technische Univ. Bergakademie Freiberg, Germany, 4 - European XFEL GmbH, Germany

We have studied the UV reduction process of thin graphene oxide films, deposited on silicon substrate from ethanol suspension. Chemical structure of obtained material was analyzed by XPS method. TEM images showed holes formation during reduction process, that are connected into network. Films with observed structure have great variety of possible future applications, such as gas-sensors and different organic/nonorganic nanocompisites.

R1. SOLID-STATE LASERS

TuR1-p01 **15:00-19:00**

Stability of the misaligned MOPA Nd:YAG DPSSL

V.M. Polyakov, A.V. Kovalev, V.V. Vitkin, A.A. Mak; ITMO Univ., Russia

We consider a compact MOPA DPSSL system for the space-based rangefinding. The plane cavity Nd:YAG master oscillator (MO) was passively Q-switched. The amplifier consisted of Nd:YAG active media in a ring cavity with two passes and polarization decoupling. The MOPA system was used as a source for a space-based altimeter-roll stabilizer to control spacecraft landing process. The polarizer decoupler finite contrast leads to the parasitic lasing effect which acts as a seeding signal for the MO causing instabilities in the system output.

TuR1-p02 **15:00-19:00**

10 W level Nd:YAG end-pumped CW amplifier

A.F. Kornev, V.P. Pokrovskyi, S.S. Sobolev, S.S. Terekhov; ITMO Univ., Russia

End pumped CW Nd:YAG amplifier for low power stable single-frequency laser was built and investigated. High extraction efficiency ~30% in double-pass amplifier is achieved due to high small-signal gain provided with longitudinal pumping. Pumping of amplifier is near uniformly distributed along 2 laser rods with low concentration using two-lens relay between them in order to decrease end overheating.

TuR1-p03 **15:00-19:00**

Pulse shaping in Yb doped all-in-fiber laser using fiber Bragg grating filter

T. Bartulevičius, N. Rusteika; EKSPLA, Ltd., Lithuania

In this work the minimization of gain narrowing in Yb doped all-in-fiber fiber chirped pulse amplification (FCPA) system was investigated. Spectral filtering technique using fiber Bragg grating filter with desired transmission spectrum was demonstrated.

TuR1-p04 **15:00-19:00**

Compact Yb:YAG crystal fiber CPA for fiber laser oscillator

A.M. Rodin[1,2], S. Frankinas[1,2], N. Rusteika[2]; 1 - Center for Physical Sciences and Technology, 2 - UAB Ekspla, Lithuania

We present results of experimental investigation of chirped pulse amplification in a single and double-pass Yb:YAG crystal fiber amplifier seeded with fiber laser pulses of 480 ps FWHM and ~ 350 mW average power at 100 kHz. High brightness fiber coupled laser diodes of 50 W power at 940 nm were used in a single and dual end-pumping geometry.

TuR1-p05 **15:00-19:00**

Study of the thermooptical distortions of transversely diode pumped Yb-Er glass laser

I.V. Chavkin, D.A. Abramov; ITMO Univ., Russia

Since the thermooptical distortions have a significant impact on the output characteristics of the laser, it is necessary to their detailed study. Investigation method of thermo-optical distortions in solid-state lasers was developed and presented. The method can be easily used for research of small diameter active elements.

TuR1-p06 **15:00-19:00**

2.92 μm Cr2+:CdSe single crystal laser pumped by repetitively-pulsed Tm3+:Lu2O3 ceramics lasers

O.L. Antipov[1,2], I.D. Eranov[2], M.P. Frolov[3,4], Yu.V. Korostelin[3], V.I. Kozlovsky[3,5], A.A. Novikov[1], Yu.P. Podmar'kov[3,4], Ya.K. Skasyrsky[2]; 1 - Inst. of Applied Physics RAS, 2 - Nizhniy Novgorod State Univ., 3 - Lebedev Physical Inst. RAS, 4 - Moscow Inst. of Physics and Technology (State Univ.), 5 - National Research Nuclear Univ. MEPhI, Russia

Laser oscillator based on Cr2+:CdSe single crystal pumped by radiation of Tm3+:Lu2O3-ceramic laser was created and investigated. Repetitively-pulsed oscillations at the wavelength of 2.92 μm with bandwidth of 80 nm were demonstrated. The output power was up to 3W at 15-30 kHz repetition rate with the pulse duration of ~40-300 ns in the good-quality beam.

TuR1-p07 **15:00-19:00**

Thermal effects in eye-safe ring optical parametric oscillator based on KTiOPO4 crystal

A.A. RUnited Statesk, V.I. Dashkevich, G.I. Timofeeva, V.A. Orlovich; Stepanov Inst. of Physics NASB, Belarus

In eye-safe ring optical parametric oscillator (OPO) containing three KTiOPO4 crystals the crystal placed first in the path of pump radiation is subjected to the strongest thermal distortion caused by idler absorption. For the 10-Hz 35-mJ OPO, thermally induced lenses generate an increase in the signal beam divergence by 10% and moderate decrease in the signal energy.

TuR1-p08 **15:00-19:00**

High-energy compact-size diode-pumped Nd:YAG laser with self-pumped phase-conjugate dynamic cavity

G.V. Burkovsky[1], A.S. Boreysho[1], A.V. Fedin[1,2]; 1 - Baltic State Technical Univ., 2 - Laser Systems LTD, Russia

Compact-size, multiloop, self-phase-conjugated Nd:YAG laser pumped by 4D diode stacks was studied. The use of a passive LiF:F2- Q-switch resulted in pulse train oscillation depending on the passive Q-switch position and length of diffractive feedback in the cavity. The laser energy of up to 2.55 J in trains of 13 pulses with 11-ns duration was obtained.

TuR1-p09 **15:00-19:00**

Compact laser schematics for generation of stable subnanosecond pulses with energy up to 1J

M. Inochkin, K. Fedin, L. Khloponin, V. Khramov; ITMO Univ., Russia

Different schematics of compact Nd:YAG laser system capable to generate sub-nanosecond output pulses with energy up to 1J are described. Trade-offs and advantages of different laser schematics are discussed.

TuR1-p10 **15:00-19:00**

Polarisation effects in lasers with intracavity second harmonic generation

N. Belashenkov, M. Inochkin; ITMO Univ., Russia

Influence of different kind of polarization effects on intracavity second harmonic generation of powerful laser radiation is discussed. Theoretical predictions are compared with experimental data.

TuR1-p11 **15:00-19:00**

High beam quality 4.5W Q-switched Nd:YAG laser operating up to 1 kHz

A.S. Davtian, A.F. Kornev, V.P. Pokrovsky, S.S. Sobolev, S.S. Terekhov; ITMO Univ., Russia

The study was to develop high-power stable Nd:YAG master oscillator for MOPA laser system. Output power of 4.5 W was achieved with 30 W of pump power for wide range of Q-switched lasing repetition rate. 15mJ@300Hz lasing of 10 ns pulses was achieved after optimization.

TuR1-p12 **15:00-19:00**

Hollow glass waveguide transmittance for laser radiation at wavelengths 1.06, 1.32 and 1.44 μm

N. Kapitch[1], M. Němec[2], K. Nejezchleb[1], H. Jelinková[2]; 1 - Crytur Ltd., 2 - Czech Technical Univ. Prague, Czech Republic

This study is to present the compact Nd:YAG three-wavelengths laser generating 1.06, 1.32 and 1.44 μm with delivery part presented by the special hollow glass waveguide which inner coating was made from silver layer covered with cyclic olefin polymer. The transmittance of waveguides with inner diameters 700 and 1000 μm at 1.06, 1.32 and 1.44 μm were measured.

TuR1-p13 **15:00-19:00**

The amplification of transform-limited pulses in media with homogeneously broadened line

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

We propose the model of the amplification of the transform-limited pulses in a homogeneously broadened medium. The model provides the information about the output characteristics of an unchirped pulse after passing through an active homogeneously broadened medium and about the population inversion inside the medium at any moment of time.

TuR1-p14 **15:00-19:00**

A parametric amplification unit based on nonlinear borate crystals for multiterawatt femtosecond laser system

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

The calculation of parametric amplification unit based on nonlinear borate crystals for multiterawatt femtosecond laser system has been carried out. A gaussian gain profile with a ~20% dip near the center is proposed to optimize the amplified signal spectral shape. Optimal parameters of the noncollinear type I BBO-based parametric amplifier were established.

TuR1-p15 **15:00-19:00**

Cavity dumping by the second harmonic generation

R.I. Navitskaya, I.V. Stashkevitch; Belarusian State Univ., Belarus

This paper presents a method of cavity dumping by the second harmonic generation. A theoretical model of the process is proposed; the influence of the pump power and cavity losses on the output pulse shape is analyzed.

R1. SOLID-STATE LASERS

TuR1-p16 15:00-19:00

Diode-pumped continuous wave Tm:KLu(WO4)2 and Tm:KY(WO4)2 microchip lasers

O.P. Dernovich[1], S.V. Kurilchik[1,2], N.V. GUnited Stateskova[1], A.S. Yasukevich[1], V.E. Kisel[1], A.A. Pavlyul[3], N.V. Kuleshov[1]; 1 - Belarusian National Technical Univ., Belarus, 2 - Kazan Federal Univ., Russia, 3 - Nikolaev Inst. of Inorganic Chemistry SB RAS, Russia

Laser performance of Tm3+ doped KLu(WO4)2 and KY(WO4)2 crystals was investigated in a microchip cavity configuration with fiber coupled laser diode as a pump source. The highest output power of 1013 mW with 51 % slope efficiency was obtained for Tm:KY(WO4)2 crystal. Using Tm:KLu(WO4)2 crystal output power of 912 mW and slope efficiency of 38 % were achieved.

TuR1-p17 15:00-19:00

The high-energy system of the master oscillator-power amplifier based on the Ho:YAG crystal

N.G. Zakharov, Yu.N. Frolov, S.D. Velikanov, A.V. Muhin, C.V. Vorontsov, A.S. Nadezhin, G.N. Mishjenko, V.A. Garutkin, N.I. Nikolaev; RFNC – VNIIEF, Russia

The numerical modeling and the experimental research of the Ho:YAG system are done, which consists of the master oscillator and three power amplifiers. The doping level influence of the active elements on the laser oscillator work is researched. The conversion efficiency of the pumping reached 10% when the pulse repetition rate was about 100 Hz. The beam propagation-factor is ~ 1.3.

TuR1-p18 15:00-19:00

High power and high repetition rate picosecond Nd:LuVO4 laser

X. Liang, P. Gao; Shanghai Inst. of Optics and Fine Mechanics CAS, China

We developed a high average power and high repetition rate picosecond laser based on crystal of Nd:LuVO4. The Maximum average power of 28 W is obtained at the repetition rate of 58 MHz. With a cavity dumping technique, the pulse energy is scaling up to 40.7 μJ at 300 kHz, and the shortest pulse duration is 4.0ps.

TuR1-p19 15:00-19:00

Two microns Y2O3:Tm ceramics laser upon diode pumping

A.N. Chabushkin[1], P.A. Ryabochkina[1], Yu.L. Kopylov[2], V.V. Balashov[2], K.V. Lupkhin[2]; 1 - Ogarev Mordovia State Univ., 2 - Kotel'nikov Inst. of RadioEngineering and Electronics RAS, Russia

We demonstrate laser experiments of thulium-doped Y2O3 ceramics. The continuous-wave laser have been obtained for Y2O3:Tm ceramics at 1,95 μm and 2,05 μm pumped by a diode laser emitting at 808 nm.

R9. OPTICAL NANOMATERIALS

TuR9-p01 15:00-19:00

Precision UV vacuum spectral reflectivity test system

Y. Jiang, Sh. Xu; Engineering Univ. of CAPF, China

The optical reflectance of the remote sensing instrument must be calibrated in vacuum conditions before being launched. The system to test the reflectivity of less than 280 millimeter diameter optical element in vacuum is constructed and consist of a light source, the Seya-Namioka vacuum visible monochromator, the sample room as the main structural and electronic system components. The monochromator work band is from 160 nm to 780 nm, spectral resolution is 0.5 nm. Dual optical compensation method is used to eliminate the source of time drift, improve the measurement accuracy with phase-locked weak signal amplification method. To ensure the precision detection, the phase-sensitive detector function can be adjustable. The output value is not more than 10 mV before each measurement, so it can be ensured that the stability of the measured radiation spectrum is less than 1 percent. The reflectivity test results show that the wavelength accuracy is 0.1 nm, and the wavelength repeatability is 0.035 nm, it high-precision measurement of optical components under vacuum body can be achieved.

TuR9-p02 15:00-19:00

THz-wave gain in asymmetric graphene-SiC hyperbolic metamaterial

O.N. Kozina[1], L.A. Melnikov[2], A.S. Zotkina[2], I.S. Nefedov[3]; 1 - Kotel'nikov Inst. of RadioEngineering and Electronics RAS, Saratov Branch, Russia, 2 - Gagarin State Technical Univ., Russia, 3 - Aalto Univ., Finland

Investigation of the THz radiation propagation in hyperbolic graphene-semiconductor metamaterial is presented. Anisotropy of the hyperbolic media slab was taken into account. The 4x4 Berreman matrix method was adopted for arbitrary orientation of optical axis according to slab boundary.

TuR9-p03 15:00-19:00

Laser-assisted deposition of the bimetal thin films with pre-difined optical and electrical properties

S. Kutrovskaya[1], A. Antipov[1], S. Arakelian[1], A. Kucherik[1], A. Osipov[1], T. Vartanyan[2], A. Istratov[1], T. Itina[3]; 1 - Stoletov Vladimir State Univ., Russia, 2 - ITMO Univ., Russia, 3 - Hubert Curien Laboratory, France

In this work, we investigated the influence of morphology (particle diameter in the colloid, the distance between the deposited particles, the number of layers etc.) on the optical and electrical properties of the deposited thin film of bimetallic clusters.

TuR9-p04 15:00-19:00

Search of optimal conditions of Nd:Y2O3 nanopowder synthesis by using a powerful fiber ytterbium laser

G.S. Evtushenko[3], V.V. Lisenkov[1], V.V. Osipov[1], V.V. Platonov[1], A.V. Podkin[1], A.V. Spirina[1], E.V. Tikhonov[1], M.V. Trigub[2], K.V. Fedorov[3]; 1 - Inst. of Electrophysics UB RAS, 2 - Zuev Inst. of Atmospheric Optics SB RAS, 3 - National Research Tomsk Polytechnic Univ., Russia

We investigated the evaporation of the 1%Nd:Y2O3 with the help of 600W fiber laser and the synthesis by this method 1%Nd:Y2O3 nanopowder. It is shown that in the first ~200mks substance from the target is removed only by evaporation, but then also begins the spray droplets. These data helped to increase the productivity of this powder and its output with 15g/h to 23g/h and from 9wt.% to 30 wt.%, respectively.

TuR9-p05 15:00-19:00

The influence of the dipole-dipole interaction on the radiative properties of point-like impurity centers in Fabry-Perot microcavity

A.S. Kuraptsev, I.M. Sokolov; Peter the Great St. Petersburg Polytechnic Univ., Russia

We analyze the role of the dipole-dipole interaction between point-like impurity centers inside a Fabry-Perot microcavity on its radiative characteristics. The spontaneous decay dynamics is calculated and cooperative effects are analyzed. The results are compared with the case of absence of the cavity and the difference is discussed.

TuR9-p06 15:00-19:00

Light-matter coupling in nonideal array of coupled microresonators with quantum dots

V.V. Rumyantsev[1,2], S.A. Fedorov[1]; 1 - Galkin Inst. for Physics and Engineering, Ukraine, 2 - Mediterranean Inst. of Fundamental Physics, Italy

A numerical model is developed for a defect-containing lattice of microcavities with embedded ultracold atomic clusters (quantum dots). The dispersion relations for polaritonic modes are derived as functions of defect concentrations and on this basis the band gap, the effective masses of lower and upper dispersion branch polaritons as well as their densities of states are evaluated.

TuR9-p07 15:00-19:00

Temperature dependent optical properties of the titanium nitride broadband perfect absorber

J. Wang, M. Zhu, J. Shao; Shanghai Inst. of Optics and Fine Mechanics CAS, China

The temperature dependence of the absorber based on the titanium nitride and titanium dioxide layer is investigated by finite difference time domain simulation. It is shown the absorption is larger than 0.98 from 550nm to 715nm. The intensity of absorption will reduce and the peak will be blue-shift when the temperature is increased from 18°C to 325°C.

TuR9-p08 15:00-19:00

Matrix photoreceiver based on carbon nanotubes for control laser radiation

E.V. Blagov[2], A.Yu. Gerasimenko[1], A.A. Dudin[2], L.P. Ichkitidze[1], E.P. Kitsyuk[2], A.P. Orlov[2,3], A.A. Pavlov[2], A.A. Polohin[1], Yu.P. Shaman[4]; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Nanotechnology of Microelectronics RAS, 3 - Kotel'nikov Inst. of Radio-engineering and Electronics RAS, 4 - Scientific-Manufacturing Complex «Technological Centre", Russia

This work is aimed at the development of the new matrix photoreceiver. Photoreciever is a matrix of 16 sensitive elements and each has 10000 sensitive cells with synthesized carbon nanotubes. The parameters of matrix photoreceiver based on carbon nanotubes, such as working wavelength range, performance and sensibility were studied.

TuR9-p09 15:00-19:00

IR and Raman spectroscopy of biocomposite with carbone nanotubes

A.A. Polohin[1], L.P. Ichkitidze[1], A.A. Pavlov[2], Yu.P. Shaman[3], A.Yu. Gerasimenko[1]; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Nanotechnology of Microelectronics RAS, 3 - Scientific-Manufacturing Complex «Technological Centre"/ Laboratory of perspective processes, Russia

This work is aimed at spectral research of composite based on singlewall carbon nanotubes in matrix of bovine serum albumin (biocomposites). Biocomposites

are received by laser sintering. Interpritation of oscillation IR spectrums of absorbing and Raman dispertion of biocomposites allowed to determine the affection of carbon nanotubes concentration on the degree of its attachment with bovine serum albumin.

TuR9-p10 **15:00-19:00**

The copper nanostructures produced by in situ laser synthesis reveal catalytic activity

D.I. Gordeychuk[1], M.S. Panov[1], I.I. Tumkin[1], A.G. Kuzmin[2], V.A. Kochemirovsky[1], I.A. Balova[1]; 1 - St. Petersburg State Univ., 2 - Inst. for Analytical Instrumentation RAS, Russia

The laser-induced metal deposition technique attracts a great interest not only due to its application in microelectronics and manufacturing of electrochemical sensors but also due to its possible implementation for in situ laser synthesis of nanostructured metal catalysts directly in the reaction mixture. The synthesized nano-sized metal structures may take part in organic catalysis using solvent as a reaction medium.

TuR9-p11 **15:00-19:00**

The nanostructured membrane investigation by optical methods

A.A. Mikhaylina[1,2], A.V. Prikhodko[2], O.I. Konkov[2,3], N.N. Rozhkova[1]; 1 - Inst. of Geology Karelian Research Centre RAS, 2 - Peter the Great St. Petersburg Polytechnic Univ., 3 - Ioffe Inst., Russia

The known technology for producing fullerene membrane was applied to the natural carbon material. The basic structural elements of shungite carbon have been identified in the prepared nanostructured sample by optical methods.

TuR9-p12 **15:00-19:00**

The electric-dipole transitions in an emitter

K.K. Pukhov; General Physics Inst. RAS, Russia

Here we present the theoretical study of the electric-dipole emission rate modification of the luminescence centers inside and outside of the subwavelength core-shell nanoparticles.

TuR9-p13 **15:00-19:00**

Quantum dots luminescence in the photonic cristal fibers modified with polymer layers

S.A. Pidenko[1], S.D. Bondarenko[1], A.A. Chibrova[2,3], A.A. Shuvalov[2,4], N.A. Burmistrova[1], Y.S. Skibina[2], I.Y. Goryacheva[1,5]; 1 - Saratov National Research State Univ., 2 - SPC Nanostructured Glass Technology Ltd, 3,4 - Saratov National Research State Univ., 5 - St.Petersburg State Univ., Russia

The luminescence of the quantum dots of different colors glow in the samples of photonic crystal fibers modified with self-organizing layers of polyaniline was studied.

TuR9-p14 **15:00-19:00**

NO2 gas sensor based on Au-tZnPc-OH Langmuir-Blodgett thin film

D.M. Krichevsky[1], A.V. Zasedatelev[1,3], A.Yu. Tolbin[4], T.V. Dubinina[2,4], V.I. Krasovskii[1,3], A.B. Karpo[3]; 1 - National Research Nuclear Univ. «MEPhI», 2 - Lomonosov Moscow State Univ., 3 - Prokhorov General Physics Inst. RAS, 4 - Inst. of Physiologically Active Compounds RAS, Russia

As a result of increased toxic gas production in chemical industry and its influence on human health an effective detection of CO2, NO, NO2, NH3, and other gases becomes a crucial task in environmental safety. The most spread gas sensors are based on chemiresistive oxide thin films, however they have some drawbacks, such as low selectivity and high power consumption. In contrast, optical sensors are potentially more selective and have fast response time. Optical gas sensors based on organic thin films can operate at room temperatures without external thermal stabilization. Among promising starting compounds for NO2 gas detection phthalocyanines (Pc) have found good application due to their thermal and chemical stability, as well as low production costs.

TuR9-p15 **15:00-19:00**

Eu3+-doped transparent lead fluoroborate glass-ceramics

T.S. Sevostjanova, E.V. Zhukova, A.V. Khomyakov, O.B. Petrova; Mendeleev Univ. of Chemical Technology, Russia

Lead fluoroborate glasses doped with Eu3+ were synthesized. Glass-ceramics were made by heat-treatment. In a glass-ceramic the rare-earth ions were located in fluoride crystal nanoparticles distributed in a borate glass. The changes in structural, mechanical and optical properties of the glass-ceramics were revealed in comparison with the initial glasses. Structural, optical and spectral properties of Pb1-xEuxF2+x polycrystalline were investigated.

TuR9-p16 **15:00-19:00**

Yb3+-doped glasses and glass ceramics based on Bi2O3 and GeO2 in different proportions

I.V. Stepanova, A.V. Khomyakov; Mendeleev Univ. of Chemical Technology, Russia

The glass ceramics was produced by heat-treatment of xBi2O3-yGeO2 glasses doped with Yb3+. Both glasses and glass ceramics were researched by X-ray diffraction analysis, optical and luminescence spectroscopy methods. The glass ceramics contains Bi2GeO5 or Bi2GeO5+Bi4Ge3O12 phases according to initial oxides ratio. It's shown that spectral properties depend on only Yb3+ ions concentration and do not affected by glass matrix.

TuR9-p17 **15:00-19:00**

Synthesis condition influence on stability of metal-organic phosphor based on 8-hydroxyquinoline

A.A. Akkuzina, A.V. Khomyakov, R.I. Avetisov, I.Ch. Avetissov; Mendeleev Univ. of Chemical Technology, Russia

Tris(8-hydroxyquinoline) aluminum (Alq3) powders were synthesized under controlled 8-Hq partial pressure. It was shown that the P8-Hq increase resulted to changes in the photoluminescence characteristics and the life-time of the Alq3 phosphor.

TuR9-p18 **15:00-19:00**

Synthesis and study of efficient up-conversion luminophores based M1-x-yYbxEryF2+x+y (M = Ca, Ba) for biomedical applications

M.N. Mayakova[1], E.O. Solovyeva[2], R.G. Vahrenev[3], S.V. Kuznetsov[1], D.V. Pominova[1], A.V. Ryabova[1], V.V. Voronov[1], P.P. Fedorov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Mendeleev Univ. of Chemical Technology, 3 - Lomonosov Moscow State Univ., Russia

Study of phase composition, morphology and up-conversion luminescence of ytterbium- and erbium-doped barium and calcium fluoride nanopowders has revealed the influence of their synthetic conditions on their up-conversion luminescence energy yields.

TuR9-p19 **15:00-19:00**

New type of nanocomposite material for SERS

N.V. Mitetelo, A.I. Maydykovskiy, S.E. Svyakhovskiy, A.A. Tepanov, A.D. Gartman, T.V. Murzina; Lomonosov Moscow State Univ., Russia

We experimentally observe effects of second harmonic generation, nonlinear absorbtion in porous quartz with metallic nanoparticles in order to find a possibility to make a new device for SERS-experiments.

TuR9-p20 **15:00-19:00**

The obtaining and deposition of silicon nanoparticles: size control, luminescence in visible spectra

A. Osipov[1], A. Kucherik[1], S. Kutrovskaya[1], A. Evlyukhin[2], B. Chichkov[2]; 1 - Stoletov Vladimir State Univ., Russia, 2 - Laser Zentrum Hannover e.V., Germany

In this work we have used a CW-laser ablation for nanoparticle synthesis. Laser ablation allow to control particle sizes according to the irradiation parameters. For the particle deposition we have used the nanosecond laser. This method of deposition allows to sedimintate the silicon clusters very precisely.

TuR9-p21 **15:00-19:00**

Optical properties of cyanine dyes in the nanoporous chrysotile asbestos

A.A. Starovoytov[1], V.I. Belotitskii[2], Yu.A. Kumzerov[2], A.A. Sysoeva[2]; 1 - ITMO Univ., 2 - Ioffe Inst., Russia

The optical properties of the cyanine dye in nanotubes of the chrysotile asbestos are studied. The fluorescence decay lifetime of dye in asbestos is longer that in films, due to hindrance of stereoisomerization in the excited state. Observed linear dichroism and fluorescence anisotropy indicate that embedded dye molecules are well-isolated monomer oriented predominantly along asbestos nanotubes.

TuR9-p22 **15:00-19:00**

Novel transparent glass-ceramics based on Co:Li(Al,Ga)5O8 nanocrystals for passive Q-switching of Er lasers

O.S. Dymshits[1], A.A. Zhilin[1], I.P. Alekseeva, M.Ya. Tsenter[1], A.M. Malyarevich[2], K.V. Yumashev[2], V.V. Vitkin[3], P.A. Loiko[2], N.A. Skoptsov[2], K.V. Bogdanov[3], I.V. Glazunov[2]; 1 - NITIOM Vavilov State Optical Inst., Russia, 2 - Belarusian National Technical Univ., Belarus, 3 - ITMO Univ., Russia

Transparent glass-ceramics of the lithium gallium aluminosilicate system based on cobalt-doped Li(Al,Ga)5O8 spinel nanosized crystals were developed. Their structure and optical properties were evaluated. Passive Q-switching of an Er, Yb:glass laser with 1 mJ/45 ns pulses at ~1.54 μm is realized.

TuR9-p23 **15:00-19:00**

Photodesorbtion of Rb atoms from glass and sapphire surfaces

P.A. Petrov[1], A.S. Pazgalev[2], T.A. Vartanyan[1]; 1 - ITMO Univ., 2 - Ioffe Inst., Russia

We presents results of ours researches and calculations of dependence between kinetic energy of desorbed atoms and desorb pulse wavelength.

TuR9-p24 **15:00-19:00**

Glass-ceramics with Yb,Tm:YNbO4 nanocrystals: novel NIR-to-NIR upconversion phosphor

E.V. Vilejshikova[1], P.A. Loiko[1], O.S. Dymshits[2], A.A. Zhilin[2], I.P. Alekseeva[2], M.Ya. Tsenter[2], K.V. Yumashev[1]; 1 - Belarusian National Technical Univ., Belarus, 2 - NITIOM Vavilov State Optical Inst., Russia

Transparent lithium alumosilicate glass-ceramics containing nanosized (8-15 nm) crystals of rare-earth orthoniobates, Yb,Tm:YNbO4, and β-quartz solid solutions are synthesized. Under the near-IR excitation by an InGaAs diode, they demonstrate intense near-IR upconversion luminescence at ~800 nm. The efficiency of Yb3+ → Tm3+ energy transfer is ~90%.

R1. SOLID-STATE LASERS

Location: Stenberg Room, floor 3, 09:00 – 11:00

Solid-State Lasers III

Session Chair: Uwe Griebner, Max-Born-Inst., Germany

WeR1-14 Invited **09:00-09:30**

Octave spanning pulses based on adiabatic frequency conversion

H. Suchowski; Tel Aviv Univ., Israel

Adiabatic frequency conversion, a recent advance in frequency conversion allowed the achievement of efficient scalable and robust broadband frequency conversion. In recent years, it was successfully applied to the conversion of ultrashort pulses, demonstrating near-100% efficiency for ultrabroadband spectrum. Also, it offers spectral pulse shaping for coherent control experiments. Here we review the development and recent advances in the field.

WeR1-15 **09:30-09:45**

Novel approach table-top Vis-NIR OPCPA system

R. Danilevičius[1,2], A. Zaukevičius[1,2], A. Michailovas[1,2], N. Rusteika[1]; 1 - Ekspla Ltd., 2 - Center for Physical Sciences and Technology, Lithuania

In this work we developed femtosecond tunable wavelength OPCPA system with a novel front-end. Picosecond all-in-fiber source is used for seeding DPSS pump laser and parametrical amplifier based white light supercontinuum generator. We measured up to 0.85 mJ and less than 40 fs pulses at the system output performing the wavelength tuning from 680 nm to 930 nm.

WeR1-16 **09:45-10:00**

Diode-pumped solid state Nd:KGW laser for eye-safe optical parametrical oscillator

M.V. Bogdanovich, A.V. Grigor'ev, K.I. Lantsov, K.V. Lepchenkov, A.G. Ryabstev, G.I. Ryabtsev, M.A. Shchemelev, U.S. Tsitavets; Stepanov Inst. of Physics NASB, Belarus

Compact eye-safe pulsed optical parametrical oscillator based on Nd:KGW laser with two orthogonal diode pump modules has been developed. The oscillator is characterized by output energy at 1.57 um in excess of 30 mJ and the pulse repetition rate up to 20 Hz.

WeR1-17 **10:00-10:15**

Front-end system for few circle OPCPA amplification

I.B. Mukhin, I.I. Kuznetsov, E.A. Perevezentsev, O.V. Palashov; Inst. of Applied Physics RAS, Russia

A front-end laser system with optical synchronization is developed for OPCPA amplification. A pulse duration in femtosecond part is less than 35 fs and this signal may be compressed to few circle duration. The signal in pump part is amplified to 0.1 mJ for further developing of high energy pump laser based on Yb:YAG disks.

WeR1-18 **10:15-10:30**

High power picosecond Nd:YVO4 laser with 671, 447 and 224 nm output at 300 kHz repetition rate

A.M. Rodin[1,2], A. Michailovas[1,2], G. Chazevskis[2]; 1 - Center for Physical Sciences and Technology, 2 - UAB Ekspla, Lithuania

Fundamental output radiation from the NIR high power ps Nd:YVO4 laser was converted to the 2nd, 3rd and 6th harmonics at 671, 447 and 224 nm wavelength with the average power in excess of 6 W, 5 W and 0.7 W respectively.

WeR1-19 **10:30-10:45**

Spatiotemporal distortions in noncollinear optical parametric chirped-pulse amplifiers

A. Giree[1,2], F.J. Furch[1], M. Mero[1], M.J.J. Vrakking[1]; 1 - Max Born Inst., Germany, 2 - Amplitude Technologies, France

We perform numerical simulations to study spatiotemporal distortions in noncollinear optical parametric chirped-pulse amplifiers under different amplification conditions and show that pulse front tilt is always present.

WeR1-20 **10:45-11:00**

Compact 1 mJ high repetition rate eye-safe OPO laser

V. V. Vitkin, A.V. Polishchuk, A.A. Krylov, V.M. Polyakov; ITMO Univ., Russia

A compact high repetition rate eye-safe laser for atmosphere lidar was developed. The device is Nd:YAG laser with KTP OPO, wavelength is 1.57 um, Q-switched pulse energy is 1.1 mJ and pulse duration is 10 ns. The laser rod and laser diodes are conductive cooled. The 100 Hz operation with good beam quality is demonstrated.

- Coffee Break -

Location: Stenberg Room, floor 3, 11:30 – 13:30

Solid-State Lasers IV

Session Chair: Uwe Morgner, Inst. für Quantenoptik Leibnitz Univ., Germany

WeR1-21 Invited **11:30-12:00**

Subharmonic GaAs OPO pumped by a Cr:ZnS laser with an instantaneous bandwidth 3.6-5.6 μm

V.O. Smolski[1,2], S. Vasilyev[2], P.G. Schunemann[3], S.B. Mirov[2,4], K.L. Vodopyanov[1]; 1 - Univ. Cent. Florida, 2 - IPG Photonics, Mid-IR Lasers, 3 - BAE Systems, 4 - Univ. Alabama Birmingham, United States

High-power (110 mW) mid-IR output suitable for producing ultra-broadband frequency combs in the mid-infrared portion of the spectrum was produced in a subharmonic optical parametric oscillator (OPO) based on orientation patterned GaAs. The OPO was synchronously pumped by a compact 0.5-W femtosecond Cr:ZnS oscillator with the central wavelength 2.38 μm at pulse repetition frequency 175 MHz.

WeR1-22 **12:00-12:15**

Optimization of 37-W Q-switched Ho:YAG laser at 2100 nm pumped by Tm-fiber laser

O.L. Antipov[1,2], I.D. Eranov[1,2], R.I. Kositsyn[1], A.A. Novikov[1], V.V. Sharkov[2]; 1 - Inst. of Applied Physics RAS, 2 - Lobachevsky State Univ. of Nizhniy Novgorod, Russia

High efficient CW and Q-switched oscillations at 2097 nm were achieved in Ho:YAG laser pumped by a Tm fiber laser. Stable repetitively-pulsed oscillations (with the repetition rate of 10-30 kHz and the pulse duration of 26-50 ns) in a high-quality beam with the average power up to 37.5 W and total efficiency of 67.5% were obtained.

WeR1-23 **12:15-12:30**

Comparison of Tm:YLF laser with and without composites in thermal stress and laser performance

P.B. Meng[1], F.J. Yan[1], B.Q. Yao[2]; 1 - Beijing Inst. of Space Mechanics & Electricity, 2 - Harbin Inst. of Technology, China

Compared with non-composite Tm:YLF laser theoretically and experimentally, diode-pumped composite Tm:YLF laser's peak stress and output power was decreased and increased about 86% and 42.3%, respectively, generating 37 W at 42.4% slope-efficiency and M^2<2.

WeR1-24 Invited **12:30-13:00**

High-power femtosecond Kerr-lens mode-locked thin-disk oscillators

O. Pronin; Max-Planck Inst. of Quantum Optics, LMU Munich, Germany

Recent progress in the development of femtosecond thin-disk oscillators is reported. A novel mode-locking technique relying on distributed Kerr-lenses is presented. Applications such as the generation of high-power mid-infrared and extreme ultraviolet frequency combs are addressed.

WeR1-25 **13:00-13:15**

Laser action of pulsed Nd-YAG laser with multiloop cavity and laser pulse injection diffusely reflected from plasma mirror

V.F. Lebedev; ITMO Univ., Russia

Self-Q-switch and self-Q-switched mode lock regimes with multiloop phase-conjugate cavity were obtained. It was shown that these regimes are caused by diffusely reflected laser pulse from laser plasma that produced via interaction of the focused laser beam with solid target.

R2. HIGH POWER LASERS

Location: Petrov-Vodkin 1 Room, floor 2, 11:30 – 13:30

High Power Lasers I

Session Chair: Andrey A. Ionin, Lebedev Physical Inst. of RAS, Russia

WeR2-01 Invited **11:30-12:00**

Optically pumped rare gas lasers

M.C. Heaven; Emory Univ., United States

We have demonstrated gain and lasing for optically pumped Ne*, Ar*, Kr* and Xe*. Three-level lasing schemes were used, with He as the collisional energy transfer agent that established the population inversion. These laser systems have the advantage using inert reagents that are gases at room temperature, with excellent potential for closed-cycle operation.

WeR2-02 Invited **12:00-12:30**

High power lasers application for the substances rheological properties research

V. Rogachev; RFNC – VNIIEF, Russia

Experimental setup and results of laser experiments on researching rheological properties of various substances are discussed.

WeR2-03 Invited **12:30-13:00**

High power femtosecond laser systems for industrial and biomedical applications

G.H. Kim[1], J. Yang[1], B. Lee[1], B. Jeong[1], S.A. Chizov[1], E.G. Sall[1], V.E. Yashin[2]; 1 - Korea Electrotechnology Research Inst., Republic of Korea, 2 - Vavilov State Optical Inst., Russia

We presented that a high power femtosecond laser system was developed and applied for industrial applications. The system is based on a MOPA structure of master oscillator and dual-crystal regenerative amplifier in the configuration of chirped pulse amplification. It is capable to operate with average power of 15W at the repetition rate of 1MHz and pulse length of 250fs. Details of laser system will be presented and its industrial application, for example, making a very small hole on a diamond will be discussed.

WeR2-04 Invited **13:00-13:30**

«White light» mid-infrared gas laser systems

A.A. Kotkov, O.V. Budilova, A.A. Ionin, I.O. Kinyaevskiy, Yu.M. Klimachev, A.Yu. Kozlov; Lebedev Physical Inst. RAS, Russia

Mid-infrared laser systems consisting of CO and CO2 lasers with frequency conversion of laser radiation in nonlinear crystals were developed. The laser systems can operate within wavelength range from 2.5 to 16.6 microns, which by analogy with the visible range can be called «white light» in the mid-IR range.

- Lunch Break -

Location: Hall Petrov-Vodkin 1 Room, floor 2, 15:00 – 17:00

High Power Lasers II

Session Chair: Oleg B. Danilov, Vavilov State Optical Inst., Russia

WeR2-05 Invited **15:00-15:30**

High power laser system of a visible range with output XeF(C-A) amplifire

V.F. Losev[1,2], S.V. Alekseev[1], N.G. Ivanov[1], M.V. Ivanov[1], G.A. Mesyats[3], L.D. Mikheev[3], Yu.N. Panchenko[1], N.A. Ratakhin[1,2], A.G. Yastremskii[1]; 1 - Inst. of High Current Electronics SB RAS, 2 - Tomsk Polytechnic Univ., 3 - Lebedev Physics Inst. RAS, Russia

THL-100 hybrid femtosecond laser system operating in the visible spectral range and the experimental results obtained by now are presented.

WeR2-06 Invited **15:30-16:00**

Characterization of Tb- and Yb- doped media, produced in Russia

O.V. Palashov; Inst. of Applied Physics RAS, Russia

It is not objective of report to enumerate all known media and all domestic manufacturers of Tb- and Yb-doped media. Objective of report is to draw attention to the progress made in the development of such materials in Russia and to share results (TSAG, Tb2O3, NTF, ...) obtained by our team over the past couple of years.

WeR2-07 Invited **16:00-16:30**

Modern compensation methods of thermally induced optical distortions

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

The report presents an overview of compensation methods of thermally induced depolarization and thermal lens in optical elements of high-average power lasers. An analytical description of the compensation process is presented and the question about the possibility of a complete compensation of optical distortion is considered. Using the suggested methods has allowed realizing optical components for lasers with high average power with record characteristics.

WeR2-08 Invited **16:30-17:00**

New generation of ultra-high peak and average power laser systems with thin disk Ti:sapphire amplifiers

V. Chvykov[1], H. Cao[1], R.S. Nagymihaly[1], M. Kalashnikov[1,2], K. Osvay[1]; 1 - ELI-Hu Nkft., Hungary, 2 - Max.Born-Inst., Germany

New technology utilized the combination Extraction During Pumping (EDP) method and thin disc amplifiers (EDP-TD) applied to PW-level Ti:Sapphier laser systems for increasing of the repetition rate will be presented. Proof–of-principal experiment results, when EDP-TD final amplifier was inserted in to 100TW/10Hz laser system will be discussed.

- Coffee Break -

Location: Petrov-Vodkin 1 Room, floor 2, 17:30 – 18:45

High Power Lasers III

Session Chair: Vladimir E. Yashin, Vavilov State Optical Inst., Russia

WeR2-09 **17:30-17:45**

2kW single-end hybrid diode-pumped all-fiber integrated laser oscillator

B. Yang, H. Zhang, X. Wang, R. Su, P. Zhou, X. Xu, Q. Lu; National Univ. of Defense Technology, China

We report an all-fiber integrated laser oscillator with a maximum output of 2kW operating at 1080nm. The laser oscillator is single-end pumped by 976nm and 915nm laser diodes. It can overcome the relatively lower mode instability threshold while maintaining the relatively higher stimulated Raman scattering threshold. The influence of the pump power ratio on the maximum output power is also investigated.

WeR2-10 **17:45-18:00**

High efficiency volume Bragg gratings for 2-micron laser systems

V.I. Smirnov, O. Mokhun, L. Glebova, O. Mokhun, R. Vasilyeu, A.L. Glebov, L.B. Glebov; OptiGrate Corp, United States

Volume Bragg Gratings (VBGs) in photo-thermo-refractive glass have outstanding properties in 2-micron spectral region providing extremely high spectral and angular selectivity, diffraction efficiency up to 99.99%. This paper reviews recent VBG technology developments as well as various results on VBG applications that can lead to major improvements of fiber, solid-state, and diode laser system performance in 2-micron spectral range.

WeR2-11 **18:00-18:15**

High average power diode pumped solid state laser

Y. Gao, Y. Wang, A. Chan, M. Dawson, B. Greene; EOS Space Systems Pty Ltd, Australia

A completely diode pumped high energy system capable of generating pulse energy 4.7J, beam quality M2~3, pulse width 10–20ns, repetition rate 100–200Hz has been developed. It is a fully automated multi-stage system consisting a pulsed single frequency oscillator, pre-amplifiers, power-amplifiers, and SBS cell. The system has been in service for almost 2 years with excellent performance and reliability.

WeR2-12 **18:15-18:30**

Impact of water vapor concentration on O2(a) yield in optically pumped oxygen-iodine laser

M.S. Malyshev[1], M.V. Zagidullin[1,2]; 1 - Samara State Aerospace Univ., 2 - Lebedev Physical Inst., Samara branch, Russia

A parametric study of the earlier proposed new optically-pumped oxygen-iodine laser (OPOIL) was conducted. A water vapor relative concentration was varied. It was found that higher relative water vapor concentrations have a significant impact on system operation, hindering iodine dissociation process. Optimal relative H2O concentration estimate is 10-3.

WeR2-13 **18:30-18:45**

Ab initio calculations of transition dipole moments of (O2)2 complex

A.A. Pershin[1,2], A.M. Mebel[3], M.V. Zagidullin[1,2], A.S. Insapov[1], V.N. Azyazov[1,2]; 1 - Samara State Aerospace Univ., Russia, 2 - Lebedev Physical Inst. RAS, Russia, 3 - Florida International Univ., United States

Theoretical studies of collision induced emission of singlet oxygen molecules in the visible range have been performed. The experimental results were rationalized in terms of ab initio calculations of the ground and excited potential energy and transition dipole moment surfaces of singlet electronic states of the (O2)2 dimole, which were utilized to compute rate constants.

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

Location: Deyneka Room, floor 2, 09:00 – 11:00

Novel devices and emerging applications I

Session Chair: Ksenia Fedorova, Aston Univ., United Kingdom

WeR3-22 Invited **09:00-09:30**

Brillouin and Raman scattering in silicon and silicon nitride photonic integrated circuits

R. Baets; Ghent Univ., Belgium

Silicon photonics has gained considerable momentum as a platform for the on-chip integration of advanced photonic functions on the basis of CMOS-technology, especially in the fields of telecom and datacom. Here we report on the use of this platform for photon-phonon interaction in nanophotonic silicon or silicon nitride waveguides. We discuss the first demonstration of Brillouin gain in silicon waveguides as well as Raman spectroscopy taking advantage of silicon nitride photonic circuits.

WeR3-23 **09:30-09:45**

AFM visualization of half-disk WGM laser modes

P.A. Alekseev[1], M.S. Dunaevskiy[1,2], A.M. Monakhov[1], V.V. Dudelev[1], G.S. Sokolovskii[1,3], A. Baranov[4], R. Teissier[4]; 1 - Ioffe Inst., Russia, 2 - ITMO Univ., Russia, 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia, 4 - Inst. d'Electronique du Sud, France

By means of atomic force microscopy (AFM) the spatial mapping of the laser intensity was performed on the cleavage of the whispering gallery modes (WGM) half-disk laser. The study was carried out in the near- and far-field regime. It showed a strong spatial divergence of different modes in the laser.

WeR3-24 Invited **09:45-10:15**

Compact external cavity laser with photonic crystal cavity reflector

L. O'Faolain[1,3], A.A. Liles[1], A.P. Bakoz[2,3], A.A. Gonzalez-Fernandez[1], S.P. Hegarty[2,3]; 1 - Univ. St. Andrews, United Kingdom, 2 - Tyndall National Inst., Ireland, 3 - Cork Inst. of Technology, Ireland

Energy efficient Wavelength Division Multiplexing (WDM) is the key to satisfying the future bandwidth requirements of datacentres. As the silicon photonics platform is regarded the only technology able to meet the required power and cost efficiency levels, the development of silicon photonics compatible narrow linewidth lasers is now crucial. We discuss the requirements for such laser systems and report the experimental demonstration of an external-cavity hybrid lasers consisting of a III-V Semiconductor Optical Amplifier and Photonic Crystal (PhC) based resonant reflector.

WeR3-25 **10:15-10:30**

Photonic crystal reflector laser

A.P. Bakoz[1,2], A.A. Liles[3], E.A. Viktorov[4,5], L.O. Faolain[3], G. Huyet[1,2,4], S.P. Hegarty[1,2]; 1 - Cork Inst. of Technology, Ireland, 2 - Tyndall National Inst., Ireland, 3 - Univ. St Andrews, United Kingdom, 4 - ITMO Univ., Russia, 5 - Univ. Libre de Bruxelles, Belgium

We describe the lasing characteristics of a semiconductor laser device, utilising a reflective semiconductor amplifier as a combined gain/mirror component, and a high Q photonic crystal reflective filter as the second cavity mirror.

WeR3-26 Invited **10:30-11:00**

Photonic crystal surface emitting lasers – coherent arrays and external feedback

R.J.E. Taylor[1], G. Li[2], P. Ivanov[2], D.T.D. Childs[2], B.J. Stevens[3], N. Babazadeh[2], O. Ignatova[2], Y. Nakano[1], T. Tanemura[1], R.A. Hogg[2]; 1 - Univ. of Tokyo, Japan, 2 - Univ. of Glasgow, United Kingdom, 3 - Univ. of Sheffield, United Kingdom

Electronic control of coherence in 2D arrays of photonic crystal surface emitting lasers is discussed.

- Coffee Break -

Location: Deyneka Room, floor 2, 11:30 – 13:30

Novel devices and emerging applications II

Session Chair: Richard Hogg, Univ. of Glasgow, United Kingdom

WeR3-27 Invited **11:30-12:00**

Light sheet microscopy for visualising fast biological dynamics in 3D

O.E. Olarte, J. Andilla, J. Licea-Rodriguez, D. Artigas, P. Loza-Alvarez; ICFO-Inst. de Ciencies Fotoniques, The Barcelona Inst. of Science and Technology, Spain

High resolution and fast dynamic visualization in 3D can be achieved by combining light sheet and wavefront coding. This results in a system that allows the light sheet to be positioned at different distances from the focus plane. By scanning the light sheet through the sample, it is possible to produce high-resolution volumetric images of living samples at unprecedented speeds.

WeR3-28 Invited **12:00-12:30**

The use of angular momentum of light for characterization of biological tissues

A. Bykov[1], A. Popov[1], A. Doronin[2], I. Meglinski[1]; 1 - Univ. of Oulu, Finland, 2 - Yale Univ., United States

We investigate the applicability of use of Laguerre-Gaussian laser beams for optical biopsy. In current presentation a Monte Carlo based numerical simulation of complex vector light beams propagating that undergoing anisotropic scattering in turbid tissue-like scattering media will be presented in comparison with the plane wave light beams. Several basic phenomena associated with the anisotropic scattering of the vector light beams in turbid media are discussed, including the mutual influence of light's polarization and its directional awareness during the multiply scattering.

WeR3-29 **12:30-12:45**

Development of a US laser system for the gravitational wave mission LISA

J. Camp, K. Numata; NASA Goddard Space Flight Center, United States

A highly stable and robust laser system is a key component of the space-based, Gravitational Wave mission LISA architecture. In this talk I will describe our plans to demonstrate a TRL 5 LISA laser system at Goddard Space Flight Center by 2017. The laser system includes a low-noise oscillator followed by a power amplifier. The oscillator is a low-mass, compact 10 mW External Cavity Laser, consisting of a semiconductor laser coupled to an optical cavity, built by the laser vendor Redfern Integrated Optics. The amplifier is a diode-pumped Yb fiber with 2.5 W output, built at Goddard. I will show noise and reliability data for the full laser system, and describe our plans to reach TRL 5 by 2017.

WeR3-30 **12:45-13:00**

Conical refraction with low-coherent light sources

G.S. Sokolovskii[1], V.Yu. Mylnikov[2], S.N. Losev[1,2], K.A. Fedorova[3], E.U. Rafailov[3]; 1 - Ioffe Inst., Russia, 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia, 3 - Aston Univ., United Kingdom

We report on conical refraction (CR) experiments with low-coherent light sources such as light-emitting diodes (LEDs) that demonstrated different CR patterns. Variation of the pinhole size from 25 to 100 μm reduced the spatial coherence of the LED radiation and resulted in disappearance of the dark Poggendorf ring. This is attributed to the interference nature of the Lloyd's distribution.

WeR3-31 Invited **13:00-13:30**

All semiconductor akinetic swept source for optical coherence tomogpraphy

Z. Chen[1], M. Bonesi[1], H. Sattmann[1], L. Ginner[1], R. Leitgeb[1], E. Hoover[2], K. Nammari[2], M. Crawford[2], J. Ensher[2], M. Minneman[2], W. Drexler[1]; 1 - Medical Univ. Vienna, Austria, 2 - Insight Photonic Solutions, Inc., United States

All-semiconductor, all-electronic tunable, akinetic (without any form of movement in the tuning mechanism) compact and cost-effective swept source laser technology is used for demonstrating OCT and OCT angiography at 1550nm and 1300 nm with unprecedented imaging performance.

- Lunch Break -

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

Location: Deyneka Room, floor 2, 15:00 – 16:45

Novel devices and emerging applications III

Session Chair: William Whelan-Curtin, Univ. of St.Andrews, United Kingdom

WeR3-32 Invited **15:00-15:30**

Interband Cascade Lasers for sensing

S. Höfling[1,2], R. Weih[1], M. Kamp[1]; 1 - Univ. Würzburg, Germany, 2 - Univ. of St Andrews, United Kingdom

The Interband Cascade Laser (ICL) combines the interband transition as in a conventional diode laser with the cascading scheme of a Quantum Cascade Laser. ICLs allow for an external quantum efficiency greater than which is enabled because of the special band alignment of GaInSb/AlAs/InAs-interfaces that separates hole and electron injector and internally feed each cascade with carriers. This makes ICLs a unique with great design flexibility. By changing the InAs layer thickness of the typically used W-shaped quantum well (W-QW) the emission wavelength can be tuned within the entire mid infrared region which is known as the fingerprint region of a variety of industrially relevant molecules. We present our prgress achieved inthe field of ICL device research.

WeR3-33 **15:30-15:45**

Broadly tunable dual-wavelength InAs/GaAs quantum-dot laser for THz generation

K.A. Fedorova[1,2], A.A. Gorodetsky[1,3], D.A. Livshits[4], N.A. Maleev[2], S.A. Blokhin[2], K.K. Soboleva[5], V.M. Ustinov[6], E.U. Rafailov[1]; 1 - Aston Univ., United Kingdom, 2 - Ioffe Inst., Russia, 3 - ITMO Univ., Russia, 4 - Innolume GmbH, Germany, 5 - Peter the Great St. Petersburg Polytechnic Univ., Russia, 6 - Submicron Heterostructures for Microelectronics, Research Engineering Center RAS, Russia

We demonstrate an ultra-compact, room-temperature, continuous-wave, broadly-tunable dual-wavelength InAs/GaAs quantum-dot external-cavity diode laser in the spectral region between 1150nm and 1301nm with maximum output power of 280mW. This laser source generating two modes with tunable difference-frequency (300GHz-30THz) has a great potential to replace commonly used bulky lasers for THz generation in photomixer devices.

WeR3-34 Invited **15:45-16:15**

Generation of intense sub-100 fs pulses from Yb-doped solid-state lasers based on nanostructured semiconductor saturable absorbers

A. Major; Univ. of Manitoba, Canada

Results on dual action of semiconductor saturable absorber and Kerr-lens mode locking of Yb-ion doped solid-state lasers will be reported. Using both quantum-dot and quantum-well nanostructured semiconductor saturable absorbers, the developed approach enabled demonstration of record high performance of Yb:KGW and Yb:CALGO lasers among other Yb-ion materials in sub-100-fs regime with peak powers ranging from >100 kW to >1 MW.

WeR3-35 **16:15-16:30**

Generation of THz radiation in epitaxial InGaAs films on InP substates of various crystallographic orientations

G.B. Galiev[1], G.H. Kitaeva[2], E.A. Klimov[1], V.V. Kornienko[2], K.A. Kuznetsov[2], A.N. Klochkov[1], S.S. Pushkarev[1]; 1 - Inst. of Ultrahigh Frequency Semiconductor Electronics RAS, 2 - Moscow State Univ., Russia

We study the THz wave generation by the time-domain spectroscopy method in low-temperature grown InGaAs layers on InP substrates with crystallographic orientations (100) and (411) It was found that the THz wave generation is 3-5 times more effective in the case of (411)A InP substrates as compared to the (100) substrates. In samples grown at high pressure of As4 generation of THz waves is more effective at low-frequency range less than 200 GHz.

WeR3-36 **16:30-16:45**

Wavelength-swept laser based on semiconductor optical amplifier for dynamic optical fiber sensors

M. Yong Jeon, J. Woo Park, M. Ock Ko; Chungnam National Univ., Republic of Korea

We report two kinds of wavelength-swept lasers based on semiconductor optical amplifier for dynamic optical fiber sensors. The wavelength-swept laser has a linear relationship that exists between wavelength and time. As an application using the wavelength-swept laser for dynamic optical fiber sensors, we measure a dynamic modulation frequency of the applied electric field using a nematic liquid crystal cell. The amplitude modulation frequency is measured up to 2.5 kHz.

- Coffee Break -

Location: Deyneka Room, floor 2, 17:30 – 19:30

Novel devices and emerging applications IV

Session Chair: Guillaume Huyet, Tyndall National Inst. and Cork Inst. of Techn., Ireland

WeR3-37 Invited **17:30-18:00**

Directly-modulated lasers monolithically integrated with an optical filter for long-range access network

N. Chimot, S. Joshi, J.-G. Provost, K. Mekhazni, F. Lelarge; 3-5 Lab, a joint laboratory Nokia Bell Labs France, Thales Research and Technology, CEA Leti, France

The future access networks requires to develop key innovative transmitters operating at 10Gb/s around 1550nm and capable of transmitting data in extended reach passive optical networks (>60km). In this contribution, we demonstrate a novel cost-effective transmitter based on the monolithic integration on InP substrate of a directly modulated laser and a ring resonator compatible with the NGPON2 requirements.

WeR3-38 Invited **18:00-18:30**

Light interaction with colloidal photonic crystals: theoretical and experimental studies

S.O. Yurchenko, E.A. Gorbunov, K.I. Zaytsev; Bauman Moscow State Technical Univ., Russia

The effects of strong interaction of optical electromagnetic fields with colloidal photonic crystals (PCs) are considered in our talk. We justify the fingerprints of structural light focusing effect (strong localization of light in multiple hot spots, like at usual focusing) by recent results of our theoretical studies and experimental observations using opal colloidal globular photonic crystals.

WeR3-39 Invited **18:30-19:00**

Extreme events in laser systems

M. Agüero[1], C. Bonazzola[1], M. Kovalsky[1], A. Hnilo[1], C. Metayer[2], J.R. Tredicce[2,3]; 1 - CEILAP, CITEDEF-CONICET, Argentina, 2 - Univ. de la Nouvelle Calédonie, France, 3 - Univ. de Buenos Aires, Argentina

We consider simple laser systems like a laser with modulated phase or modulated losses, a laser with injected signal and a laser with saturable absorber.

WeR3-40 Invited **19:00-19:30**

Slow and Fast Graphene Oxide Photonics

R. M. De La Rue[1], C.K. Lai[2], W.H. Lim[2], H. Ahmad[2], W.Y. Chong[2], Y.K. Yap[3]; 1- Univ. of Glasgow, United Kingdom, 2 - Univ. of Malaya, Malaysia, 3 - Heriot-Watt Univ., Malaysia

Graphene oxide is a 2D material that can be used in a variety of applications of photonics - both as a mono-layer and in multi-layer formats. The presentation will explore how the anisotropic material properties of graphene oxide multi-layers can be exploited to obtain useful photonic functionality, with response times that can be very fast – but also much slower.

R4. LASER BEAM CONTROL

Location: Stenberg 2 Room, floor 3, 15:00 – 17:00

Laser Beam Control I

Session Chair: Ivan Kislyakov, ITMO Univ., Russia

WeR4-01 Invited **15:00-15:30**

Measurements of the second hyperpolarizability and nuclear rotational response of liquids and gases

D.J. Hagan, M. Reichert, P. Zhao, E.W. Van Stryland; Univ. of Central Florida, United States

A beam deflection technique is used to separate the bound-electronic and molecular rotational components of nonlinear refractive transients of molecular gases. Coherent rotational revivals from air and carbon disulfide (CS2) vapor are identified. Dephasing rates, rotational and centrifugal distortion constants of each species are measured. Polarization-resolved studies allow unambiguous measurement of the bound-electronic nonlinear refractive index of air and second hyperpolarizability of CS2. Agreement between gas and liquid phase second hyperpolarizability measurements is found using the Lorentz-Lorenz local field correction.

WeR4-02 Invited **15:30-16:00**

Ultrafast modulators of light beams based on pristine or modified single-wall carbon nanotubes

E.D. Obraztsova[1], N.R. Arutyunyan[1], P.A. Obraztsov[1], E.P. Kharitonova[1], D.-J. Liaw[2]; 1 - Prokhorov General Physics Inst. RAS, Russia, 2 - National Taiwan Univ. of Science and Technology, Taiwan

In this work a procedure for formation of homogeneous thermostable composites "polyimide + single-wall carbon nanotubes" has been developed. With such composite (used as a saturable absorber) the mode-locking regime was realized in Yb fiber laser.

WeR4-03 Invited **16:00-16:30**

Two-dimensional semiconductors for nonlinear optical modulation

J. Wang; Shanghai Inst. of Optics and Fine Mechanics CAS, China

Realized that the sizable and thickness-dependent bandgap offers transition metal dichalcogenides (TMDCs) a huge potential in the development of photonic devices with high performance and unique functions, we studied extensively the ultrafast NLO property of a range of TMDCs. TMDCs with high-quality layered nanosheets were prepared using liquid-phase-exfoliation technique. Ultrafast saturable absorption, two-photon-absorption were observed from the 2D nanostructures.

WeR4-04 **16:30-16:45**

Spectral shift of the transparency line of a semiconductor multilayer resonator under pulsed laser radiation

A.A. Ryzhov[1,2], I.M. Belousova[1,2], G.E. Tsyrlin[3], A.I. Khrebtov[3], R.R. Reznik[3,4]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., 3 - Academic Univ. RAS, 4 - Peter the Great St. Petersburg Polytechnic Univ., Russia

Multilayer microresonators are of interest as low-threshold nonlinear optical devices. Such a resonator for near IR in the form of GaAs/AlAs heterostructure was fabricated and tested. The spectral shift of its transparency line accompanied by the transmittance peak reduction was experimentally observed as a function of the laser pulse energy. Optical limiting characteristic of the resonator was measured as well.

WeR4-05 **16:45-17:00**

Enhancement of optical limiting by polymer doping of aqueous nano-carbon suspensions

A.V. Sokolov[1], I.M. Kislyakov[1,2], S.A. Povarov[1,2], C.S. Yelleswarapu[3]; 1 - ITMO Univ., Russia, 2 - Vavilov State Optical Inst., Russia, 3 - Univ. of Massachusetts Boston, United States

We report on augmenting materials for optical limiting of laser power radiation by introduction of polymers into nano-carbon aqueous suspensions, the throughput being controllable healing of the solid optical material and higher bleaching resistibility of the fluid state.

- Coffee Break -

Location: Stenberg 2 Room, floor 3, 17:30 – 19:15

Laser Beam Control II

Session Chair: Vladimir Yu. Venediktov, Saint-Petersburg State Electrotechnical Institute "LETI", Russia

WeR4-06 Invited **17:30-18:00**

Holographic recording of relief-free infrared diffractive optics based on semiconductor nanomaterials

S.G. Krivoshlykov; ANTEOS, Inc., United States

A broad technology platform for holographic recording of various infrared diffractive optical elements in semiconductor materials for application in spectral devices, telecom components and lasers is described. The room temperature process of photo-modification of the material refractive index at low light intensity is applied to fabrication of the infrared diffractive optics based on polycrystalline ZnSe and single-crystal GaAs semiconductor materials.

WeR4-07 **18:00-18:15**

Interference comb-spectroscopy with increasing sensitivity

S.A. Pulkin[1], E.N. Borisov[1], D.V. Venediktov[1], V.Yu. Venediktov[1,2], M.V. Balabas[1], S. Savel'eva[1], S.V. Uvarova[1], I.N. Strel'nikov[1], V. Arnautov[1], V. Shevtzov[1], O.Tret'yak[1], A. Kalinichev[1]; 1 - St. Petersburg State Univ., 2 - St. Petersburg State Electrotechnical Univ., Russia

The wide spectrum from comb – generator of femtosecond laser was applied for illuminating of Michelson interferometer with atomic vapor. The method of holographic interferometry with increasing sensitivity using phase modulator was applied for treatment of digital hologram.

WeR4-08 **18:15-18:30**

Digital correction of distortions in holographic interferometer

A.A. Sevruygin[1], S.A. Pulkin[2], I.M. Tursunov[1], D.V. Venediktov[1], V.Yu. Venediktov[1,2,3]; 1 - St. Petersburg State Electrotechnical Univ., 2 – St. Petersburg State Univ., 3 – ITMO Univ., Russia

The paper considers the use of holographic interferometer for hologram re-recording with correction of distortions. This is done with spatially combined interferograms using matrix spatial light modulator and digital image processing of the interferograms recorded by CMOS camera.

WeR4-09 **18:30-18:45**

3D ellipsoidal beam shaping in laser drivers for photoinjectors

E.I. Gacheva[1], S.Yu. Mironov[1], A.K. Poteomkin[1], V.V. Zelenogorsky[1], A.V. Andrianov[1], E.A. Khazanov[1], M. Krasilnikov[2], F. Stephan[2]; 1 - Inst. of Applied Phys. RAS, Russia, 2 - Deutsches Elektronen-Synchrotron, Germany

Ellipsoidal laser pulses with central wavelength of 1030 nm and duration of 40 ps were obtained. It is expected that after conversion into the fourth harmonic this will reduce appreciably emittance of the electron beam, injected by the laser.

WeR4-10 **18:45-19:00**

Direction measurement by means of dynamic goniometer method

Yu.V. Filatov, E.D. Bohkman, P.A. Ivanov, R.A. Larichev, P.A. Pavlov; St. Petersburg State Electrotechnical Univ., Russia

The angle measurement system intended for measuring angles between some directions set in the space by reflectors is presented in the report. The system operates by continuous rotation of platform with the autocollimating null-indicator. The angle measurements are provided by the ring laser or the holographic optical encoder.

WeR4-11 **19:00-19:15**

The influence of rotation on the parameters of the whispering gallery modes resonator

Yu.V. Filatov[1], E.V. Shalymov[1], V.Yu. Venediktov[1,2]; 1 - St. Petersburg State Electrotechnical Univ., 2 - St. Petersburg State Univ., Russia

The review of the various effects arising in resonators of whispering gallery modes is provided in the paper.

R5. SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES

Location: Pudovkin Room, floor 3, 09:00 – 11:00

Super-Intense Light Fields and Ultra-Fast Processes I

Session Chair: Alexander A. Andreev,
Vavilov State Optical Inst., Russia,
MBI, Germany, ELI-ALPS, Hungary

WeR5-01 Invited **09:00-09:30**

Science with a petawatt laser

L. Roso; Centro de Láseres Pulsados, Spain

What kind of new science can be done with a petawatt laser? There are some applications as particle acceleration, extreme plasmas, or basic QED analysis. But each of them depends on many laser laser parameters, much more than just an outrageous laser peak power. Probably it is the time to begin to design ad hoc lasers for each of the applications.

WeR5-02 **09:30-09:45**

New generation of ultra-high power laser systems for super–intense light fields

V. Chvykov[1], M. Kalashnikov[1,2], K. Osvay[1]; 1 - ELI-Hu Nkft., Hungary, 2 - Max.Born-Inst., Germany

Super–intense light field can be produced combining three properties inherent to the laser light which are the high energy, short pulse duration and sharp focusing. Our report will be devoted all of them, namely higher energy extraction and shortening of the pulse duration of the final large aperture amplifiers and utilization of the adaptive optics for wave front compensation.

WeR5-03 **09:45-10:00**

Beam combining with nonlinear frequency conversion for petawatt class laser systems

S.A. Frolov, V.I. Trunov; Inst. of Laser Physics SB RAS, Russia

Beam combining with nonlinear frequency conversion for noncollinear second harmonic generation for high energy pump beams and multibeam pumped parametric amplification are investigated theoretically. Prospects of creation of high repetition rate petawatt class laser system with parametric amplification stages are discussed. Parasitic wave mixing effects influence are analyzed with numerical simulation.

WeR5-04 **10:00-10:15**

Characterization of TW-power UV sub-picosecond pulses produced at GARPUN-MTW Ti:Sapphire/KrF laser facility for target irradiation experiments

V.D. Zvorykin, A.A. Ionin, A.O. Levchenko, D.V. Mokrousova, L.V. Seleznev, A.V. Shutov, E.S.Sunchugasheva, N.N. Ustinovskii; Lebedev Physical Inst. RAS, Russia

Initial experiments on targets irradiation by sub-picosecond UV pulses with peak intensity ~ 2•10^16 W/cm^2 at GARPUN-MTW Ti:Sapphire / KrF laser facility are reported.

WeR5-05 **10:15-10:30**

Femtosecond Raman lasers with double pulse pumping

N.V. Didenko[1], A.V. Konyashchenko[1], P.V. Kostryukov[1], L.L. Losev[1], V.S. Pazyuk[1], S.Yu. Tenyakov[2], V.Ya. Molchanov[3], S.I. Chizhikov[3], K.B. Yushkov[3]; 1 - Lebedev Physical Inst., 2 - Avesta Ltd., 3 - National Univ. of Science and Technology (MISIS), Russia

We present our experimental research on femtosecond Raman lasers pumped by two orthogonally polarized chirped pulses. It was developed technique for generation of femtosecond Stokes pulses with duration closed to pump one. The shortest 40 fs Stokes pulses were generated at stimulated Raman scattering in hydrogen.

WeR5-06 Invited **10:30-11:00**

Compression of powerful femtosecond pulses after compressor

V.N. Ginzburg, S.Yu. Mironov, I.V. Yakovlev; Inst. of Applied Physics RAS, Russia

Spectrum broadening by self-phase modulation (SPM) may be used for increasing PW-class laser pulse power. The influence of high-order spectral phase on SPM and compression of intensity pulses will be discussed. The results of compression of sub-PW pulses of the PEARL laser will be presented.

- Coffee Break -

Location: Pudovkin Room, floor 3, 11:30 – 14:00

Super-Intense Light Fields and Ultra-Fast Processes II

Session Chair: Paul McKenna,
Univ. of Strathclyde, United Kingdom

WeR5-07 Invited **11:30-12:00**

Ultra-bright gamma-ray beams from Compton scattering of an electron beam in an intense laser field

G. Sarri[1], D.J. Corvan[1], M. Zepf[1], A. Di Piazza[2], C.H. Keitel2 ; 1 - The Queen's Univ. of Belfast, United Kingdom, 2 - Max-Planck-Inst. für Kernphysik, Germany

We report on experimental results concerning the generation of ultra-bright multi-MeV gamma-ray beams following non-linear Thomson scattering of a laser-driven ultra-relativistic electron beam in the field of a high intensity laser. The short duration (~20fs), narrow divergence (~2-3 mrad), and small source size (~30 microns) make this compact source the brightest ever generated in the multi-MeV regime.

WeR5-08 Invited **12:00-12:30**

High field plasmonics and laser-plasma acceleration in solid targets

A. Sgattoni[1,2,3], L. Fedeli[4], G. Cantono[3,5,6,7], T. Ceccotti[5], A. Macchi[3,7]; 1 - LULI, Sorbonne Univ., École Polytechnique, CNRS, CEA , France, 2 - LESIA, Observatoire de Paris, CNRS, UPMC, Univ. Paris Diderot, France, 3 - CNR, National Inst. of Optics, Italy, 4 - Dipartimento di Energia Politecnico di Milano, Italy, 5 - LIDYL, CEA, CNRS, Univ. Paris-Saclay, France, 6 - Univ. of Paris Sud, France, 7 - Univ. of Pisa, Italy

Plasmonics is a vibrant research field exploiting the properties of surface plasmons. Propagating surface plasmons can be excited by laser light on a surface with a shallow periodic modulation. Using femtosecond laser pulses with ultra-high contrast it is now possible to extend this approach to intense laser pulses, allowing to study plasmonics in a nonlinear regime characterized by high fields and relativistic electron dynamics.

WeR5-09 **12:30-12:45**

High optical harmonics polarization state due to incident field spatial inhomogeneity

A.V. Andreev[1], S.Yu. Stremoukhov[1,2], O.A. Shoutova[1]; 1 - Lomonosov Moscow State Univ., 2 - Russian National Research Centre «Kurchatov Inst.», Russia

High optical harmonics generation process in atomic gases interacting with bichromatic laser field in non-collinear scheme is studied with the aim of polarization state of atomic response investigation in dependence on incident field spatial properties. It is shown that the non-dipole transitions (the impact of which increases with laser field intensity) play the crucial role in discussed process.

WeR5-10 **12:45-13:00**

High-order harmonic generation in density-modulated gaseous targets

V. Nefedova[1,2], J. Nejdl[1,3], T. Fok[4]; 1 - Inst. of Physics AS CR, Czech Republic, 2 - Faculty of Nuclear Sciences and Physical Engineering CTU, Czech Republic, 3 - Inst. of Plasma Physics AS CR, Czech Republic, 4 - Military Univ, of Technology, Poland

The study of effects of Phase-Matching and Quasi-Phase-Matching in High-Order Harmonic generation process is performed. The experimental investigation of the influence of various gas target geometries on high-harmonic yield is presented.

WeR5-11 Invited **13:00-13:30**

Relativistic laser nano-plasma atto-physics

A.A. Andreev; Vavilov State Optical Inst., Russia, MBI, Germany, ELI-ALPS, Hungary

Interaction of an ultrashort and ultraintense laser pulse with nano-structured targets is considered. Maximum energy of fast particles, conversion efficiency of laser energy to fast ions and the divergence of particle beams are compared for various types of targets. Efficient conversion of fundamental laser radiation into characteristic sub-femtosecond X-ray radiation and generation of tunable up-converted radiation are predicted. The results of the simulations were compared with the experimental data and have shown a good coexistence.

WeR5-12 Invited **13:30-14:00**

Recent advances in the numerical modelling of plasmas under extreme laser intensities

L.O. Silva; Univ. de Lisboa, Portugal

Intense laser and particle beams can be focused to intensities in excess of 10^23 W/cm^2. These intensities, or even higher, are present in extreme astrophysical scenarios. The interaction of these intense beams and fields with plasmas is very rich, permeated by collective processes, relativistic nonlinearities and ultra high field physics. Large scale numerical simulations play a critical role to unveil the complexity of these scenario and massively parallel high performance computing are driving new discoveries and the design of new facilities. I will review the recent developments on the in silico extreme plasma physics, ranging from the dynamics of electron-positron fireballs, or to the physics and the dynamics of intense fields including QED effects.

R7. LASERS IN ENVIRONMENTAL MONITORING

Location: Petrov-Vodkin 3 Room, floor 2, 15:00 – 17:00

Lasers in Environmental Monitoring I

Session Chair: Alexandr P. Zhevlakov, ITMO Univ., Russia

WeR7-01 Invited **15:00-15:30**

Application of tunable diode laser absorption spectroscopy for planetary studies, on lander board for planned missions to Moon, Mars and Venus

I.I. Vinogradov[1], V.V. Barke[1], V.A. Kazakov[1], Yu.V. Lebedev[1], A.V. Rodin[1,2], O.Z. Roste[1], O.V. Benderov[2], A.Yu. Klimchuk[2], V.M. Semenov[2], A.A. Zakharova[2], A.V. Kalyuzhnyi[3], A.I. Nadezhdinskii[4], Ya.Ya. Ponurovskiy[4], V.V. Spiridonov[4], J. Cousin[5], G. Durry[5], L. Joly[5]; 1 - Space Research Inst. RAS, Russia, 2 - Moscow Inst. of Physics and Technology, Russia, 3 - Special Design Bureau of Space Device Engineering of IKI RAS, Russia, 4 - Prokhorov General Physics Inst. RAS, Russia, 5 - Univ. de Reims, France

In a couple of years, researchers of IKI RAS, together with colleagues from MIPT, GPI RAS, and from GSMA team (University of Reims, France) are developing TDLAS instruments for carrying out in situ measurements for several future space missions to our neighbor planets. In the report, we discuss TDLAS instrument adaptation to actual lander probes, scheduled for research missions to Moon, Mars and Venus.

WeR7-02 Invited **15:30-16:00**

Ozone high resolution spectroscopy using FTIR and TDL techniques for atmospheric research

C. Janssen[1], C. Boursier[1], H. Elandaloussi[1], P. Jeseck[1], M. Minissale[1,2,3], Y. Té[1], T. Zanon[1]; 1 - LERMA-IPSL, Sorbonne Univ., UPMC Univ Paris 6, CNRS, 2 - Aix Marseille Univ., CNRS, 3 - Inst. Fresnel UMR 7249, France

Atmospheric remote sensing of ozone is of major concern for understanding atmospheric change and the climate system. We present recent results of ground based atmospheric FTIR measurements that illustrate the limitations of current spectroscopic data. New measurement strategies, which cope with these requirements, and first results based on different high resolution spectroscopic systems are presented, in particular the study of ozone line intensities, pressure-shifts and time-resolved ozone isotope kinetics using an interferometrically stabilized TDL spectrometer and a free running QCL (Quantum Cascade Laser) at 10 μm.

WeR7-03 **16:00-16:15**

Carbon monoxide concentration mesurement on the base of GaInAsSb heterolaser

Ya. Lebiadok[1], D. Kabanau[1], Yu. Yakovlev[2], A. Imenkov[2]; 1 - SSPA "Optics, Optoelectronics & Laser Technology", Belarus, 2 - Ioffe Inst., Russia

The method of detection of carbon monoxide on the base of laser diode with GaInAsSb quantum active layer and its characteristics are discussed in the report.

WeR7-04 **16:15-16:30**

Ice thickness measurements by Raman & Rayleigh scattering technique

S.M. Pershin[1,4], V.N. Lednev[1,2], R.N. Yulmetov[1,3], A.F. Bunkin[4], M.Ya. Grishin[1,5]; 1 - Prokhorov General Physics Inst. RAS, Russia, 2 - National Univ. of Science and Technology MISiS, Russia, 3 - The Univ. Centre in Svalbard, Norway, 4 - Concern 'Agat', Russia, 5 - Moscow Inst. of Physics and Technology (State Univ.), Russia

An efficient technique for ice thickness measurements by Raman & Rayleigh scattering is suggested. The elastic scattering is used for air-to-sample borders indication but fails to detect floating ice border. The Raman spectroscopy is used to detect interfaces between transparent materials such as ice-water interface. This approach is a promising express and non-invasive technique for remote thickness measurements in field experiments.

WeR7-05 **16:30-16:45**

Raman lidar measurements of the alkane molecules concentration

V.G. Shemanin[1], V.E. Privalov[2]; 1 - Novorossiysk Polytechnic Inst., KubSTU, 2 - Peter The Great St. Petersburg Polytechnic Univ., Russia

This paper is about the accounting of the laser line and apparatus function widths in the Raman lidar equation for the hydrocarbon molecules sensing in the atmosphere and an assessment of the relative error of such a concentration measurements of the relative error of such a concentration measurements. The isobutane was used as an example. All of these results show that the laser line width and the of the Raman lidar instrumental function width leads to increase the relative error of the concentration measurements for the studied molecules in the atmosphere in all the ranging distance.

WeR7-06 **16:45-17:00**

Coordinate measuring systems based on solid chip and microlasers

A.S. Grishkanich[1], D. N. Redka[2]; 1 - ITMO Univ., 2 - St. Petersburg Electrotechnical Univ., Russia

According to the current great interest concerning Large-Scale Metrology applications in many different fields of manufacturing industry, technologies and techniques for dimensional measurement have recently shown a substantial improvement. Ease-of-use, logistic and economic issues, as well as metrological performance, are assuming a more and more important role among system requirements. The project is planned to conduct experimental studies aimed at identifying the impact of the application of the basic laws of chip and microlasers as radiators on the linear-angular characteristics of existing measurement systems.

- Coffee Break -

Location: Petrov-Vodkin 3 Room, floor 2, 17:30 – 19:30

Lasers in Environmental Monitoring II

Session Chair: Christof Janssen, LERMA-IPSL, Sorbonne Univ., Observatoire de Paris, PSL Research Univ., France

WeR7-07 Invited **17:30-18:00**

Monitoring of aerosol loading in the middle atmosphere using Siberian – Far Eastern lidar network

A.A. Cheremisin; Irkutsk State Univ. of Railway Engineering, Krasnoyarsk Railway Inst., Siberian Federal Univ., Russia

A network of stratospheric lidar stations operates in Siberia and Far East: Tomsk, Yakutsk, Kamchatka. The lidar in itself is a powerful tool for atmospheric aerosol investigation. Meanwhile, it is a very fruitful to analyze the lidar data along with the global satellite data and the aerosol particles motion simulation results.

WeR7-08 **18:00-18:15**

A selective and highly sensitive MIR photoacuostic sensor for trace gas monitoring

M. Lassen[1], L. Lamard[2], D. Balslev-Harder[1], Y. Feng[3], J.-F. Focant[4], A. Peremans[2], J. C. Petersen[1]; 1 - Danish Fundamental Metrology, Denmark, 2 - Laserspec BVBA, Belgium, 3 - COPAC ApS, Denmark, 4 - Univ. of Liège, Belgium

A highly sensitive, and selective photoacoustic (PA) sensor pumped by a single-mode mid-infrared (MIR) ns pulsed optical parametric oscillator (OPO) has been developed. The sensor has a wide tuning range covering absorption bands for a large number of molecules. The potential sensor applications include climate, environmental, and industrial monitoring and monitoring of exhaled breath for medical diagnostics. The sensor has been validated by monitoring acetone, formaldehyde, butane, propane, methanol, nitrogen dioxide, and methane.

WeR7-09 Invited **18:15-18:45**

Conception of underwater femtosecond lidar

V.A.Semenova, V.G.Bespalov, A.P.Zhevlakov; ITMO Univ., Russia

We introduce a concept of underwater lidar based on compact Yb-doped high energy femtosecond fiber laser. It is assumed that simultaneous registration of scattered supercontinuum radiation, conical emission and fluorescence from filament in water may allow obtaining information about media pollution as well as about oil and gas presence.

WeR7-10 **18:45-19:00**

Laser techniques for monitoring physical processes in water under substantial refraction conditions

I.L. Raskovskaya, I.N. Pavlov, B.S. Rinkevichyus, A.V. Tolkachev, A.V. Vedyashkina; National Research Univ. «MPEI», Russia

Techniques are suggested for the laser visualization and quantitative monitoring of physical processes occurring in water featuring substantial refractive index gradients. Methods are worked out for solving inverse refraction problems with a view to reconstructing temperature, pressure, and aqueous solution concentration fields and surface reliefs of water films.

WeR7-11 **19:00-19:15**

Remote water temperature measurements quantifying Raman OH-band spectra

M.Ya. Grishin[1,2], V.N. Lednev[1,3], S.M. Pershin[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), 3 - National Univ. of Science and Technology MISiS, Russia

Raman spectroscopy is an ideal tool for subsurface water temperature measurements. This approach is based on temperature dependence of Raman OH stretching band profile for liquid water. A comparison of four different mathematical approaches quantifying variation of Raman OH band spectra was carried out. The best accuracy was achieved for «weighting procedure» and was better than 0.15 deg. C.

WeR7-12 **19:15-19:30**

Simulation and processing techniques for lidar data

V.S. Goryainov[1,2], A.A. Buznikov[1], V.I. Chernook[2], A.N. Vasilyev[2], Y.A. Goldin[3]; 1 - Peter the Great St. Petersburg Polytechnic Univ., 2 - JSC Giprorybflot, 3 - Shirshov Inst. of Oceanology, Russia

The paper describes some recent experience in United Statesge of lidars for the monitoring of hydrosphere. An example of a present-day lidar system is given, along with several methods for simulation and processing of lidar data.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Location: Pudovkin Room, floor 3, 15:00 – 17:00

Nonlinearities for Optical and Terahertz Radiation

Session Chair: Andrey A. Sukhorukov,
Australian National Univ., Australia

WeR8-27 Invited **15:00-15:30**

Nonlinear refractive index for crystals in terahertz spectral range

S.A. Kozlov[1], A.A. Drozdov[1], K. Dolgaleva[2], R.W. Boyd[2]; 1 - ITMO Univ., Russia, 2 - Univ. of Ottawa, Canada

We develop a simple analytical model for calculating the vibrational contribution to the nonlinear refractive index n2 of a crystal at terahertz frequencies in terms of known crystalline parameters such as the coefficient of thermal expansion, atomic density, and the natural oscillation frequency of the vibrational modes of the crystal lattice. Theoretical methods of analysis and features of self-action of few-cycle terahertz waves in nonlinear media are discussed.

WeR8-28 Invited **15:30-16:00**

Interaction of intense laser pulses

A.V. Balakin[1], A.V. Borodin[1,2], M.S. Dzhidzhoev[1], V.M. Gorgienko[1], M.N. Esaulkov[2], I.A. Zhvaniya[1], K.A. Ivanov[1], I.A. Kotelnikov[3], N.A. Kuzechkin[2], I.A. Ozheredov, A.Yu. Sidorov[1], A.B. Savel'ev[1], P.M. Solyankin[1], A.P. Shkurinov[1,2]; 1 - Lomonosov Moscow State Univ., 2 - Inst. on Laser and Information Technologies RAS, 3 - Budker Inst. of Nuclear Physics RAS, Russia

We present the results of experimental and theoretical study of interaction of intense femtosecond laser pulses with gas cluster beam aimed to the generation of terahertz (THz) and x-ray emission. Clusters ware produced by partial condensation of various gases during their expansion through a conical nozzle into vacuum:pure Ar, mixtures CF2Cl2+He, Ar+He etc. We analyze the use of two laser pulse excitation schemes in our experiments, single- and two-color geometries (fundamental frequency mixed with its second harmonic) for the generation of high power terahertz (THz) radiation.

WeR8-29 **16:00-16:15**

A method for nonlinear-optical calibration of the terahertz wave spectral brightness

G.Kh. Kitaeva[1], V.V. Kornienko[1], Yu.A. Mityagin[2], A.N. Penin[1]; 1 - Lomonosov Moscow State Univ., 2 - Lebedev Physical Inst. RAS, Russia

Experimental results are presented for the detection of 0.22 THz radiation from a frequency-doubled impact ionization avalanche transit-time (IMPATT) diode. A procedure is discussed for standard-less measurement of the terahertz wave spectral brightness. The method is based on the use of spontaneous parametric down-conversion of light under the nonlinear-optical detection of terahertz wave radiation.

WeR8-30 **16:15-16:30**

Polarization of THz radiation generated during two-color filamentation of arbitrarily polarized laser pulses

V.A. Andreeva[1], M.N. Esaulkov[2], N.A. Panic[1], P.M. Solyankin[1], V.A. Makarov[1], D.E. Shipilo[1], A.P. Shkurinov[1,2], O.G. Kosareva[1], S.L. Chin[3]; 1 - Lomonosov Moscow State Univ., Russia, 2 - Inst. on Laser and Information Technologies RAS, Russia, 3 - Univ. Laval, Canada

We examined experimentally and theoretically polarization of THz radiation generated during dual-color co-propagation of femtosecond laser pulses in gases. We reveal that THz radiation polarization is predominantly defined by the generation of the nonlinear photocurrent in the self-induced laser plasma and remains relatively stable with respect to the change of the initial polarization angle between the 800 and 400 nm fields.

WeR8-31 **16:30-16:45**

Optimization of the laser plasma source of terahertz radiation and interferometric study of its spatio-temporal field distribution

A.A. Ushakov[1,2,3], P.A. Chizhov[1], R.V. Volkov[2,3], V.V. Bukin[1], S.V. Garnov[1], A.B. Savel'ev[2,3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Lomonosov Moscow State Univ., 3 - International Laser Center, Lomonosov Moscow State Univ., Russia

The efficiency of terahertz radiation generation induced by focusing two-color femtosecond laser pulses in the air with different polarization state of the pump fields was studied. A new measurement technique for the detection of the spatio-temporal THz electric field strength distribution in an electro-optic crystal using optical interferometry was demonstrated.

WeR8-32 **16:45-17:00**

Femtosecond supercontinuum generation and superfilamentation in liquids and supercritical fluids

V.N. Bagratashvili, V.M. Gordienko, E.I. Mareev, N.V. Minaev, F.V. Potemkin, A.V. Ragulskaya; Lomonosov Moscow State Univ., Russia

We for the first time report a generation of multioctave supercontinuum in supercritical CO2 and Xe by 0.6 mJ 1240nm femtosecond (200 fs) laser pulse. In supercritical CO2 it ranges from 350 to 1900 nm and have a plateau-like behavior in the range 1400-1900 nm, besides 50% of energy is transferred to the first Stokes component. The increase of laser energy and focusing lens numerical aperture in liquids leads to the formation of superfilament, which triggers shock waves generation, cavitation bubble formation and provides tightly divergent supercontinuum.

- Coffee Break -

Location: Pudovkin Room, floor 3, 17:30 – 19:45

Localized Structures of Optical and Matter Waves

Session Chair: Andrei I. Maimistov,
Moscow Inst. of Physics and Technology, National Nuclear Research Univ., Russia

WeR8-33 Invited **17:30-18:00**

Topological solitons in partially PT-symmetric potentials

Y.V. Kartashov[1,2], V.V. Konotop[3], L. Torner[1]; 1 - ICFO-The Inst. of Photonic Sciences, Spain, 2 - Inst. of Spectroscopy, Russia, 3 - Univ. of Lisbon, Portugal

We introduce partially-parity-time-symmetric azimuthal potentials composed from individual PT-symmetric cells located on a ring, where two azimuthal directions are nonequivalent. Such non-conservative ratchet-like structures support rich families of stable vortex solitons whose properties depend not only on modulus, but also on sign of their topological charge.

WeR8-34 Invited **18:00-18:30**

New results for spontaneous symmetry breaking in nonlinear optics and matter waves

B.A. Malomed; Tel Aviv Univ., Israel

The presentation will give an overview of recent theoretical results which reveal new features of the spontaneous symmetry breaking (SSB) effect. It is produced by the interplay of the symmetry of an underlying potential, which traps optical or matter waves, and self-focusing nonlinearity.

WeR8-35 **18:30-18:45**

Population inversion gratings: creation and control with few-cycle non-overlapping optical pulses

R.M. Arkhipov[1], M.V. Arkhipov[2], I. Babushkin[3,4], N.N. Rosanov[1,5]; 1 - ITMO Univ., Russia, 2 - St. Petersburg State Univ., Russia, 3 - Max Born Inst., Germany, 4 - Leibniz Univ. Hannover, Germany, 5 - Vavilov State Optical Inst., Russia

We consider theoretically a possibility of creating and control of population inversion gratings in two-level resonant medium coherently interacting with few-cycle light pulses. It is shown that it is possible to create, erase, and modify the spatial period of such gratings.

WeR8-36 **18:45-19:00**

Formation of localized states of electromagnetic radiation in dynamic cavities

N.N. Rosanov[1,2,3], E.G. Fedorov[1,4]; 1 - Vavilov State Optical Inst., Russia, 2 - ITMO Univ., Russia, 3 - Ioffe Inst., Russia, 4 - Technion-Israel Inst. of Technology, Israel

Presented are results of numerical simulation of parametric generation of single and multiple uni- and bipolar radiation pulses in a cavity with oscillating mirrors characterized by Lorentz-type frequency dispersion of reflection coefficient, in terms of classical electrodynamics.

WeR8-37 **19:00-19:15**

Interaction of spatial and temporal cavity solitons in mode-locked lasers and passive cavities

D.V. Turaev[1,2], A.G. Vladimirov[2,3], S.V. Zelik[2,4]; 1 - Imperial College London, United Kingdom, 2 - Lobachevsky Univ. of Nizhny Novgorod, Russia, 3 - Weierstrass Inst., Germany, 4 - Univ. of Surrey, United Kingdom

We study interaction of well-separated localized structures of light in the presence of periodic perturbations. Oscillating localized structures were found to emit weakly decaying dispersive waves leading to a strong enhancement of the interaction and formation of new types of bound states. We discuss the applicability of our analytical results to the interpretation of experimental and numerical data reported earlier.

WeR8-38 **19:15-19:30**

Self-induced transparency coherent mode-locking in lasers

R.M. Arkhipov[1], M.V. Arkhipov[2], I. Babushkin[3,4], N.N. Rosanov[1,5]; 1 - ITMO Univ., Russia, 2 - St. Petersburg State Univ., Russia, 3 - Max Born Inst., Germany, 4 - Leibniz Univ. Hannover, Germany, 5 - Vavilov State Optical Inst., Russia

Coherent mode-locking (CML) is based on intracavity self-induced transparency phenomena and allows generating single-cycle laser pulses. We propose a new technique based on McCall and Hahn Area theorem, allowing to predict the main features of CML regimes, study theoretically the possibility of single-cycle optical pulse generation and provide experimental study of mode-locked regimes in laser with a coherent absorber.

WeR8-39 **19:30-19:45**

Rotating three-dimensional vortex dissipative optical soliton

N.A. Veretenov[1,2], N.N. Rosanov[1,2,3], S.V. Fedorov[1,2]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., 3 - Ioffe Inst., Russia

We present a new type of three-dimensional dissipative vortex soliton in homogeneous medium with nonlinear gain and absorption. The soliton has a fixed torus-like intensity distribution with a number of maxima in azimuthal direction, rotating with constant angular velocity without deformations (a solid-like structure).

R1. SOLID-STATE LASERS

WeR1-p20 **15:00-19:00**

Evolution of Cr4+, Cr3+ and Cr2+ contents in Cr:Mg2SiO4 crystals during those oxidizing annealing

K.A. Subbotin[1], V.V. Slavkina[2], D.A. Lis[1], O.N. Lis[1], E.V. Zharikov[2,1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Mendeleyev Univ. of Chemical Technology, Russia

The evolution of Cr4+, Cr3+ and Cr2+ contents in Cr:Mg2SiO4 crystals during those prolonged high-temperature oxidizing annealing have been studied. The concentration of Cr4+ increases by factor of 1,5-2,5, whereas the parasitic Cr2+ ions practically disappear during such annealing. Therefore this post-growth treatment of Cr:Mg2SiO4 crystals considerably enhances their spectroscopic properties as the active laser media.

WeR1-p21 **15:00-19:00**

Quantum cutting of UV emission in Yb doped NaGd(MoO4)2 and NaLa(MoO4)2 crystals

K.A. Subbotin, Yu.N. Osipova, D.A. Lis, D.A. Nikolaev, E.V. Zharikov, I.A. Shcherbakov; Prokhorov General Physics Inst. RAS, Russia

The efficient 1 μm Yb luminescence in Scheelite-like molybdate Yb:NaGd(MoO4)2 and Yb:NaLa(MoO4)2 single crystals was found at UV-excitation. The character the of dependence of Yb luminescence intensity on its content in the samples at UV-excitation indicates that the mechanism of cooperative down-conversion (quantum cutting) switches on at high Yb concentrations. It can be used for increase the efficiency of photovoltaic cells at crystalline silicon.

WeR1-p22 **15:00-19:00**

Spectroscopic properties of UV active media Ce3+:LiCa1-xSrxAlF6

A.A. Shavelev, A.S. Nizamutdinov, V.V. Semashko, M.A. Marisov; Kazan Federal Univ., Russia

Optical absorption spectroscopy studies have shown that mixed crystals Ce3+:LiCa0,2Sr0,8AlF6 grown by Bridgeman technique exhibit more than 3 times higher absorption coefficient compared to Ce3+:LiCaAlF6 sample. An important result is based on the fact that this enhancement was achieved for two types of Ce3+ centers in a multisite Ce:LiSr0.8Ca0.2AlF6 system.

WeR1-p23 **15:00-19:00**

Investigations of a highly efficient and compact diode-pumped Yb:KYW laser

S.A. Kuznetsov[1], V.S. Pivtsov[1,2]; 1 - Inst. of Laser Physics SB RAS, 2 - Novosibirsk State Technical Univ., Russia

Record high differential efficiency (53.2%) and full optical efficiency (48%) for a multimode diode-pumped Yb:KYW laser have been achieved. Preliminary results of investigations with a distributed Bragg reflector tapered diode laser (DBR TDL) pumping have been obtained. The characteristics of the laser and methods for improving its efficiency are discussed.

WeR1-p24 **15:00-19:00**

The diode-pumped Nd:SrMoO4 self-Raman-parametric laser generation of shortened 300-picosecond pulses without any mode-locking device

S.N. Smetanin[1], M. Jelínek[2], V. Kubeček[2], H. Jelínková[2], L.I. Ivleva[1], A.S. Shurygin[3], M.N. Ershkov[3]; 1 - Prokhorov General Physics Inst. RAS, Russia, 2 - Czech Technical Univ. in Prague, Czech Republic, 3 - Kovrov State Technological Academy, Russia

The diode-pumped Nd:SrMoO4 self-Raman-parametric laser generation of shortened 300-ps pulse with the increased pulse energy of up to 1 μJ without any mode-locking device is experimentally demonstrated and theoretically studied.

WeR1-p25 **15:00-19:00**

Light-induced periodic structures and their characteristics in crystals CaF2-LuF3 activated by Ce3+ and Yb3+ ions

N.F. Rakhimov, A.S. Nizamutdinov, V.V. Semashko, M.A. Marisov, S.A. Shnaidman; Kazan Federal Univ., Russia

Here we discuss the opportunity of using Ce-doped fluorite-type crystals as basis for amplitude photonic crystals with modulation of color centers absorption due to complex picture of the dynamic processes occurring in this medium under UV pump. The results of time resolved absorption saturation studies and key parameters of dynamic processes evaluation are presented. Also discuss the results of experiments of creating periodic inhomogeneities of the absorption coefficient of color centers and the gain in mixed crystals with the fluorite structure CaF2-LuF3, doped Ce3+ and Yb3+.

WeR1-p26 **15:00-19:00**

Upconversion processes in BaY2F8:Yb3+,Pr3+,Ce3+

A.A. Pushkar[1], T.V. Uvarova[1], E.A. Komarnitskaya[2], A.G. Uvarova[2]; 1 - Prochorov General Physics Inst. RAS, 2 - National Univ. of Science and Technology MISIS, Russia

Various up-conversion processes in crystals BaY2F8:(Yb3+,Pr3+,Ce3+) at single- and multi-wave excitation by serial laser diodes (960, 808 and 840 nm) are studied. The white luminescence from 3Po, 3P1+1I6 multiplets of the ion Pr3+ are obtained. Our study showed on the great potential of the population of high level states of rare-earth ions in crystals BaY2F8 that will provide efficient laser emission when up-conversion excited by serial laser diodes.

WeR1-p27 **15:00-19:00**

Q-switched Tm:Ho:YbAG laser pumped at 1678 nm

Yu.D. Zavartsev, A.I. Zagumennyi, Yu.L. Kalachev, S.A. Kutovoi, V.A. Mikhailov, I.A. Scherbakov; Prokhorov General Physics Inst. RAS, Russia

Lasing of the acousto-optically Q-switched Tm:Ho:YbAG laser was realized. Laser demonstrated a good slope ~ 30% and total 11% efficiencies and output power up to 80 mW at pulse repetition rate of 50 kHz. It was found a great influence of upconversion effects on laser efficiency.

WeR1-p28 **15:00-19:00**

Dual wavelength tunable LiF:F2-color center laser

P.G. Zverev, N.N. Skryabin; Prokhorov General Physics Inst. RAS, Russia

The dual wavelength LiF:F2- color center laser working in near IR spectral region with smoothly tunable frequency shift from 1 to 10 THz was demonstrated.

WeR1-p29 **15:00-19:00**

High-efficiency thin-disk lasers based on Tm:KLu(WO4)2 crystals

S.M. Vatnik[1], I.A. Vedin[1], P.F. Kurbatov[1], A.A. Pavlyuk[2]; 1 - Inst. of Laser Physics SB RAS, 2 - Inst. of Inorganic Chemistry SB RAS, Russia.

We report on a high-efficiency room-temperature thin-disk lasers based on the monoclinic 5%Tm:KLuW crystals, epitaxial layers, and composite structures 5%Tm:KLuW/KLuW. The output spectra and oscillation performances of various types of thin-disk active elements are comparatively studied.

WeR1-p30 **15:00-19:00**

Synthesis, structure and Q-switching behaviour of transparent glass-ceramics based on a mixture of Co:β-Zn2SiO4 and Co:ZnO nanocrystals

O.S. Dymshits[1], P.A. Loiko[2], N.A. Skoptsov[2], A.A. Zhilin[1], D.V. Shemchuk[1], M.Ya. Tsenter[1], A.M. Malyarevich[2], K.V. Bogdanov[3], I.V. Glazunov[2], K.V. Yumashev[2], V.V. Vitkin[3]; 1 - NITIOM Vavilov State Optical Inst., Russia, 2 - Belarusian National Technical Univ., Belarus, 3 - ITMO Univ., Russia

We report on synthesis, structure, optical spectroscopy, nonlinear properties and passive Q-switching performance of novel transparent potassium zinc aluminosilicate glass-ceramics containing a mixture of cobalt-doped β-willemite, Co:Zn2SiO4 and zinc oxide, Co:ZnO.

WeR1-p31 **15:00-19:00**

The spectroscopic study of a Tm:Sc2SiO5 crystal

Yu.D. Zavartsev, A.I. Zagumennyi, Yu.L. Kalachev, S.A. Kutovoi, V.A. Mikhailov, I.A. Scherbakov; Prokhorov General Physics Inst. RAS, Russia

Six absorption bands of Tm:SSO crystal were analyzed on the basis of decomposition of each band to a number of Lorentz peaks. This analysis was applied to all possible combinations of crystal axis orientations and light polarization. The result is performed as a table of peak parameters:(wavelength, height, width).

WeR1-p32 **15:00-19:00**

Spectroscopy of monoclinic Eu:KLu(WO4)2: promising crystal for red lasers

E.V. Vilejshikova[1], P.A. Loiko[1], V.I. Dashkevich[2], V.A. Orlovich[2], A.S. Yasukevich[1], K.V. Yumashev[1], N.V. Kuleshov[1], E.B. Dunina[3], A.A. Kornienko[3], S.N. Bagaev[4], A.A. Pavlyuk[5]; 1 - Belarusian National Technical Univ., Belarus, 2 - Stepanov Inst. of Physics NASB, Belarus, 3 - Vitebsk State Technological Univ., Belarus, 4 - Inst. of Laser Physics SB RAS, Russia, 6 - Nikolaev Inst. of Inorganic Chemistry SB RAS, Russia

Polarized absorption and stimulated-emission cross-sections spectra of monoclinic Eu:KLu(WO4)2 are determined. Spectroscopic properties of this crystal are modeled within Judd–Ofelt theory modified for systems with an anomalously strong configuration interaction. Eu:KLu(WO4)2 crystal is promising for deep-red lasers at 703 nm.

WeR1-p33 **15:00-19:00**

1.34-μm Nd:YAG laser with an open-loop self-adaptive cavity

M.N. Ershkov[1], S.A. Solokhin[1], A.E. Shepelev[1], S.N. Smetanin[2]; 1 - Degtyarev Kovrov State Technological Academy, 2 - Prokhorov General Physics Inst. RAS, Russia

For the first time, operation of the 1.34-μm Nd:YAG laser with an open-loop self-adaptive cavity is demonstrated. In free-running and passive Q-switching regimes output energy and temporal laser parameters were studied.

WeR1-p34 **15:00-19:00**

Investigation of thermal distribution in end-pumped composite laser rods by finite difference method

I. Osmani, F. Lakhdari, O. Kholai; Ferhat Abbas Univ., Algeria

Temperature distribution of diode-pumped solid-state lasers based on conventional and YAG/Nd:YAG composite crystal is studied by using of finite difference method .The simulation results show that the peak temperature of composite rod is obviously reduced to less than 49% comparing with non-composite crystal.

R1. SOLID-STATE LASERS

WeR1-p35 **15:00-19:00**

Q-switch Er:YLF-laser generation control through dual-wave diode pumping

V.Yu. Khramov, V.V. Nazarov; ITMO Univ., Russia

The results of investigations of multivalve generation of dual-wavelength diode pumped Q-switch Er:YLF-laser are presented. The analysis of 3um range laser generation spectrum using the mathematical model based on rate equations was implemented. The theoretical optimization of power and time parameters of dual-wave diode pumping for achievement of selective lasing on wavelengths 2.66, 2.71, 2.81μm was carried out.

WeR1-p36 **15:00-19:00**

Polarization instability in Nd:YAG laser with linearly polarized pump

P.A. Khandokhin[1], N.D. Milovsky[2]; 1 - Inst. of Applied Physics RAS, 2 - Lobachevsky State Univ., Russia

We propose a model of a bipolarized solid-state laser, taking into consideration real positions of active Nd3+ centers in the unit cells of yttrium aluminum garnet, which adequately describes the basic features of the gain anisotropy effect induced by linearly polarized pump radiation observed in experiment. The model predicts a new type of instability arising due to two competing pump channels.

WeR1-p37 **15:00-19:00**

The research of dispersion mirrors for ultrafast laser system

Y.-Z. Wang, Y. Chen, M.-P. Zhu, H.-J. Qi, G.-H. Hu, J.-D. Shao; Shanghai Inst. of Optics and Fine Mechanics CAS, China

One of the key techniques of generating ultrafast pulse is the perfect management of different dispersions. Three types of dispersion mirrors, broadband chirped mirror, high dispersion mirror, and low dispersion mirror, are discussed for different dispersion requirements.

WeR1-p38 **15:00-19:00**

Q-switched 946 nm Nd:YAG laser with cavity dumping

A.F. Kornev[2], V.P. Pokrovskiy[2], E.A. Buslaeva[1,2], A.S. Kovyarov[1,2], S.V. Gagarskiy[1], P.A. Gnatyuk[1]; 1 - ITMO Univ., 2 - Lasers and Optical Systems Ltd, Russia

946 nm Nd:YAG end-pumped Q-switched master oscillator with a pulse duration of 3 ns, repetition rate 50 Hz was developed. The problem of obtaining a short pulse associated with a high saturation energy Es = 5.7 J/cm2, resolved by using the cavity dumping. The lasing energy was up to 5 mJ.

WeR1-p39 **15:00-19:00**

Principles of influence on the spectral properties of solid-state laser with loop cavity

A.P. Pogoda[1,2], V.M. Petrov[3], A.V. Fedin[1,2], A.S. Boreysho[1,2]; 1 - Baltic State Technical Univ., 2 - Laser Systems LTD, 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

Principles of spectral narrowing of radiation of laser with loop cavity due to phase conjugation phenomenon are discussed. The gain gratings in active media results in competition in longitudinal modes and spectral selectivity.

WeR1-p40 **15:00-19:00**

Tunable diode-pumped Er:GGAG laser

J. Šulc[1], P. Boháček[2], M. Němec[1], H. Jelínková[1], B. Trunda[2], L. Havlák[2], K. Jurek[3], M. Nikl[3]; 1 - Czech Technical Univ. in Prague, 2 - Inst. of Physics AS CR, 3 - Inst. of Physics AS CR, Czech Republic

Lasing and wavelength tunability of laser based on Er-doped mixed gadolinium-gallium-aluminium garnet Gd3Ga3Al2O12 crystal was investigated for the first time. A fiber coupled laser diode (emission 1463 nm) was used for pumping. Tuning was accomplished by MgF2 birefringent filter placed inside laser resonator. The laser was tunable in three bands in spectral region from 1610 nm to 1650 nm.

WeR1-p41 **15:00-19:00**

Actively Q-switched Nd:YAG twisted-mode cavity laser with a RTP electro-optic modulator

Z.H. Cong, Z.J. Liu, X.Y. Zhang, Z.G. Qin, S.J. Men, Q. Fu, H. Rao; Shandong Univ., China

A single-longitudinal-mode Nd:YAG laser was demonstrated using a twisted-mode cavity and an etalon. Stable laser pulses at 10 kHz were obtained with a RTP electro-optic modulator. Under an incident pump power of 8.1 W, the maximum output power of the single-longitudinal-mode laser was 1.07 W, and the linewidth was less than 0.1 GHz.

WeR1-p42 **15:00-19:00**

Longitudal modes lock-in in YAG:Cr4+ laser gyroscope at mode locking regime and its influence on lock-in of counterpropagating waves

Yu.Yu. Broslavets, A.A.Fomichev; Moscow Inst. of Physics and Technology (State Univ.), Russia

In this paper we present the results of research the dynamics of longitudinal modes frequencies lock-in on mode locking and its influence on lock-in of counter waves in laser gyroscope on YAG:Cr4+. We have developed the dynamic model of generation in mode-locking for the gyroscope on YAG:Cr4+. We have performed the analysis of mode locking regimes, lock-in of counter waves and possibilities of angular value registration for gyroscopes on YAG:Cr4+.

WeR1-p43 **15:00-19:00**

Mode-locking of Pr:YAlO3 laser by nonlinear mirror

M. Fibrich[1,2], J. Šulc[1], H. Jelínková[1], A. Zavadilová[1]; 1 - Czech Technical Univ. in Prague, 2 - Inst. of Physics ASCR, Czech Rebublic

We report on first nonlinear mirror mode-locked praseodymium based solid-state laser. As an active medium, the Pr:YAlO3 crystal was used. For mode-locking, a nonlinear BBO crystal together with a properly designed dichroic mirror were employed. Using 1W InGaN pump laser diode, 22 mW of mean output power with pulse duration and repetition rate of ~250 ps and 105 MHz, respectively, was demonstrated at 747 nm wavelength.

R5. SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES

WeR5-p01 **15:00-19:00**

Trap split induced by nonlinear polarization in femtosecond laser trapping

Yu. Jin[1,2]; L. Huang[1]; Yu. Jiang[1]; 1 - Inst. of Genetics and Developmental Biology, CAS, 2 - South China Normal Univ., China

A phenomenon called "trap split" had been found when gold nanoparticles were trapped by femtosecond laser pulses, and the trap split was demonstrated strongly dependent on the polarization, energy and wavelength of the laser pulses. The 3-dimension distribution of trap split and its mechanism were systemically investigated in this work.

WeR5-p02 **15:00-19:00**

Managing of spatial characteristics of internal modifications by means of optical delay in cases of femtosecond micromachining of materials

D.V. Ganin[1,2], K.E. Lapshin[1], F.Z. Obidin[1], S.K. Vartapetov[1]; 1 - Physics Instrumentation Center, Prokhorov General Physics Inst. RAS, 2 - National Research Nuclear Univ. «MEPhI», Russia

Presents the results of direct managing of spatial characteristics of the modifications in the case of focusing of femtosecond laser pulses in a bulk of material. Managing performed by inserting optical delay into different parts of the focused beam.

WeR5-p03 **15:00-19:00**

Direct femtosecond-pulse inscription of fiber Bragg gratings with special characteristics for sensing and laser applications

A.A. Wolf[1], A.V. Dostovalov[1,2], A.V. Parygin[1], M.I. Skvortsov[1], S.S. Yakushin[2], S.A. Babin[1,2]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Novosibirsk State Univ., Russia

The paper presents the results on inscription of long (up to 100 mm) fiber Bragg gratings with point-by-point technique and phase-shifted gratings inscription with continuous core-scanning technique by femtosecond laser pulses.

WeR5-p04 **15:00-19:00**

Study of optimal regimes and oxide type at formation of thermochemical LIPSS on Ti film under fs irradiation

A.V. Dostovalov[1,2], V.P. Korolkov[1,2], K.A. Okotrub[1], S.A. Babin[1,2]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Novosibirsk State Univ., Russia

The paper presents the results of investigation of the thermochemical laser-induced periodic surface structures formation on Ti film at femtosecond irradiation with different spot sizes, pulses powers, polarization directions.

WeR5-p05 **15:00-19:00**

More than 500 mm deformable mirrors for high-power laser beam correction

V. Samarkin[1], A. Aleksandrov[1], A. Kudryashov[1,2], P. Romanov[1], G. Borsoni[2], J. Sheldakova[1]; 1 - Moscow State Univ. of Mechanical Engineering, Russia, 2 - AKAoptics SAS, France

Deformable mirrors with the size of 410x470 mm for high power lasers was developed. The results of the measurements of the response functions of all the actuators and of the surface shape of the deformable mirror are presented in this paper. The study of the mirror with a Fizeau interferometer and a Shack-Hartmann wavefront sensor has shown that it was possible to improve the flatness of the surface down to a residual roughness of 0.033 μm (RMS). The possibility of correction of the aberrations in high power lasers was numerically demonstrated.

WeR5-p06 **15:00-19:00**

Electron acceleration in vacuum by optimized nonlinearly chirped laser pulse

M. Akhyani, M.R. Pandari, F. Jahangiri, A.R. Niknam, R. Massudi; Shahid Beheshti Univ., Iran

Electron acceleration in vacuum by a nonlinearly chirped laser pulse is studied and it is shown that utilizing optimized higher order chirp functions leads to enhancement of the electron energy gain.

WeR5-p07 **15:00-19:00**

Optical-to-THz conversion and scattering in metals

I.V. Oladyshkin, D.A. Fadeev, V.A. Mironov; Inst. of Applied Physics RAS, Russia

Laser induced terahertz waves generation from metals is a result of thermal nonlinear effects in the electron gas near the surface. We discuss the generation mechanism and the possibility of electron scattering investigation with a help of nondestructive optical-to-THz conversion on the surface. It is shown that THz response can be used to determine electron scattering frequency for electron gas temperatures up to 1-2 eV.

WeR5-p08 **15:00-19:00**

Passively mode-locked fiber laser at 1μm with tungsten disulphide absorber

Ya. Song, H. Guoyu, K. Li, Zh. Dou; Beijing Univ. of Technology, China

A passively yb-doped mode-locked fiber laser around 1 μm with an WS2 film SA is demonstrated. The stable mode locking was obtained with a pulse width of 2.5 ns. The 3-dB bandwidth was 1.1nm at 1030.3 nm and the repetition rate was 2.84 MHz. At the maximum pump power of 350 mW, the average output power was 8.02 mW, corresponding to pulse energy of 2.82 nJ.

WeR5-p09 **15:00-19:00**

Calculation of optimal parameters of the laser radiation in metal ablation by femtosecond pulses

R.V. Davydov, V.I. Antonov; Peter the Great St. Petersburg Polytechnic Univ., Russia

In this paper a mathematical model for femtosecond laser ablation of metals is proposed, based on standard two-temperature model connected with 1D hydrodynamic equations. A good agreement for numerical results of simulation ablation of several metals with experiment shows that this model can be employed in choosing laser parameters for better accuracy in nanoparticles production by this method.

WeR5-p10 **15:00-19:00**

Filamentation of four beams under focusing in air

V.A. Andreeva[1], A.A. Ionin[2], O.G. Kosareva[1], D.V. Mokrousova[2,3], N.A. Panov[1], A.B. Savel'ev[1], L.V. Seleznev[2], D.E. Shipilo[1], E.S. Sunchugasheva[2,3]; 1 - Lomonosov Moscow State Univ., 2 - Lebedev Physical Inst. RAS, 3 - Moscow Inst. of Physics and Technology, Russia

The interaction of four focused beams under filamentation was studied both experimentally and numerically. In this case single axial filament formation near the geometrical focus of the system takes place.

WeR5-p11 **15:00-19:00**

PIC simulation and physical interpretation of the formation and evolution of an electrostatic shock in a collisionless plasma produced by a fs laser pulse

A. Nechaev[1], M. Garasev[1,2], V. Kocharovsky[1]; 1 - Inst. of Applied Physics RAS, 2 - Lobachevsky State Univ. of Nizhny Novgorod, Russia

We carry out 1D and 2D PIC-simulation of the formation and evolution of a (quasi)electrostatic shock in a dual-temperature collisionless plasma with parameters typical for the laboratory femtosecond-laser experiments. We consider various profiles of a transition layer between the cold background and hot bulk expanding plasmas and analyzed how their parameters influence the properties and dynamics of the shock.

WeR5-p12 **15:00-19:00**

Controlling parameters of the accelerated particles by target relief choice for short relativistic laser pulse

K.Yu. Platonov[1,2], A.A. Andreev[3,4,5]; 1 - Vavilov State Optical Inst., Russia, 2 - St. Petersburg State Technical Univ., Russia, 3 - St. Petersburg State Univ., Russia, 4 - ITMO Univ., Russia, 5 - Max-Born Inst., Germany

By means of analytical and numerical modeling are constructed the dependences of numbers and temperatures of hot and cold electrons from the parameters of a relief targets irradiated by a short laser pulse of relativistic intensity. It is shown, that changing of a relief size, period and a thickness of a target substrate, it is possible to manipulate parameters of two temperature electron energy distribution function and to increase selectively transformation of laser energy into K-α radiation or into proton acceleration.

WeR5-p13 **15:00-19:00**

Modeling of the characteristic plasma emission produced by the interaction between nanostructured targets and ultrashort laser pulse of relativistic intensity

M.V. Sedov[1], A.A. Andreev[1,2,3], K.Yu. Platonov[2]; 1 - St. Petersbug State Univ., Russia, 2 - Vavilov State Optical Inst., Russia, 3 - Max Born Inst., Germany

We provide the laser-plasma interaction with a Particle-In-Cell code (LPIC) and a hydrodynamic simulation of the plasma expansion (MEDUnited States) to provide the plasma density profile for the PIC simulation. We use a Monte Carlo code to calculate the scattering of the hot electrons in the solid and the production of x-rays.

WeR5-p14 **15:00-19:00**

High intensity femrosecond pulse ionization effect on prepulse induced preplasma

D.A. Krestovskikh, K.A. Ivanov, I.N. Tsymbalov, S.A. Shulyapov, R.V. Volkov, A.B. Savel'ev; Lomonosov Moscow State Univ., Russia

The expansion dynamics of high power nanosecond laser-induced plasma plume is studied. The effect of field ionization of preformed plasma at irradiation by femtosecond laser pulse is demonstrated, leading to the increase of plasma electron density.

WeR5-p15 **15:00-19:00**

Novel bright melted-metal based laser-driven X-ray source for phase contrast imaging

M.A. Dubatkov[1], K.A. Ivanov[1], A.B. Savel'ev[1], A.V. Brantov[2], V.G. Nedorezov[3]; 1 - Lomonosov Moscow State Univ., 2 - Lebedev Physical Inst. RAS, 3 - Intst. for Nuclear Research RAS, Russia

The possibilities of laser-driven hard X-ray source utilizing melted metal target are demonstrated. The size, brightness and stability of the source are experimentally investigated. The numerical simulations indicate, that such source may be used for X-ray phase contrast imaging.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

WeR8-p01 **09:30-13:30**

Output beam quality improvement in broad-area class-B lasers subject to optical injection

A.V. Pakhomov[1,2], N.E. Molevich[1,2], A.A. Krents[1,2], D.A. Anchikov[1]; 1 - Samara State Aerospace Univ., 2 - Lebedev Physical Inst., Samara, Russia

We study analytically and numerically the spatio-temporal dynamics of class-B broad-area lasers under external optical injection into the cavity. It is shown that weak external optical injection can enable stabilizing of transverse instabilities inherent for class-B broad-area lasers. The coherent optical injection can be also applied for the effective suppression of the relaxation oscillations and spiking behaviour.

WeR8-p02 **09:30-13:30**

Quantum entanglement of vectorial optical self-diffraction in ion-implanted silicon quantum dots

C. Torres-Torres[1], J. Bornacelli[2], R. Rangel-Rojo[3], A. Oliver[2]; 1 - National Polytechnic Inst., 2 - National Autonomous Univ. of Mexico, 3 - Optics Dept., CICESE, Mexico

Entangled multi-spatial-optical fields provided by a multi-wave mixing process in silicon quantum dots were analyzed. The samples were nucleated by an ion-implantation method in a silica matrix. It is highlighted that configurable quantum correlations can be tailored by controlling the physical mechanisms responsible for the third order optical nonlinearities.

WeR8-p03 **09:30-13:30**

Polarizing properties of Ti-indiffused lithium niobate optical waveguides

M. Parfenov[1], P. Karavaev[2], P. Agruzov[2], I. Ilichev[2], A. Shamray[1,2,3]; 1 - Peter the Great St. Petersburg Polytechnic Univ., 2 - Ioffe Inst., 3 - ITMO Univ., Russia

Methods for selection, transformation, and control of light polarization in Ti-indiffused waveguides on lithium niobate (LiNbO3) substrates are described. The influence of technological parameters and waveguide topology is considered. The polarization extinction ratio higher than 40 dB/cm was experimentally demonstrated.

WeR8-p04 **09:30-13:30**

Stationary and dynamically persistent modes in nonlinearly-coupled three-dimensional harmonic oscillators

R. Driben[1,2], V.V. Konotop3 , B.A. Malomed[4], T. Meier[2]; 1 - ITMO Univ., Russia, 2 - Univ. of Paderborn, Germany, 3 - Univ. de Lisboa, Portugal, 4 - Tel Aviv Univ., Israel

The dynamics of a pair of three-dimensional matter-wave harmonic oscillators (HOs) coupled by a repulsive cubic nonlinearity is investigated through direct simulations of the respective Gross-Pitaevskii equations (GPEs) and with the help of the finite-mode Galerkin approximation (GA).

WeR8-p05 **09:30-13:30**

Generation of high extinction optical pulses by means of LiNbO3 Mach-Zehnder modulators

V.V. Lebedev[1], A.V. Tronev[1,2], A.N. Petrov[1], P.M. Agruzov[1], I.V. Ilichev[1], A.V. Shamray[1,2,3]; 1 - Ioffe Inst., 2 - ITMO Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

High extinction optical pulse generation via cw modulation in lithium niobate Mach-Zehnder integrated optical modulators is discussed, and methods for bias point stabilization and pulse shape measurements are presented. Generation of high dynamic extinction (>40 dB) optical pulses by a high static extinction lithium niobate modulator was experimentally demonstrated.

WeR8-p06 **09:30-13:30**

Threshold effect in the substance with carbon nanotubes and graphene oxide within optical limiting

M.S. Savelyev, A.Yu. Gerasimenko, S.A. Tereshchenko, V.M. Podgaetsky; National Research Univ. of Electronic Technology (MIET), Russia

Determination of nonlinear optical characteristics of active substances of the limiters of high-power laser radiation was carried out with the help of non-threshold and new threshold models. Experimental data of z-scan with open aperture was obtained, which helped to determine values of the nonlinear optical characteristics for dispersion media with carbon nanotubes and graphene oxide. Advantages of threshold model experimental data processing in comparison with non-threshold model was shown.

WeR8-p07 **09:30-13:30**

Nonlinear band-structure of an exciton-polariton condensate in a one-dimensional lattice

I.Yu. Chestnov[1], A.V. Yulin[2], A.P. Alodjants[1,2], I.A. Shelykh[3], O.A. Egorov[4]; 1 - Stoletovs Vladimir State Univ., Russia, 2 - ITMO Univ., Russia, 3 - Univ. of Iceland, Iceland, 4 - Friedrich-Schiller-Univ. Jena, Germany

We study steady-states and nonlinear band structure of dissipative incoherently driven exciton-polariton condensate localized in periodic one-dimensional potential. Within the framework of mean-field description we predict existence of the persistent current Bloch states at the edge of Brillouin zone. Influence of the nonlinear band-structure on exciton-polariton condensate dynamics is discussed.

WeR8-p08 **09:30-13:30**

Laser processing of materials in the multiple filamentation mode

K.S. Khorkov, D.A. Kochuev, D.V. Abramov, A.S. Chernikov, S.M. Arakelian, V.G. Prokoshev; Stoletovs Vladimir State Univ., Russia

The phenomenon of filamentation of femtosecond laser pulses enables to implement controlled redistribution of intensity in the cross section of the laser beam. Registration of spatial distribution of radiation intensity after passing through the transparent medium shows further spread the multiple filaments that allows realize laser microprocessing of materials.

WeR8-p09 **09:30-13:30**

Non-trivial regimes of a polariton Rabi oscillator

N.S. Voronova[1,2], A.A. Elistratov[3], Yu.E. Lozovik[4]; 1 - National Research Nuclear Univ. MEPhI, 2 - Russian Quantum Center, 3 - Inst. for Nanotechnologies in Microelectronics RAS, 4 - Inst. for Spectroscopy RAS, Russia

We analyze the effects of detuning, gain, and dissipation on Rabi oscillations in semiconductor microcavities, assuming a cw pumping via excitonic reservoir. We show the existence of non-trivial regimes reminiscent of internal Josephson effect, Van de Pol oscillations with amplitude-dependent damping, and the «inverted» stationary state with polaritons accumulating at the upper polariton branch while the lower branch becomes unstable.

WeR8-p10 **09:30-13:30**

Slow soliton-like elastic waves in metals: one more observation and application

E.M. Kudriavtsev[1], S.D. Zotov[1], A.A. Lebedev[1], V.V. Roshchupkin[2]; 1 - Lebedev Physical Inst. RAS, 2 - Baykov Inst. of Metallurgy and Material Science RAS, Russia

To decrease the number of defects in preliminary deformed sample of nickel, it was annealed in vacuum furnace (during 5 hours at T~1000°C). This time period could be markedly decreased by help of previous sample irradiation with the 2 Hz CO2 laser pulses during 30 hours but now at room temperature.

WeR8-p11 **09:30-13:30**

Investigation of nonlinear properties of media with Kerr nonlinearity by imaging of an amplitude object with powerful laser radiation

A.A. Murzanev, V.O. Martynov; Inst. of Applied Physics RAS, Russia

Propagation of the powerful radiation through the optical system may be accompanied by a number of distortions in the transmitted image. We characterize the nonlinear phase of the laser beam for the media with instantaneous local Kerr nonlinearity by characterization of distortions in the image transferred through the nonlinear optical system.

WeR8-p12 **09:30-13:30**

Influence of clasic noise on entangled state formation in nonequlibrium systems

V.O. Martynov, V.A. Mironov, L.A. Smirnov; Inst. of Applied Physics RAS, Russia

Features of high-temperature entangled states formation have been studied in a system consisting of two parametrically coupled identical quantum harmonic oscillators, each of which is placed in a separate independent thermal bath, in the conditions of partially coherent pumping.

WeR8-p13 **09:30-13:30**

Temperature dependence of SHG efficiency by focusing of laser radiation

A.L. Bondarenko[1], S.G. Grechin[2], D.G. Kochiev[3], A.N. Sharikov[3]; 1 - Space Research Inst. RAS, 2 - Bauman Moscow State Technical Univ., 3 - Prokhorov General Physics Inst. RAS, Russia

The paper presents the peculiarities of the temperature dependence for the second harmonic generation efficiency of focusing laser radiation. It is shown that an asymmetry of the dependence is the result of the vector phase-matching process near the crystal axis.

WeR8-p14 **09:30-13:30**

Damage of an AR-coated LBO crystal by laser pulses of microsecond duration

S.G. Grechin[1], D.G. Kochiev[2], A.E. Kokh[3], A.N. Sharikov[2]; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, 3 - Sobolev Inst. of Geology and Mineralogy SB RAS, Russia

The optical damage of an LBO crystal by laser pulses of microsecond duration at 1.0796 μm and 0.5398 μm is investigated.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

WeR8-p15 **09:30-13:30**

Numerical simulation of image inversion of small-scale opaque object by the phase contrast technique with adaptive nonlinear Kerr filter

E.L. Bubis[1], V.O. Martynov[1], A.A. Murzanev[1], V.V. Lozhkarev[1], O.A. Malshakova[1], A.N. Stepanov[1,2], A.I. Smirnov[1,2]; 1 - Inst. of Applied Physics RAS, 2 - Lobachevski State Univ., Russia

Numerical simulation of the process of inversion of the small-scale image of the object in phase-contrast scheme with nonlinear Kerr filter described.

WeR8-p16 **09:30-13:30**

Advanced scheme of amplifier similariton laser

D.A. Korobko[1], O.G. Okhotnikov[1,2], I.O. Zolotovskii[1]; 1 - Ulyanovsk State Univ. Russia, 2 - Tampere Univ. of Technology, Finland

We propose an advanced scheme of amplifier similariton laser providing an output pulse spectrum much wider than the gain bandwidth. The proposed scheme demonstrates a drastic increase of the output pulse spectrum width, reduction of the pulse duration, and increase of the output pulse peak power after compression.

WeR8-p17 **09:30-13:30**

Growth and characterization of new laser & nonlinear optical crystal Nd0,83Y0,22Sc2,95(BO3)4

A.E. Kokh[1], N.G. Kononova[1], K.A. Kokh[1,2], A.B. Kuznetsov[1,2], A. Maillard[3], R. Maillard[3], F. Khaled[4], P. Loiseau[4], G. Aka[4]; 1 - Sobolev Inst. of Geology and Mineralogy SB RAS, Russia, 2 - Novosibirsk State Univ., Russia, 3 - LMOPS Lorraine Univ. and Supelec, France, 4 - PSL, Research Univ. Inst. de Recherche de Chimie Paris IRCP, France

Single crystals of Nd0,83Y0,22Sc2,95(BO3)4 (NdYSB) have been grown in LiBO2–LiF system. NdYSB crystallizes in non centrosymmetrical huntite-like structure with space group R32. The nonlinear optical coefficient deff (I) = d11cosθcos3φ has been determined to be 1.77 pm/V. Fluorescence spectra of the NdYSB by the exciting at λ=811 nm shows 4F3/2 → 4I11/2 transition of the Nd3+ ions expected NdYSB crystal to laser oscillations at 1061nm. In fact NdYSB crystal can investigate as self doubling laser material.

WeR8-p18 **09:30-13:30**

Raman gain coefficients in potassium-gadolinium tungstate at the wavelength of 532 nm

R. Chulkov[1], V. Markevich[1], V. Orlovich[1], M. El-Desouki[2]; 1 - Stepanov Inst. of Physics NASB, Belarus, 2 - King Abdulaziz City for Science and Technolodgy (KACST), Saudi Arabia

Experimental and numerical data on Stokes generation under the spectrally-limited nanosecond pulse excitation are collated to find the steady-state Raman gain coefficients. The approach is tested for barium nitrate. For potassium-gadolinium tungstate, the coefficients values of 14±3 and 11±3 cm/GW are determined in the p[mm]p and p[gg]p sample orientations, respectively, at 532 nm wavelength.

WeR8-p19 **09:30-13:30**

Dispersive distortions of signals in an analog fiber-optic link with direct intensity modulation

V.V. Shcherbakov[1], A.F. Solodkov[1], A.A. Zadernovsky[2]; 1 - JSC "Center VOSPI", 2 - Technological Univ. MIREA, Russia

We present experimental results on transmission of signals in an analog fiber-optic link with direct intensity modulation and direct detection of photocurrent. It was found that the output signals reveal ether power suppression or power revival depending on the modulation frequency. We also observed nonlinear distortions of the signals. Theoretical interpretation of the experimental results is presented.

WeR8-p20 **09:30-13:30**

Approach for producing the nanocrystalline sitall samples with distributed refractive index

I.L. Vinogradova, A.I. Salihov, R.V. Kutluyarov, A.Kh. Sultanov; Ufa State Aviation Technical Univ., Russia

We have explored a novel technique for producing transparent volumetric nanocrystalline sitall by means of intensive plastic deformation. This material is intended to be used for components of fiber optic devices, including various applications in all-optical networks. We have examined properties of the material experimentally and by means of the proposed analytical model.

WeR8-p21 **09:30-13:30**

Numerical modeling of the dynamics of bidirectional long ring Raman fiber laser

S.V. Sukhanov, L.A. Melnikov, Yu.A. Mazhirina; Gagarin State Technical Univ. of Saratov, Russia

We demonstrate the numerical model which allows investigation of gyroscopic effect in hybrid mode-locked bidirectional Erbium-doped fibre ring laser. The model is based on transport theory with accounting of dispersion, gain in EDFA and saturable absorption. The predictions of gyroscopic effect are also presented for the particular laser cavity.

WeR8-p22 **09:30-13:30**

LuAB crystal for frequency conversion

Yu.D. Arapov, S.G. Grechin, I.V. Kasianov; RFNC-VNIITF, Russia

In the last decade it synthesized a promising nonlinear crystal aluminum-borate lutetium. The paper presents the evaluation of the applicability of the crystal for various applications of nonlinear optical frequency conversion.

WeR8-p23 **09:30-13:30**

Investigation of interaction femtosecond radiation with biological objects

P.I. Rogov, V.G. Bespalov; ITMO Univ., Russia

In this paper we presented a mathematical model that describes the linear and nonlinear processes arising from action of femtosecond laser radiation on the skin and in vitreous of human eye. By methods of numerical simulation, it was performed the spectral solution of nonlinear equation describing dynamics of a two-dimensional TE-polarized radiation in a homogeneous isotropic medium with instantaneous cubic nonlinearity without using slowly varying envelope approximation. We have completed the solution of the equations describing the dynamics of the electron and phonon subsystems. The results of this work can be used to create a laser safety standard for femtosecond laser systems.

WeR8-p24 **09:30-13:30**

Vanadium doped gadolinium-scandiun aluminium garnet as a promising material for Q-switching in 1.0-1.7 μm spectral range

A.V. Sandulenko, A.N. Titov, L.I. Krutova, V.N. Vetrov, B.A. Ignatenkov; NITIOM Vavilov State Optical Inst., Russia

The absorption spectra gadolinium-scandium aluminum garnet crystals grown by Czochralski method have been investigated. Vanadium absorption bands have been identified. The additional absorption has been obtained via high temperature thermal treatment.

WeR8-p25 **09:30-13:30**

Functional capabilities of temperature insensitive frequency conversion using biaxial crystals

S.V. Gagarskiy[1], S.G. Grechin[2], P.J. Druginin[1]; 1 - ITMO Univ., 2 - Bauman Moskow State Univ., Russia

The processes of temperature insensitive sum and difference frequency generation (SFG and DFG, correspondingly) using KTO and LBO crystals within their transparency range are discussed. It is shown that a temperature width of phase-matching condition as large as tens to hundreds degrees can be obtained within the wavelength range comparable with this of phase synchronism.

WeR8-p26 **09:30-13:30**

Nonlinear dynamics of two coupled fiber lasers for generation of THz radiation

L.A. Kochkurov, M.I. Balakin, L.A. Melnikov, V.V. Astakhov; Gagarin Saratov State Technical Univ., Russia

Nonlinear dynamics of two fiber lasers coupled with intracavity difference frequency generation for generation of THz has been studied. Proposed model is based on the transport-type equations, spatial discretization along the cavity axis, and calculation of temporal variations both electric field amplitude and active media inversion at these points. It is shown that system under study can demonstrate steady-state, periodic and quasiperiodic regimes.

WeR8-p27 **09:30-13:30**

Control of structure of magnetic field by laser radiation

E.V. Rukin[1], N.S. Myazin[1], A.A. Petrov[1], V.V. Davydov[1], E.N. Velichko[1,2]; 1 - Peter the Great St. Petersburg Polytechnic Univ., 2 - ITMO Univ., Russia

A method for constructing an optical image of the structure of magnetic field lines with the help of a ferrofluid cell is considered. The experimental results have shown that the method allows one to determine in real time the heterogeneity and direction of the magnetic field in addition to the structure of magnetic field lines.

WeR8-p28 **09:30-13:30**

Fluorescent properties of chromone-class isomers converted by single- and multiphoton excitation

A. Ayt[1], V.A. Barachevsky[1], S.V. Gagarskiy[2], V.V. Kiyko[3], A.N. Sergeev[2], Y.Y. Sukhikh[2], A.V. Veniaminov[2], V.V. Zakharov[2]; 1 - Photochemistry Center RAS, 2 - ITMO Univ., 3 - Prokhorov General Physics Inst. RAS, Russia

This work describes some aspects of photo-transformation of Chromone-based organic compounds and optical properties dynamics of different isomers as well. The multiple fluorescent forms of chromone molecules can be obtained under multi photon excitation as opposite to single photon one.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

WeR8-p29 **09:30-13:30**

Optical vortex generation using photoinduced orientational defects in nematic liquid crystals

I.A. Budagovsky[1], S.A. Shvetsov[1,2], M.P. Smayev[1], A.S. Zolot'ko[1], M.I. Barnik[3]; 1 - Lebedev Physical Inst. RAS, 2 - Moscow Inst. of Physics and Technology, 3 - Shubnikov Inst. of Crystallography RAS, Russia

Optical vortices were generated by means of photoinduced point defects in orientation of the nematic liquid crystal (NLC). The axisymmetric distribution of NLC director field was produced due to photorefractive effect in NLC or due to isotropic channel formation in light absorbing NLC.

WeR8-p30 **09:30-13:30**

Nonlinear polarization in comb-spectroscopy

S. Uvarova, A. Antipov, S. Pulkin, E. Borisov, V. Arnautov; St. Petersburg State Univ., Russia

Two methods were applied to compute the 2-level atom driven by a polychromatic field. The first method is a direct numerical solution of the density matrix equations and the second one is a harmonic basis decomposition resulting in an infinite linear algebraic equation system. It is showed the resonance frequency mostly follows the transition frequency. But some frequency pulling or pushing is observed depending on the transition frequency inside the field component bounds or not.

WeR8-p31 **09:30-13:30**

On diagnostic capability of scattered laser radiation in internal defect analysis of conduct pipe

V.A. Vologdin[1], V.V. Davydov[1], E.N. Velichko[1,2], V.V. Nikolsky[1]; 1 - Peter the Great Saint Petersburg Polytechnic Univ., 2 - ITMO Univ., Russia

A new method of diagnostics of defects on internal parts of pipelines by scattered laser radiation on flowing fluid is considered. A coordinate of junction point of laser beams in section plane of pipeline with fluid flow was calculated.

WeR8-p32 **09:30-13:30**

Swift C5+ ion irradiated optical ridge waveguides in nonlinear Yb:YCOB crystal

Ya. Cheng[1], Sh. Zhou[2], F. Chen[1]; 1 - Shandong Univ., China, 2 - Inst. of Ion Beam Physics and Materials Research, Germany

We report on the fabrication of optical ridge waveguides in Yb:YCOB crystal. The ridge waveguide structures show good guiding properties at 1064 nm along TM polarization and the lowest propagation loss is measured to be 1.7 dB/cm.

WeR8-p33 **09:30-13:30**

Induced modulation instability of surface plasmon polaritons in an ultra-thin metal film

S. Moiseev[1,2], D. Korobko[1], I. Zolotovskii[1]; 1 - Ulyanovsk State Univ., 2 - Kotel'nikov Inst. of RadioEngineering and Electronics RAS, Russia

The effect of the modulation instability of surface plasmon polariton waves in an ultra-thin metal film is demonstrated. It is shown that the modulation instability effect could be used for the generation of signals with a repetition rate in the terahertz range and ultrafast trains of picosecond optical pulses.

WeR8-p34 **09:30-13:30**

Numerical modeling of gyroscopic effect in bidirectional ultrafast erbium-doped fibre laser

S. Sukhanov[1,2], L. Melnikov[1], M. Chernysheva[2]; 1 - Gagarin State Technical Univ. of Saratov, Russia, 2 - Aston Univ., United Kingdom

We demonstrate the numerical model which allows investigation of gyroscopic effect in hybrid mode-locked bidirectional erbium-doped fibre ring laser. The model is based on transport theory with accounting of dispersion, gain in EDFA and saturable absorption. The predictions of gyroscopic effect are also presented for the particular laser cavity.

WeR8-p35 **09:30-13:30**

Collision of 3D bipolar light pulses in an array of carbon nanotubes

A.V. Zhukov[1], R. Bouffanais[1], B.A. Malomed[2], H. Leblond[3], D. Mihalache[4,5], E.G. Fedorov[6,7], N.N. Rosanov[7,8,9], M.B. Belonenko[10,11]; 1 - Singapore Univ. of Technology and Design, Singapore, 2 - Tel Aviv Univ., Israel, 3 - Univ. of Angers, France, 4 - Academy of Romanian Scientists, Romania, 5 - Horia Hulubei National Inst. of Physics and Nuclear Engineering, Romania, 6 - Technion-Israel Inst. of Technology, Israel, 7 - Vavilov State Optical Inst., Russia, 8 - ITMO Univ., Russia, 9 - Ioffe Inst., Russia, 10 - Volgograd Inst. of Business, Russia, 11 - Volgograd State Univ., Russia

We study the propagation and collision of extremely short electromagnetic pulses in an array of semiconductor carbon nanotubes. The mathematical model takes into account non-uniformity of the pulses' fields and redistribution of electron concentration in the system. We establish a possibility of stable post-collision propagation of pulses over distances much greater than their sizes.

R1. SOLID-STATE LASERS

Location: Stenberg Room, floor 3, 09:00 – 11:00

Solid-State Lasers V

Session Chair: Maximilian Lederer, European XFEL GmbH, Germany

ThR1-26 Invited **09:00-09:30**

High energy and average power laser drivers via large aperture cryogenic composite thin disk method

L.E. Zapata[1], F. Reichert[2], M. Hemmer[1], F.X. Kaertner[1,2,3]; 1 - Deutsches Elektronen Synchrotron, Germany, 2 - Univ. Hamburg, Germany, 3 - Massachusetts Inst. of Technology (MIT), United States

We are constructing chirped-pulse multipass amplifiers capable of delivering high energy (to 1-J) at high repetition rate (to 1-kHz) using liquid nitrogen cooled Yb:YAG gain-elements of composite disk geometry. Recent experimental progress that yielded 160 mJ at 250 Hz will be discussed. The ongoing effort in scaling to 1-J/1-kHz output will be presented.

ThR1-27 **09:30-09:45**

A new beam shaping technique implemented in 260 watt 1 kilohertz repetition rate picosecond pulse amplifier

J. Adamonis[1], A. Aleknavicius[1], S. Balickas[1], T. Gertus[2], A. Michailovas[1,3], A. Zaukevicius[1,3], K. Michailovas[1], V. Petrauskiene[1]; 1 - EKSPLA, 2 - Workshop of Photonics, 3 - Center for Physical Sciences and Technology, Lithuania

We present a practical implementation of a novel beam shaping technique (based on spatially variable phase retardation plate inscription in fused silica glass by femtosecond pulses) in a high average power picosecond pulse amplifier.

ThR1-28 **09:45-10:00**

Thermal distortions and heat sources in disk laser active element

M.R. Volkov, I.I. Kuznetsov, I.B. Mukhin; Inst. of Applied Physics RAS, Russia

Thermally induced phase distortions of disc laser active element are measured and calculated. Theoretical model shows deviation from experiment. Extra heat sources are expected to be the reason of the deviation.

ThR1-29 **10:00-10:15**

All-solid-state laser system with coherent combining of independent channels via common laser beam

A.P. Pogoda, A.V. Fedin, A.S. Boreysho; Baltic State Technical Univ., Laser Systems LTD, Russia

The multichannel laser system with coherent combining as a result of fourwave mixing in active laser media is proposed.

ThR1-30 **10:15-10:30**

Single frequency MOPA based on Nd:YAG bulk and fiber single crystals

Z. Liu, S. Men, Y. Liu, H. Rao, Z. Cong, S. Zhang, X. Zhang; Shandong Univ., China

By employing Nd:YAG single crystal fiber and rods, single frequency 1064-nm master oscillator power amplifier is realized. Output power is 31.3 W with peak power of 464 kW and linewidth of less than 130 MHz.

ThR1-31 **10:30-10:45**

Thin-tapered-rod Yb:YAG amplifier for fiber oscillator

I.I. Kuznetsov, I.B. Mukhin, O.V. Palashov; Inst. of Applied Physics RAS, Russia

High average power and high-gain laser amplifier based on thin-tapered-rod Yb:YAG crystal with waveguide diode pumping is realized. Signal of the subpicosecond fiber oscillator is amplified up to 15 W average power with 20% optical efficiency.

ThR1-32 **10:45-11:00**

A 13 W LD-pumped narrow-linewidth linearly polarized Yb-doped fiber laser operating at 1152 nm

L. Huang, H. Zhang, X. Wang, R. Su, P. Zhou; National Univ. of Defense Technology, China

We demonstrate a 1152 nm narrow-linewidth linearly polarized all-fiber laser directly pumped by laser diodes at 976 nm. When temperature of gain fiber is increased to about 115 °C, a maximum output power of 13 W is obtained and corresponding slope efficiency is ~45%. The polarization extinction ratio and 3dB linewidth at the maximum output power are 18 dB and 0.14 nm respectively, which is an attractive result for some special applications such as nonlinear conversion.

- Coffee Break -

Location: Stenberg Room, floor 3, 11:30 – 13:15

Solid-State Lasers VI

Session Chair: Uwe Griebner, Max-Born-Inst., Germany

ThR1-33 Invited **11:30-12:00**

High-power Yb:amplifiers seeded by a femtosecond Er:fiber laser

D. Brida, J. Fischer, P. Storz, A. Leitenstorfer; Univ. of Konstanz and Center for Applied Photonics, Germany

We present two alternative implementations of high-power Yb:amplifiers designed for advanced applications in ultrafast science. The seed is generated by ultrabroadband Er:fiber laser technology. Our fiber-based setup produces pulses at 1030 nm with energies of 6 μJ at a repetition rate of 10 MHz and duration of 145 fs. The thin-disk amplifier is operated at 3 kHz repetition rate and generates 655-fs pulses with energies up to 17 mJ.

ThR1-34 **12:00-12:15**

Dispersion-managed soliton generation in the hybrid mode-locked Erbium-doped All-fiber ring raser

D.A. Dvoretskiy[1], S.G. Sazonkin[1], V.S. Voropaev[1], S.O. Leonov[1], A.B. Pnev[1], V.E. Karasik[1], A.A. Krylov[2], E.D. Obraztsova[3]; 1 - Bauman Moscow State Technical Univ., 2 - Fiber Optics Research Center RAS, 3 - Prokhorov General Physics Inst. RAS, Russia

We report on the ultra-short dispersion-managed soliton generation in the erbium-doped all-fiber ring laser hybrid mode-locked with Carbon:Boron Nitride Single-Walled Nanotubes in the co-action with a nonlinear polarization evolution.

ThR1-35 **12:15-12:30**

Uni- and bidirectional hybrid mode-locked Erbium-doped isolator-free fibre laser

M. Chernysheva[1], M. Al Araimi[1,2], S. Sukhanov[1,3], R. Arif[4], A. Rozhin[1]; 1 - Aston Inst. of Photonic Technologies, Aston Univ., United Kingdom, 2 - Al MUnited Statesnna College of Technology, Sultanate of Oman, 3 - Gagarin Saratov State Technical Univ., Russia, 4 - Univ. of Sulaimani, Iraq

We have investigated a hybrid mode-locked Erbium-doped fibre ring laser without optical isolator. Creating different losses in the cavity for counter-propagating pulses via net birefringence adjusting, the laser can operate in both unidirectional regimes with extinction over 22 dB, as well as can establish stable bidirectional generation.

ThR1-36 **12:30-12:45**

Generation of harmonic oscillations in ring resonator with high Q-factor

S.A. Kolpakov, H. Kbashi, Yu. Loika, S. V. Sergeyev; Aston Univ., United Kingdom

We report on generation of harmonic oscillations with frequencies of hundreds of MHz and radio-frequency linewidth of 13 Hz in unidirectional ring laser oscillator. This high stability makes these oscillators a suitable substitute for existing quartz resonators used in high frequency optoelectronics applications.

ThR1-37 **12:45-13:00**

All-fiber hybridly mode-locked similariton ring laser for frequency metrology

V.A. Lazarev[1], A.A. Krylov[2], S.G. Sazonkin[1], A.B. Pnev[1], S.O. Leonov[1], D.A. Shelestov[1], M.K. Tarabrin[1], V.E. Karasik[1], A.N. Kireev[3], M.A. Gubin[3,4]; 1 - Bauman Moscow State Technical Univ., 2 - Fiber Optics Research Center RAS, 3 - Lebedev Physical Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia

We demonstrate the generation of stable 127 fs selfsimilar pulses at a central wavelength of 1560 nm with 7.14 mW average output power. Similariton lasers have low repetition rate deviation in the averaging time interval 1 – 1·10^3 s, a low relative intensity noise –125 dBc/Hz, a narrow single comb line width of 32 kHz, and high reliability. Thus, such lasers are highly promising for further development of the stabilized combs.

ThR1-38 **13:00-13:15**

Highly compact stretcher-compressor module for ultrafast chirped pulse amplification laser system

B. Lee[1], B. Jeong[1], S.A. Chizhov[1], E.G. Sall[1], J. Yang[1], V.E. Yashin[2], G.H. Kim[1]; 1 - Korea Electrotechnology Research Inst., Republic of Korea, 2 - Vavilov State Optical Inst., Russia

We introduce and demonstrate a simple, compact stretcher-compressor module that uses a single transmission diffraction grating. Three stretcher-compressor modules with different compression ratio have been compared.

- Lunch Break -

R1. SOLID-STATE LASERS

Location: Stenberg Room, floor 3, 15:00 – 17:00

Solid-State Lasers VII

Session Chair: Maximilian Lederer, European XFEL GmbH, Germany

ThR1-39 **15:00-15:15**

1 kHz, 10 mJ Q-switched diode pumped Nd:YAG laser with a variable reflctivity mirror

B. Oreshkov[1], K. Popov[2], S. Gagarsky[3], N. Belashenkov[3], I. Buchvarov[1]; 1 - Sofia Univ., Bulgaria, 2 - IBPhotonics Ltd., Sofia Univ., Bulgaria, 3 - ITMO Univ., Russia

We demonstrate 1 kHz, 10mJ actively Q-switched Nd:YAG laser with 15 ns pulse duration at 1 kHz repetition rate. A smooth output beam intensity distribution is achieved by the use of variable reflectivity Gaussian output mirror.

ThR1-40 **15:15-15:30**

Post-pulse generation effect in Q-switched lasers

K.F. Burdonov, E.A. Khazanov, A.A. Shaykin; Inst. of Applied Physics, Russia

We revealed experimentally the generation of a second giant pulse at the neighboring longitudinal mode in an Nd:YLF Q-switched laser and implemented new method of longitudinal mode selection based on this effect.

ThR1-41 **15:30-15:45**

6 mJ@3.3kHz Q-switched single mode single-frequency Nd:YAG end pumped laser

A.F. Kornev, V.P. Pokrovskyi, S.S. Sobolev, S.S. Terekhov; ITMO Univ., Russia

End pumped MOPA Nd:YAG pulsed laser was built and investigated. High extraction efficiency ~50% in single-pass amplifier is achieved due to high small-signal gain provided with longitudinal pumping. Pumping of amplifier is near uniformly distributed along 2 laser rods with low concentration using two-lens relay between them in order to decrease end overheating.

ThR1-42 **15:45-16:00**

946 nm Nd:YAG regenerative amplifier 20 mJ/3 ns

E.A. Buslaeva[1,2], S.V. Gagarskiy[2], P.A. Gnatyuk[2], A.S. Kovyarov[1,2], A.F. Kornev[1], V.P. Pokrovskiy[1]; 1 - Lasers and optical systems, Ltd., 2 - ITMO Univ., Russia

Laser is based on scheme "master oscillator with cavity dumpin g (MO) → regenerative amplifier (RA)". It produces 20 mJ with pulse repetition rate 50 Hz and pulse length 3 ns. High- speed drivers were used. The radiation divergence close to the diffraction -limited and high stability of output signal were obtained.

ThR1-43 **16:00-16:15**

Diode-pumped Pr:LiY0.3Lu0.7F4 and Pr:LiYF4 red laser at 640 nm

A.A. Lyapin[1], P.A. Ryabochkina[1], V.V. Semashko[2], V.G. Gorieva[2]; 1 - Inst. of Physics and Chemistry, Ogarev Mordovia State Univ., 2 - Kazan Federal Univ., Russia

The laser quality Pr:LiY0.3Lu0.7F4 and Pr:LiYF4 fluoride single crystals have been prepared by Bridgman method. Laser oscillations of Pr:LiY0.3Lu0.7F4 crystal was obtained at 640nm under diode pumping at 442nm, with the slope efficiency of 9%. Also, the continuous-wave laser have been obtained for Pr:LiYF4 crystal at 640nm pumped by a diode laser with the slope efficiency of 8.5%.

ThR1-44 **16:15-16:30**

On the nature of donor centres involved into the down-conversion in Yb doped Scheelite-like crystals

K.A. Subbotin, Yu.N. Osipova, D.A. Lis, D.A. Nikolaev, V.A. Smirnov, E.V. Zharikov, I.A. Shcherbakov; Prokhorov General Physics Inst. RAS, Russia

The efficient 1 μm Yb3+ luminescence was found in Scheelite-like molybdate and tungstate crystals at UV-excitation. The presentation is devoted to discussion about the nature of optical donor centres in the crystals, which absorb the UV excitation and non-radiatively transfer their excited state energy to the 2F5/2 excited state of Yb3+ ions.

ThR1-45 **16:30-16:45**

Color centers transient absorption and ultra-short pulse lasing from LiLu0.7Y0.3F4:Ce3+ active medium

I.I. Farukhshin, A.S. Nizamutdinov, V.V. Semashko, S.L. Korableva, M.A. Marisov; Kazan Federal Univ., Russia

We have obtained the single pulse laser oscillation with 400±10 ps pulse duration at 311 nm from LiLu0.7Y0.3F4:Ce3+ crystal was obtained from intracavity loss modulation via pump-induced color centers bleaching. Modulation of intracavity losses is regulated via color centers concentration.

ThR1-46 **16:45-17:00**

A tunable laser near 535 nm

X. Liu, G. Tang, X. Zhang, Zh. Cong, X. Chen, Z. Qin, Zh. Liu, J. Lu; Shandong Univ., China

This paper presents a tunable laser near 535 nm. It is obtained by the intracavity frequency doubling of the tunable Stokes laser emission based on the stimulated polariton scattering in MgO:LiNbO3 crystal. The tunable green laser wavelength range was from 534.8 nm to 536.9 nm. The maximum output energy at 535.7 nm was 4.48 mJ.

R2. HIGH POWER LASERS

Location: Petrov-Vodkin 1 Room, floor 2, 09:00 – 11:00

High Power Lasers IV

Session Chair: Oleg B. Danilov, Vavilov State Optical Inst., Russia

ThR2-14 **09:00-09:15**

Pressure broadening of Ar (811.5 nm) by neon

A.R. Gildina[1,2], P.A. Mikheyev[1,2], A.K. Chernyshov[2], N.I. Ufimtsev[2], V.N. Azyazov[1,2], M.C. Heaven[1,3]; 1 - Samara State Aerospace Univ., 2 - Lebedev Physical Inst. RAS, Samara Branch, Russia, 3 - Emory Univ., United States

Results of systematic measurements of pressure broadening for argon in 40 MHz RF discharge plasma in neon are presented. Using the tunable diode laser spectroscopy, we obtained the experimental data on pressure broadenings for argon 811.5 nm line by neon and pressure broadening coefficient was determined for the first time.

ThR2-15 **09:15-09:30**

A non-chain HF laser with repetitive rate of 100Hz

H. Chao, H. Ke, Y. Ai-ping, T. Ying, Zh. Feng, M. Lian-ying, L. Gao-peng; Northwest Inst. of Nuclear Technology, China

The non-chain HF laser with the self-acting ultraviolet preionization was developed. A pair of like Chang profiled electrodes defines a 12×17×480 mm3 discharge volume through which gas flow is forced in the direction transverse to the optical axis. In 100Hz pulse repetitive operation, the average power obtained was 40W in a 92% SF6:8% C2H6 gas mixture.

ThR2-16 **09:30-09:45**

Vibrational kinetics of molecular singlet oxygen

A.P. Torbin[1,2], P.A. Mikheyev[1,2], M.C. Heaven[1,3], V.N. Azyazov[1,2]; 1 - Samara State Aerospace Univ., 2 - Lebedev Physical Inst. RAS, Samara Branch, Russia, 3 - Emory Univ., United States.

Experimental study of vibrationally-excited singlet oxygen O2(a,v) kinetics have been performed. Rate constant of O2(a,v=1) quenching by CO2 was measured. It was shown that vibrational excitation of singlet oxygen molecule accelerates the rate of reaction between O2(a,v) and O3 molecules.

ThR2-17 **09:45-10:00**

Long-term mode degradation in ytterbium-doped pulsed fiber lasers

K.K. Bobkov, M.M. Bubnov, S.S. Aleshkina, M.E. Likhachev; Fiber Optics Research Center RAS, Russia

A novel effect of long-term mode degradation in a low-average-power high-peak-power ytterbium-doped pulsed fiber lasers based on large mode area step-index fibers has been reported for the first time.

ThR2-18 **10:00-10:15**

10-60 kHz operation mode of waveguide CO2-laser with wavelength selection option

A.A. Boyko[1], A.I. Karapuzikov[2], S.B. Chernikov[2], V.V. Spitcin[2], K.G. Zenov[1], I.B. Kuznetsova[1], A.A. Markelov[1]; 1 - Special Technologies, Ltd., 2 - Inst. of Laser Physics, SB RAS, Russia

Possibility of obtaining the pulse-periodic lasing mode with 100% modulation at pulse repetition rates from 10 kHz to 60 kHz is reported.

ThR2-19 **10:15-10:30**

Absorption in N2O and CH4 of overtone CO laser radiation measured by the using a topographic target and receiving telescope

A.A. Ionin[1], I.O. Kinyaevskiy[1], Yu.M. Klimachev[1], A.Yu. Kozlov[1], A.A. Kotkov[1], G.G. Matveenko[2,3], O.A. Romanovskii[2,3], S.V. Yakovlev[2,3]; 1 - Lebedev Physical Inst. RAS, 2 - Zuev Inst. of Atmospheric Optics SB RAS, 3 - Tomsk National Research State Univ., Russia

The trace remote sensing scheme of atmospheric gas components (nitrous oxide and methane) with emission lines of pulsed first-overtone CO laser is tested using a topographic target and receiving telescope. Results of the measurements and calculation of absorption on 20 selected emission lines in gas mixtures with the studied gases at various configurations of the experimental scheme are presented.

ThR2-20 **10:30-10:45**

Optimization of the parameters of gas-discharge active medium and optical resonator of RF excited planar CO-laser at room temperature

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

An output power of CO-lasers has been studied for operation at room temperature of the cooling running water from +7 to +16oC. A cw output power of 41 W for stable resonator and 21 W for unstable resonator has been achieved. The new configuration of hybrid waveguide-unstable optical resonator with the external additional mirror for the lasers is proposed and realized. We carried out experiments about the possibility of the optimization of the coupling coefficient of optical resonator with the aid of the external mirror, that is plane-parallel plate with different reflection coefficients.

ThR2-21 **10:45-11:00**

Laser on polycrystalline ZnSe:Fe2+ with high efficiency and pulse radiation energy at room temperature

K.N. Firsov[1,2], E.M. Gavrishchuk[3,4], V.B. Ikonnikov[3], S.Yu. Kazantsev[1], I.G. Kononov [1], T.V. Kotereva[3], D.V. Savin[3], N.A. Timofeeva[3]; 1 - Prokhorov General Physics Inst. RAS, 2 - National Research Nuclear Univ. MEPhI, 3 - Devyatykh Inst. of Chemistry of High-Purity Substances RAS, 4 - Lobachevski Nizhny Novgorod State Univ., Russia

A laser on polycrystalline ZnSe:Fe2+ is investigated at room temperature. Pumping of the laser was performed by pulsed electrodischarge HF laser. In experiments, the spot diameter of HF laser radiation incident to the surface of polycrystal varied from 6.7 to 14.5 mm. The generation energy of ~1.1 J has been obtained with the efficiency with respect to the energy absorbed in the polycrystal ηslope≈50%.

- Coffee Break -

Location: Hall Petrov-Vodkin 1 Room, floor 2, 11:30 – 12:45

High Power Lasers V

Session Chair: Vladimir E. Yashin, Vavilov State Optical Inst., Russia

ThR2-22 **11:30-11:45**

Exploration of gas flow optical quality of Chemical Oxygen-Iodine Laser (COIL) resonator area

Yu.A. Adamenkov, M.I. Bezrukov, M.A. Gorbunov, M.L. Leonov, A.V. Seleznev, D.V. Sokolov; RFNC-VNIIEF, Russia

Optical techniques for supersonic Chemical Oxygen-Iodine Laser (COIL) active medium exploration using methods of interferometry based on Talbot effect have been developed and implied. We have implemented these techniques in experiments on test gaseous mixture, that modeling real COIL gas flow conditions without COIL generation. We have measured Δn/n and Strehl number of active medium gas flow in optical resonator area.

ThR2-23 **11:45-12:00**

Elaboration of power optics for laser processing heads

P.A. Nosov, A.F. Shirankov, G.N. Martynov, V.Yu. Pavlov; Bauman Moscow State Technical Univ., Russia

The need to use the theory of laser optics to develop modern high-performance optical systems of laser processing heads, which form the beam of the high-power fibre laser, is discussed. A technique for synthesis of high-performance optical heads of laser systems for various purposes is elaborated and software-implemented.

ThR2-24 **12:00-12:15**

The CO laser sum frequency radiation obtained in a nonlinear crystals AgGaSe2 and ZnGeP2 and its absorption in CO2 and N2O gases

O.V. Budilova, A.A. Ionin, I.O. Kinyaevskiy, Yu.M. Klimachev, A.A. Kotkov, A.Yu. Kozlov; Lebedev Physical Inst. RAS, Russia

The broadband laser system based on sum frequency radiation of multi-line Q-switched CO laser in a nonlinear crystals AgGaSe2 and ZnGeP2 was developed. The absorption of the sum frequency radiation in such gaseous substances as nitrous oxide and carbon dioxide was studied. A comparison of the experimental data with the theoretically calculated absorption spectrum of radiation was carried out.

ThR2-25 **12:15-12:30**

Novel laser design based on intracavity chirped Bragg grating

V. Smirnov[1,2], O. Mokhun[1], R. Vasilyev[1], A. Glebov[1], L. Glebov[1], A.E. Zubko[2], E.V. Shashkov[2], A.V. Smirnov[2], .N.S. Vorobyev[2]; 1 - OptiGrate Corp., United States, 2 - Prokhorov General Physics Inst. RAS, Russia

Chirped Bragg Gratings (CBGs) in photo-thermo-refractive glass allow stretching and compression of ultra-short pulses. United Statesge of CBG as an intracavity element of Nd;Yag laser results in generation ps-pulses in compact and robust design. This paper will discuss properties of Nd:Yag laser and discuss potential applications for this laser.

ThR2-26 **12:30-12:45**

Precise testing of reflection and transmission coefficients of optical coatings of wide aperture elements

C.Yu. Golovkin, V.N. Derkach, D.V. Sizmin, V.A. Shenikov, V.O. Lashuk; RFNC-VNIIEF, Russia

Technique has been developed for measuring of the reflectance of dielectric coatings of optics having different optical strength. An absolute inaccuracy less than 0.1% and distribution of reflection for optics having aperture up to 800 mm are get.

R4. LASER BEAM CONTROL

Location: Deyneka Room, floor 2, 09:00 – 11:00

Laser Beam Control III

Session Chair: Alexis Kudryashov, AKAoptics SAS, France, Moscow State University of Mechanical Engineering, Russia

ThR4-12 Invited **09:00-09:30**

Spacial and temporal control of laser beams for biomedical multiphoton imaging

J.M. Bueno; Univ. Murcia, Spain

The performance of multiphoton microscopes is limited by both aberrations and pulse broadening. In this talk, adaptive optics and pulse compression procedures used to improve multiphoton imaging will be described. The implementation of these techniques enhances the quality of the acquired multiphoton images for different experimental conditions. The visibility of details is also improved, what is important for the characterization and analysis of certain tissues.

ThR4-13 Invited **09:30-10:00**

Adaptive optics for ultrashort pulse manipulation

C. Manzoni[1], A. Cantaluppi[2], S. Bonora[3], G. Cerullo[1]; 1 - Politecnico di Milano, Italy, 2 - Max Planck Inst. for the Structure and Dynamics of Matter, Germany, 3 - Univ. degli studi di Padova, Italy

Shaping of femtosecond light pulses is typically performed in the frequency domain, by manipulation of the pulse spectral intensity and phase. One tool for phase control uses a deformable mirror in the Fourier plane of a 4-f stretcher. In this work we show the ability of adaptive optics to shape femtosecond pulses. By including the shaper and the characterization block in a closed loop, it is possible to correct spectral phase distortions accumulated in an optical chain in few automatic iterations.

ThR4-14 **10:00-10:15**

Uniform focal spot formation in adaptive system with Shack-Hartmann sensor and M2 sensor

J. Sheldakova, A. Kudryashov, A. Rukosuev, A. Lylova; Moscow Univ. of Mechanical Engineering, Russia

Recent results of formation of uniform beam intensity distribution at the focal plane of a lens by means of bimorph deformable mirrors are presented. An approach based on the use of Shack-Hartmann wavefront sensor together with focal spot sensor (M2 meter) is suggested. Advantages and disadvantages are discussed.

ThR4-15 **10:15-10:30**

The laser beam focusing closed-loop control system on the long-range dynamic point target, implementing the method of double frequency of the spherical wave front probing

V.S. Denkevich, A.N. Kleymenov, Ya.I. Malashko, A.V. Nazarenko, A.O. Skvortsov; PJSC «SPA «Almaz», Russia

Control capabilities of an adaptive focusing loop on the plane of the distant dynamic point target using algorithm of maximizing the ratio of signal amplitudes on the doubled frequency and probe frequency is considered. Difference of control algorithm from earlier offered by us consists in use of small part of angular distribution of laser power. Physical modeling results of flight experiment for the purpose of focusing of powerful laser radiation on the distant dynamic point target without adaptive circuit are provided.

ThR4-16 **10:30-10:45**

A new method of the real-time atmospheric turbulence modeling

A. Lylova[1], A. Kudryashov[1], Ju. Sheldakova[1], G. Borsoni[2]; 1 - Moscow State Univ. of Mechanical Engineering, Russia, 2 - AKA Optics (SAS), France

It is suggested to reconstruct the real-time atmospheric turbulence in the lab by means of the stacked-actuator deformable mirror and the bimorph deformable mirror. The characteristics of the spatial reconstruction are shown. The phase screens interpolation methods are presented. The problems of the reconstruction are discussed.

ThR4-17 **10:45-11:00**

Influence of atmospheric turbulence on quality of multichannel laser radiation and correction for distortion

V.P. Lukin[1], O.L. Antipov[2], F.Yu. Kanev[1], N.A. Makenova[1]; 1 - Zuev Inst. of Atmospheric Optics SB RAS, 2 - Inst. of Applied Physics RAS, Russia

Influence of atmospheric turbulence on multichannel laser radiation is considered theoretically in the report. The model of turbulence is verified by comparison of numerical results with published theoretical and experimental data. The review of current investigations is also included into the report which allowed us to show the essence of results obtained by our group. To correct for distortion we used a flexible mirror with continuous reflecting surface and phase modulation in channels of the system. It was shown that influence of atmospheric turbulence and effectiveness of correction depends on number of optical fibres. Distortion decreases with increase of the number of channels and adaptive correction results in two-times increase of energy concentration for systems with 9 and 81 channels. For systems with greater number of channels (200 and more) the results of correction do not depend on turbulence intensity.

- Coffee Break -

Location: Deyneka Room, floor 2, 11:30 – 13:30

Laser Beam Control IV

Session Chair: Vladimir Yu. Venediktov, Saint-Petersburg State Electrotechnical Institute "LETI", Russia

ThR4-18 Invited **11:30-12:00**

A review of large scale lasers using adaptive optics

B. Le Garrec; LULI/ Ecole Polytechnique, France

The first laser systems to be equipped with adaptive optics are the fusion lasers. This was possible because wavefront sensors were becoming available and because many attempts were made to successfully design and operate large size deformable mirrors. There are different challenges that are encountered for delivering high-power lasers and I will be highlighting some of the main features of adaptive optics in laser design. ***(withdrawal)***

ThR4-19 Invited **12:00-12:30**

Active coherent beam combining of a fiber lasers array based on cascaded phase control

R. Su, Zh. Zhang, P. Zhou, Y. Ma, X. Wang, X. Xu; National Univ. of Defense Technology, China

An experiment for coherent beam combining of 16 fiber lasers based on cascaded phase control is demonstrated. In our experiment, both stochastic parallel gradient descent(SPGD) algorithm and single-frequency dithering technique are employed, and the residual phase error is $\lambda/24$.

ThR4-20 **12:30-12:45**

Fast focal-spot-based control algorithm for adaptive optics

D. Yagnyatinskiy, D. Lyakhov, A. Borshevnikov, V. Fedoseyev; FSUE SRI SIA "LUCH", Russia

A focal-spot-based algorithm for the elimination of aberrations in adaptive optical systems is proposed. The number of iterations connected with the physical impact on the deformable mirror isn't large. The algorithm uses the parabolic dependency of the focal-spot size square upon the coefficient of perturbations of the initial surface. It's required that the perturbation function's derivatives are orthogonalized.

ThR4-21 **12:45-13:00**

Orbital angular momentum of the vortex laser beams in a turbulent atmosphere: numerical modeling and asymptotic theory

V.P. Aksenov[1], V.V. Kolosov[1,2], G.A. Filimonov[1], C.E. Pogutsa[1]; 1 - Zuev Inst. of Atmospheric Optics RAS, 2 - Tomsk Scientific Center SB RAS, Russia

The total orbital angular momentum (OAM) of laser beams propagating through the turbulent atmosphere has been studied numerically and analytically. The variance of OAM fluctuations calculated from the numerical simulation is in a good agreement with the asymptotic estimates of the OAM variance in the domain of their applicability.

ThR4-22 **13:00-13:15**

Beam quality improvement in kHz solid state laser amplifier through utilization of a piezoelectric deformable mirror

B. Oreshkov[1], D. Chuchumishev[1], I. Buchvarov[1,2] , S. Gagarsky[2], V. Bezzubik[2], N. Belashenkov[2]; 1 - Sofia Univ., Bulgaria, 2 - ITMO Univ., Russia

We demonstrate a beam quality optimization of high energy, high average, high peak power solid state laser amplifier, by the use of a deformable mirror (DM) coupled with a CCD sensor.

ThR4-23 **13:15-13:30**

Beam control for wire lasers based on formation of optical image of laser modes

E.E. Orlova; Inst. for Physics of Microstructures RAS, Russia

We develop an approach to beam control of the lasers with subwavelength transverse dimensions and the length much larger than the wavelength (wire lasers). High radiation divergence of such lasers enables the formation of three-dimensional optical image of laser modes due to the interference of radiation from the distribution of sources along the laser waveguide. We analyze the structure of the image of a wire laser formed by a spherical lens and show that narrow beam can be obtained by choosing the parameters of the optical system leading to formation of a uniform image extended along the lens axis or by separating one of the maxima with a diaphragm.

R5. SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES

Location: Deyneka Room, floor 2, 15:00 – 17:00

Super-Intense Light Fields and Ultra-Fast Processes III

Session Chair: Luis Roso,
Centro de Láseres Pulsados, Spain

ThR5-13 Invited **15:00-15:30**

Collective particle dynamics driven by a relativistic plasma aperture in an ultra-thin foil

P. McKenna[1], B. Gonzalez-Izquierdo[1], R.J. Gray[1], M. King[1], R.J. Dance[1], R. Wilson[1], J. McCreadie[1], N.M.H. Butler[1], R. Capdessus[1], S. Hawkes[2], J.S. Green[2], M. Borghesi[3], D. Neely[2]; 1 - Univ. of Strathclyde, 2 - STFC Rutherford Appleton Laboratory, 3 - The Queens Univ. of Belfast, Northern Ireland

We report on experiment and simulation results which show that a 'relativistic plasma aperture' is produced in intense laser pulse interactions with an ultrathin foil target. Diffraction of the laser propagating through this aperture produces a near-field diffraction pattern, to which electrons collectively respond. Static and rotating beam profiles can be induced by variation of the laser polarization.

ThR5-14 **15:30-15:45**

Generation of attosecond relativistic electron jets in laser pulse interaction with gas targets

V.V. Kulagin[1,2], V.A. Cherepenin[2], V.N. Kornienko[2]; 1 - Sternberg Astronomical Inst. of Lomonosov Moscow State Univ., Russia, 2 - Kotel'nikov Inst. of RadioEngineering and Electronics RAS, Russia

Formation of attosecond relativistic electron jets from tape gas targets of subcritical concentration with a powerful ultra-short laser pulse is considered. Achievable characteristics of the jets are found. It is shown that for some range of parameters, a single relativistic electron mirror can be formed, which is appropriate for generation of coherent attosecond x-ray pulse using the counter reflection of the probe laser pulse.

ThR5-15 **15:45-16:00**

Laser energy absorption and hot electrons generation in near-critical plasma at relativistic intensities

I.N. Tsymbalov[1], K.A. Ivanov[1], S.A. Shulyapov[1], D.A. Krestovskih[1], R.V. Volkov[1], A.B. Savel'ev[1], P.A. Ksenofontov[2], A.V. Brantov[2], V.Yu. Bychenkov[2]; 1 - Lomonosov Moscow State Univ., 2 - Lebedev Physical Inst. RAS, Russia

Strong dependency of hot electron yield and energies in relativistic laser-plasma interaction on the pre-plasma properties is demonstrated. Experimental data and numerical simulation results are presented.

ThR5-16 **16:00-16:15**

Dynamics of inhomogeneous plasma expansion in intense femtosecond laser-ablated aluminum plumes

A. Stepanov, M. Garasev, A. Korytin, V. Kocharovsky, Yu. Mal'kov, A. Murzanev, A. Nechaev, D. Yashunin; Inst. of Applied Physics RAS, Russia

Dynamics of an inhomogeneous plasma expansion generated by intense fs laser radiation from a metal Al foil was investigated experimentally and simulated numerically. A shock wave-like structure moving at a constant velocity V ≈ 1.5•10^7 cm/s (close to ion-acoustic one) was observed and explained as a quasi-electrostatic collisionless shock owing to inhomogeneous pre-plasma swept by a flow of hot electrons.

ThR5-17 Invited **16:15-16:45**

Ion acceleration with PW-ultrashort laser pulse

S. Ter-Avetisyan; Inst. for Basic Science, Gwangju Inst. of Science and Technology, Republic of Korea

The unique exploratory mission of this research is to build the scientific foundation needed to develop high energy laser particle accelerators, to expand the fundamental understanding of matter at very high temperature and density conditions and its dynamics. After short survey of relevant background, this presentation will discuss the recently obtained experimental results on PW laser system available at CoReLS, IBS, Korea.

ThR5-18 **16:45-17:00**

Use of super-intense lasers for research in the field of nuclear laboratory astrophysics

A.P. Matafonov[1], V.S. Belyaev[1], B.V. Zagreev[1], A.Yu. Kedrov[1], A.V. Lobanov[1], S.A. Shulyapov[2], A.B. Savel'ev[2]; 1 - Central Research Inst. for Machine Building, 2 - Lomonosov Moscow State Univ., Russia

The main problems of nuclear astrophysics which can be studied with the lasers of 10^18 W/cm^2 or more intensity are identified:lithium problem, the sources of neutrons in s-processes of the heavy elements production, synthesis of neutron-deficient stable p-nuclei, nuclear reactions with isotopes used in astronomy for diagnostics. The results of the experiments and proposals for further research are presented.

- Coffee Break -

Location: Deyneka Room, floor 2, 17:30 – 19:30

Super-Intense Light Fields and Ultra-Fast Processes IV

Session Chair: Sargis Ter Avetisyan,
European XFEL GmbH, Germany

ThR5-19 Invited **17:30-18:00**

Laser-driven ion acceleration and application to ultrahigh dose rate radiobiology

M. Borghesi[1], S. Kar[1], D. Doria[1], H. Ahmed[1], P. Chaudary[2], L. Romagnani[3], A. Sgattoni[6], M. Cherchez[5], R. Prasad[5], S. Brauckmann[5], F. Hanton[1], D. Gwynne[1], C. Maiorino[2], H. Padda[4], C. Scullion[1], A. Macchi[6], P. McKenna[4], O. Willi[5], K. Prise[2]; 1 - Centre for Plasma Physics, The Queen's Univ. of Belfast, Northern Ireland, 2 - Centre for Cancer Research and Cell Biology, The Queen's Univ. of Belfast, Northern Ireland, 3 - LULI, École Polytechnique, CNRS, CEA, UPMC, Palaiseau, France, 4 - Univ. of Strathclyde, United Kingdom, 5 - Heinrich-Heine-Univ., Germany, 6 - Department of Physics E. Fermi, Italy

An intense research activity is currently devoted worldwide to the development of laser-driven ion acceleration, in view of a number of application, including potential use in future cancer therapy. We will report on the activities of the UK-wide A-SAIL consortium towards developing novel acceleration mechanisms, as well as applying the ions in a range of radiobiology investigations.

ThR5-20 Invited **18:00-18:30**

Femtosecond X-rays from laser plasma accelerators

K. Ta Phuoc, B. Mathieu, A. Doepp, C. Thaury, S. Corde, J. Gautier, E. Guillaume, V. Malka, A. Rousse, L. Lecherbourg, N. Jourdain, F. Dorchies, A. Lifschitz; Laboratoire d'Optique Appliquée, ENSTA Paristech, CNRS, Ecole Polytechnique; CEA, CELIA, France

We will present the principle of these sources, their characterization, recent developments and a few application examples.

ThR5-21 **18:30-18:45**

Turbulence in relativistic plasma - from magnetohydrodynamic to kinetic regime

Makoto Takamoto; Univ. of Tokyo, Japan

In this presentation, we report our recent finding on turbulence in relativistic plasma. We performed a series of 3-dimensional numerical simulations of turbulence using relativistic magnetohydrodynamics code, and investigated properties of each characteristic mode. We also report our recent results of 3-dimensional Weibel turbulence obtained by Particle-in-Cell simulations.

ThR5-22 **18:45-19:00**

Intense ultrafast laser-plasma source of quazimonochromatic Mo-Kα X-radiation

V. Tcheremiskine, Y. Azamoum, R. Clady, L. Charmasson, A. Ferre, N. Sanner, O. Uteza, M. Sentis; Aix-Marseille Univ., CNRS, France

Characteristics of intense ultrafast quazi-monochromatic laser-plasma x-ray source at 17.4 keV produced using solid Molybdenum target are studied. The source is generated by Ti:Sa laser system "ASUR" capable to deliver 10 TW laser pulses of 25 fs duration with 100 Hz repetition rate and temporal contrast of >10^9. Fluxes of K-alpha X-radiation of 10^9 photon/sr per shot and energy conversion efficiency >10^-4 are obtained.

ThR5-23 **19:00-19:15**

Electron-free UV laser pulse filamentation under coherent rotational SRS in air

I.V. Smetanin[1], A.O. Levchenko[1], A.V. Shutov[1], N.N. Ustinovskii[1], V.D. Zvorykin[1,2]; 1 - Lebedev Physical Inst.RAS, 2 - National Research Nuclear Univ. MEPhI, Russia

Coherent stimulated rotational Raman self-scattering is proposed as the mechanism of electron-free filamentation of the ultra-short KrF laser pulse in air.

ThR5-24 **19:15-19:30**

Ultrashort laser pulse multifilamentation in fused silica: plasma channels statistics

A.A. Zemlyanov, Yu.E. Geints; Zuev Inst. of Atmospheric Optics SB RAS, Russia

The regime of multiple filamentation of gigawatt-power femtosecond laser pulses in fused silica bar is theoretically investigated. The dependence of the number, spatial position, and length of different generations of plasma channels on the energy and focusing conditions of the optical pulse is studied.

R7. LASERS IN ENVIRONMENTAL MONITORING

Location: Petrov-Vodkin 3 Room, floor 2, 11:30 – 13:30

Lasers in environmental monitoring III

Session Chair: Alexandr A. Cheremisin,
Irkutsk State Univ. of Railway Engineering, Krasnoyarsk Railway Inst.,
Siberian Federal Univ., Russia

ThR7-13 **11:30-11:45**

Using of laser scanner for mobile scanning of environment in work of earthmoving and construction machines and for control of deformation of pit's slopes

T.V. Golubeva, S.V. Konshin, E.O. Zaytcev; Almaty Univ. of Power Engineering & Telecommunications, Kazakhstan

The authors propose the use of laser scanning for positioning earthmoving and construction machines relative to terrain and environment, including the objects that are in the places of construction works to eliminate the human factor and increase the quality and speed of the given work.

ThR7-14 Invited **11:45-12:15**

Cavity enhanced spectroscopy in application to spectral line shape study

A. Cygan; Nicolaus Copernicus Univ., Poland

Three cavity enhanced spectroscopy methods are presented: well-known cavity ring-down spectroscopy and two recent techniques: cavity mode-width spectroscopy and one-dimensional cavity mode-dispersion spectroscopy. Application of these techniques to spectral line-shape study and atmospheric research is discussed.

ThR7-15 Invited **12:15-12:45**

Identification of the sources of aerosol contamination using laser methods

A. Nagy, M. Veres, A. Kerekes, A. Czitrovszky; Wigner Research Centre for Physics of the HAS, Hungary

Optical aerosol instrumentation was utilized to identify the sources of aerosol contamination in the air of Budapest. The results of the size distribution and absorptivity measurements show clear correlation with weather conditions, indicating the differences between the locations in the neighborhoods.

ThR7-16 **12:45-13:00**

Gold-plated silicon nanostructures for surface-enhanced Raman scattering (SERS)

I. Rigó[1], L. Himics[1], A. Nagy[1], A. Czitrovszky[1], S. Tóth[1], P. Fürjes[2], G. Singh[3], M. Veres[1]; 1 - Wigner Research Centre for Physics HAS, Hungary, 2 - Centre for Energy Research HAS, Hungary, 3 - Malaviya National Inst. of Technology, India

Surface-Enhanced Raman Scattering (SERS) with its single molecule sensitivity is a promising tool for the detection of very low amounts of substances. The effective use of the technique requires specific substrates offering high levels of Raman enhancement. This work compares the performance of gold coated silicon SERS arrays of different morphology.

ThR7-17 **13:00-13:15**

Temperature measurement by projection on latent structures of fluorescence spectra of potassium-alumina-borate glasses with copper-containing molecular clusters

M.A. Khodasevich[1], A.N. Babkina[2], P.S. Shirshnev[2]; 1 - Stepanov Inst. of Physics NASB, Belarus, 2 - ITMO Univ., Russia

The use of projection on latent structures allows to reduce the relative error of temperature measurement via a wideband fluorescence spectra of potassium-alumina-borate glasses with copper-containing molecular clusters to value about 1%. These glasses are shown to be a promising material as a temperature sensor head.

ThR7-18 **13:15-13:30**

Remote determination of size of surface heterogeneity and displacements of diffusely scattering objects

D.V. Kiesewetter[1], V.I. Malyugin[1], N.V. Ilyin[1], Ch. Sun[2]; 1 - Peter the Great St. Petersburg Politechnic Univ., 2 - Dalian Univ. of Technology, China

The spectral correlation method for determining the height of the optical inhomogeneities and speckle-interferometer based on optical vortices for increasing sensitivity to longitudinal displacements of the scattering objects ares presented.

- Lunch Break -

Location: Petrov-Vodkin 3 Room, floor 2, 15:00 – 17:00

Lasers in environmental monitoring IV

Session Chair: Alexandr P. Zhevlakov,
ITMO Univ., Russia

ThR7-19 Invited **15:00-15:30**

SERS identification of labile products in the system «phenol-semiquinone-quinone»

E.A. Iasenko[1,2], V.P. Chelibanov[1,2], A.M. Marugin[2], M.Z. Kozliner[3]; 1 - ITMO Univ., Russia, 2 - JSC OPTEC, Russia, 3 - JSC OPTEC (US Office), United States

The paper presents the results of SERS studies of the dynamic behavior of «phenol - semiquinone - quinone» system. This system is a key in the formation of precursors of the electronic excitations of the composite materials and chemiluminescent sensors of the reactive oxygen species. The THz range of Raman spectrums were registered for the labile products formed in the processes initiated by a proton transfer. A mechanism of the reaction initiated by a proton transfer has been proposed.

ThR7-20 Invited **15:30-16:00**

Use of wavelength-scanned cavity ring-down spectroscopy to obtain high-precision gas mixtures with micro-concentrations of formaldehyde

L.A. Konopel'ko[1,2], Ya.K. Chubchenko[1], V.V. Beloborodov[1,2]; 1 - Mendeleyev Inst. for Metrology (VNIIM), 2 - ITMO Univ., Russia

The article reviews the work in the field of provision of comparability of formaldehyde in the air by preparation of reference gas mixtures for the transfer of mole fraction of formaldehyde. Verification and study of the gas mixture stability were carried out by wavelength-scanned cavity ring-down spectroscopy analyzer (WS-CRDS).

ThR7-21 **16:00-16:15**

Metrological problems of 13C/12C measurements in the environment and food

L.A. Konopel'ko[1,2], V.V. Beloborodov[1,2], Ya.K. Chubchenko[1]; 1 - Mendeleyev Inst. for Metrology (VNIIM), 2 - ITMO Univ., Russia

The article reviews the work in the field of provision comparability of absolute 13C/12C isotope amount ratios in the environment and food.

ThR7-22 **16:15-16:30**

Combined LIBS and Raman measurements within a single laser event

V.N. Lednev[1,2], M.Ya. Grishin[1,3], A.N. Fedorov[1], V.V. Bukin[1], S.M.Pershin[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - National Univ. of Science and Technology MISiS, 3 - Moscow Inst. of Physics and Technology (State Univ.), Russia

A new approach for combined Raman and Laser induced breakdown (LIBS) spectrometry measurements within a single laser event was suggested. A double pulse mode lasing (two nanosecond laser pulses with microsecond delay) was used to combine two spectrometry methods. The feasibility of combined Raman and LIBS spectrometry measurements was demonstrated for solid and liquid samples.

ThR7-23 Invited **16:30-17:00**

Laser-based trace gas detection with applications in biology and medical science

F.J.M. Harren; Radboud Univ., Netherlands

Here, the performance of OPOs, QCLs and near infrared lasers for trace gas sensing is demonstrated. We analyzed human breath detecting CH4, C2H6, CO (marker for Heme degradation).

- Coffee Break -

Location: Petrov-Vodkin 3 Room, floor 2, 17:30 – 18:00

Lasers in environmental monitoring V

Session Chair: Alexandr P. Zhevlakov,
ITMO Univ., Russia

ThR7-24 **17:30-17:45**

Real-time automatic recognition of solids using laser-induced breakdown spectroscopy

V.F. Lebedev, P.S. Makarchuk; ITMO Univ., Russia

Real-time automatic recognition by laser-induced breakdown spectroscopy of both bulk and granular materials at distances up to 5 m was performed. As a radiation source diode-side-pumped passively Q-switched Nd:YAG laser with a multiloop self-adaptive reciprocal cavity was used. Also, the possibility of materials recognition by mean of self-Q-switching on plasma mirror was demonstrated.

ThR7-25 **17:45-18:00**

Lidar scanning module for remote environmental monitoring

V.V. Elizarov, A.S. Grishkanich, S.V. Kascheev, A.A. Mak, A.P. Zhevlakov; ITMO Univ., Russia

Lidar module that allows to perform spiral scanning of the investigated area was developed. Software for managing and reading the angular coordinates of the laser beam was created. An example of implementation of such a module performing a combined scan in wide and narrow angle fields was shown.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Location: Pudovkin Room, floor 3, 09:00 – 11:00

Nonlinear Cavities and Traps

Session Chair: Leonid Melnikov,
Gagarin Saratov State Technical Univ.,
Saratov Branch of Kotel'nikov Inst. of Radioengineering and Electronics RAS, Russia

ThR8-40 Invited **09:00-09:30**

Applications of VCSELs in optical transmission lines and vortex generation

A. Chipouline[1], V.S. Lyubopytov[1,2], T. von Lerber[1,4], M. Lassas[4], S. Paul[1], M.F. Schumann[3], J. Cesar[1], M. Wegener[3], F. Küppers[1]; 1 - Technische Univ. Darmstadt, Germany, 2 - Ufa State Aviation Technical Univ., Russia, 3 - Karlsruhe Inst. of Technology, Germany, 4 - Univ. of Helsinki, Finland

The VCSEL (Vertical Cavity Surface Emission Laser) can generate phase replica of the phase modulation of the seeding signal and at the same time suppress its amplitude modulation. This phenomena is pretty universal for nonlinear auto-oscillating systems. Various applications could be forecasted. Rectification of the phase modulated signal from the residual amplitude modulation and consequent BER (Bit Error Rate) improvement and doubling of the information capacity have been experimentally proven. The MEMS (Micro Electro Mechanical System)-VCSELs can be used for wavelength-tunable vortex beam generation, providing an ideal solution for the simultaneous OAMand wavelength-division multiplexed optical communications.

ThR8-41 Invited **09:30-10:00**

Dissipative Kerr combs in microresonators: from chaos to solitons

M.L. Gorodetsky; Lomonosov Moscow State Univ., Russian Quantum Center, Russia

Optical frequency combs, generated with mode-locked femtosecond lasers and microstructured fibers produced in recent years a revolution in metrology and experimental physics. A new phenomenon of nonlinear optics was discovered recently - spontaneous formation of similar combs in passive optical microresonators with continuous wave pumping. Such microresonator Kerr combs result from multiple hyper-parametric four-wave mixing processes. The report presents the results of recent theoretical and experimental studies, leading to the development of compact and integrated coherent frequency comb sources.

ThR8-42 **10:00-10:15**

Phase-dependent stimulated emission in a polymer

M. Saito, Y. Nishimura; Ryukoku Univ., Japan

Weak spontaneous emission and strong stimulated emission were switched reversibly by melting and freezing a polyethylene-glycol solution of rhodamine 6G, which exhibited a phase transition from transparent liquid to turbid solid.

ThR8-43 Invited **10:15-10:45**

Bose-Einstein condensate of exciton-polaritons in optically induced resonators

E.A. Ostrovskaya; The Australian National Univ., Australia

Exciton-polaritons in semiconductor microcavities can be driven to condensation, confined, and manipulated by a spatially structured optical pump. Using an off-resonant pump, we create micron-scale resonators for nonlinear exciton-polariton waves, which enable exploration of multi-mode behavior, quantum chaos, and non-Hermitian quantum physics. In particular, exceptional points and the associated topological Berry phase are observed in this quantum many-body system.

ThR8-44 **10:45-11:00**

Hysteretic behavior of matter-wave solitons in dynamic cavities

N.N. Rosanov[1,2,3], N.V. Vysotina[1]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., 3 - Ioffe Inst., Russia

We present the analysis of hysteresis for motion of soliton of Bose-Einstein condensate (i) between two oscillating atomic mirrors and (ii) above one oscillating mirror in presence of gravitation force.

- Coffee Break -

Location: Pudovkin Room, floor 3, 11:30 – 13:30

Nonlinear Surfaces, Waveguides and Cavities

Session Chair: Arkadi Chipouline,
Technische Univ. Darmstadt, Germany

ThR8-45 Invited **11:30-12:00**

Ultra-low-power polariton solitons in semiconductor waveguides and microcavities

P.M. Walker[1], C. Whittaker[1], L. Tinkler[1], M. Sich[1], E. Cancelliery[1], D.V. Skryabin[2,3], A. Gorbach[2], A. Yulin[3], B. Royall1 , I. Farrer[4,5], D.A. Ritchie[4], M.S. Skolnick[1], D.N. Krizhanovskii[1]; 1 - Univ. of Sheffield, United Kingdom, 2 - Univ. of Bath, United Kingdom, 3 - ITMO Univ., Russia, 4 - Univ. of Cambridge, United Kingdom, 5 - Present address: Univ. of Sheffield, United Kingdom

The physics of ultra-low power conservative and dissipative polariton solitons in GaAs photonic structures is reviewed. Polariton solitons form on a short length scale of 10's of micrometers and can be manipulated within few picoseconds. The effect of spin-dependent polariton nonlinearity on soliton formation is also discussed.

ThR8-46 Invited **12:00-12:30**

Nonlinear regime of surface polaritons including exciton polaritons in organic materials

B.D. Fainberg[1,2], G. Li[3]; 1 - Holon Inst. of Technology, Israel, 2 - Tel Aviv Univ., Israel, 3 - Northwestern Univ., United States

We develop a theory of nonlinear organic «plasmonics» with strong laser pulses. The bistability response of the electron-vibrational model of organic materials in the condensed phase has been demonstrated. We propose the exciton control of Coulomb blocking in the quantum dot wire based on non-steady-state nonlinear organic «plasmonics» that enable us to obtain near-zero dielectric permittivity during a short time.

ThR8-47 **12:30-12:45**

The role of ferroelectric domain wall in nonlinear Cerenkov frequency up-conversion in 1D nonlinear crystal

N. An[1], X. Chen[2]; 1 - Shanghai Inst. of Laser Plasma, 2 - Shanghai Jiao Tong Univ., China

We reveal a variety of nonlinear Cerenkov radiation patterns that occurs in a single photonic crystal modulated by domain walls, which manifest themselves as normal, degenerated and anomalous-dispersion-like nonlinear Cerenkov radiation type sum-frequency generation.

ThR8-48 **12:45-13:00**

Low-threshold 1064 to 1907 nm hydrogen Raman laser based on hollow-core fiber

A.V. Gladyshev, A.F. Kosolapov, A.N. Kolyadin, G.K. Alagashev, A.D. Pryamikov, Yu.P. Yatsenko, A.S. Biriukov, I.A. Bufetov, E.M. Dianov; Fiber Optics Research Center RAS, Russia

1907 nm generation by pure vibrational stimulated Raman scattering in hydrogen-filled hollow-core fiber is demonstrated. Due to special design of hollow-core revolver fiber with nested capillaries, the Raman threshold as low as 270 W of peak power is achieved.

ThR8-49 **13:00-13:15**

Two-dimensional vortex dissipative optical solitons in polariton laser with saturable absorber

S.V. Fedorov[1,2], N.N. Rosanov[1,2,3], I.G. Savenko[2]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., 3 - Ioffe Inst., Russia

We consider conditions for existing and stability of two-dimensional dissipative vortex solitons in condensates of excitons in a semiconductor polariton laser with a saturable absorber inside the microcavity. Presented is the structure of energy flows in the cases of inertialess media and media with finite relaxation rates.

ThR8-50 **13:15-13:30**

Optically controlling the optical spin Hall effect

P. Lewandowski[1], O. Lafont[2], M.H. Luk[3], N.H. Kwong[4], K.P. Chan[5], M. Babilon[1], P.T. Leung[5], E. Galopin[6], A. Lemaitre[6], J. Tignon[2], S. Schumacher[1], E. Baudin[2], R. Binder[4]; 1 - Physics Department and Center for Optolelectronics and Photonics Paderborn, Germany, 2 - École Normale Supérieure - PSL Research Univ., CNRS, Univ. Pierre et Marie Curie - Sorbonne Univ., Univ. Paris Diderot, France, 3 - Univ. of Arizona, Tucson, United States, 4 - College of Optical Sciences, University of Arizona, Tucson, United States, 5 - The Chinese Univ. of Hong Kong SAR, China, 6 - Laboratoire de Photonique et de nanostructures, CNRS, France

The optical spin-Hall effect can lead to a significant spin-polarization of exciton-polaritons in planar semiconductor microcavities. In this work, we experimentally and theoretically demonstrate a novel approach to control this effect using only optical means.

- Lunch Break -

Location: Pudovkin Room, floor 3, 15:00 – 17:00

Nonlinear Frequency Conversion

Session Chair: Boris I. Mantsyzov,
Lomonosov Moscow State Univ., Russia

ThR8-51 Invited **15:00-15:30**

Quasi-phase-matching second harmonic generation caused by pendulum effect in photonic crystals

D.A. Kopylov[1], L.V. Dergacheva[1], A.I. Maydykovskiy[1], S.E. Svyakhovskiy[1], V.O. Kompanets[2], S.V. Chekalin[2], V.A. Bushuev[1], T.V. Murzina[1], B.I. Mantsyzov[1]; 1 - Lomonosov Moscow State Univ., 2 - Inst. for Spectroscopy RAS, Russia

Second harmonic generation (SHG) in the Laue scheme of the dynamical Bragg diffraction in 1D photonic crystal (PhC) is studied. The experiments are performed for partially annealed porous-silicon PhC containing 250 periods of the structure. Our measurements confirm phase-matched SHG under the Bragg condition. Possible types of phase- and quasi-phase-matching realized in the studied PhC are discussed.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

ThR8-52 **15:30-15:45**

Phase-matched second harmonic generation in one-dimensional photonic crystals in the Laue geometry

V.B. Novikov, B.I. Mantsyzov, A.I. Maydykovskiy, T.V. Murzina; Lomonosov Moscow State Univ., Russia

We experimentally observe phase-matched second harmonic generation under Bragg diffraction in the Laue geometry in one-dimensional porous silica based photonic crystals infiltrated by a ferroelectric salt.

ThR8-53 **15:45-16:00**

Frequency conversion of multi-line carbon monoxide laser in PbIn6Te10 crystal

A.A. Ionin[1], I.O. Kinyaevskiy[1], Yu.M. Klimachev[1], A.Yu. Kozlov[1], A.A. Kotkov[1], V.V. Badikov[2], K.V. Mitin[3]; 1 - Lebedev Physical Inst. RAS, 2 - Kuban State Univ., 3 - Astrophysica, National Center for Laser Systems & Complexes, Russia

Frequency conversion of carbon monoxide laser was for the first time obtained in PbIn6Te10 nonlinear crystal. Laser-induced damage threshold, sum and different frequency generation efficiency under multi-line CO laser pumping were measured.

ThR8-54 **16:00-16:15**

Stimulated low-frequency Raman scattering in viruses

O.V. Karpova[1], A.D. Kudryavtseva[2], V.N. Lednev[3], V.B. Oshurko[4], S.M. Pershin[3], E.K. Petrova[1], N.V. Tcherniega[2], K.I. Zemskov[2]; 1 - Lomonosov Moscow State Univ., 2 - Lebedev Physical Inst. RAS, 3 - Prokhorov General Physics Inst. RAS, 4 - Moscow Technical Univ. "STANKIN", Russia

Stimulated low-frequency Raman scattering (SLFRS), caused by laser pulses interaction with the radial breathing modes of tobacco mosaic virus (TMV) in Tris-HCl pH7.5 buffer was registered. SLFRS frequency shift, conversion efficiency and threshold are measured.

ThR8-55 **16:15-16:30**

Extraordinary time-depended processes in the parametric interaction of counter-propagating waves

V.A. Tkachenko[1], A.K. Popov[2], S.A. Myslivets[3], V.V. Slabko[1]; 1 - Siberian Federal Univ., Russia, 2 - Purdue Univ., United States, 3 - Kirensky Inst. of Physics SB RAS, Russia

Three-wave mixing of ordinary and backward electromagnetic waves in the pulsed regime is investigated. It is shown that opposite direction of phase velocity and energy flux in the backward wave gives rise to extraordinary transient processes in the greatly enhanced optical parametric amplification and frequency-shifting nonlinear reflectivity.

ThR8-56 **16:30-16:45**

Wide tunable BaGa4Se7 optical parametric oscillator pumped by Nd:YLF laser

N. Kostyukova[1,2], A. Bobylev[1], A. Boyko[1,2], K. Zenov[1], A. Shadrintseva[1], N. Tretyakova[1], V. Badikov[4], D. Badikov[4], D. Kolker[1,2,3]; 1 - Special technology LTD, 2 - Novosibirsk State Univ., 3 - Inst.of Laser Physics SB RAS, 4 - Kuban State Univ., Russia

BaGa4Se7 optical parametric oscillator (OPO) pumped by compact nanosecond Nd:YLF laser was demonstrated. Wide tuning range from 2.93 up to 9.3 mkm is shown for first time of our knowledge.

ThR8-57 **16:45-17:00**

Optical nonlinear response of liquid crystalline polymer

I.A. Budagovsky[1], V.N. Ochkin[1], S.A. Shvetsov[1,2], A.S. Zolot'ko[1], A.Yu. Bobrovsky[3], N.I. Boiko[3], V.P. Shibaev[3]; 1 - Lebedev Physical Ins. RAS, 2 - Moscow Inst. of Physics and Technology, 3 - Moscow State Univ., Russia

Optical nonlinearity of nematic liquid crystalline polymer caused by molecular reorientation was found and investigated. Under the action of light on the polymer film, director of polymer reorients to light field increasing the refractive index. If the polymer is doped with an azobenzene compound, nonlinear response dramatically increases; in this case, the light-induced refractive index becomes negative.

- Coffee Break -

Location: Pudovkin Room, floor 3, 17:30 – 19:30

Nonlinearity of Solids, Gases and Plasmas

Session Chair: Alexander P. Shkurinov,
Lomonosov Moscow State Univ., Inst. on Laser and Information Technologies RAS, Russia

ThR8-58 **17:30-17:45**

Time-resolved non-linear optical response and photosensitivity of glassy semiconductors

E.A. Romanova[1], Yu.S. Kuzyutkina[1], S. Guizard[2], T.M. Benson[3], A.B. Seddon[3]; 1 - Saratov National Research State Univ., Russia, 2 - Ecole Polytechnique, France, 3 - niv. of Nottingham, United Kingdom

An interferometric pump-probe method with the femtosecond resolution in time is used to study the third-order non-linear optical response and photosensitivity of a variety of chalcogenide glasses of the system As-S-Se.

ThR8-59 **17:45-18:00**

Strong saturable-absorption effect in subphthalocyanines caused by plasmonic nanoparticles

A.V. Zasedatelev[1,2], T.V. Dubinina[3,4], V.I. Krasovskii[1,2], A.B. Karpo[2]; 1 - National Research Nuclear Univ. "MEPhI", 2 - Prokhorov General Physics Inst. RAS, 3 - Lomonosov Moscow State Univ., 4 - Inst. of Physiologically Active Compounds RAS, Russia

Nonlinear optical properties of subphthalocyanines coupled with gold nanoparticles have been studied. We have found out many-fold enhancement in the saturable-absorption effect which originated from the strong near-field and great increase in the decay rate of excited states. Such plasmon-induced phenomenon gives the unique opportunity to reduce saturation intensity and boost absorption modulation depth of organic saturable absorbers.

ThR8-60 **18:00-18:15**

Nonlinear polarization effects on 2D rf-SQUID arrays

I.R. Gabitov[1], Zh.A. Kudyshev[1], A.I. Maimistov[2,3]; 1 - Skolkovo Inst. of Science and Technology, 2 - National Research Nuclear Univ., 3 - Moscow Inst. for Physics and Technology, Russia

Electromagnetic field scattering on a 2D array of rf-SQUIDs is considered. Within thin film approximation, we demonstrated bifurcation in the number of refraction states depending on the incident field. Difference in refraction and polarization characteristics of refraction states gives an opportunity to switch the direction of propagation and polarization of the electromagnetic wave with a device of ultrathin thickness.

ThR8-61 **18:15-18:30**

Giant Goos-Hanchen effect and focusing of Gaussian light beam by one-dimensional photonic crystal with modulated band gap

S.E. Svyakhovskiy, E.A. Kekkonen, A.A. Konovko, A.V.Andreev, T.V. Murzina; Lomonosov Moscow State Univ., Russia

We present the theoretical and experimental studies of the giant Goos-Hanchen effect and the effect of focusing of light beam in one-dimensional photonic crystals with spatial modulation of photonic band gap position. We show that the photonic crystal with slow exponentially modulated band gap applies the second-order phase modulation to the reflected light and can focus or defocus the light beam.

ThR8-62 **18:30-18:45**

Spectral dependence of the (2+1) resonance-enhanced multiphoton ionization (REMPI) of atmospheric oxygen around 248 nm laser wavelength

A.V. Shutov[1], S.A. Goncharov[2], A.O. Levchenko[1], S.V. Ryabchuk[2], I.V. Smetanin[1], N.N. Ustinovskii[1], V.D. Zvorykin[1]; 1 - Lebedev Physical Inst. RAS, 2 - National Research Nuclear Univ. "MEPhI", Russia

The spectral dependence of resonance-enhanced multiphoton ionization (REMPI) of oxygen in the atmospheric air was studied around the 248 nm laser wavelength. It is shown that (2+1) REMPI through the 3IIu intermediate Rydberg state took place. Rotational constant B′ of the 3IIu state was measured.

ThR8-63 **18:45-19:00**

Two-photon absorption bandwidth determination in the 420-750 nm wavelength range for ZnTe and ZnSe crystals

M.O. Osipova, E.A. Makarov, V.G. Bespalov; ITMO Univ., Russia

Two-photon absorption bandwidth in the 420-750 nm wavelength range for ZnTe and ZnSe crystals has been investigated using femtosecond pump-probe technique with supercontinuum, generated in a water jet.

ThR8-64 **19:00-19:15**

Energy accumulation and transformation of laser radiation in PbWO4 crystal

V.I. Lukanin, A.Ya. Karasik; Prokhorov General Physics Inst. RAS, Russia

Picosecond interband two-photon laser excitation of PbWO4 crystal at temperature of 10K leads to 100% induced absorption (450′ 750-nm spectral range) with ~100min relaxation time. Electronic excitation energy accumulated in crystal at 10K excites intrinsic luminescence with ~ 1 hour decay time. Decay kinetics and spectra of the intrinsic luminescence of crystal at temperature of 10K were measured under two-photon excitation.

ThR8-65 **19:15-19:30**

Third order nonlinear optical response of plasmonic nanoprism arrays

H. Sánchez-Esquivel[1], K.Y. Raygoza[1], B. Kalinić[2], N. Michieli[2], G. Mattei[2], T. Cesca[2], R. Rangel-Rojo[1]; 1 - CICESE, México, 2 - Univ. degli Studi di Padova, Italia

One of the most promising Metallic Nanoparticle (MNP) geometries is the 2D ordered Plasmonic Nanoprism Array (PNPA), on which the plasmonic effects present in an array of thin triangular MNPs are used to provide greatly increased third order Nonlinear Optics (NLO) effects. In this work, gold and silver 2D ordered PNPAs were fabricated using the Nanosphere Lithography (NSL) method. The third-order nonlinear response of these two samples was then observed in the Dipolar regime by the use of the Z-Scan technique. These experiments were performed by using a chopped ultra-short-pulse train at a wavelength of 821 nm. The sample NLO phenomena dependence with intensity and thermal load are presented.

R2. HIGH POWER LASERS

ThR2-p01 **15:00-19:00**

120W single-frequency laser based on active LMA double-clad fiber amplifier

A.I. Trikshev, V.B. Tsvetkov; Prokhorov General Physics Inst. RAS, Russia

We present CW single-frequency laser at 1080 nm (linewidth used for the first, second and third stages of amplifier. A large mode area double-clad fiber is used for the fourth stage of amplifier.

ThR2-p02 **15:00-19:00**

Prospect of optically pumped oxygen laser

M.V. Zagidullin[1,2], V.N. Azyazov[1], M.S. Malyshev[1], A.S. Insapov[1]; 1 - Samara State Aerospace Univ., 2 - Lebedev Physical Inst., Samara branch, Russia

O2–I2 gas is irradiated by light near 500nm and further pumped by light at wavelength 1315 nm in resonance with 2P3/2/–2P1/2 transition of atomic iodine. A set of chemical and energy exchange reactions result in generation of inverse population and gain of 0.04 m-1 on b–X transition of molecular oxygen.

ThR2-p03 **15:00-19:00**

Experimental study of iodine dissociation in active medium of oxygen-iodine laser

M.V. Zagidullin[1,2], M.S. Malyshev[1], N.A. Khvatov[1,2]; 1 - Samara State Aerospace Univ., 2 - Lebedev Physical Inst., Samara, Russia

Results of experiments on dissociation of iodine molecules in oxygen-iodine laser medium are presented. Rates constant of key reactions have been reexamined. The experiments confirmed mechanism of iodine dissociation proposed in (J. Phys. Chem., 87, 2348 (1983)). The experiments did not reveal the contribution of vibrationally excited oxygen molecules or three body reactions in the dissociation of iodine.

ThR2-p04 **15:00-19:00**

Coherent combining of high average power nanosecond pulse laser beams

G. Khosrovian[1], T. Kitamura[1], M. Fujita[1,2], Y. Izawa[1], K. Tsubakimoto[2], H. Yoshida[2], N. Miyanaga[2]; 1 - Inst. for Laser Technology, 2 - Inst. of Laser Engineering, Japan

Four high average power, high repetition rate, ns pulse laser beams have been coherently combined by single-detector, binary-tree filled-aperture coherent beam combining technique. For the present photonic crystal fiber based MOPA system, over 400 Watts combined average output power with 0.75 combining efficiency has been obtained. Combining efficiency degradation sources have been identified and its dependence on some specific misalignments discussed.

ThR2-p05 **15:00-19:00**

High power CPA cryogenic Yb:YAG laser

E.A. Perevezentsev, I.B. Mukhin, O.V. Palashov; Inst. of Applied Physics RAS, Russia

For a several femtosecond pulse OPCPA amplification several picosecond pump is required. To develop such pump a laser system for a stretched picosecond pulse amplification is created in the Institute of Applied Physics RAS. It is then planned to prepare for the integration of a femtosecond seed laser with the cryogenic amplifier.

ThR2-p06 **15:00-19:00**

TEA–CO2 laser with pulse repetition rates up to 5 kHz for technological applications

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

Some investigation results, directed to the creation of sealed–off TEA–CO2 laser with pulse repetition rates from 1 to 5 kHz for technological applications are given. In TEA–CO2 laser with active volume V =28×0,5×2 см3 maximum values of radiation energy per pulse 20÷25 mJ at 2÷3 kHz are obtained. At the 5 kHz the laser energy decreases up to 5÷6 mJ. Perspectives of increas-ing of pulse repetition rates up to 20 kHz are discussed.

ThR2-p07 **15:00-19:00**

Super–atmospheric metal–ceramic small–sized sealed–off TE–CO2 laser with PRR up to 25 Hz

B.A. Kozlov[1], D. Kuang Manh[1,2]; 1 - Ryazan State Radio Engineering Univ., Russia, 2 - Vietnam

The main interrelations of "electrical wind" velocity in supper–atmospheric pressure CO2–laser mixtures are investi-gated. For the first time "electrical wind" effect was used for increasing pulse repetition rates (PRR) in TE–CO2 laser at total pressures 1÷12 atmospheres. Generation characteristics mall–sized sealed–off TE–CO2 laser at pulse repetition rates 1–25 Hz are studied. Laser energy per pulse 5÷6 mJ at PRR 20÷25 Hz with duration 4÷5 nanoseconds from active volume V = 5×0,8×0,8 cm3 are obtained.

ThR2-p08 **15:00-19:00**

Carrier-envelope offset phase control and stabilization of kilohertz solid-state laser system

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

The operating modes of the solid-state laser system with 1 kHz pulse repetition rate consisting of a master oscillator and nine-pass amplifier were investigated and parameters optimization has been carried out. A carrier-envelope offset phase stabilization system was developed and implemented allowing one to achieve residual instability ~0.17 radian (rms) for the 30 fs-pulse. It is considered to be sufficient to generate attosecond pulses in subsequent experiments.

ThR2-p09 **15:00-19:00**

Products of reaction Rb with C2H6 or CH4

G.I. Tolstov[1], S.N. Naumkin[1], A.P. Torbin[1,2], A.M. Mebel[3], M.C. Heaven[1,4], V.N. Azyazov[1,2]; 1 - Samara State Aerospace Univ., Russia, 2 - Lebedev Physical Inst. RAS, Samara branch, Russia, 3 - Florida International Univ., United States, 4 - Emory Univ., United States

Diode-pumped alkali vapor lasers (DPAL) commonly use CH4 or C2H6 to induce energy transfer between n2P3/2 and n2P1/2 levels. A complication is that the alkali metal reacts with the hydrocarbons. High-level ab initio calculations have been used to study the reactive interactions between Rb and CH4 or C2H6.

ThR2-p10 **15:00-19:00**

Ablation of optical transparent materials using picosecond laser pulses

A.G. Verkhogliad, M.F. Stupak; Technological Design Inst. of Scientific Instrument Engineering SB RAS, Russia

We present experimental results of the different processes that can give from focusing an ultrafast laser light in the picosecond regime on a host of transparent materials, e.g., a silica, a silica glass and dielectric films. We summarize the physical processes and surface and bulk applications and highlight how picosecond lasers can be used to process various materials. Throughout this paper, we will show the advantages and disadvantages of using ultrafast lasers demonstrate their potential for the precision processing of materials and structures.

ThR2-p11 **15:00-19:00**

Electrohydrodynamic flow application in gas discharge laser circulation system

I.E. Rebrov, D.V. Dremin, Yu.V. Khomich, V.A. Yamshchikov; Inst. for Electrophysics and Electric Power RAS, Russia

Electric discharge N2-laser with circulation system based on electrohydrodynamic (EHD) flow is described. Experimental studies and mathematical modeling of EHD flow considering configuration of circulation chamber and discharge gap have shown value of a stream more then 15 l/s.

ThR2-p12 **15:00-19:00**

Exploration of optical quality of Chemical Oxygen-Iodine Laser (COIL) active medium

Yu.A. Adamenkov, M.I. Bezrukov, M.A. Gorbunov, M.L. Leonov, A.V. Seleznev, D.V. Sokolov; RFNC-VNIIEF, Russia

We have developed optical techniques for supersonic Chemical Oxygen-Iodine Laser (COIL) active medium exploration using focal spot methods. It has been found out that optical impurities of active medium density in optical resonator area were less than resolution limit of out apparatus, that is $\Delta n/n$.

ThR2-p13 **15:00-19:00**

Modeling of photolysis oxygen-iodine laser

S.Yu. Pichugin[1], A.A. Pershin[1,2], V.N. Azyazov[1,2]; 1 - Lebedev Physical Inst., Samara Branch, 2 - Samara State Aerospace Univ., Russia

A theoretical model for predicting of the pulsed photolysis oxygen-iodine laser (POIL) performance has been developed. The calculated output energies of the POIL are in good agreement with experimental ones. Pathways in which the energy of O(1D) is converted to excitation energy of singlet oxygen molecule are discussed.

ThR2-p14 **15:00-19:00**

Radio frequency and microwave excited planar inert gas mixture infrared lasers

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

Radiation characteristics of planar diffusion-cooled RF excited IR-lasers (Xe-He, Ar-He and Kr-He) created using the same design and excited by a large-aperture RF discharge (2.7x40x385 mm) at a frequency of 40.68 MHz in dependence on gas mixture composition and pressure have been studied. As a result of our experiments we were the first to produce a generation of a planar Ar-He and Kr-He lasers with the transverse cw RF discharge. Planar laser with the transverse cw RF discharge is shown as promising radiation source at a wavelength of 1.79-3.65 μm. The characteristics of the radiation of a planar Xe-laser excited by MW discharge with diffusive cooling of the active medium have been investigated. An average lasing power of 50 mW (pulse power 2.5 W) is obtained.

R2. HIGH POWER LASERS

ThR2-p15 **15:00-19:00**

The efficiency research of laser energy conversion to the third harmonic for 'Iskra 5' iodine laser

A.V. Zubkov, S.V. Kalipanov, V.P. Kovalenko, S.P. Kurnopyalov, V.S. Fayzullin; RFNC - VNIIEF, Research Inst. of Laser Physics, Russia

The phase-matching angles for 3w generation in DKDP crystals have been obtained experimentally. Experimental results on the research of 3w generation have been presented for 'Iskra 5' laser conditions.

ThR2-p16 **15:00-19:00**

Optical components testing of powerful laser facility based on wavefront and surface profile analysis

S.A. Belkov[1], I.N. Voronich[1], I.N. Derkach[1], I.V. Epatko[2], A.A. Eremin[1], R.V. Serov[2], D.I. Lobachov[1], I.E. Chernov[1]; 1 - RFNC-VNIIEF, 2 - Prokhorov General Physics Inst, RAS, Russia

The report presents the results of testing of wide aperture optical elements of powerful laser facility based on wavefront and surface profile analysis. Some features of interferometric measurements and data processing are presented. The inspection results used in 3D modeling of optical scheme. The simulation aimed on improvement of the laser channel structure and predicting of the beam quality at its output, and optimizing the requirements to quality of optics as well.

ThR2-p17 **15:00-19:00**

Research of energy characteristics of the «Luch» facility power amplifier containing KNFS Nd-phosphate glass slabs and MIRO Silver foil reflectors

I.A. Belov, S.A. Bel'kov, I.N. Voronich, S.G. Garanin, V.N. Derkach, S.V. Koshechkin, M.I. Lysov, S.S. Markov, S.V. Savkin; RFNC-VNIIEF, Russia

Amplifier elements upgrade on the «Luch» laser facility was carried out. Provided gain measuring shown that amplifier elements upgrade had resulted to amplifier small signal gain coefficient K0 growth from 12.9% to 14.3% depending on charging voltage, linear gain coefficient growth g0 ≈(6-8)%. Full-scale laser experiments showed the power amplifier gain coefficient growth consistent with active medium gain growth results.

ThR2-p18 **15:00-19:00**

The system for uniform irradiation of targets applying partially coherent light generated in multimode waveguide at the Luch facility

I.A. Belov, S.A. Bel'kov, I.N. Voronich, S.G. Garanin, V.N. Derkach, B.G. Zimalin, D.V. Sizmin, K.V. Starodubtsev; RFNC-VNIIEF, Russia

The system for spatial and temporal smoothing of laser radiation by multimode optical fiber was developed at the laser facility Luch. The system consist of broadband master oscillator, smoothing fiber and preamplifiers. Experiments on the amplification and conversion into second harmonic have been conducted. Integral over pulse small-scale uniformity of the target irradiation with the use of lens raster was decreased by 1-2 orders of magnitude as compared with the unsmoothed beam.

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

ThR3-p01 **09:30-13:30**

High-power 808 nm laser bars (5mm) with wall-plug efficiency more than 67%

T.A. Bagaev, M.A. Ladugin, A.Y. Andreev, A.A. Marmalyuk, S.M. Sapozhnikov, A.V. Lobintsov; R&D Inst. Polus, Russia

In present paper the device characteristics of the 808 nm laser diodes bars with different waveguides have been compared. It was demonstrated that structures with broad asymmetrical waveguide has higher output power than that with narrow symmetrical waveguide.

ThR3-p02 **09:30-13:30**

Spatial current density distribution of «vertical» and «face-up» high-power blue AlGaInN LEDs

A.V. Aladov, A.E. Chernyakov, A.L. Zakgeim; Submicron Heterostructures for Microelectronics, Research Engineering Center RAS, Russia

This paper studies current spreading, light emission and heat transfer in high-power «vertical» and «face-up» AlGaInN light emitting diodes (LEDs).

ThR3-p03 **09:30-13:30**

Frequency stability of miniature quantum magnetometer with laser pumping

S.V. Ermak[1], M.V. Petrenko[2], V.V. Semenov[1]; 1 - Peter the Great St. Petersburg Polytechnic Univ., 2 - Ioffe Inst., Russia

The experiments performed using the system of two quantum magnetometers with laser pumping showed the possibility of reduction of the light shift influence on frequency stability of the miniature quantum magnetometer.

ThR3-p04 **09:30-13:30**

Q-switch in injected quantum dot laser

E.A. Viktorov[1,2], T. Erneux[2], B. Tykalewicz[3,4,5], D. Goulding[3,4,5], S.P. Hegarty[3,4,5], G. Huyet[1,3,4,5], I.N. Dubinkin[1], N.A. Fedorov[1], B. Kelleher[5]; 1 - ITMO Univ., Russia, 2 - Univ. Libre de Bruxelles, Belgium, 3 - Univ. College Cork, Ireland, 4 - Cork Inst. of Technology, Ireland, 5 - Tyndall National Inst., Ireland

We report on Q-switched operation in an optically injected quantum dot laser. It results from the ability of the laser to emit simultaneously from the ground state (GS) and first excited state (ES). The injected GS operates as a gate for the ES output.

ThR3-p05 **09:30-13:30**

Carbon monoxide concentration mesurement on the base of GaInAsSb heterolaser

Y.V. Lebiadok[1], D.M. Kabanau[1], A.N. Imenkov[2], Y.P. Yakovlev[2]; 1 - SSPA "Optics, Optoelectronics & Laser Technology", Belarus, 2 - Ioffe Inst., Russia

The method of detection of carbon monoxide on the base of laser diode with GaInAsSb quantum active layer and its characteristics are discussed in the report.

ThR3-p06 **09:30-13:30**

Modeling a semiconductor quantum dot laser

I.V. Koryukin; Inst. of Applied Physics RAS, Russia

We analyze the electron-hole asymmetry model of a semiconductor quantum dot laser at different relaxation rates of the transitions between electron and hole levels. It is shown that the model can be simplified when the relaxation between hole levels is much faster than the relaxation between electron levels.

ThR3-p07 **09:30-13:30**

Quantum cascade laser grown by MOCVD and operating at 9.7 μm

M.A. Ladugin[1], A.Yu. Andreev[1], T.A. Bagaev[1], P.V. Gorlachuk[1], A.V. Lobintsov[1], A.A. Marmalyuk[1], A.A. Padalitsa[1], Yu.L. Ryaboshtan[1], S.M. Sapozhnikov[1], V.A. Simakov[1], K.Yu. Telegin[1], I.I. Zasavitskii[2], A.N. Zubov[2]; 1 - R&D Inst. Polyus, 2 - Lebedev Physical Inst. RAS, Russia

A quantum cascade laser emitting in the spectral range of 9.7 mm at 77 K has been developed. The laser heterostructure based on GaAs/AlGaAs was grown by the MOCVD technology. In the pulsed operation mode, the threshold current density of ~2 kA/cm2 and the emission power of above 200 mW have been obtained for the laser of the dimensions of 30 mm x 3 mm.

ThR3-p08 **09:30-13:30**

Perforated microring resonators

I.V. Levitskii[1], V.P. Evtikhiev[2]; 1 - SHM R&E Center RAS, 2 - Ioffe Inst., Russia

We propose a novel approach to control mode structure of microring resonators using subwavelength hollow core defects. Their influence on mode structure was studied computationally and experimentally.

ThR3-p09 **09:30-13:30**

Metamaterial for the second harmonic generation

G.M. Savchenko[1,2], V.V. Dudelev[1], K.K. Soboleva[1,3], V.V. Lundin[1], A.V. Sakharov[1], A.G. Deryagin[1], V.I. Kuchinskii[1,2], N.S. Averkiev[1], G.S. Sokolovskii[1]; 1 - Ioffe Inst., 2 - St. Petersburg Electrotechnical Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

We investigate the metamaterial with the structure comprising alternating semiconductor layers with intrinsic and metallic conductivity that can be grown epitaxially. The metamaterial is designed to demonstrate artificially low dispersion of the refractive index for the efficient second harmonic generation.

ThR3-p10 **09:30-13:30**

Dynamic model of laser-thyristor based on AlGaAs/GaAs heterostructure for subnanosecond optical pulse generation

O.S. Soboleva, A.A. Podoskin, V.S. Yuferev, N.A. Pikhtin, S.O. Slipchenko, I.S. Tarasov; Ioffe Inst., Russia

A new approach to high power laser pulse generation based on current switch integrated in to laser heterostructure has been demonstrated. The modeling of various structure designs has been performed and the possibility of obtaining short (2ns) and high amplitude (16 A) current pulses and generating of high-power (46W) optical pulses in optimized structure has been shown.

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

ThR3-p11 **09:30-13:30**

Dark soliton generation from semiconductor optical amplifier gain mediumin ring fiber configuration

S.N. Turtaev[1], M.A. Chernysheva[2], K.A. Fedorova[2], A.A. Gorodetsky[2], E.U. Rafailov[2]; 1 - Univ. of Dundee, 2 - Aston Univ., United Kingdom

We have investigated the mode-lock operation from a semiconductor optical amplifier (SOA) gain chip in the ring fibre configuration. At lower pump currents, the laser generates dark soliton pulses both at the fundamental repetition rate of 39 MHz and supports up to the 6th harmonic order corresponding to 234-MHz repetition rate with an output power of ~2.1mW. At higher pump currents, the laser can be switched between the bright, dark and concurrent bright and dark soliton generation regimes.

ThR3-p12 **09:30-13:30**

Effect of waveguide design on AlGaInAs/InP laser diode characteristics

D.A. Veselov[1], I.S. Shashkin[1], K.R. Ayusheva[1], A.V. Lyutetskiy[1], N.A. Pikhtin[1], S.O. Slipchenko[1], A.A. Padalitsa[2], M.A. Ladugin[2], A.A. Marmalyuk[2], Yu.L. Ryaboshtan[2], I.S. Tarasov[1]; 1 - Ioffe Inst., 2 - JSC Sigm Plus, Russia

1550nm-lasers based on MOCVD-grown heterostructures are investigated. It is determined, that additional barrier layers grown between waveguide and cladding layers block carrier leakage into the cladding layers but results in internal optical loss rise with drive current increase. It is demonstrated that incorporation of barrier layers allows attaining 92% internal quantum efficiency and 3.2W CW RT output optical power.

ThR3-p13 **09:30-13:30**

ZnSe-based laser array pumped by electron beam with energy below 6 keV

M.M. Zverev[1], N.A. Gamov[1], E.V. Zhdanova[1], V.B. Studionov[1], I.V. Sedova[2], S.V. Sorokin[2], S.V. Gronin[2], S.V. Ivanov[2]; 1 - Moscow Technological Univ. MIREA, 2 - Ioffe Inst., Russia

ZnSe-based laser array pumped by a pulsed electron beam with an energy of 5.6 keV has been studied. Output pulse power up to 180 W per one facet at wavelength of about 548 nm was measured at room-temperature.

ThR3-p14 **09:30-13:30**

Theory to optical properties of compound semiconductors for laser applications

K. Jandieri, M. Wiemer, S.D. Baranovskii; Philipps Univ. Marburg, Germany

Using analytical calculations based on the set of rate equations and straightforward Monte Carlo computer simulations we provide theoretical description of the temperature-dependent effects for photoluminescence in Ga(NAsP) and Ga(AsBi) successfully used for optically pumped and for electrically injected lasers. Comparison of the theoretical results with experimental data allows one to determine such decisive material parameters as the concentration of non-radiative centres, the compositional dependence of the band gap, and the energy dependence of the density of localized states in the band tails.

ThR3-p15 **09:30-13:30**

Statistical properties of polarization noise in multimode VCSELs

V.N. Chizhevsky[1], A.S. Maloshtan[1,2], A.V. Glejm[2]; 1 - Stepanov Inst. of Physics NASB, Belarus, 2 - ITMO Univ., Russia

We report an experimental study of local and integral statistical properties of polarization noise in multimode VCSELs in broad ranges of the injection current and the laser diode temperature with the aim to find maximal min-entropy of polarization noise used as a source of randomness for the fast random bit generation.

ThR3-p16 **09:30-13:30**

Defect vizualization and characterization in ZnSe crystals using two-photon confocal microscopy

A.A. Gladilin[1], V.P. Kalinushkin[1], O.V. Uvarov[1], E.M. Gavrischuk[2], N.A. Timofeeva[2], V.B. Iconnikov[2], M.I. Studenikin[1], V.A. Chapnin[1], A.V. Ryabova[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Devyatykh Inst. of Chemistry of High-Purity Substances RAS, Russia

We have studied the luminescence of extended defects of single-crystalline and polycrystalline ZnSe using two-photon confocal microscopy in the spectral range 450 - 720 nm; we have also investigated the influence of Cr and Fe doping on the defect structure of ZnSe. Maps of luminescence were obtained with micro-scale spatial resolution from the depth reaching 3 mm under the surface.

ThR3-p17 **09:30-13:30**

InSb quantum dashes heterostructures in narrow-gap InAs(Sb,P) matrix system

K.D. Moiseev, V.V. Romanov, E.V. Ivanov, P.A. Dement'ev, L.A. Sokura, V.N. Nevedomsky, N.A. Bert; Ioffe Inst., Russia

Heterostructures based on the InSb quantum dashes buried into the InAs unipolar matrix exhibited the electroluminescence near 3.62 μm at room temperature. Use of the multi-component InAsSbP matrix layers lattice-matched with the InAs substrate allows to control the matrix surface chemistry and to determine the shape of the deposited nano-islands.

ThR3-p18 **09:30-13:30**

Multi-mode dynamics of intracavity OPO pumped by vertical external cavity surface-emitting laser

Yu.A. Morozov[1], V.I. Kozlovsky[2]; 1 - Kotel'nikov Inst. of RadioEngineering and Electronics RAS (Saratov Branch), 2 - Lebedev Physical Inst. RAS, Russia

The multi-mode transient dynamics of a singly-resonant intracavity optical parametric oscillator (ICSRO) pumped by a vertical external cavity surface-emitting laser has been numerically analyzed. Nonlinear parametric interaction in the ICSRO was shown to stimulate multi-mode lasing with the intensity dip at a central frequency of emission. The insertion of an etalon makes the device exhibit a single-mode operation.

ThR3-p19 **09:30-13:30**

Study of particle drag force in a channel for optical trapping applications

S.A. Poniaev[1], K.K. Soboleva[2], A.I. Sobolev[2], G.S. Sokolovskii[1]; 1 - Ioffe Inst., 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia

Application of semiconductor light sources for optical trapping and manipulation of micrometer-sized objects for lab-on-a-chip applications requires careful consideration of the drag force acting on a particle moving in a fluid. We present results of numerical simulation of the drag force acting on a micro-particle in a two-wall channel and its dependence on the distance between the particle and the channel wall.

R4. LASER BEAM CONTROL

ThR4-p01 **15:00-19:00**

Characterizing photonic nanojets from phase diffraction gratings

A.A. Zemlyanov, Yu.E. Geints; Zuev Inst. of Atmospheric Optics SB RAS, Russia

We investigated numerically the specific spatially localized intense optical structure, a photonic nanojet (PNJ), formed in the near-field scattering of optical radiation at phase diffraction gratings. The finite-difference time-domain technique was employed to study the PNJ key parameters (length, width, focal distance, intensity) produced by diffraction gratings with the saw-tooth, rectangle, and hemispheric line profiles.

ThR4-p02 **15:00-19:00**

Analysis of optical fiber complex propagation matrix on the basis of vortex modes

V.S. Lyubopytov[1], A. Tatarczak[2], X. Lu[2], R.V. Kutluyarov[1], S. Rommel[2], A.Kh. Sultanov[1], I. T. Monroy[2]; 1 - Ufa State Aviation Technical Univ., Russia, 2 - Technical Univ. of Denmark, Denmark

We propose and experimentally demonstrate a novel method for reconstruction of the complex propagation matrix of optical fibers supporting propagation of multiple vortex modes. This method is based on the azimuthal decomposition approach and allows the complex matrix elements to be determined by direct calculations. We apply the proposed method to demonstrate the feasibility of optical compensation for coupling between vortex modes in optical fiber.

ThR4-p03 **15:00-19:00**

Correction of wavefront distortion in YAG:Nd active elements in oblique geometry

Yu.D. Arapov[1], V.P. Korolkov[2], R.K. Nasyrov[2], A.I. Malyshev[2], I.M. Ustyantsev[1], I.V. Kas'yanov[1]; 1 - RFNC-VNIITF, 2 - Inst. of Authomation and Electrometry SB RAS, Russia

The paper is devoted to correction of wavefront distortion in large aperture YAG:Nd active elements in oblique geometry by means of conformal correctors.

ThR4-p04 **15:00-19:00**

Specific features of defects image in doped lithium niobate crystals in polarized light

V.A. Maksimenko; Far Eastern State Transport Univ., Russia

This paper presents the experimental investigation of the photo-induced defects in doped lithium niobate crystals with various polarizations of inducing and testing laser beams. How do the forms of defect images depend on the light polarization is being discussed.

R4. LASER BEAM CONTROL

ThR4-p05 **15:00-19:00**

Diffraction caused spatial noise occuring in multiple pass laser amplifier

A.V. Kovalev, V.M. Polyakov, A.A. Mak; ITMO Univ., Russia

We overview methods for numerical analysis of diffraction patterns from arbitrary shaped apertures and for arbitrary beams. We present the FFT-based convolution calculation method modification and the results of numerical analysis of noises in a spatial intensity profile of a beam from a compact multiple pass laser amplifier.

ThR4-p06 **15:00-19:00**

Optical vortex array in broad-area laser

A.A. Krents[1,2], D.A. Anchikov[1], N.E. Molevich[1,2], A.V. Pakhomov[1,2]; 1 - Samara State Aerospace Univ., 2 - Lebedev Physical Inst. RAS, Russia

The formation of optical vortex array in broad-area laser is studied using the Maxwell-Bloch equations. The square optical vortex array solution was obtained analytically. Stability of the vortex array solution was investigated both analytically and numerically. Instability leads to oscillations in the vortex array. The frequency of vortices oscillations was obtained.

ThR4-p07 **15:00-19:00**

Measurement and correction of the wavefront of laser beam propagated through scattering medium

I. Galaktionov, Ju. Sheldakova, A. Kudryashov, A. Byalko, G. Kalenkov; Moscow State Univ. of Mechanical Engineering, Russia

Laser beam propagation through the scattering suspension of polystyrene microspheres in distilled water was investigated both theoretically and experimentally. Dependence of the wavefront aberrations on the turbid medium concentration was obtained. The existence of low-order and high-order symmetric wavefront aberrations of the laser beam passed through scattering suspension was shown. The investigation showed that with the use of bimorph deformable mirror the wavefront aberrations of scattered light could be effectively corrected.

ThR4-p08 **15:00-19:00**

100 KW noncontact CW laser parameter measurement device

A.N. Lobanov, O.V. Chesnokova; Electrosteklo LLC, Russia

BeamWatch instrument is the first noncontact laser beam profiler that can measure CW laser beams with 980 to 1080 nm wavelengths with power levels from 1 kW to 100 kW on beam sizes up to 12.5 mm.

ThR4-p09 **15:00-19:00**

Visualization of transparent microinhomogeneity in the nonlinear optical crystals by phase-contrast technique with adaptive photothermal Zernike filter

E.L. Bubis, V.V. Lozhkarev, V.N. Portnov, A.P. Prohorov, I.V. Kuzmin, O.A. Malshakova; Inst. of Applied Phys. RAS, Russia

Visualization of growth-sector boundary and point defects in non-linear optic crystal (KDP) was performed by phase- contrast method with adaptive photothermal Zernike filter.

ThR4-p10 **15:00-19:00**

Low cost adaptable laser transmitter for ground-based orbital observations

F. Sproll, D. Hampf, P. Wagner, L. Humbert, W. Riede; Inst. of Technical Physics, German Aerospace Center, Germany

Several theoretical laser transmitter concepts for low Earth orbit free space optical applications were investigated. A suitable, cost effective design including a beam steering unit as well as a fully automated laser divergence control was realized and characterized. For this only commercial off the shelf components were used.

ThR4-p11 **15:00-19:00**

Fiber-array-based vortex beams propagation through a turbulent atmosphere

V.P. Aksenov[1], V.V. Dudorov[1], V.V. Kolosov[1,2]; 1 - Zuev Inst. of Atmospheric Optics SB RAS, 2 - Tomsk Scientific Center SB RAS, Russia

We suggest a technique for generation of optical vortex beams with a variable orbital angular momentum based on a fiber laser array. Requirements for the number of subbeams and the spatial arrangement for the vortex beam generation are determined. The propagation dynamics of a vortex beam synthesized is compared with that of a continuous Laguerre-Gaussian beam in free space and in a turbulent atmosphere. Spectral properties of a beam synthesized, which is represented as a superposition of different azimuth modes, are determined.

ThR4-p12 **15:00-19:00**

Development and production of complicated electrode topologies for SAW-based inertial sensors

D.V. Safronov; Laser Center, Russia

A novel method of surface acoustic wave-based sensors production using laser ablation method is proposed. It provides excellent matching of topologies on opposite sides of wafers and a possibility to correct electrode structure after packaging. An experimental delay line is produced and tested.

ThR4-p13 **15:00-19:00**

Design of axial aberration compensation on picosecond pulsed laser machining system

Y. Liu, Z.W. Fan, J. Wang, T.Z. Zhao, W.R. Lin; Academy of Opto-Electronics CAS, China

Through the axial aberration compensation design, the maximum distance of axial focus compensation reaches 0.4mm with the focus spot size of 3μm in diameter. The results show that the picosecond laser micro-machining is able to reach the precision of microns with good quality.

ThR4-p14 **15:00-19:00**

The accuracy of the cross-wind speed calculation by the Shack-Hartmann wavefront sensor

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

The method to calculate the cross-wind speed at the entrance aperture of an adaptive optical system from the centroid coordinates measured by Shack-Hartmann wavefront sensor is presented. It is shown that the method accuracy can improved by using the vernier method.

ThR4-p15 **15:00-19:00**

The assessment of noise in the algorithm for calculating the speed of the cross-wind transfer of phase distortion

N.V. Goleneva[1,2], L.N. Lavrinova[1], V.V. Lavrinov[1]; 1 - Zuev Inst. of Atmospheric Optics SB RAS, 2 - Tomsk National Research State Univ., Russia

Calculation the cross-wind speed at the entrance aperture of an adaptive system is performed based on the correlation analysis of the centroids coordinates measured by a Shack–Hartmann wavefront sensor. To ensure the accuracy of the algorithm that calculate cross-wind speed, it must be resistant to noise caused by the sensor construction and performance of mathematical operations. Results of the numerical simulation are presented.

ThR4-p16 **15:00-19:00**

Statistically optimal control algorithm for the adaptive optics system

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

We present optimized predictive controller for adaptive optics system (AOS) that used hypothesis of «frozen» turbulence and Kalman filtering to predict turbulent phase distortions.

ThR4-p17 **15:00-19:00**

Focusing of the laser beam by the conical axicon and the matched linearly layered lens

D.A. Savelyev[1,2], A.V. Ustinov[2], S.N. Khonina[1,2]; 1 - Samara State Aerospace Univ., 2 - Image Processing Systems Inst. RAS, Russia

The paper considers the action of conical axicon and the matched linearly layered lens on focusing of the laser beam with using FDTD method.

ThR4-p18 **15:00-19:00**

Research of temperature-induced laser emission characteristics in large-area VCSEL

D.A. Anchikov[1], A.A. Krents[1,2], A.V. Pakhomov[1,2], N.E. Molevich[1,2]; 1 - Samara State Aerospace Univ., 2 - Samara Branch of Physical Inst. RAS, Russia

We report on the investigation of temperature induced laser dynamics in the model of wide-aperture vertical cavity surface emitting semiconductor laser based on two-dimensional Maxwell-Bloch equations with circular and square apertures. The results of numerical simulation in near and far fields are shown in dependence on frequency detuning, which can be presented as function of temperature in VCSEL.

ThR4-p19 **15:00-19:00**

Suppression of self-mode-locking and control of mode-locking regime of neodymium laser with single crystal GaAs into the cavity

M.V. Kozlova, A.M. Smirnov, R.M. Al-Khuzairi, V.N. Mantsevich, V.S. Dneprovskii; Lomonosov Moscow State Univ., Russia

A simple way of suppression of self-mode-locking in a nanosecond Nd3+:YAlO3 laser by placing single-crystal GaAs introducing a negative feedback into the laser cavity, exhibiting two-photon absorption, is implemented. Placing the element into the cavity of a pulsed picosecond Nd3+:Y3Al5O12 laser allowed an increase in the number of pulses and a change in the energy distribution between the pulses.

ThR4-p20 **15:00-19:00**

Measurement of laser cavity loss with algorithmic correction of dynamic effects

V.V. Azarova, A.S. Bessonov, A.L. Bondarev, A.P. Makeev, E.A. Petrukhin; R&D Inst. «Polus», Russia

We propose a dual-channel method for the measuring of a loss in a ring optical cavity. The loss value in a measured cavity is determined by comparing with intensity resonance of exemplary cavity. The algorithm of the intensity resonance processing takes into account the distortion of resonance shape by the dynamic effect.

R4. LASER BEAM CONTROL

ThR4-p21 **15:00-19:00**

Acousto-optical modulators made of KYW

M.M. Mazur[1], L.I. Mazur[1], V.E. Pozhar[2,3], V.N. Shorin[1]; 1 - National Research Inst. for Physicotechnical and Radio Engineering Measurements, 2 - Scientific Technological Center of Unique Instrumentation RAS, 3 - National Research Nuclear Univ. MEPhI, Russia

Potassium-yttrium tungstate is analysed as material for modulation of high power laser beams. It is found two promising AO modulator configurations:first of them provides the highest diffraction efficiency for linear polarized radiation, while the second one is capable to modulate random polarized radiation.

ThR4-p22 **15:00-19:00**

Thermo-optical phase distortions alanalysis in high power fiber laser systems

P.A. Semenov, I.P. Zhigan, V.Yu. Kiselev, A.S. Filatov; KB «Kuntsevo», Russia

This work provides theoretical and experimental results of thermo optical phase distortions analysis in 5 kW high power fiber laser with various optical systems. The comparative analysis of beam formation system with various optical materials is conducted. Optimal parameters of various systems are defined.

ThR4-p23 **15:00-19:00**

Image processing by means of orientational self-action of light in nematic liqud crystal

E.L. Bubis[1], I.V. Kuzmin[1], I.A. Budagovsky[2], S.A. Shvetsov[2,3], M.P. Smayev[2], A.S. Zolot'ko[2], A.Yu. Bobrovsky[4]; 1 - Inst. of Applied Physics RAS, 2 - Lebedev Physical Inst. RAS, 3 - Moscow Inst. of Physics and Technology, 4 - Lomonosov Moscow State Univ., Russia

The Zernike method using a nematic liquid crystal (NLC) filter with orientational optical nonlinearity was applied to visualize phase objects. It was shown that the contrast sign of the image switches by means of varying the incidence angle of a light beam on liquid crystal cell. The comparison of a contrast sign change of opaque object in the schemes based on NLC-filter and on liquid filter with thermal optical nonlinearity was performed.

ThR4-p24 **15:00-19:00**

Assessment of the microoptical gyro parameters for provision of the given limiting sensitivity

Yu.V. Filatov[1], E.V. Shalymov[1], V.Yu. Venediktov[1,2]; 1 - St. Petersburg State Electrotechnical Univ., 2 - St. Petersburg State Univ., Russia

The paper considers the assessment of the parameter values of microoptical gyro, that uses amplitude and phase characteristics of the passive ring resonator, are required to achieve the limiting sensitivity 1 °/h.

ThR4-p25 **15:00-19:00**

The results of experimental research adaptive optical system at different wavelengths

V.Yu. Venediktov[1,2], A. Gorelaya[1], E. Shubenkova[1], D. Dmitriev[3], I. Lovchiy[3], A. Tsvetkov[3]; 1 - St. Petersburg State Electrotechnical Univ., 2 - St. Petersburg State Univ., 3 - Scientific Research Inst. for Optoelectronic Instrument Engineering, Russia

The paper presents the first results of investigations of implementation of the closed-loop adaptive optical system at the beamlet segment with the differet length optic path, and reserch operation on different optical wavelengths.

ThR4-p26 **15:00-19:00**

The gradient method of deformable mirror surface calculation and method realization in 'Luch' facility wavefront correction system

I.N. Voronich, V.Y. Gladkiy, M.A. Gluhov, V.N. Derkach, I.N. Derkach, R.S. Kuzin, I.E. Chernov; RFNC-VNIIEF, Russia

The new method of deformable mirror surface calculation based on rms phase gradient minimization is described. The method introduced on 'Luch' allows to minimize laser beam divergence using adaptive system and to decrease calculation time up to 1-2ms at the same time. The experimental dependence of laser beam divergence on rms phase gradient for «Luch» facility is given.

ThR4-p27 **15:00-19:00**

Auto alignment system for 100 Hz Nd:YAG laser

A.A. Kharitonov[1], V.M. Polyakov[1], A.V. Kovalev[1], A.U. Karseeva[2], S.V. Kruzhalov[3]; 1 - ITMO Univ., 2 - FSUE "RI PhOOLIOS" of RC "S.I. Vavilov SOI", 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

The optical corrector for beam stabilization is investigated. We use galvo motors and position-sensitive photodetector for real time optical axis guiding. The system is developed for the purpose of 1.064 μm 100 Hz pulsed laser auto alignment system.

ThR4-p28 **15:00-19:00**

Spectral and optical limiting properties of ZnS nano and bulk crystals

A.A. Ryzhov[1], I.M. Belousova[1,2], D.A. Videnichev[1,2], A.C. Panfutova[1], S.K. Evstropiev[1,2], K.S. Evstropiev[2], I.M. Kislyakov[1,2]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., Russia

Some features of spectral and non-linear optical properties of ZnS quantum dots stabilized by high-molecular polyvinylpyrrolidone have been studied. It is shown that the absorption spectra of ZnS composite materials (sols, coatings) in UV spectral region are determined by quantum confinement effect, exhibiting the dependence of the absorption edge of the size of the ZnS nanocrystals.

ThR4-p29 **15:00-19:00**

Propagation of vortex eigenfunctions of bounded hankel transform in a parabolic fiber

M.S. Kirilenko[1,2], O.A. Mossoulina[1], S.N. Khonina[1,2]; 1 - Samara State Aerospace Univ., 2 - Image Processing Systems Inst. RAS, Russia

The fractional Fourier transform (FrFT) was considered in the paper. The vortex singular eigenfunctions of bounded Hankel transform and its propagation through FrFT were studded.

ThR4-p30 **15:00-19:00**

Quantum dots as luminescent label for immunoassay

A.M. Sobolev[1], M.V. Pozharov[1], N.V. Beloglazova[1,2], I.Yu. Goryacheva[1,3]; 1 - Saratov National Research State Univ., Russia, 2 - Ghent Univ., Belgium, 3 - St. Petersburg State Univ., Russia

Luminescent semiconductor quantum dots are popular labels for immunoassay. Synthesis and application of quantum dots as luminescent label and also acceptor for fluorescence resonance energy transfer is described.

R7. LASERS IN ENVIRONMENTAL MONITORING

ThR7-p01 **09:30-13:30**

A twin path laser interferometer for the contact-free length measurement of absorption cells at the ten micrometer accuracy level

H. Elandaloussi, C. Rouillé, P. Marie-Jeanne, C. Janssen; LERMA-IPSL, Sorbonne Univ., Observatoire de Paris, PSL Research Univ., France

We present a new twin path laser interferometer for length measurements of absorption cells using the optical path length change due to the refractive index diminution when the cell originally filled with nitrogen gas is evacuated. At a resolution of about 1/300 of a HeNe fringe, a standard uncertainty of u(L) = 7.5 micrometer is demonstrated, providing an about eightfold improvement over previous reports.

ThR7-p02 **09:30-13:30**

Characterisation of 4.329 and 4.439μ m tunable interband cascade lasers (ICL) for CO2 clumped isotope analysis by direct absorption spectroscopy

I. Prokhorov[1,2], T. Kluge[1,2], Ch. Janssen[3]; 1 - Heidelberg Univ., Germany, 2 - Heidelberg Graduate School of Fundamental Physics, Germany, 3 - Sorbonne Univ., UPMC Univ. Paris 06, CNRS, Observatoire de Paris, France

Precise clumped isotopes analysis of carbon dioxide opens up new horizons in atmospheric and biogeochemical research. Recent advances in laser and spectroscopic techniques allows to develop the instrumentation necessary to access extremely low sub-permill variations of multiply-substituted isotopologues.

ThR7-p03 **09:30-13:30**

Use of adaptive nonlinear Zernike filter in phase-contrast technique for registration of weak absorption of the medium

E.L. Bubis[1], V.V. Lozhkarev[1], I.V. Kuzmin[1], Yu.A. Mamaev[1], V.O. Martynov[1], A.I. Smirnov[1,2], A.N. Stepanov[1,2]; 1 - Inst. of Applied Physics RAS, 2 - Lobachevsky State Univ., Russia

The use of photothermal Zernike phase-contrast filter for measuring the absorption of the medium proposed. Results of numerical simulation are given. It is shown that the efficiency is comparable to the imaging scheme that uses linear filters, with a significant simplification of the process of its adjustment.

ThR7-p04 **09:30-13:30**

About Zernike method visualization of transparent structures by laser beam reflection from thin layer of oil by thermo-capillary convection

E. Bubis; Inst. of Applied Phys. RAS, Russia

The Zernike method visualization of transparent objects by laser beam reflection from thin layer of oil by thermo-capillary convection was investigated. The experiments were performed in the low-power (sub mW) level laser radiation.

R7. LASERS IN ENVIRONMENTAL MONITORING

ThR7-p05 **09:30-13:30**

Influence of physical factors on the zero drift of laser gyroscope at displacement of the optical path

Yu.Yu. Broslavets, E.A. Polukeev, A.A. Fomtchev; Moscow Inst. of Physics and Technology (State Univ.), Russia

In this article it is under investigating the influence of the shift of optical path in nonplanar cavity on the laser gyroscope drift characteristics magnitude involving magnetic field gradients, non-uniform ga flow and the diffraction nonreciprocity.

ThR7-p06 **09:30-13:30**

Photoactivation of gibberellin influenced by laser radiation on the surface of plant tissues

A.A. Yakovlev[1,2], A.S. Durova[1,2], A.S. Grishkanich[2], S.V. Kascheev[2], A.A. Mak[2], J.S. Ruzankina[2]; 1 - St. Petersburg State Forest Technical Univ., 2 - ITMO Univ., Russia

Researches are directed on studying of the biological processes caused by violet (405 nm) and red (640 nm) laser radiation on seed integumentary layers. A cycle of experiments was carried out to study the dependence of Picea abies (a fir-tree ordinary, family pine) seed sowing qualities from the influence of laser radiation in different conditions. After being exposed by laser influence, seed germinating ability and seedling growth were studied and compared with the indexes of control group. Results showed that the radiated seed germinating ability is higher, than the one of control group of seeds.

ThR7-p07 **09:30-13:30**

The concept of building a high-sensitive laser sensor for detection of iodine isotopes

V.V. Elizarov, Y.K Chubchenko, A.S. Grishkanich, S.V. Kascheev, L.A. Konopelko, A.A. Mak, A.P. Zhevlakov; ITMO Univ., Russia

Design and functional subsystems of a lidar sensor for the remote detection of iodine isotopes and indicators of radioactive contamination was developed. CARS-lidar allows to register the radionuclide with a concentration level of 3-10 molecules has been shown.

ThR7-p08 **09:30-13:30**

Increase of steel corrosion resistance by photonics

J.S. Ruzankina[1], S.V. Kascheev[1], O.S. Vasilyev[1,2], V.A. Parfenov[1,3]; 1 - ITMO Univ., 2 - LLC "Laser center", 3 - St.Petersburg State Electrotechnical Univ., Russia

The study is devoted to metal corrosion resistance increase possibility by means of laser oxidation. There are represented the results of experimental research of metal surface anti-corrosion protection while oxidizing it by constant fiber laser emission on wavelength $\lambda = 1064$ nm. Several tests were carried out to define the optimal processing parameters providing the high anti-corrosion protection of irradiated metal surface.

ThR7-p09 **09:30-13:30**

Creation platinum nanostructures for pH environment analyzer

V.V. Stepanov, V.V. Elizarov, A.S. Grishkanich, A.P. Zhevlakov; ITMO Univ., Russia

Role and value of pH measurement in bionanotechnologies. Development operation of pH element on the basis of Pt-nanofilms created by the LED method. Manufacture Pt-nanofilm by LED method, agreement with the hypothesis and confirmation of touch element serviceability and suitability. Experiment realization and obtaining the experimental data.

ThR7-p10 **09:30-13:30**

The investigation of aging process of writing inks printed on paper using Raman spectroscopy

K.O. Gorshkova[1], I.I. Tumkin[1], A.S. Tver'yanovich[1], E.R. Rossinskaya[2], V.A. Kochemirovsky[1]; 1 - St. Petersburg State Univ., 2 - Kutafin Moscow State Univ. of Law, Russia

The durability against light and aging dynamics of heteroatomic aromatic colorants containing nitrogen atoms used in writing inks was studied using Raman spectroscopy. The mechanisms of their thermal, photo-decomposition were proposed and the rates of these processes were determined. The results obtained in this study can be used for the age estimation of the paper documents up to 15 years.

ThR7-p11 **09:30-13:30**

Eye-safe DPSSL-based TOF-camera for geodesy

A.V. Kovalev, V.M. Polyakov, V.A. Buchenkov; ITMO Univ., Russia

We present a new TOF camera design based on a compact actively Q-switched diode pumped solid-state laser operating in 1.5 um range and a receiver system based on a short wave infrared InGaAs PIN diodes focal plane array with an image intensifier and a special readout integration circuit. The compact camera is capable of depth imaging up to 4 kilometers with 10 frame/s and 2.5 m resolution. The camera could be applied for airborne and space geodesy location and navigation.

ThR7-p12 **09:30-13:30**

Imaging of hidden objects in millimeter wavelength range

G.S. Rogozhnikov, I.V. Mishina; RFNC-VNIIEF, Russia

Electromagnetic radiation of millimeter and sub-millimeter wavelength range can penetrate through the sufficient number of constructional and domestic materials, that's why it is widely used in remote sensing of objects hidden behind the opaque barriers. Present-day technologies and methods make it possible to obtain information both about the appearance of the hidden object with spatial resolution on the order of wavelength and its structure. In this paper we show some ways of enhancing the self-descriptiveness of images being registered at 139-141 GHz frequencies by taking into account barrier features and object location behind the barrier.

ThR7-p13 **09:30-13:30**

SERS-platforms based on alumina and silica with embedded Ag nanoparticles for pre-concentration and detection

N.S. Yurova, A.V. Markin, T.Yu. RUnited Statesnova; Saratov National Research State Univ., Russia

New SERS-active materials were obtained by preparation of alumina and silica with embedded silver nanoparticles. Synthesized materials were applied for pre-concentration of model analytes and their SERS detection directly within the sorbents. The optimal conditions (ionic strength of Ag nanoparticles solution, conditions of silica and alumina synthesis and conditions of analyte pre-concentration) for maximum SERS signal enhancement were chosen.

ThR7-p14 **09:30-13:30**

Self-visualization and self-inverting of objects and structures when focusing spatially-phase-modulated laser radiation in weakly absorbing air environment

E.L. Bubis[1], A.M. Kiselev[1], I.V. Kuzmin[1], S.A. Gusev[2], E.V. Skorohodov[2]; 1 - Inst. of Applied Physics RAS, 2 - Inst. for Physics of Microstructures RAS, Russia

Processes of self-visualization and self-inverting of objects and structures when focusing spatially - phase-modulated laser radiation in weakly absorbing air environment about addition of small amount of vapors of molecular bromine are realized. The required power of laser radiation for realization of processes doesn't exceed 200 mW. Processes can be useful when developing laser lidar techniques and measurements for atmospheric remote sensing.

ThR7-p15 **09:30-13:30**

Detecting of thin oil films on water surface via UV filaments

A.A. Ionin[1], D.V. Mokrousova[1,2], L.V. Seleznev[1], D.V. Sinitsyn[1], E.S. Sunchugasheva[1,2]; 1 - Lebedev Physical Ins. RAS, 2 - Moscow Inst. of Physics and Technology, Russia

Femtosecond UV laser pulse induced fluorescence of thin oil films located on water surface was studied experimentally. Wide range of laser pulse intensity including filamentation mode was studied. This method was implemented for femtosecond UV pulses of two central wavelengths of 248 or 372 nm. Spatial resolution of the fluorescence localization was demonstrated to be not worse than 30 cm.

JUNE 27 – JULY 1, ST. PETERSBURG, RUSSIA

LASER OPTICS

ОПТИКА ЛАЗЕРОВ

2016

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

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KEY TOPICS OF THE SYMPOSIUM

- High power fiber lasers for material processing applications
- Cutting and welding with kW fiber lasers
- Fiber laser cladding, sintering, heat treatment and additive technology
- Fiber lasers for automotive applications
- Mid power fiber laser applications
- Pipe and thick section welding
- Marking and engraving
- Mid infra-red, 2 to 3 micron fiber lasers, processing including
- Cutting and welding of plastics
- Visible, UV and ultrafast fiber lasers and applications
- Hybrid lasers
- Life Sciences, medical, surgical, food production, agricultural pest and herbal control applications of fiber lasers
- New materials and parts for fiber lasers: fibers, crystals, glasses, optics, nonlinear elements

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

PLENARY SESSION

Location: Petrov-Vodkin 2+3 Rooms, floor 2, 09:00 – 11:00

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

TuS1P-01 Plenary **09:00-09:40**

Modern state and prospects of applications high-power fiber lasers

V.P. Gapontsev; IPG Photonics Corp., United States

Modern accessories of fiber lasers - their designs and manufacturing techniques. New opportunities of application over powerful lasers.

TuS1P-02 Plenary **09:40-10:20**

New developments for laser beam welding with high power fiber laser

J. Standfuss[1], E. Beyer[1,2], D. Dittrich[1], B. Brenner[1], S. Nowotny[1], S. Thieme[1], F. Brueckner[1], C. Leyens[1,2]; 1 - Fraunhofer Inst. for Material and Beam Technology, IWS, 2 - Technical Univ. Dresden, Germany

New fiber laser offers a wide range for new advanced laser beam welding technologies for hard-to-weld materials like aluminum or for precise built-up welding. The paper will describe different possibilities and technologies. The brilliant beam quality allows multi-pass welding with extremely narrow gap of less than 5 mm for welding depth up to 50 mm and above. With high frequent beam oscillation of up to 4 kHz and resulting keyhole stabilization pressure die casting aluminum are weldable with tight weld seams. Furthermore new optical configurations like processing heads with coaxial wire feeding allow new applications for welding, cladding and additive manufacturing.

TuS1P-03 Plenary **10:20-11:00**

Theory and technology of high productive direct laser deposition by means of high power fiber laser

G.A. Turichin, D.Yu. Kolodyagniy, E.V. Zemlyakov, E.A. Valdaytseva, O.G. Klimova, K.D. Babkin; Inst. of Laser and Welding Technology, Peter the Great St. Petersburg Polytechnic Univ., Russia

The article deals with physical processes of material transfer and shape formation in direct laser deposition. Mathematical model of deposition process, joined jet dynamics, powder transfer and heating by laser beam, melt pool formation and stability was developed. Experimental installation was designed on the base of 5 kW fiber laser. Calculation results were verified by comparison with experimental ones.

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

SECTION S1A. FIBER LASERS AND COMPONENTS

Location: Petrov-Vodkin 2 Room, floor 2, 11:30 – 13:30

Fiber Lasers and Components I

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

TuS1A-01 Invited **11:30-11:50**

Raman fiber lasers with direct pumping by high-power laser diodes

S.A. Babin[1,2], E.I. Zlobina[1], S.I. Kablukov[1]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Novosibirsk State Univ., Russia

A brief review of recent results obtained with LD-pumped Raman fiber lasers (RFLs) is given. Direct pumping of gradient-index fibers by multimode LDs offers RFL operation at ~980 and ~950nm with efficiency >40%. Herewith, the quality of output beam is greatly improved as compared with that of LDs. Further development in direction of all-fiber design and higher efficiency is shown.

TuS1A-02 Invited **11:50-12:10**

High-energy femtosecond all-fiber oscillator

D.S. Kharenko[1,2], V.A. Gonta[2], S.A. Babin[1,2]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Novosibirsk State Univ., Russia

We demonstrate a successful scaling of the pulse energy by increasing the cavity length and the mode-field diameter of the fiber simultaneously. Highly-chirped pulses with energy above 50 nJ at 250 fs compressed duration are generated in the all-fiber all-normal-dispersion cavity with 40-m long 10-μm core PM fiber. The maximum pulse energy was limited by the Raman effect.

TuS1A-03 **12:10-12:30**

Acousto-optically Q-switched fiber-bulk hybrid Er:YAG and Ho:YAG lasers

O. Vershinin, S. Larin, I. Larionov, A. Pigarev, A. Surin; NTO "IRE-Polus", Russia

Fiber-bulk hybrid lasers are investigated. Radiation of 30 W power at 2090 nm is obtained from Ho:YAG laser, pumped by 1908 nm thulium fiber laser. Radiation of 2.4 W at 1645 nm is obtained from Er:YAG laser, pumped by 1475 nm Raman fiber laser. TeO2 AOM is used as a Q-switch for high pulse energy generation.

TuS1A-04 **12:30-12:50**

2-μm hybrid lasers based on Tm3+:Lu2O3 ceramics in-band pumped by Raman-shifted erbium fiber lasers and their OPO frequency conversion

O. Antipov[1], A. Novikov[1], S. Larin[2], I. Obronov[2]; 1 - Inst. of Applied Physics RAS, 2 - NTO «IRE-Polus», Russia

High efficient 2-μm laser oscillators based on Tm:Lu2O3 ceramics in-band pumped at 1670 nm by Raman-shifted erbium fiber laser were investigated. Both 24 W CW and 15 W active Q-switched oscillations with 40 ns pulse duration and 15-30 kHz repetition rate were achieved in high quality beam. Evolution of two generated waves at 1966 nm and 2064 nm in dependence on pump power was studied. The mid-infrared frequency conversion of the ceramics-laser radiation in ZGP-based optical parametric oscillator was realized.

TuS1A-05 **12:50-13:10**

Milijoule level nanosecond hybrid thulium pulsed laser

I.V. Obronov[1,2], V.E. Sypin[1,3], S.V. Larin1, D.V. Myasnikov[1,3], O.L. Antipov[4]; 1 - NTO «IRE-Polus», 2 - National Research Nuclear Univ. MEPHI, 3 - Moscow Inst. of Physics and Technology, 4 - Inst. of Applied Physics RAS, Russia

New thulium laser module with hybrid Tm:Lu2O3 booster is presented. Module operates in pulsed mode and has following characteristics: pulse width 10ns, pulse energy up to 1mJ, pulse repetition rate up to 20kHz.

TuS1A-06 **13:10-13:30**

Single-mode broadband red fiber laser

O.A. Byalkovskiy[1], V.A. Tyrtyshnyy[1], E.S. Golubyatnikov[1,2]; 1 - NTO "IRE-Polus", 2 - Moscow Inst. of Physics and Technology, Russia

18 W of red laser radiation at 0.63 μm with 3 nm spectral bandwidth was achieved by sum frequency generation (SFG) of Er and Yb pulsed fiber lasers radiations at 1.55 μm and 1.06 μm wavelengths respectively. Noncritical phase matching in lithium triborate (LBO) crystal at 16°C of temperature was used.

- Lunch Break -

Location: Petrov-Vodkin 2 Room, floor 2, 15:00 – 17:00

Fiber Lasers and Components II

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

TuS1A-07 **15:00-15:20**

Simulation of nonlinear polarisation rotation laser with consideration of continious wave emission

D.V. Protasenya, A.I. Baranov, D.V. Myasnikov; NTO «IRE-Polus», Russia

Simulation of mode-locked lasers operation became an indispensable part of their investigation. Some drawbacks of conventional model have been revealed in my work. Addition of continuous emission to numerical model was shown to give much better correspondence with experiment.

TuS1A-08 **15:20-15:40**

High power ultrashort fiber laser system at 1.55 μm

A.I. Baranov, D.V. Myasnikov, D.V. Protasenya, A.S. Demkin, V.P. Gapontsev; NTO "IRE-Polus", Russia

Ultrashort erbium fiber laser system is presented. Optical module is integrated in IPG standard rack. Pulses with energy up to 20 microjoules are obtained, whereas maximum pulse repetition rate is 2 MHz. One of the main features of the system is fast individual pulse energy modulation. Burst mode of several pulses with specified pulse energy is also supported.

TuS1A-09 **15:40-16:00**

High power QCW Raman fiber laser at 1246 nm

A.V. Pigarev[1,2], A.A. Surin[1,2], D.V. Myasnikov1; 1 - NTO "IRE-Polus", 2 - Moscow Inst. of Physics and Technology, Russia

A quasi-continuous-wave all-fiber Raman fiber laser is demonstrated with a master oscillator power amplifier scheme. Ytterbium-doped booster is seeded with wavelengths 1069 and 1246 nm at the same time. Amplified pump at 1069 nm converts to signal Raman wavelength in phoshosilicate passive fiber. A 510 W peak power Raman fiber laser at 1246 nm with an optical efficiency of 58% for the respect to semiconductor multimode laser diode pump is demonstrated.

TuS1A-10 **16:00-16:20**

Pulsed erbium fiber laser with second harmonic generation in PPLT crystal

A.S. Demkin, A.I. Baranov, V.T. Ahtyamov, D.V. Myasnikov; NTO «IRE-Polus», Moscow Inst. of Physics and Technology, Russia

Nanosecond erbium fiber laser with frequency doubling in PPLT crystal at 780 nm is presented. Laser operates in the regime of constant pulse energy of 5 uJ and pulse duration of 2 ns at different frequencies in the range of 0.5-5 MHz. Average output power of 20 W was reached at the of 780 nm with 70 % conversion efficiency.

TuS1A-11 Invited **16:20-16:40**

Ultra-wide wavelength tuning of fiber lasers

Ya. Feng; Shanghai Inst. of Optics and Fine Mechanics CAS, China

In the talk, we will review the recent development on ultra-wide wavelength tuning of fiber lasers based on stimulated Raman scattering and Rayleigh scattering.

TuS1A-12 Invited **16:40-17:00**

Thermal optimization of high power fiber laser systems

C. Jauregui[1], H.-J. Otto[1], C. Stihler[1], J. Limpert[1,2], A. Tünnermann[1,2,3]; 1 - Inst. of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Univ., 2 - Helmholtz-Inst., 3 - Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany

This work presents an overview on the latest advancements in the understanding of transverse mode instabilities (TMI) together with guidelines to optimize high power fiber laser systems from the thermal point of view.

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERSAND THEIR APPLICATIONS

SECTION S1B. FIBER LASER TECHNOLOGIES AND EQUIPMENT

Location: Petrov-Vodkin 3 Room, floor 2, 11:30 – 13:30

Fiber Laser Technologies and Equipment I

Session Chair: V.D.Gorbach,
Central Research Inst. of Structural Materials «Prometey»

TuS1B-01 **11:30-11:50**

Fiber laser in stainless steel tube manifacturing

A. Cavallini; IPG Photonics, Italy

The laser Technology offers a higher welding speed (specially at higher material thickness), with less heating and a smaller heat affected zone. Higher processing speed of stainless steel is not only a matter of productivity, but also of quality.

TuS1B-02 Invited **11:50-12:10**

Welding of high-strength aluminum alloys by high-power fiber lasers

I.N. Shiganov; Bauman Moscow State Technical Univ., Russia

Welding of high-strength aluminum alloys by fiber laser is investigated. The possibility of laser cleaning of welded edges is showed. The features of welding with filler wire and hybrid laser-arc welding are studied. Microstructural researches and tests of mechanical properties are carried out.

TuS1B-03 **12:10-12:30**

Technological features of welding by powerful fiber lasers

I. Begunov, N. Grezev, E. Shamov, Yu. Markushov; NTO «IRE-Polus», Russia

We present results of our experimental welding by powerful fiber lasers different metals and alloys.

TuS1B-04 **12:30-12:50**

Formation of qualitative welding joints by hybrid laser arc welding of hull structures using high power fiber lasers

N.A. Nosyrev; Laser Center of Shipbuilding, JSC "Shipbuilding and Shiprepair Technology Center", Russia

The key features of qualitative welding joints formation using hybrid laser arc welding technology investigated in this work including estimation of influencing parameters, numerical modeling and full scale experiments.

TuS1B-05 **12:50-13:10**

Characteristics of yttrium oxide ablation by high-power fiber ytterbium laser

V.V. Platonov, E.A. Kochurin, V.V. Lisenkov, V.V. Osipov, E.V. Tikhonov, N.M. Zubarev; Inst. of Electrophysics, Ural Branch RAS, Russia

Characteristics of neodymium activated yttrium oxide ablation by high-power fiber ytterbium laser have been investigated. The high-speed photography of laser plume glow was carried out. The parameters of crater formed by laser radiation were measured. On the basis of obtained data we can conclude that the main part substance is removed from a target as liquid drops. The mechanism of formation of these drops was proposed and studied theoretically in the paper.

TuS1B-06 **13:10-13:30**

Research of process of laser welding of thin titanium plates by modeling the distribution of thermal fields

A.B. Lyukhter[1], A.V. Grigoriev[2], D.A. Kochuev[3], P.A. Palkin[2], A.N. Shlegel[2]; 1 - Vladimir State Univ., 2 - Engineering Centre at VlSU, Russia

The paper deals with the research of the problem of thin titan plates laser welding by calculating the distribution of thermal fields with the method of the final element analysis for predicting structural phase state of the weld. The results of modeling were being checked by experiments. The patterns obtained were being investigated for phase-structural transformations, efforts to tear. There were found the modes enabling to weld thin titan plates with a high quality of the weld.

- Lunch Break -

Location: Petrov-Vodkin 3 Room, floor 2, 15:00 – 16:40

Fiber Laser Technologies and Equipment II

Session Chair: V.D.Gorbach,
Central Research Inst. of Structural Materials «Prometey»

TuS1B-07 **15:00-15:20**

Advanced YLS-5000-BR laser developed for brazing applications

E. Shcherbakov, V. Fomin, A. Abramov, D. Yagodkin, D. Mochalov, V. Mironov; IPG Laser GmbH, Germany

High efficient, low footprint, industrial-grade fiber laser for brazing application was developed. The solution offers the following advanced features: unique replaceable three-core Process Fiber, independent power control via industrial field bus interfaces, high WPE thanks to usage of ECO-grade laser modules, advanced IPG Power Supply with integrated safety, integrated water-water chiller. The laser is fully compatible with all types of industrial processing heads thanks to usage of LCA (QD) output connector.

TuS1B-08 Invited **15:20-15:40**

The features of gear teeth hardening process using fiber laser

O.G. Devoino, V.V. Garskij; Belarusian National Technical Univ., "RUCH Servomotor", Belarus

Results of theoretical analysis of possibility surface laser hardening of gear teeth have been presented. It's shown that necessary properties of hardening layers may be obtain by using special scanning optic system. It is established that optimal distribution of micro hardness on hardening layers depth it is necessary for exploitation in contact stress loading conditions.

TuS1B-09 Invited **15:40-16:00**

High spatial adaptability beam delivery system for the laser surface hardening of automotive components by high power fiber lasers

P. Sancho[1], J. Domínguez[1], J. Isaza[2], F. Cordovilla[3], A. García Beltrán[3], J.L. Ocaña[3]; 1 - IKERGUNE A.I.E., 2 - Talens Systems, 3 - Polytechnical Univ. of Madrid, Spain

One of the major challenges for laser hardening is finding a way to deal with geometrical singularities of the treated components. In the present paper, developments are presented in the way of dynamical conformation of the laser beam assuring a high treatment quality in the treatment of automotive components by high power fiber lasers.

TuS1B-10 **16:00-16:20**

Approaches for profitable ultrashort pulse micromachining

B. Resan[1], C. Fuhrer[1], A. Stumpp[1], F. Senn[1], R. Witte[2], R. Holtz[1,2]; 1 - Univ. of Applied Sciences and Arts, 2 - Class 4 Laser Professionals AG, Switzerland

We will review several approaches for ultrashort pulse micromachining applications: new market development, competing in the existing application of direct machining with other conventional laser technologies, high volume replication using a micromachined tool, and parallel macro and micromachining. We will discuss advantages and disadvantages of each approach and report on our progress in development of a machine for parallel macro and micro machining.

TuS1B-11 **16:20-16:40**

Applications of fiber lasers for personalization of high security ID documents

V. Elokhin, V. Gotlib, I. Korzhavin; Scientific Instruments JSC, Russia

We present the technologies and apparatus for laser personalization of high security ID documents based of fiber lasers, including new security element utilizing enclosed laser ablation technique.

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

SECTION S1A. FIBER LASERS AND COMPONENTS

Location: Petrov-Vodkin 2 Room, floor 2, 09:00 – 11:00

Fiber Lasers and Components III

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

WeS1A-13 **09:00-09:20**

QCW thulium fiber laser for medical application

V. Sypin[1,2], A. Volkov[1,2], D. Myasnikov[1,2], F. Shcherbina[3], A. Mashkin[3]; 1 - NTO IRE-Polus, Russia, 2 - Moscow Inst. of Physics and Technology, Russia, 3 - IPG Laser GmbH, Germany

New compact thulium fiber laser module is presented. Module operates in millisecond-pulse mode with peak power up to 500W, average power up to 50W, and pulse energy up to 5J. The module is air-cooled and can be easily integrated in laser system.

WeS1A-14 **09:20-09:40**

Multi-kilowatt CW fiber laser systems with record wall-plug efficiency exceeding 50%

V. Gapontsev[1], E. Shcherbakov[2], V. Fomin[2], A. Abramov[2], M. Abramov[2], A. Ferin[2], V. Mironov[2], A. Doronkin[2]; 1 - IPG Photonics, United States, 2 - IPG Laser GmbH, Germany

The new family of industrial-grade fiber lasers having wall-plug efficiency (WPE) exceeding 50% in 1 ÷ 10 kW CW optical power range is presented. Maximal achieved WPE value is world's record 51.2%. Laser concept is based on the preliminary selection of laser components and matching of optimal operation ranges of different laser parts.

WeS1A-15 **09:40-10:00**

5 kW average power nano pulse fiber laser

V.P. Gapontsev[1], E. Shcherbakov[2], V. Fomin[2], A. Unt[2], S. Maryashin[2], M. Abramov[2], V. Mironov[2], A. Ferin[2], V. Kholoburdin[2]; 1 - IPG Photonics, United States, 2 - IPG Laser GmbH, Germany

Parallel combining of multiple nanosecond pulse fiber lasers by means of fused fiber combiners is proposed to scale up the output power of pulse fiber lasers. The radiation of 7 laser modules is coupled into 300 μm core delivery fiber with BPP equalled to 18 mm x mrad. The achieved peak power 0.5 MW and pulse energy 50 mJ correspond to the average power 5 kW within 1064 nm wavelength range.

WeS1A-16 **10:00-10:20**

Industry grade ultrafast ytterbium fiber lasers for glass and sapphire

A. Yusim[1], O. Shkurikhin[1], D. Myasnikov[2], A. Podvyaznyy[1], A. Sevian[1], A. Bordenyuk[1], I. Samartsev[1], N. Platonov[1], V. Gapontsev[1]; 1 - IPG Photonics Corp., United States, 2 - NTO «IRE-Polus», Russia

We report an industrial grade picosecond pulse Yb fiber lasers with >100 μJ pulse energy and 100s of Watts of average power for improved laser machining speed of sapphire and glass. The highly efficient laser with >25% wall plug efficiency resides in a compact 3U rack mountable configuration. Customer controllable features such as repetition rate, pulse duration, burst mode and adjustable pulse energy permit the customer to tailor the laser to their application.

WeS1A-17 **10:20-10:40**

Theoretical modeling of Er/Yb-doped fiber laser

A.M. Volkov, V.E. Sypin, A.I. Baranov, D.V. Myasnikov; NTO «IRE-Polus», Moscow Inst. of Physics and Technology, Russia

High power Er/Yb-doped fiber laser generation is analyzed. Parameters of rate equations are clarified. Upconversion and excited state absorption coefficients are measured.

WeS1A-18 **10:40-11:00**

Compact broadly tunable high energy nanosecond Ti:Sapphire laser for photoacoustic applications

D.A. Oulianov, I.I. Kuratev, R.S. Biryukov, V.A. Konovalov, O.G. Melovatsky, Z.V. Hamatov; LASER-COMPACT, Laser-export Co. Ltd., Russia

We introduce TiSon GS - a novel gain-switched Ti:Sapphire laser. The laser outputs up to 1 mJ pulse energies with 10 ns pulse duration and 0.5 nm line width at 1 kHz repetition rate. Wavelength is automatically tuned in the range of 700-900 nm. Random wavelength access is possible with less than 1 ms switching time per any wavelength change.

- Coffee Break -

Location: Petrov-Vodkin 2 Room, floor 2, 11:30 – 13:30

Fiber Lasers and Components IV

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

WeS1A-19 **11:30-11:50**

Looking for efficient compressor for high pulse energy femtosecond fiber laser

S. Frankinas, A. Michailovas, N. Rusteika; Ekspla Ltd, Center for Physical Sciences and Technology, Lithuania

The results of pulse compression using different stretcher/compressor configurations of the fiber chirped pulse amplification system are demonstrated.

WeS1A-20 **11:50-12:10**

Influence of a backward optical signal on mode instability in Yb3+-doped fiber amplifier

D.A. Alekseev[1,2], V.A. Tyrtyshnyy[1], M.S. Kuznetsov[3,4], O.L. Antipov[3,4]; 1 - NTO «IRE-Polus», 2 - Moscow Inst. of Physics and Technology, 3 - Inst. of Applied Physics RAS, 4 - Nizhniy Novgorod State Univ., Russia

Influence of both backward reflections and laser radiation of independent source propagating in backward direction of ytterbium fiber amplifier on mode instability was investigated. Dependences of mode instability threshold on both power and wavelength of the backward signal were measured. In order to explain threshold behavior we took into account backward signal in our theoretical model.

WeS1A-21 **12:10-12:30**

Mode instability observation in fiber amplifier of single-frequency radiation at 1560 nm wavelength

P.V. Puju, M.V. Zelenova, V.A. Tyrtyshnyy; NTO «IRE-Polus», Russia

Mode instability was observed in fiber amplifier of single-frequency radiation at 1560 nm wavelength. Mode instability threshold is 3,5 W at 20 mW input signal and 12 W pump power. High order modes intensity, measured using fast photodiode, oscillates at 2 – 3 kHz frequency.

WeS1A-22 **12:30-12:50**

Experimental comparison of mode instability threshold in high power fiber amplifier and oscillator

X. Wang, H. Zhang, R. Su, R. Tao, P. Zhou, X. Xu; National Univ. of Defense Technology, China

We investigated the behavior and threshold of mode instability both in high power fiber amplifier and oscillator experimentally. Fiber oscillator and fiber amplifier using the same fiber with core/cladding diameter of 21/400μm and all pumped by laser diodes with center wavelength of 976nm. Results shows that fiber laser oscillator holds a lower mode instability threshold than that in fiber amplifier.

WeS1A-23 **12:50-13:10**

Laser and supercritical fluid technologies for optical nano-composite materials fabrication

N.V. Minaev[1], A.O. Rybaltovsky[2], V.N. Bagratashvili[1]; 1 - Inst. of Laser and Information Technologies RAS, 2 - Moscow State Univ., Russia

The technology of structured nanocomposite materials fabrication using supercritical fluid and laser approaches is elaborated. Different types of structures from Ag and Au nanoparticles in polymer and porous optical materials are produced:periodic layered nanostructures (horizontal to film surface) from Ag nanoparticles with unexpectedly short period (90 - 180 nm); filamentary tracks from Ag and Au nanoparticles (5-90 μm in thickness and up to 5 mm in length), which are growing along a laser beam axis, and other structures; silica aerogels with Ag nanoparticles and rare earth metals. These composite materials are prospective for photonic, plasmonic, and sensor applications.

WeS1A-24 Invited **13:10-13:30**

Periodically poled MgO doped LiNbO3 and LiTaO3 for coherent light frequency conversion

V.Ya. Shur[1,2], A.R. Akhmatkhanov[1,2], I.S. Baturin[1,2], M.A. Chuvakova[1], A.A. Esin[1]; 1 - Ural Federal Univ., 2 - Labfer Ltd., Russia

We present the recent achievements in periodical poling in MgO doped single crystals of lithium niobate and lithium tantalate used for second harmonic generation and optical parametric oscillation based on quasi-phase-matched nonlinear optical wavelength conversion. The compact and highly efficient sources of visible and mid-IR laser light have been developed.

- Lunch Break -

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

SECTION S1A. FIBER LASERS AND COMPONENTS

Location: Petrov-Vodkin 2 Room, floor 2, 15:00 – 17:00

Fiber Lasers and Components V

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

WeS1A-25 Invited **15:00-15:40**

CVD diamond-prospective optical material

V.I. Konov; Prokhorov General Physics Inst. RAS, National Research Nuclear Univ. MEPhI, Russia

It will be shown that diamond films and plates produced by plasma chemical deposition technique (CVD diamond) have a number of unique properties such as broadband trandparency, record hardness and thermal conductivity. This combination makes CVD diamond extremely attractive for optics, in particular for high power laser systems. Examples of such applications will be demonstrated. Possibility of precise and productive surface and bulk micro and nanostructuring of diamond will be also considered.

WeS1A-26 **15:40-16:00**

Holmium doped fiber amplifier in the spectral region 2-2.15 μm

V.A. Kamynin[1,2], S.A. Filatova[1], I.V. Zhluktova[1,3], V.B. Tsvetkov[1,4]; 1 - General Physics Inst. RAS, 2 - Perm Scientific Center, Ural Branch RAS, 3 - Moscow Technological Univ., 4 - National Research Nuclear Univ. MEPhi, Russia

We have demonstrated the amplification of the small signals in a spectral range of 2-2.15 μm by all-fiber Ho-doped amplifier pumped at 1125 nm. Maximum gain more than 35 dB was achieved.

WeS1A-27 **16:00-16:20**

Investigation of the reasons of spectrum distortion of the ytterbium femtosecond fiber laser, working by the Nonlinear Polarization Evolution effect

I.S. Ulyanov, I.N. Bychkov, A.I. Baranov, D.V. Myasnikov; Moscow Inst. of Physics and Technology (State Univ.), NTO «IRE-Polus», Russia

In this work we have investigated an influence of intracavity polarizer extinction ratio on the spectral shape of an Ytterbium mode-locked fiber laser, working by the Nonlinear Polarization Evolution effect. We have established both experimentally and theoretically, that reducing this extinction ratio causes distortion of spectral shape of the laser pulse specific ripple occurs. In present work physics involved in this process is explained.

WeS1A-28 **16:20-16:40**

Error analysis and experimental verification of a fiber based displacement interferometer

X.C. Zhao[1], Z.N. Li[1], X.S. Tao[1], Y.F. Wu[2], N.W. Liu[1]; 1 - Inst. of Fluid Physics, CAEP, 2 - Univ. of Electronic Science and Technology of China, China

The error structure of fiber based displacement interferometers was studied, and an error compensation system developed. Experimental verification was achieved, contrasting gravitational acceleration between theoretical and measured results. The effective measurement velocity range was large with excellent precision.

WeS1A-29 Invited **16:40-17:00**

Double-clad Yb-free Er-doped fibers for high average and peak power lasers

L.V. Kotov[1], M.M. Bubnov[1], L.D. Lipatov[2], M.V. Yashkov[2], A.N. Guryanov[2], M.E. Likhachev[1]; 1 - Fiber Optics Research Center RAS, 2 - Inst. of High Purity Substances RAS, Russia

An overview of recent progress in development of highly efficient, high average and peak power lasers based on Yb-free Er-doped double clad fibers is presented. The most promising applications of such devices are discussed.

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

SECTION S1A. FIBER LASERS AND COMPONENTS

Location: Petrov-Vodkin 2 Room, floor 2, 09:00 – 11:00

Fiber Lasers and Components VI

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

ThS1A-30 Invited **09:00-09:20**

Bismuth-doped fiber lasers and amplifiers: review and prospects

M.A. Melkumov, S.V. Alyshev, S.V. Firstov, E.M. Dianov; Fiber Optics Research Center RAS, Russia

Review on recent results on lasers and amplifiers operating in four bands between 1.1 and 1.8 μm using Bi-doped active fibers with different compositions will be given. Future prospects of the Bi-doped fibers and devices will be discussed.

ThS1A-31 **09:20-09:40**

Mode locked fiber laser based on self-phase modulation and spectral filtering

I.N. Bychkov[1,2], A.I. Baranov[1,2], I.S. Ulianov[1,2], D.V. Myasnikov[1,2], I.E. Samartsev[3]; 1 - Moscow Inst. of Physics and Technology (State Univ.), Russia, 2 - NTO «IRE-Polus», Russia, 3 - IPG Photonics, United States

In this work we have investigated properties of passive mode-locked fiber laser based on spectral filtering and self-phase modulation effects. We achieved single-pulse mode-lock operation without external source using relaxation oscillations and accurately setting pump power. Numerical analysis of pulse generation in laser has been performed.

ThS1A-32 **09:40-10:00**

Wide aperture bimorph mirrors for high-power laser beam control

A. Kudryashov[1,2], V. Samarkin[2], A. Alexandrov[2], P. Romanov[2], G. Borsoni[1], J. Sheldakova[2]; 1 - AKAoptics SAS, France, 2 - Moscow State Univ. of Mechanical Engineering, Russia

The deformable mirror with the size of 410x468 mm controlled by the bimorph piezoceramic plates and multilayer piezoceramic stacks was developed. The results of the measurements of the response functions of all the actuators and of the surface shape of the deformable mirror are presented in this paper. The study of the mirror with a Fizeau interferometer and a Shack-Hartmann wavefront sensor has shown that it was possible to improve the flatness of the surface down to a residual roughness of 0.033 μm (RMS). The possibility of correction of the aberrations in high power lasers was numerically demonstrated.

ThS1A-33 **10:00-10:20**

High power CW visible laser radiation at 623 nm generated by single pass SHG in PPcLT crystal pumped by Raman fiber laser

Y.S. Stirmanov[1,2] A.A. Surin[1,2], T.E. Borisenko[1]; 1 - NTO IRE-Polus, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

We introduce efficient, linearly polarized, continuous wave Raman fiber laser (RFL) operating at 1246 nm with maximum output power 94 W and narrow spectral linewidth 0.17 nm. Single pass second harmonic generation (SP-SHG) was demonstrated using 20 mm long MgO:PPcLT crystal and 28 W of 623 nm radiation with 34 % conversion efficiency from 80 W of RFL radiation was achieved.

ThS1A-34 **10:20-10:40**

State of polarization in anisotronic tapered fiber with extremely large core diameter

V.E. Ustimchik[1,2,3], M.Yu. Vyatkin[1], S.M. Popov[1], Yu.K. Chamorovskii[1], V.N. Filippov[4], S.A. Nikitov[1,2]; 1 - Inst. of Radio-engineering and Electronics of RAS, Russia, 2 - Moscow Inst. of Physics and Technology, Russia, 3 - Russian Quantum Center, Russia, 4 - Tampere Univ. of Technology, Finland

We produced numerical and experimental research of polarization maintaining properties of adiabatic anisotropic tapered optical fiber with extremely large output core diameter. Results show that polarization state of light coupling in the narrow end did not degrade dramatically through whole fiber length (while core diameter increasing adiabatically upto tens of wavelengths).

ThS1A-35 **10:40-11:00**

Revolver hollow core fibers: optical properties and outlook

A.F. Kosolapov; Fiber Optics Research Center, Russia

The optical properties and applications of low-loss revolver hollow-core fibers are reviewed. The revolver fiber with nested capillaries with core diameter as low as 25 um and minimum optical losses of 75 dB/km is demonstrated for the first time.

- Coffee Break -

Location: Petrov-Vodkin 2 Room, floor 2, 11:30 – 13:30

Fiber Lasers and Components VII

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

ThS1A-36 **11:30-11:50**

Large mode area W-type double clad fiber as high order mode filter

W. J. Lai; Nanyang Technological Univ., Singapore

We studied the mode behavior of large mode area (LMA) W-type double clad fiber (DCF), and identified its potential as high order mode filter in high power fiber laser systems. This will help to improve the output beam quality of the fiber lasers.

ThS1A-37 **11:50-12:10**

High power picosecond ytterbium tapered fiber MOPA

A. Vorotinskii[1], V. Filippov[1], Yu. Chamorovskii[2], K. Golant[2], R. Gumenyuk[1], O.G. Okhotnikov[1]; 1 - Tampere Univ. of Technology, Finland, 2 - Kotel'nikov Inst. of Radio Engineering and Electronics, Russia

The powerful picosecond master oscillator – power amplifier (MOPA) with double clad ytterbium tapered fiber as a buster amplifier has been demonstrated in the presented paper. The developed MOPA has generated 60ps pulses with 300mJ pulse energy and 5MW peak power.

ThS1A-38 Invited **12:10-12:30**

Heavily RE-doped composite optical fibers with phosphate core and silica cladding

O.N. Egorova[1], S.L. Semjonov[1], O.I. Medvedkov[1], B.I. Denker[2], B.I. Galagan[2], S.E. Sverchkov[2], E.M. Dianov[1]; 1 - Fiber Optics Research Center RAS, 2 - General Physics Inst. RAS, Russia

We describe composite optical fibers with Yb and Er/Yb co-doped phosphate-glass core and silica cladding. Due to high RE-ion concentration in phosphate glass core fibe r length can be reduced in comparison with silica fibers. The silica cladding permit to achieve high mechanical strength and easy handling of this type of fibers.

ThS1A-39 **12:30-12:50**

Precise power measurement of laser radiation propagating along optical fiber

O.A. Ryabushkin, I.A. Larionov, S.V. Dolgolenok; NTO «IRE-Polus», Moscow Inst. of Physics and Technology, Russia

We introduce novel approach for precise power measurement of high power fiber lasers. It is based on detecting of thermal shift of piezoelectric crystal vibration mode frequencies. Sensing crystal is heated by laser radiation scattered from the curved section of laser output optical fiber. Measured sensitivity of the crystal sensor was near 140 Hz/Watt.

ThS1A-40 **12:50-13:10**

Coaxial model of active fiber heating in conditions of generation and amplification of laser radiation

O.A. Ryabushkin, R.I. Shaidullin, V.T. Ahtyamov; NTO «IRE-Polus», Moscow Inst. of Physics and Technology, Russia

Coaxial model of active fiber heating taking into account optical radiation absorption in polymer cladding is considered. Experimental method of active fiber heating temperature measurement based on radiofrequency impedance spectroscopy is presented.

ThS1A-41 **13:10-13:30**

Measurement of longitudinal temperature distribution inside active optical fiber in lasing conditions

O.A. Ryabushkin, V.E. Sypin, K.Yu. Prusakov; NTO «IRE-Polus», Moscow Inst. of Physics and Technology, Russia

A novel method for precise measurement of temperature in active fibers in conditions of generation and amplification of laser radiation is introduced. The method allows the determination of longitudinal temperature distribution in active fibers at different optical pump powers.

- Lunch Break -

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

SECTION S1A. FIBER LASERS AND COMPONENTS

Location: Petrov-Vodkin 2 Room, floor 2, 15:00 – 17:00

Fiber Lasers and Components VIII

Session Chair: Nikolay N. Evtikhiev
NTO "IRE-Polus", Russia

ThS1A-42 Invited **15:00-15:20**

Structure simulation and surface modification of photonic crystal fibers for the 2.0-25.0 μm range

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

Infrared optical fibers, particularly transparent within 3-5, 8-12 ranges, etc., are applicable for a number of objectives. For such fibers, single mode is preferable with considerably low optical losses and as large mode field diameter as possible, e.g. up to 100 μm.

ThS1A-43 Invited **15:20-15:40**

Creating an antireflection coating on the surface of silver and a monadic thallium halide crystalline materials

A.S. Korsakov, A.E. Lvov, D.S. Vrublevsky, L.V. Zhukova; Ural Federal State Univ., Russia

On the global market the demands for the quality and, more important, for the level of the special properties of polycrystalline IR optical fibers is rapidly rising. The transition at progressively longer wavelengths requires the use of materials with high refractive index. In this regard, the issue arises to create the antireflective coatings, which could neutralize this effect.

ThS1A-44 **15:40-16:00** **Invited**

Nanodefective crystals and crystal-derived optical fibers for the spectral range of 0.4-45.0 μm

L.V. Zhukova, A.S. Korsakov, D.D. Salimgareev, V.S. Korsakov, V.V. Zhukov; Ural Federal Univ., Russia

The crystalline substances form a new class of materials for the infrared fiber optics. For these purposes, the defective crystals are necessary, which have different structure-sensitive properties: optical, mechanical, luminescent, photochemical, et al.

ThS1A-45 **16:00-16:20**

Fast local photorefractive response in doped strontium barium niobate crystals

N.V. Bogodaev; NTO «IRE-Polus», Russia

Fast local photorefractive effect in doped SBN crystals ware found. The investigation of the interaction the laser longitudinal modes by two-wave mixing in photorefractive medium outside laser cavity located ware carry out.

ThS1A-46 **16:20-16:40**

New approach to growth of lithium triborate crystals for laser applications

A.P. Sadovskiy[1], S.V. Konstantinov[1], V.A. Sukharev[1], M.N. Artyushenko[1], I.S. Zhyrkova[1], D.D. Perlov[2]; 1 - NTO «IRE-Polus», Russia, 2 - IPG Photonics Corporation, United States

New approach to growth of lithium triborate (LBO) crystals for laser applications was submitted. LBO crystal growth conditions are presented. Estimation of properties of crystals LBO was held.

ThS1A-47 **16:40-17:00**

Generation of single-mode blue radiation by two steps sum frequency mixing in LBO crystal

E.S. Golubyatnikov[1,2], O.A. Byalkovskiy[1], V.A. Tyrtyshnyy[1]; 1 - NTO "IRE-Polus", 2 - Moscow Inst. of Physics and Technology, Russia

Blue laser radiation of 0.7 W power at 0.448 μ was obtained by cascading sum frequency generation of radiations with 1.55 μ and 0.63 μ wavelengths. Red radiation was obtained by summing the frequencies mixing of radiations of an erbium (1.55 μ) and an ytterbium (1.06μ) pulsed fiber lasers with 100 KHz pulse repetition rate and 1.5 ns pulses duration.

8TH INTERNATIONAL SYMPOSIUM ON HIGH-POWER FIBER LASERS AND THEIR APPLICATIONS

SECTION S1B. FIBER LASER TECHNOLOGIES AND EQUIPMENT

Location: Petrov-Vodkin 3 Room, floor 2, 09:00 – 10:40

Fiber Laser Technologies and Equipment III

Session Chair: V.D.Gorbach,
Central Research Inst. of Structural Materials «Prometey»

ThS1B-12 Invited **09:00-09:20**

Weld joints formation during welding of dissimilar materials by high power fiber laser

G.A. Turichin, E.A. Valdaytseva, O.G. Klimova-Korsmik, K.D. Babkin; Inst. of Laser and Welding Technology, Peter the Great St. Petersburg Polytechnic Univ., Russia

The article devoted to experimental and theoretical investigations of laser welding of dissimilar materials. Technological research (the composition of the protective environment, the welding speed, output power, the thickness of the welded plates) and analysis of the influence of process parameters on the weld were made for creation of possibility to weld dissimilar materials without intermediate layers. Improving the welding of dissimilar materials deals with solution of such problems as: formation of continuous layers of intermetallic compounds, cracks and pores in the weld and heat affected zone, formation of oxides at high temperature welding (a must-shielded welding). Theoretical and experimental results shown, that high power and beam quality of fiber lasers allow get weld joints with acceptable quality for dissimilar materials.

ThS1B-13 **09:20-09:40**

Optimization of the regimes of laser sintering of powder materials based on nickel universal equipment to produce blanks of machine parts

D.Yu. Tatarkin[1], V.P. Biryukov[2], M.A. Murzakov[1], V.D. Ivanisov[1]; 1 - NTO «IRE-Polus», 2 - IMASH RAS, Russia

The paper presents a metallographic investigation of preparations obtained by alloying powder materials based on nickel. It is shown that the performance of the cultivation process using a fiber laser and universal equipment 1,5 times higher than in serial production installations layer-by-layer laser sintering of metal powders.

ThS1B-14 **09:40-10:00**

Ways of optimization the process of three-dimensional laser cladding using a layer by layer strategy of powder alloying

D.P. Bykovskiy[1], A.O. Andreev[1], V.D. Mironov[1], V.N. Petrovskiy[1], I.S. Popkova[2], A.N. Solonin[2], V.V. Cheverikin[2]; 1 - NRNU MEPhI, 2 - NUST MISiS, Russia

316L stainless steel powder was used for volumetric laser cladding. We studied the microstructure of obtained objects, diffusion processes of the substrate components and the metal of laser cladding. Various strategies of layering metal powder were offered and mechanical tests of the samples properties were performed.

ThS1B-15 **10:00-10:20**

Laser drilling of dense micro holes in titanic plates

A.B. Lyukhter[1], D.A. Kochuev[3], A.A. Voznesenskaya[2], K.V. Skvortsov[3]; 1 - Vladimir State Univ., 2 - Engineering Centre at VlSU, 3 - LLC "VlSU IC", Russia

There have been carried out the experiments on ultra- perforation sheet titan with the thickness of 0,5 mm. Optimal laser action modes and the approach algorithm for laser drilling have been selected. There has been presented the totality of solutions enabling to ease the residual strain in the material after laser micro-processing.

ThS1B-16 **10:20-10:40**

The influence of the addition nanocarbide refractory metals in a serial of powder materials based on nickel to improve the wear resistance by laser cladding

M.A. Murzakov[1], D.U. Tatarkin[1], V.P. Biryukov[2]; 1 - NTO «IRE-Polyus», 2 - IMASH RAN, Russia

Laser cladding technology was used to conduct experiments on production of wear-resistant coatings with additive nanoparticles of refractory metals (WC, TaC). Mechanical testing of coating abrasion was made using Brinell-Howarth method. The obtained data was compared with wear-resistance of commercial powder containing WC. It was found that at a concentration 10-15% coating with nanopowder additives shows a dramatic increase in wear-resistance by 4-6 times as compared to carbon steel substrate. There were conducted metallurgical studies of coatings on inverse electron reflection. There was determined elemental composition of deposited coating and substrate, and microhardness measured. It was found that structure of deposited coating with nanoparticles is fine.

«LASER OPTICS 2016»

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS»

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PLENARY SESSION

Location: Levinson Hall, floor 2, 09:00 – 11:00
Session Chair: Ivan A. Shcherbakov,
Prokhorov General Physics Inst. RAS, Russia

TuS2P-01 Plenary **09:00-09:30**

The physics of perfect skin-enhancing the integument through laser

E. Victor Ross; Scrips Clinic, UCSD Medical Center, United States

As an example of this problem based method, a specific new approach to tattoo removal will be discussed. Also, recent works and future strategies for scar reduction will be presented.

TuS2P-02 Plenary **09:30-10:00**

Laser technologies in ophthalmic surgery

S.K. Vartapetov[1], I.A. Shcherbakov[1], A.V. Doga[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Fedorov Eye Microsurgery Federal State Inst., Russia

Modern lasers technologies and systems on the base excimer and femto lasers for refractive surgery are described.

TuS2P-03 Plenary **10:00-10:30**

Enhanced optical imaging and laser treatment in medicine: from UV to terahertz

V.V. Tuchin; Saratov National Research State Univ., Russia

Fundamentals and advances of tissue optical clearing (OC) technology that provides enhanced imaging and treatment of living tissues are presented.

TuS2P-04 Plenary **10:30-11:00**

"New" photons for existing and new medical applications

G. Altshuler[1], V. Gapontsev[2]; 1 - IPG Medical Corp., 2 - IPG Photonics Corp., United States

We will review existing and potential new medical application of fiber laser, QCW diode laser (currently used for pumping fiber laser) fiber laser and fiber laser pumped solid–state laser (hybrid laser) in ophthalmology, dermatology, urology and dentistry.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2A. ADVANCED LASER SYSTEMS FOR MEDICAL APPLICATIONS

Location: Levinson Hall, floor 2, 11:30 – 13:30

Advanced laser systems for medical applications I

Session Chair: David Kochiev,
Prokhorov General Physics Inst. RAS, Russia

TuS2A-00 Invited **11:30-11:50**

Spaser as smallest laser and best cellular probe to break the diffraction, spectral and detection limits

E.I. Galanzha[1], D.A. Nedosekin[1], A.I. Plekhanov[2], M.I. Stockman[3], V.P. Zharov[1]; 1 - Univ. of Arkansas for Medical Sciences, United States, 2 - Inst. of Automation and Electrometry SB RAS, Russia, 3 - Georgia State Univ., United States

The unique combination of superbright monochromatic emission and strong absorption of the spaser allows to consider this smallest laser as one of the best multifunctional super-contrast low toxicity optical probes that can overcome the spectral, diffraction, and other optical limits with focus on super-resolution spectral microscopy, in vivo flow cytometry, and early theranostics of cancer, infections, and cardiovascular diseases.

TuS2A-01 Invited **11:50-12:10**

Pulsed transverse discharge CO2 laser for medical applications

S. Nikiforov[1], Ya. Simanovsky[1], A. Pento[1], K. Moshkunov[2], N. Gorbatova[3], S. Zolotov[3], S. Alimpiev[1,4]; 1 - Prokhorov General Physics Inst. RAS, 2 - «Energomashtechnica» LLC, 3 - Inst. of Emergency Children's Surgery and Traumatology, 4 - Advanced Energy Technologies, Russia

Transverse discharge CO2 laser is characterized by high pulse power and high pulse energy. It provides effective ablation of various materials. We have designed a medical laser with pulse energy up to 40 mJ, repetition rate up to 100 Hz and pulse duration 5-20 μs. This laser is used in plastic surgery, otolaryngology and organic tissue laser mass spectrometry.

TuS2A-02 Invited **12:10-12:30**

1.56 μm laser thermotherapy in treatment of venous and arteriovenous malformations

I.A. Abushkin[1], A.G. Denis[2], V.O. Lapin[1], V.A. Privalov[1], A.V. Lappa[3], O.A. Romanova[4]; 1 - South Ural State Medical Univ., 2 - Tver Regional Children's Hospital, 3 - Chelyabinsk State Univ., 4 - Chelyabinsk Regional Children's Hospital, Russia

Treatment results of severe vascular pathologies: venous and arteriovenous malformations, with using of two types lasers, 1.56 and 0.97 μm wavelengths, are presented in this work. They are good for both these types, but the results of 1.56 μm laser are better.

TuS2A-03 Invited **12:30-12:50**

Possible fiber lasers applications in urology

A.Z. Vinarov; Sechenov First Moscow State Medical Univ., Russia

Tendency for minimally invasive treatment of the urological malignances (kidney and prostate cancer) leads for use of lasers for focal thermal tissue coagulation, through a percutaneous approach to the tumor under ultrasound or CT or MRI guidance. Fiber lasers applications plays a tremendous role in the treatment of urological patients, but physical properties of fiber lasers could open new horizons.

TuS2A-04 Invited **12:50-13:10**

Complex measurement of aerosol drug deposition using laser methods

A. Czitrovszky, A. Nagy, M. Veres, A. Kerekes, I. Rigo; Wigner Research Centre for Physics of the HAS, Hungary

Optical and spectroscopic methods were developed and applied for the investigation of aerosol drug delivery in idealized and realistic human airway models.

TuS2A-05 Invited **13:10-13:30**

Prospects of fiber lasers use in the ENT surgery

V.M. Svistushkin, E.V. Sinkov; Sechenov First Moscow State Medical Univ., Russia

Laser scalpel-coagulator produced by NTO "IRE-Polus" with Er-doped fiber laser (wavelength 1.56μm) is actively used in our clinic. We use it for treatment patients with exudative otitis, benign tumors of ear, throat and nose removal and nasal septum correction via laser cartilage thermoplastics. Now we develop in clinic some surgical treatment ENT techniques, used new laser with Tm-doped fiber with wavelength 1.94 μm.

- Lunch Break -

Location: Levinson Hall, floor 2, 15:00 – 17:20

Advanced laser systems for medical applications II

Session Chair: Gregory B. Altshuler,
IPG Medical Corporation, Marlboro, United States

TuS2A-06 Invited **15:00-15:20**

Recent advances in fiber and hybrid lasers widen opportunities for medical applications

S.V. Larin, D.V. Myasnikov; NTO «IRE-Polus», Russia

Recent developments of fiber and hybrid lasers covering broad spectral range are reported. Family of high power narrow-linewidth Raman fiber lasers for the treatment of biological tissues and drug composites is presented. Hybrid systems comprising fiber pump laser and solid-state wavelength converter for visible to mid-IR range are proposed. Medical applications for these sources are discussed.

TuS2A-07 **15:20-15:35**

Minimally-invasive percutaneous nephrolithotomy in the management of staghorn stones

O.V. Teodorovich[1,2], S.A. Naryshkin[1,2], G.G. Borisenko[2], D.G. Kochiev[3]; 1 - Central Clinical Hospital No1 JSC RZhD «Russian Railways», 2 - Russian Medical Academy of Postgraduate Education, 3 - Prokhorov General Physics Inst. RAS, Russia

We report our experience of minimally invasive percutaneous nephrolithotomy (Mini PCNL) in the management of staghorn kidney stones. Mini PCNL by laser lithotripter with microsecond pulse duration and second harmonic generation is effective and safe procedure in treatment of staghorn nephrolithiasis.

TuS2A-08 **15:35-15:50**

The laser for the precision selective photodestruction of the vascular structures of the skin and subcutaneous tissue

N.E. Gorbatova[2,3], A.G. Dorofeev[2,3], G.P. Kuzmin[1,3], A.A. Sirotkin[1,3], O.V. Tichonevich[1,3], S.A. Zolotov[2,3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Inst. of Emergency Children's Surgery and Traumatology, 3 - Advanced Energy Technologies LTD, Russia

The authors carried out work on creation of diode pumped solid state laser for the treatment of benign vascular lesions of the skin and subcutaneous tissue by precise selective photodecomposition.

TuS2A-09 **15:50-16:05**

Super Pulse diode and diode-pumped fiber lasers for fast and precise tissue surgery and regeneration

I.V. Yaroslavsky[1], K.S. Magid[2], D.M. Boutoussov[3], A.G. Vybornov[1], S.V. Larin[4], M.V. Inochkin[5], P.A. Gnatyuk[5], I.A. Perchuk[1], G.B. Altshuler[1]; 1 - IPG Medical, United States, 2 - Advanced Dentistry of Westchester, United States, 3 - Biolase Inc, United States, 4 - NTO «IRE-Polus», Russia, 5 - ITMO Univ., Russia

Super Pulse diode-based laser systems were evaluated for precision soft-tissue surgery and fractional treatment. Disruptive potential of the technology has been demonstrated.

TuS2A-10 **16:05-16:20**

In vitro comparison of Tm fiber laser vs Ho:YAG laser for lithotripsy

V.A. Zamyatina[1], A.A. Kovalenko[1], A.M. Dymov[2], D.V. Enikeev[2], V.P. Minaev[1], N.N. Sorokin[2], A.Z. Vinarov[2], I.V. Yaroslavsky[3], G.B. Altshuler[3], V.P. Gapontsev[1,4]; 1 - NTO «IRE-Polus», Russia, 2 - Sechenov First Moscow State Medical Univ., Russia, 3 - IPG Medical, United States, 4 - IPG Photonics, United States

A new thulium (Tm) fiber laser with a peak power up to 500 W for lithotripsy has been designed and prototype built. Performance has been evaluated vs. industry-leading Ho laser lithotripsy system in in vitro setting. Tm laser has demonstrated significantly increased stone fragmentation rate, decreased retropulsion effect, and reduced procedure time vs Ho system.

TuS2A-11 **16:20-16:35**

1,56 and 1,68 μm fiber lasers – possible instrument for LITT in urology. Preliminary results

A.M. Dymov[2], A.A. Kovalenko[1], V.P. Minaev[1], A.Z. Vinarov[2], V.A. Zamyatina[1], A.B. Shehter[2], A.V. Kurkov[2]; 1 - NTO «IRE-Polus», 2 - Sechenov First Moscow State Medical Univ., Russia

Using of laser radiation with wavelengths of 1,56 μm (Er-doped fiber) and 1,68 μm (Raman fiber laser) allows heating the areas of large volumes pathological tissues without carbonization. It lets to increase the efficiency of the LITT procedure.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2A. ADVANCED LASER SYSTEMS FOR MEDICAL APPLICATIONS

TuS2A-12 **16:35-16:50**

Tm fiber laser application for soft tissue surgery

A.R. Sadykov[3], A.M. Dymov[2], N.N. Enikeev[2], A.A. Kovalenko[3], V.P. Minaev[3], N.N. Sorokin[2], A.Z. Vinarov[2], V.A. Zamaytina[3], G.B. Altshuler[1]; 1 - IPG Medical, United States, 2 - Sechenov First Moscow State Medical Univ., Russia, 3 - NTO "IRE-Polus", Russia

A new thulium (Tm) fiber laser with a peak power up to 500 W for soft tissue surgery has been built. This system allows increase efficiency of soft tissue ablation and decrease collateral damage in comparison with modern Tm fiber laser with peak power up to 120 W and holmium (Ho) laser systems (experiment ex-vivo).

TuS2A-13 **16:50-17:05**

Terahertz reflectometry for the corneal tissue hydration sensing

A.A. Angeluts[1], A.V. Balakin[1], M.D. Mishchenko[1], I.A. Ozheredov[1], T.N. Saphonova[2], A.P. Shkurinov[1]; 1 - Lomonosov Moscow State Univ., 2 - FGBNU NIIGB, Russia

The cornea is one of the most important external structure of the human eye. Its transparency is an important factor for visual function and depends on the tissue hydration. For cornea hydration sensing we use terahertz reflectometer based on difference frequency generation of a pair of continuous semiconductor lasers. Spectral sensitive measurements are obtained by fine frequency tuning of terahertz source.

TuS2A-14 **17:05-17:20**

Architecture of a new fiber laser for applications in soft tissue surgery and lithotripsy

A.V. Vinnichenko[1], S.V. Larin[1], A.A. Mashkin[2]; 1 - NTO «IRE-Polus», Russia, 2 - IPG Laser GmbH, Germany

During the last decades, applications of lasers in medicine enjoyed stable growth. Surgical lasers are developed very intensively and today they occupy a significant market share. In this paper, we present a novel concept of an all-fiber-laser architecture for surgical applications.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» A3. MEMORIAL SESSION IN HONOUR OF ALEXANDER PROKHOROV (1916-2002)

Location: Levinson Hall, floor 2, 17:30 – 18:30

Advanced laser systems for medical applications II

Chair: Ivan A. Shcherbakov, Prokhorov General Physics Inst. of RAS, Russia

Official Language: Russian

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS»
SECTION S2A. ADVANCED LASER SYSTEMS FOR MEDICAL APPLICATIONS

TuS2A-p01 **15:00-19:00**

Laser percutaneous nephrolithotomy for bilateral staghorn stones

O.V. Teodorovich[1,2], S.A. Naryshkin[1,2], G.G. Borisenko[2], M.N. Shatohin[1,2], S.Y. Dalgatov[1,2], S.A. Davlatbiev[1,2]; 1 - Central Clinical Hospital No1 JSC RZhD "Russian Railways", 2 - Russian Medical Academy of Postgraduate Education, Russia

The improving outcomes of surgical treatment for bilateral staghorn kidney stones by using laser lithotriptor with microsecond pulse duration and second harmonic generation is investigated.

TuS2A-p02 **15:00-19:00**

The effectiveness of the clinical application of the multiwavelength laser medical installation with antibacterial and therapeutic effect

K.K. Baranov[2,3], N.E. Gorbatova[2,3], G.P. Kuzmin[1,3], A.A. Sirotkin[1,3], O.V. Tichonevich[1,3], S.A. Zolotov[2,3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Inst. of Emergency Children's Surgery and Traumatology, 3 - Advanced Energy Technologies LTD, Russia

In this paper, we proposed a method for the treatment of chronic middle purulent otitis. after the introduction of the optical fiber through the perforations of the tympanic membrane was carried out under the supervision of an endoscope processing structures of the middle ear laser irradiation.

TuS2A-p03 **15:00-19:00**

Improved two-channel laser Doppler flowmeter

D.G. Lapitan, D.A. Rogatkin; Vladimirsky Moscow Regional Research and Clinical Inst. «MONIKI», Russia

Noise in the differential-channel setup of a laser Doppler flowmeter was studied. Formation of false spectral components in the output signal due to electrical signals beating was found out. The improved block-diagram of the flowmeter allowing to reduce the noise was developed.

TuS2A-p04 **15:00-19:00**

Sapphire shaped crystals allow combining tissue cryodestruction, laser coagulation and diagnosis

I.A. Shikunova[1], V.N. Kurlov[1], K.I. Zaytsev[2,3,4], I.V. Reshetov[3,4]; 1 - Inst. of Solid State Physics RAS, 2 - Bauman Moscow State Technical Univ., 3 - Inst. of Improvement of Professional Skill of the Federal Medico-Biological Agency of Russia, 4 - Sechenov First Moscow State Medical Univ., Russia

Approach to combine tumor cryosurgery with laser therapy and optical diagnosis using sapphire shaped crystals has been demonstrated. Unique properties of sapphire shaped crystals (thermal, mechanical, and chemical strength complemented with high optical transparency and thermal conductivity) allow performing tissue destruction, or therapy, and optical diagnosis simultaneously.

TuS2A-p05 **15:00-19:00**

Human retina model for laser safety during corneal surgery with a femtosecond laser

H. Sun, Zh. Fan; Academy of OPTO-Electronics CAS, China

Femtosecond lasers are widely used in everyday clinical procedures to perform minimally invasive corneal refractive surgery. In the present study a numerical simulation was developed to quantify the temperature rise in the retina during femtosecond intracorneal surgery. Also, ex-vivo retinal heating due to laser irradiation was measured with an infrared thermal camera as a validation of the simulation.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2B. CLINICAL OPTICAL IMAGING AND SPECTROSCOPY

Location: Rihter Room, floor 3, 09:00 – 10:55

Clinical optical imaging and spectroscopy I

Session Chair: Natalia N. Bulgakova, Prokhorov General Physics Inst. RAS, Russia

WeS2B-01 Invited **09:00-09:20**

Modern fluorescence and other optical methods in early cancer of aerodigestive tract endoscopic diagnostics

V.V. Sokolov, D.V. Sokolov, S.S. Pirogov; Herzen Moscow Oncological Research Inst., Russia

From 1984 through 2015 - 176 early central lung cancer (ECLC) lesions were found in 128 patients, early squamous-cell esophageal carcinoma (EEC) – 43 patients. We have investigated possibilities of combination of white-light (WLI), autofluorescence (AFI), narrow-band imaging (NBI), local fluorescence spectroscopy (LFS), intelligent hemoglobin index (iHb), probe-based confocal laser endomicroscopy (pCLE) and endocytoscopy (EC) in ECLC and EEC diagnostics.

WeS2B-02 Invited **09:20-09:40**

Spectroscopic analysis of the interaction between antioxidants and free radicals in human skin

J. Lademann, S. Schanzer, M.C. Meinke, A. Patzelt, L. Zastrow, M.E. Darvin; Charité – Univ. Medizin Berlin, Germany

In the presentation various studies on the interaction between antioxidants and free radicals in human skin are presented which were performed at the Center of Experimental and Applied Cutaneous Physiology at the Department of Dermatology, Venerology and Allergology of the Charité – Universitätsmedizin Berlin.

WeS2B-03 Invited **09:40-10:00**

Autofluorescence spectroscopy techniques for skin cancer diagnostics

E. Borisova[1], Al. Zhelyazkova[1], Ts. Genova[1], P. Troyanova[2], El. Pavlova[2], N. Penkov[2], L. Avramov[1]; 1 - Inst. of Electronics BAS, 2 - Univ. Hospital «Queen Giovanna-ISUL», Bulgaria

A review of the recent achievements in the field of autofluorescence spectroscopy of cutaneous neoplasia would be presented. Excitation-emission matrices, synchronous fluorescence spectroscopy and other steady-state approaches are used for development of whole picture of the autofluorescent properties of benign, dysplastic and malignant lesions. Spectral peculiarities and fluorophores' content changes are used for development of differentiation algorithms for diagnostic needs.

WeS2B-04 Invited **10:00-10:20**

Advances in imaging human skin

M.J. Leahy; National Univ. of Ireland, Ireland

The skin is the body's largest and most accessible organ. It can act as a surrogate for other organs due to its similar immunoresponse. Nonetheless, substantial challenges have to be overcome for imaging the skin. This paper will review the challenges and progress in advanced imaging of human skin.

WeS2B-05 **10:20-10:35**

Hyperspectral imaging for skin neoplasms detection

L.A. Zherdeva[1], I.A. Bratchenko[1], O.O. Myakinin[1], A.A. Moryatov[2], S.V. Kozlov[2], V.P. Zakharov[1]; 1 - Samara State Aerospace Univ., 2 - Samara State Medical Univ., Russia

Experimental results for skin neoplasms detection in vivo and ex vivo in a visible spectral range are presented using hyperspectral imaging. Blood supply degree of a capillaries and a melanization degree of skin area are chosen as controlled criteria.

WeS2B-06 Invited **10:35-10:55**

The novel horizons in prediction of stroke: optical «instruments» and innovative strategies

O.V. Semyachkina-Glushkovskaya[1], A.S. Abdurashitov[1], E.G. Borisova[2], V.V. Tuchin[1,3]; 1 - Saratov National Research State Univ., Russia, 2 - Inst. of Electronics BAS, Bulgaria, 3 - Tomsk National Research State Univ., Russia

We show the current multi-modal technologies that are widely used in clinics and experiments for the study of brain hemorrhages (BH) in newborns: magnetic resonance imaging, ultrasonography, near infrared spectroscopy, laser Doppler, laser speckle contrast imaging and photon correlation spectroscopy. We discuss the advantages and disadvantages of these methods and show areas for future research of BH in term newborns.

- Coffee Break -

Location: Rihter Room, floor 3, 11:30 – 13:40

Clinical optical imaging and spectroscopy II

Session Chair: Ekaterina Borisova, Inst. of Electronics, Bulgarian Academy of Sciences, Bulgaria

WeS2B-07 Invited **11:30-11:50**

Combined optical and terahertz imaging for intraoperative delineation of nonmelanoma skin cancers

A.N. Yaroslavsky[1,2], C. Joseph[1], R. Patel[1], B. Fan[1], A. Musikansky[2], V.A. Neel[2], R. Giles[1]; 1 - Univ. of Massachusetts at Lowell, 2 - Massachusetts General Hospital, United States

Nonmelanoma skin cancers are the major cause of morbidity in fair-skinned population worldwide. We investigated the feasibility of combining terahertz and optical imaging for accurate intraoperative delineation of these cancers. Fresh thick skin excisions were used for the experiments. The tissue was imaged within four hours after surgery. Obtained images were compared to the corresponding histopathology, which was considered a gold standard. The results of the study indicate that combination of cross-polarized continuous wave terahertz imaging and polarized light optical imaging has potential as an intraoperative bedside tool for controlling the completeness of surgical excision.

WeS2B-08 **11:50-12:05**

Application of terahertz time-domain spectroscopy for blood glucose monitoring

O.P. Cherkasova[1], M.M. Nazarov[2], A.P. Shkurinov[2,3]; 1 - Inst. of Laser Physics SB RAS, 2 - Inst. on Laser and Information Technologies RAS, 3 - Lomonosov Moscow State Univ., Russia

Human skin optical properties were studied in vivo using terahertz time-domain spectroscopy. For the attenuated total internal reflection, the silicon Dowe prism was used. The measurements were carried out on volunteers with normal blood glucose concentration and after glucose intake. The variations of the reflection spectra of human skin were correlated with the changes in blood glucose level.

WeS2B-09 **12:05-12:20**

Medical diagnosis based on terahertz pulsed spectroscopy and imaging

K.I. Zaytsev[1,2,3], N.V. Chernomyrdin[1,2], S.O. Yurchenko[1,2], V.N. Kurlov[4], I.A. Shikunova[4], G.M. Katuba[1], K.G. Kudrin[2,3], V.E. Karasik[1,2], I.V. Reshetov[2,3]; 1 - Bauman Moscow State Technical Univ., 2 - Inst. of Improvement of Professional Skill of the Federal Medico-Biological Agency of Russia, 3 - Sechenov First Moscow State Medical Univ., 4 - Inst. of Solid State Physics RAS, Russia

We discuss recent results of our research in the area of biomedical applications of THz pulsed spectroscopy and imaging. We introduce THz aspherical lenses for high-resolution medical imaging and THz photonic crystalline waveguides for THz endoscopy. We consider the results of studying the THz dielectric characteristics of dysplastic and non-dysplastic skin nevi in vivo.

WeS2B-10 **12:20-12:35**

The study of terahertz radiation biologic effects as premise for creating of diagnostic and treatment methods

V.I. Fedorov; Inst. of Laser Physics SB RAS, Russia

The report emphasizes the importance of the study of terahertz radiation biological effects as another direction in the creation of diagnostic and therapeutic methods, along with terahertz imaging and terahertz spectroscopy. Therapeutic and diagnostic use of laser terahertz radiation based on the results of pre-conducted fundamental research of biological effects of terahertz radiation at the organismic, cellular and molecular levels presents.

WeS2B-11 Invited **12:35-12:55**

Bag-of-Features approaches for combined classification of laser scanning microscopy and spectroscopy data sets

S.G. Stanciu[1], R. Boriga[2], A.C. Dascalescu[3], R. Hristu[1], G.A. Stanciu[1]; 1 - Univ. Politehnica of Bucharest, 2 - Univ. of Bucharest, 3 - "Titu Maiorescu" Univ., Romania

The Bag-of-Features (BoF) paradigm represents a solid solution for the automated classification of digital images. Several BoF approaches for classification of microscopy data have been reported in the past decade, but their number is very low considering the potential that BoF methods hold with respect to this subject. In this contribution we discuss strategies for using BoF architectures for the automated classification of 1D and 2D data sets collected using Laser Scanning Microscopy techniques.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2B. CLINICAL OPTICAL IMAGING AND SPECTROSCOPY

WeS2B-12 **12:55-13:10**

New generation fluorescence and laser spectral analysis colposcope for early detection of cervix cancer

N.N. Bulgakova[1], E.G. Novikova[2], V.V. Smirnov[1,3], O.I. Trushina[2], V.I. Fabelinsky[1,3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Herzen Moscow Oncology Research Inst., 3 - Inlife LLC, Russia

The system has been developed to perform colposcopic examinations on a new level. It acquires high-quality color and fluorescence images and laser-excited fluorescence spectra taken by a fiberoptical probe from the points selected in course of analyzing acquired images. The colposcope is processed by special software that delivers several evaluated diagnostically-valuable parameter. Preliminary tests show that technical implementation is adequate for early cancer detection.

WeS2B-13 **13:10-13:25**

Optical alignment of component signals in assay of low proteinuria

A.I. Kuznetsov[1], A. Frorip[1], M. Ots-Rosenberg[2], A. Sünter[1]; 1 - AS Ldiamon, Tartu Science Park, 2 - Tartu Univ., Estonia

To overcome high selectivity of automated assay methods in low proteinuria a combined fractionation-optical method is proposed. Urine fractionation in the gel columns PD-10 is followed by immediate measurement of protein absorption at 280 nm. The method can be applied in the wide range of total protein concentrations 0.05 – 10 g/L.

WeS2B-14 **13:25-13:40**

Triple-modality imaging of optoacoustic pressure, ultrasonic scattering, and optical diffuse reflectance with improved resolution and speed

P.V. Subochev, I.V. Turchin; Inst. of Applied Physics, Russia

The method of cost-effective upgrade from an acoustic resolution photoacoustic microscope to a triple-modality imaging system is presented. The newly-developed experimental setup is based on a diode-pumped laser coupled to a fiber bundle with a spherically focused polyvinylidene fluoride detector integrated into the center of a ring-shaped optical illuminator. Each laser pulse illuminating the sample performs two functions. While the photons absorbed by the sample provide a measurable optoacoustic (OA) signal, the photons absorbed by the detector provide the measurable diffuse reflectance (DR) from the sample and the probing ultrasonic (US) pulse. At a 3 mm imaging depth the axial resolution of the OA/US modalities is 38μm/26μm, while the lateral resolution of the DR/OA/US modalities is 3.5mm/50μm/35μm. At LO conference we will present the imaging capabilities of the developed DR/OA/US system using the results on phantom and in vivo experiments.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2C. LASER INTERACTION WITH CELLS AND TISSUES

Location: Levinson Hall, floor 2, 09:00 – 10:55

Laser interaction with cells and tissues I

Session Chair: Alexander V. Priezzhev,
Physics Dep. and International Laser Centre of Lomonosov Moscow State Univ., Russia

WeS2C-01 Invited **09:00-09:20**

Side views in live cell microscopy

H. Schneckenburger, S. Bruns, V. Richter, P. Weber, M. Wagner, T Bruns; Aalen Univ., Germany

In contrast to epi-illumination or trans-illumination microscopy, various methods of perpendicular or oblique sample excitation are reported in view of minimizing background or out-of-focus signals and avoiding high light exposure. Techniques include scattering and light sheet fluorescence microscopy, TIRFM as well as axial tomography.

WeS2C-02 Invited **09:20-09:40**

New strategies for photothermal ablation and photoacoustic imaging of cancer based on cellular vehicles loaded with plasmonic nanoparticles

S. Centi, C. Borri, S. Lai, F. Tatini, F. Ratto, L. Cavigli, M. de Angelis, P. Matteini, F. Rossi, R. Pini; Inst. of Applied Physics CNR, Italy

Over recent years, gold nanorods (GNRs) have emerged as a promising material in biomedical optics and have been proposed as contrast agents for the photothermal therapy and the photoacoustic imaging of tumors. A pioneering approach to target tumors is the use of cellular vehicles, i.e. cells of the immune system that exhibit an innate tropism to tumors and that can be serve as Trojan horses. This strategy relies on cell types, such as tumor-associated macrophages or T cells, that are recruited by or naturally traffic to the microenvironment of tumors and that can be isolated from a patient and loaded with plasmonic particles in vitro. In this work, GNRs were synthesized and designed to combine high optical and photo-stability and the ability to accumulate into cells of the immuno system. Particles were silanized, PEGylated and conjugated with cationic moieties. Different cationic compounds were tested and the cell viability and uptake of the particles were studied on complementary cell types. Moreover, in this work we focus on how the gold nanorods photostability is affected when these particles are modified for cellular uptake, by investigating their stability and photoacoustic conversion efficiency under near infrared pulsed irradiation at different laser fluences.

WeS2C-03 Invited **09:40-10:00**

Acoustic radiation force optical coherence elastography

Zh. Chen; Univ. of California, Irvine, United States

We report on the development of an acoustic radiation force optical coherence elastography (ARF-OCE) technology to characterize tissues biomechanical properties. Knowledge of tissue mechanical properties provides valuable medical information in disease diagnosis and prognosis.

WeS2C-04 Invited **10:00-10:20**

Optoacoustic platform for noninvasive imaging, monitoring, and sensing

R.O. Esenaliev; Univ. of Texas Medical Branch, United States

Our group has proposed many biomedical applications of noninvasive optoacoustic imaging, sensing, and monitoring.

WeS2C-05 Invited **10:20-10:40**

In vivo imaging of reproductive events and cilia function in mammalian reproductive tract with optical coherence tomography

I. V. Larina, J. C. Burton, S. Wang; Baylor College of Medicine, United States

While the role of cilia in the reproductive tract is well recognized, ciliary dynamics in the oviduct is not well understood, largely owing to the lack of live imaging approaches. We report in vivo micro-scale mapping of cilia and cilia beat frequency (CBF) in the mouse oviduct using optical coherence tomography (OCT).

WeS2C-06 Invited **10:40-11:00**

In vivo imaging for detection and discrimination of actinic keratosis and squamous cell carcinoma from healthy human skin using two-photon tomography

M.E. Darvin[1], M. Klemp[1], M. Weinigel[2], M.C. Meinke[1], K. König[2], J. Lademann[1];
1 - Charité - Univ. Medizin Berlin, 2 - JenLab GmbH, Germany

Actinic keratosis (AK) is considered as squamous cell carcinoma in situ (SCC), which is developing after a cumulative exposition to ultraviolet radiation. The noninvasive in vivo imaging of healthy human skin and skin affected by AK and SCC is presented using two-photon tomography (TPT). Figure 1 shows images obtained in vivo at different depths.

- Coffee Break -

Location: Levinson Hall, floor 2, 11:30 – 13:25

Laser interaction with cells and tissues II

Session Chair: Valery V. Tuchin,
Saratov National Research State Univ., Russia

WeS2C-07 Invited **11:30-11:50**

Laser trapping and manipulation in hemorheologic studies

A.V. Priezzhev[1], K. Lee[2]; 1 - International Laser Center, Lomonosov Moscow State Univ., Russia, 2 - Univ. of Oulu, Finland

We present the results of our study of the process of red blood cells interaction. The study was performed using our homemade laser tweezers. Measurements were conducted on human red blood cells suspended in blood plasma and serum or solutions of various macromolecules. The aim of the study was to assess the red blood cells aggregation mechanism.

WeS2C-08 Invited **11:50-12:10**

Multispectral life-time imaging of tumor in small animal

A.P. Savitsky[1], V.V. Jerdeva[1], N.I. Kazachkina[1], Yu.G. Limar[1], V.I. Shcheslavsky[2]; 1 - Bach Inst. of Biochemistry RAS, Russia, 2 - Becker & Hickl GmbH, Germany

We are developing a method which will allow simultaneous monitoring of key apoptosis (programmed cell death) processes, drug distribution, such as photodynamic agents, as well as oxygen concentration, which is a critical parameter determining the efficiency of photodynamic therapy. We demonstrate the usefulness of a fluorescent protein-based sensor combined with FLIM-FRET for imaging of caspase 3, which is activated by different antitumor drugs in vitro and in vivo.

WeS2C-09 **12:10-12:25**

Multimodal embryonic imaging using selective plane illumination microscopy, optical projection tomography and optical coherence tomography

C. Wu[1], M. Singh[1], D. Mayerich[2], M.E. Dickinson[3], I.V. Larina[3], K.V. Larin[1,3];
1 - Department of Biomedical Engineering, Univ. of Houston, 2 - Department of Electrical and Computer Engineering, Univ. of Houston, 3 - Baylor College of Medicine, United States

The murine model is a common model for studying developmental diseases. Different optical techniques have been developed to investigate mouse embryos, but each has its own set of limitations and restrictions. In this study, we compare the performance of the relatively new methods of Optical Projection Tomography (OPT) and Selective Plane Illumination Microscopy (SPIM) to the well-established technique of Optical Coherence Tomography (OCT) to assess murine embryonic development at different stages. While all methods can provide spatial resolution at the micrometer scale in 3D, SPIM, based on fluorescence contrast mechanism, is able to image shallow regions with great details. OPT can provide superior imaging depth, however, it requires samples to be fixed, placed in an immobilization media such as agar, and cleared before imaging. OCT does not require fixing, it can be used to image embryos in vivo and in utero. In this study, we compare the efficacy of SPIM, OPT, and OCT for imaging murine embryonic development. The data demonstrate the superior capability of SPIM and OPT for imaging fine structures with high resolution while only OCT can provide structural and functional imaging of live embryos with micrometer scale resolution.

WeS2C-10 **12:25-12:40**

Live dynamic analysis of cardiac defects in mouse embryos with optical coherence tomography

A.L. Lopez III[1], S. Wang[1], K.V. Larin[2,3], P.A. Overbeek[1], I.V. Larina[1]; 1 - Baylor College of Medicine, United States, 2 - Univ. of Houston, United States, 3 - Samara State Aerospace, Russia

Studying embryonic mouse cardiac development can contribute to our understanding of congenital heart defects. We previously developed imaging approaches that combine static embryo culture, OCT imaging and advanced image processing to visualize the whole live mouse embryos and obtain 4D (3D+time) cardiodynamic datasets with cellular resolution. Here, we present analysis of cardiac defects using 4D OCT with dynamic imaging of early embryonic heart in live mouse embryos. Our results indicate that the live 4D OCT imaging approach has a great potential for structural and functional analysis of cardiac defects at very early stages in the mouse embryo.

WeS2C-11 **12:40-12:55**

Laser diffraction by wet blood smear and measurement of erythrocyte distribution in size

S.Yu. Nikitin[1,2], Yu.S. Yurchuk[1,2], V.D. Ustinov[1,2], G.Ya. Levin[3], A.V. Priezzhev[1,2];
1 - Lomonosov Moscow State Univ., 2 - International Laser Center of Lomonosov Moscow State Univ., 3 - Federal Medical Research Center, Russia

We present an automated laser system for measuring the erythrocytes distribution in size. In this paper we discuss the problems of photometry and processing diffraction patterns, preparation of blood samples as well as data processing algorithms, including methods for solving the inverse scattering problem.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2C. LASER INTERACTION WITH CELLS AND TISSUES

WeS2C-12 **12:55-13:10**

The influence of optical tissue clearing on polarization properties for different anisotropic media

D. Chen[1,2], N. Zeng[1], Yu. Wang[1,2], H. He[1], H. Ma[1,2]; 1 - Shenzhen Key Laboratory for Minimal Invasive Medical Technologies, Inst. of Optical Imaging and Sensing, Graduate School at Shenzhen, Tsinghua Univ., 2 - Department of Physics, Tsinghua Univ., China

According to our previous research publications, there are two type tissue anisotropy resources: the interstitial birefringence and the fibrous scatterers. During optical clearing process, different tissue anisotropy may show different polarization change. In our simulation, based on the refractive index matching, we respectively apply Mueller matrix polar decomposition (MMPD) method in a backward scattering configuration on two anisotropic tissue models: one is composed of spherical scatterers embedded in a birefringent medium, and the other is composed of a mixture of spherical and cylindrical scatterers. It can be seen that the phase retardance induced by the interstitial birefringence increases, but the slope of retardance change with the depth is constant, implying the increased retardance from the improved penetration depth by clearing. However, for cylindrical scatterers, the response by clearing is different. Due to the decreased scattering numbers, both the cylinder scattering induced retardance from superficial and deep depth decline. Furthermore, we combine the above simulation and partial experimental results to explain and discuss the real tissue clearing process.

WeS2C-13 **13:10-13:25**

Monte Carlo simulations of photon diffusion in time and frequency domains

V.L. Kuzmin[1], A.Yu. Valkov[1,2], A.D. Oskirko[1,2], L.A. Zubkov[3]; 1 - Peter the Great St. Petersburg Polytechnic Univ., Russia, 2 - St. Petersburg State Univ., Russia, 3 - Drexel Univ., United States

The Monte Carlo simulations of the photon migration in tissue models are performed for the time and frequency domains. The simulation results turn out to be in an excellent agreement with measurements for aqueous solutions of Intralipid mostly used as bio -phantoms.

- Lunch Break -

Location: Levinson Hall, floor 2, 15:00 – 16:20

Laser interaction with cells and tissues III

Session Chair: Alexander V. Priezzhev, Physics Dep. and International Laser Centre of Lomonosov Moscow State Univ., Russia

WeS2C-14 Invited **15:00-15:20**

Novel photonics in biomedical imaging: modern tools, emerging trends and applications

G. Zacharakis; Laser Interactions and Photonics Division, FORTH – IESL, Greece

Modern tools in biophotonics have revolutionized biological, preclinical and clinical research, providing new insights into the function of living organisms and disease. Technologies such as light-sheet microscopy, optical micro-tomography, optoacoustics and others can be used in label-free and targeted imaging from the single cell to the whole organism level.

WeS2C-15 **15:20-15:35**

Dynamic characteristics of channel formation in biotissue under CO2 laser radiation

V.V. Vasiltsov, M.G. Galushkin, V.A. Ulyanov; Inst. on Laser and Information Technologies RAS, Russia

The procedure of transmyocardial laser revascularization that presents an alternative approach in treatment of the patients with end-stage coronary artery disease finds wide clinical application in the world, particularly in Russia. There exist only two systems based on high-power CO2 lasers – "Heart Laser" produced in the United States and "Perfocor" developed in Russia – which have been authorized for wide clinical application.This makes very topical further investigation into the physical processes of channel formation in myocardium and other blood-filled organs under the action of powerful (several tens of joules) laser pulses.The analysis has been performed of temporal characteristics of the mechanism of channel formation in biotissue, this channel being produced by high-power waveguide CO2 laser radiation. The velocities of evaporation front movement and the typical times of gas-vapor channel deepening have been determined. The influence of laser beam expansion on the dynamics of channel depth increase has been estimated. An important role of the excess of evaporation front velocity over the characteristic fluid velocity is noted.

WeS2C-16 **15:35-15:50**

Development of the experimental setup model to quantify meat product polarization characteristics

A.A. Blokhina, V.A. Ryzhova; ITMO Univ., Russia

Designed and implemented a model of the experimental setup, the phase difference distribution is obtained in the cross section of the output beam. Theoretical principles and methods of the experiment were given as applied to the food industry.

WeS2C-17 **15:50-16:05**

Noninvasive measurement of cell nucleus by backscattered light

K.G. Domnin, E.T. Aksenov; Peter the Great St. Petersburg Polytechnic Univ., Russia

The combination of two methods (diffractometry and polarimetry) based on light scattering was discussed. An experimental setup was suggested.

WeS2C-18 **16:05-16:20**

Diagnostics of the pulmonary diseases using spectral analysis of exhaled air

Yu.V. Kistenev[1,2], A.V. Borisov[1], A.V. Shapovalov[1], D.A. Vrazhnov[3], V.V. Nikolaev[3], D.A. Kuzmin[2], A.A. Bulanova[1,2]; 1 - Tomsk National Research State Univ., 2 - Siberian State Medical Univ., 3 - Tomsklabs PTE LTD, Russia

Pulmonary diseases are widespread, symptoms are non-specific, diagnostics is based on registration of already occurred functional changes. Screening methods provide more opportunities to prevent deterioration and reduction of the societal burden of the disease. We will discuss approaches to diagnostics of pulmonary diseases based on control of the volatile metabolites-markers in the exhaled air and ability of IR laser absorption spectroscopy for screening diagnostics of these diseases.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2D. PHOTONICS AND NANOBIOTECHNOLOGY

Location: Levinson Hall, floor 2, 16:20 – 16:50

Photonics and nanobiotechnology I

Session Chair: Petr I. Nikitin, Moscow Inst. of Physics and Technology (State Univ.), Prokhorov General Physics Inst. RAS, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

WeS2D-01 Keynote presentation **16:00-16:30**

Mid-infrared biophotonics: potential and challenges

B. Mizaikoff; Ulm Univ., Germany

In the recent decade, chem/bio sensing platforms increasingly benefit from miniaturized and integrated optical technologies providing direct access to molecular information. Since in-situ analytical strategies are becoming more prevalent e.g., in harsh environments or for point-of-care diagnostics, detection schemes that do not require reagents or labels are of particular interest providing localized on-site information in - or close to - real-time.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2B. CLINICAL OPTICAL IMAGING AND SPECTROSCOPY

WeS2B-p01 **15:00-19:00**

Application of a method autofluorescence diagnosis in endoscopy for investigation mucosal structure in gastrointestinal tract

D.A. Abramov, I.V. Chavkin; ITMO Univ., Russia

Promising for the early diagnosis of malignant diseases of the respiratory organs and the gastrointestinal tract (GIT) is now considered a fluorescence method. The aim is to develop a fluorescent light source (illuminator FLU) for videoendoscopy complex and determining on the basis of scientific research and prototyping capability for creating fluorescence video endoscope.

WeS2B-p02 **15:00-19:00**

Influence of structured illumination aperture shape in numerically focused Fourier domain optical coherence microscopy: a comparison

A.A. Grebenyuk; Saratov National Research State Univ., Russia

The use of structured illumination in optical coherence microscopy (OCM) allows combining increased transverse resolution with small attenuation of the signal with defocus. This paper presents a comparative analysis of the properties of numerically focused imaging in Fourier domain OCM with different types of structured illumination aperture.

WeS2B-p03 **15:00-19:00**

The plasma protein fractions research by Raman spectroscopy method

A.A. Lykina[1], D.N. Artemyev[1], Yu.A. Khristoforova[1], I.L. Davydkin[2], T.P. Kuzmina[2], V.P. Zakharov[1]; 1 - Samara State Aerospace Univ., 2 - Samara State Medical Univ., Russia

This work is dedicated to the analysis of plasma proteins concentration using Raman spectroscopy setup. The obtained Raman spectra showed significant variation of intensities of certain spectral bands 940, 1005, 1330, 1450 and 1650 cm-1 for different protein fractions and concentrations. Partial least squares regression analysis was used for determination of correlation coefficients. We have shown that proposed method represents the structure and biochemical composition of albumin and immunoglobulins A and G.

WeS2B-p04 **15:00-19:00**

NIR autofluorescence skin tumor diagnostics

Y.A. Khristoforova[1], I.A. Bratchenko[1], D.N. Artemyev[1], O.O. Myakinin[1], A.A. Moryatov[2], S.V. Kozlov[2], V.P. Zakharov[1]; 1 - Samara State Aerospace Univ., 2 - Samara State Medical Univ., Russia

A method for skin tumors diagnostics based on the analysis of changes in the AF spectrum in the near infrared region is proposed. The analysis of the AF spectrum was implemented via its exponential approximation. Proposed approach allows for malignant melanoma diagnosis with an accuracy of 88.4% for ex vivo studies, and 86.2% for the in vivo studies.

WeS2B-p05 **15:00-19:00**

Study of cerebral bloodflow autoregulation in rats assessed by LSCI

S. Sindeev, O. Sindeeva, A. Abdurashitov, A. Horovodov, A. Shnitenkova, A. Gekaluk, M. Ulanova, A. Sharif, O. Semyachkina-Glushkovskaya; Saratov National Research State Univ., Russia

In this paper, using the method of laser speckle imaging, which has been extended to the simultaneous study of macro- and microcirculation of cerebral vessels in healthy rats, shows that the mechanisms of maintaining the «autonomy» of cerebral circulation depends on the initial state of the body and the floor. Pharmacological dose-dependent stimulation of increase of peripheral arterial pressure is not accompanied by a similar intensity of responses at the level of the cerebral circulation, and appears to «contain» the reactions in the form of redistribution of blood flow at the level of the macro (in females) and microcirculation (females and males). The results extend the idea of the importance of the method of laser speckle imaging in neurophysiological studies of reserve possibilities of cerebral autoregulation in the formation of hypertensive status.

WeS2B-p06 **15:00-19:00**

Critical changes in the brain leads to the intracranial hemorrhages in newborn rats

E. Zinchenko[1], E. Borisova[2], I. Fedosov[1], A. Namykin[1], A. Abdurashitov[1], A. Serov[1], M. Abakumov[3], M. Ulanova[1], I. Agranovich[1], O. Semyachkina-Glushkovskaya[1,4]; 1 - Saratov National Research State Univ., Russia, 2 - Inst. of Electronics BAS, Bulgaria, 3 - Russian National Research Medical Univ., Russia, 4 - Huazhong Univ. of Science and Technology, China

Intracranial hemorrhages are the bane of modern civilization, as are still blind spots in diagnostic and treatment of this disease. In our research we found time-dependent changes in sagittal sinus diameter and blood flow velocity. The decrease in oxygen saturation is accompanied by increase in red blood cell flexibility. These changes characterized by progression as incidence of brain hemorrhages.

WeS2B-p07 **15:00-19:00**

Boron-doped diamond electrodes for mid-IR spectroelectrochemistry

J. Izquierdo, D. Neubauer, B. Mizaikoff, C. Kranz; Ulm Univ., Germany

Boron-doped diamond (BDD) has recently gained considerable attention as infrared transparent electrode (ITEs) for spectroelectrochemical investigation in the mid-IR spectral region related to its due unique physical and chemical properties. Within this contribution, we present spectroelectrochemistry using a BDD-modified IR-ATR crystal in with atomic force microscopy.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2C. LASER INTERACTION WITH CELLS AND TISSUES

WeS2C-p01 **15:00-19:00**

New form of the transport equation for the case of 2D orthogonal scattering approximation in biooptics

I.A. Guseva[1], A.P. Tarasov[1,2], D.A. Rogatkin[1]; 1 - Vladimirsky Moscow Regional Research and Clinical Inst. «MONIKI», 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

Extension of the 2-flux Kubelka-Munk approach to a 2D radiative transfer problem was studied. New transport equation of the 4-th order for the case of orthogonal-scattering approximation and its strict analytical solution were derived.

WeS2C-p02 **15:00-19:00**

Inaccuracy of the classical Monte-Carlo simulation in the general case of 1D turbid biological media

A.P. Tarasov[1,2], I.A. Guseva[2], D.A. Rogatkin[2]; 1 - Inst. of Physics and Technology (State Univ.), 2 - Vladimirsky Moscow Regional Research and Clinical Inst. «MONIKI», Russia

Solution of the direct problem of light transport in 1D turbid media by Monte Carlo simulation (MC) was compared with exact analytical results based on improved Kubelka-Munk approach. The divergence of these two solutions was observed. Improvement of MC was proposed to satisfy the exact approach.

WeS2C-p03 **15:00-19:00**

Monitoring of laser-induced thermal gradients in plant cells by means of digital micro-interferometry

A.V. Belashov[1,2], N.V. Petrov[2], I.V. Semenova[1], O.S. Vasyutinskii[1]; 1 - Ioffe Inst., 2 - ITMO Univ., Russia

In this work digital holographic method has been used for investigations of plant cell heating process. An analysis of obtained phase images has been performed and major sources of the observed phase shift were determined.

WeS2C-p04 **15:00-19:00**

Multimodal detection of phase transition in adipose tissue

I.Yu. Yanina[1,2], E.K. Volkova[1,2], A.P. Popov[1,3], A.V. Bykov[1,3], I.V. Meglinski[1,4], V.V. Tuchin[1,2,5]; 1 - Univ. of Oulu, Finland, 2 - Saratov National Research State Univ., Russia, 3 - Tomsk National Research State Univ., Russia, 4 - Irkutsk State Univ., Russia, 5 - Inst. of Precise Mechanics and Control RAS, Russia

Phase transitions are revealed macroscopically through measurements of relevant parameters. Temperature-mediated phase transitions of lipid components of the adipose tissues has been observed by combined use of the Abbe refractometry, optical coherence tomography (OCT), and fluorescence spectroscopy.

WeS2C-p05 **15:00-19:00**

Combined laser and spectral holographic microscopy for investigation of phase objects

A.S. Machikhin, O.V. Polschikova, A.G. Ramazanova; Scientific and Technological Center of Unique Instrumentation RAS, Russia

A quantitative analysis of spectral dependence of phase delay distribution introduced by transparent microscopic objects is discussed. Experimental setup based on Mach-Zehnder interferometer with acousto-optic filtration of wideband low-coherence light is used for calculating the phase delay distribution by means of digital processing of interferograms. An example of a calculated phase delay distribution is shown.

WeS2C-p06 **15:00-19:00**

Terahertz waves interaction with medium ordered by cytoskeleton

S.S. Popova; Inst. of Laser Physics SB RAS, Novosibirsk State Univ., Russia

In contrast to ionizing radiation, it is a subject of controversial debate whether terahertz (THz) radiation can influence biological systems except thermal effect. The key question consists of the absorbed energy distribution in biological cells. Living cells inner media is ordered by a cytoskeleton that can affect non-equilibrium distribution of absorbed energy in inter-molecular vibrations.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2D. PHOTONICS AND NANOBIOTECHNOLOGY

Location: Levinson Hall, floor 2, 09:00 – 11:00

Photonics and nanobiotechnology II

Session Chair: Petr I. Nikitin,
Moscow Inst. of Physics and Technology (State Univ.), Prokhorov General Physics Inst. RAS, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

ThS2D-02 Keynote presentation **09:00-09:30**

Interaction of colloidal nanoparticles with cells

W.J. Parak; 1- Philipps Univ. Marburg, Germany, 2 - CIC Biomague, Spain

The fate of colloidal nanoparticles in in vitro and in vivo scenarios will be discussed.

ThS2D-03 Invited **09:30-09:50**

Nanomechanical and optomechanical systems for cancer research

J. Tamayo; Inst. de Microelectronica de Madrid CSIC, Spain

The advances in micro- and nanofabrication technologies are enabling increasingly smaller mechanical transducers capable of detecting the forces, motion, mechanical properties and masses that emerge in biomolecular interactions and fundamental biological processes. Thus, biosensors based on nanomechanical systems have gained considerable relevance in the last decade. This talk will provide insight into the mechanical phenomena that occur in suspended mechanical structures when either biological adsorption or interactions take place on their surface. In addition, I will show how coupling nanomechanics and nanooptics allows to achieve sensing devices with higher performance and novel transduction paradigms. I will describe then some relevant experiments running in our laboratory that harness nanomechanical and optomechanical systems for cancer research in three battlefronts: i) ultrasensitive detection of cancer biomarkers in blood, ii) optonanomechanical spectrometry and iii) cancer cell nanomechanics.

ThS2D-04 Invited **09:50-10:10**

Nanorobots for biomedical applications

M.P. Nikitin; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, 3 - Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

Conceptually novel approach has been demonstrated to create nanobiorobotic structures for targeted drug delivery and biosensing. The proposed nanostructures are capable of performing multi-parametric molecular analysis of the micro-environment of a therapeutic target (e.g., a cancer cell) and react to it in a pre-programmed way.

ThS2D-05 Invited **10:10-10:30**

New laser-based technology for circulating biomarker discovery: applications for early diagnosis and prevention of cancer

E.I. Galanzha[1], V.V. Tuchin[2], V.P. Zharov[1]; 1 - Univ. of Arkansas for Medical Sciences, United States, 2 - Saratov National Research State Univ., Russia

This report summarizes our recent advances of in vivo flow cytometry (FC) by the integration of photoacoustic, photothermal, Raman, fluorescent and photoswitchable FCs, high-pulse-rate multicolor lasers and multifunctional nanoprobes. Taking into account clinical relevance of photoacoustic FC, we anticipate its quick translation for use in humans to break down limit in early diagnosis and therapy of metastasis in cancer patients.

ThS2D-06 **10:30-10:45**

Laser-induce co-deposition of copper with cobalt as signal amplification method for biochemical microbiosensors

A.V. Smikhovskaia, E.M. Khairullina, I.I. Tumkin, S.S. Ermakov, D.V. Navolotskaya; St.Petersburg State Univ., Russia

The influence of cobalt (II) chloride on laser-induced copper deposition was studied. Copper deposition experiments in aqueous solutions containing various concentrations of cobalt(II) chloride upon 532 laser irradiation were performed. The influence of additives on the deposition rate, the topology, electrochemical properties of the deposited microstructures was investigated. Sensory activity of these structures towards hydrogen peroxide and glucose was studied.

ThS2D-07 **10:45-11:00**

Application of surface-enhanced infrared spectroscopy for steroids analysis

O.P. Cherkasova[1,2], A.G. Milekhin[3,2], I.A. Milekhin[2], S.A. Kuznetsov[2], E.E. Rodyakina[3,2], A.V. Latyshev[3,2]; 1 - Inst. of Laser Physics SB RAS, 2 - Novosibirsk State Univ., 3 - Rzhanov Inst. of Semiconductor Physics, Russia

The surface-enhanced infrared spectroscopy was used for analysis of steroid hormone cortisol in biological samples. The concentration dependence of the intensity of the IR absorption modes of cortisol deposited on the metal nanoantenna arrays was investigated and the minimum detectable concentration of steroid hormone was determined.

- Coffee Break -

Location: Levinson Hall, floor 2, 11:30 – 13:30

Photonics and nanobiotechnology III

Session Chair: Ekaterina I. Galanzha,
Univ. of Arkansas for Medical Sciences, United States

ThS2D-08 Invited **11:30-11:50**

Embedding molecules inside plasmonic nanostructures: a new approach for highly uniform and reproducible surface-enhanced Raman scattering

B.N. Khlebtsov[1], N.G. Khlebtsov[1,2]; 1 - Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, 2 - Saratov National Research State Univ., Russia

Surface-enhanced Raman scattering probes with a nanometer-sized interior gap between Au core and shell, also called nanomatryoshkas (NMs), have attracted great interest for SERS-based bioimaging and biosensing. We found that the structure of nanogaps inside Au NMs strongly depends on the core surface morphology. Here we report on the preparation of uniform Au@Ag core/shell nanorods with a controllable Ag shell thickness. The dependence of Raman intensity on the inside/surface location of the reporter molecules was studied.

ThS2D-09 Invited **11:50-12:10**

Magnetic platform for UV surface-enhanced resonance Raman and fluorescence

H. Bhatta[1], A. Aliev[2], I.R. Gabitov[3], V.P. Drachev[1,3]; 1 - Univ. of North Texas, Denton, United States, 2 - Univ. of Texas at Dallas, United States, 3 - Skolkovo Inst. of Science and Technology, Russia

Cobalt nanoparticles with high quality crystal structure and spin polarization support an excellent plasmon resonance at about 275 nm, which is comparable with gold nanoparticles. The quality of plasmon resonance is highly correlated with the superparamagnetic response of the isolated nanoparticles and disappeared in the aggregates. The fluorescence enhancement of about 3x103 for surfactant molecules is demonstrated.

ThS2D-10 Invited **12:10-12:30**

GoldMag nanoparticles and its applications in point-of-care testing

G. Qin[1], M. Peng[1], Q. Zhang[2], W. Hui[3], S. Zhang[3], Y. Cui[3]; 1 - Northwest Univ., 2 - The First Affiliated Hospital of Xian Jiaotong Univ., 3 - Northwest Univ., China

Fe3O4/Au hybrid nanoparticles and nanocomposites have attracted much attention due to their unique physical and chemical properties such as superparamagetism, chemical stability, biocompatibility and optical properties. Herein, the synthesis and properties of GoldMag nanoparticles are presented. Their applications in POCT such as visual protein detection, quantitative detection are discussed. Specifically, the quantitative detection, gene detection and Quantitative Immunoassay are highlighted.

ThS2D-11 Invited **12:30-12:50**

Lipid multilayer grating based biosensors

S. Lenhert; Florida State Univ., United States

Fluid diffraction gratings composed of lipids have promise as label-free and innately biofunctional sensor elements. As molecules interact with the lipid grating elements, the nanometer scale lipid droplets change shape and corresponding optical properties. The gratings can be rapidly fabricated by a new printing process that we call nanointaglio. The gratings have been used to quantify membrane remodeling by the membrane binding protein Sar1, a process that has been quantified another way. Integrating multiple lipids into arrays allows for selective detection of vapors using an optical nose approach. Recently, aptamer functionalization of lipid multilayer gratings has been developed for for selective detection of arbitrary analytes in solution.

ThS2D-12 Invited **12:50-13:10**

Living cells response to laser light and low-temperature plasma

V. Zablotskii[1], O. Lunov[1], N. Terebova[2], A. Kulikov[2], S. Kubinova[1,3], E. Sykova[3], A. Dejneka[1]; 1 - Inst. of Physics of the CAS, Czech Republic, 2 - ITMO Univ., Russia, 3 - Inst. of Experimental Medicine of the CAS, Czech Republic

Direct interactions of laser and ion irradiations with living cells can dramatically affect their functionality. However, the physical mechanisms and biochemical pathways underlying the effects of non-thermal plasma and laser light on cell fate have still not been fully explored. We show how laser and plasma ions induce either direct physical destruction of bacteria or triggers programmed cell death.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2D. PHOTONICS AND NANOBIOTECHNOLOGY

ThS2D-13 Invited **13:10-13:30**

Digital image capture and analysis for simultaneous static and dynamic light scattering for biological systems

G.S. Iannacchione[1], S. Algarni[2]; 1 - Worcester Polytechnic Inst. United States, 2 - King Saud Univ., Saudi Arabia

The Area Recorded Generalized Optical Scattering (ARGOS) approach to light scattering employs large image capture array allowing for a well-defined geometry in which images may be manipulated to extract structure with intensity at a specific scattering wave vector (I(q)) and dynamics with intensity at a specific scattering wave vector over time (I (q,t)). The ARGOS method provides morphological dynamics noninvasively over a long time period and allows for a variety of aqueous conditions. This is important because traditional growth models do not provide for conditions similar to the natural environment. The present study found that the population dynamics of bacteria do not follow a traditional growth model and that the ARGOS method allowed for the observation of bacterial changes in terms of individual particles and population dynamics in real time. The observations of relative total intensity suggest that there is no stationary phase and that the bacterial population demonstrates sinusoidal type patterns consistently subsequent to the log phase growth. These observation were compared to shape changes by modeling fractal dimension and size changes by modeling effective radius.

- Lunch Break -

Location: Levinson Hall, floor 2, 15:00 – 16:30

Photonics and nanobiotechnology IV

Session Chair: Germano Iannacchione, Worcester Polytechnic Inst. United States

ThS2D-14 Invited **15:00-15:20**

Hybrid gold-based nanoparticles and atomic clusters for analytic and theranostic applications

N.G. Khlebtsov[1,2], B.N. Khlebtsov[1,2], L.A. Dykman[1,3], V.A. Khanadeev[1,2]; 1 - Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, 2 - Saratov National Research State Univ., 3 - Saratov Science Research Veterinary Inst. RAS, Russia

Multifunctional nanocomposites combine therapeutic, diagnostic, and sensing modalities in a single nanostructure, thus constituting the technological basis of theranostic – a rapidly growing and promising field at the crossroads of plasmonics and nanomedicine. In this talk, we summarize our recent efforts in fabrication of hybrid gold-based nanocomposites for analytical and theranostic applications. We discuss also fabrication, optical properties, and applications of multifunctional fluorescent Au nanoclusters.

ThS2D-15 **15:20-15:35**

Superesolution optical imaging multimodal system

G.A. Stanciu[1], C. Stoichita[1], A. Nigro[2], M. Manfredi[2], S.G. Stanciu[1], D.E. Tranca[1], R. Hristu[1]; 1 - Univ. Politehnica of Bucharest, Romania, 2 - GNR SRL-Analytical Instruments Group, Agrate Conturbia, Italy

In our work we present a new superresolution optical optical imaging multimodal system which includes several microcopies techniques working in far field or in near field.this multimodal system integrated several optical microscopy techniques which offer the possibility for investigations at micro and nanoscale on the same area by using laser scanning microscopy techniques. It also included an atomic force microscope.

ThS2D-16 **15:35-15:50**

Trends in biosensor development: multifunctional platrorms and enchanced labels

I.Yu. Goryacheva[1,2], Yu.S. Skibina[3], S.A. Pidenko[1], N.A. Burmistrova[1], A.A. Shuvalov[3], A.A. Chibrova[3]; 1 - Saratov National Research State Univ., 2 - St. Petersburg State Univ., 3 - SPC Nanostructured Glass Technology Ltd, Russia

Hot-points in biosensors development, such as an application of new bifunctional platforms with an example of photonic crystal fibers and multiplexing of labels with an example of multiloaded with quantum dots nanostructures are discussed.

ThS2D-17 **15:50-16:05**

Luminescent quantum dots as labels for multiparametric immunoassay

N.V. Beloglazova[1,2], A.V. Gordienko[1], A. Foubert[2], O.A. Goryacheva[1], S. De Saeger[2]; 1 - Saratov National Research State Univ., Russia, 2 - Ghent Univ., Belgium

Use of quantum dots as highly sensitive labels in immunochemical assay for simultaneous screening of multiple analytes is described.

ThS2D-18 **16:05-16:20**

Quantum dots in basic research and practical applications: the role of size and quasi-multivalency

A.V. Salova, T.N. Belyaeva, V.V. Kosheverova, E.A. Leontieva, M.V. Kharchenko, E.S. Kornilova; Inst. of Cytology RAS, Russia

Quantun Dots (QDs) attract attention as possible fluorescent markers with unique optical properties suggesting their applications for multi-color simultaneous staining of intracellular targets and their detection in live cells. However, their size and quasi-multivalency could affect the overall physiological response. We have shown requirements for endocytically effective EGF-QD complexes formation and analyzed the limiting stages in their interaction with cells.

ThS2D-19 **16:20-16:35**

Lectin-based nanoagents for specific cell labelling and optical visualization

V.O. Shipunova[1], M.P. Nikitin[1,2,3], P.I. Nikitin[3], S.M. Deyev[1]; 1 – Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, 2 – Moscow Inst. of Physics and Technology (State Univ.), 3 – Prokhorov General Physics Inst. RAS, Russia

Interactions between lectin-modified nanoparticles and various glycoproteins were investigated for development of effective nanoagents for therapy and diagnostics. We screened a variety of lectin-glycoprotein pairs both in cell-free mode and in vitro in human cell culture to create a number of highly specific nanoparticle-lectin conjugates. We showed that the obtained conjugates can be successfully used as biomarker-specific agents for specific cell visualization in biomedical diagnostics.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2E. PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE

Location: Rihter Room, floor 3, 09:00 – 11:00

Photodynamic processes in biology and medicine I

Session Chair: Inna M. Belousova, Vavilov State Optical Inst., Russia

ThS2E-01 Invited **09:00-09:20**

Photoinduced processes in fullerenes and other carbon nanostructures

E.A. Katz; Univ. of the Negev, Israel

I will review the fundamental mechanisms of photoinduced charge generation, separation (charge transfer) and collection in solar cells based on fullerenes and other carbon nanomaterials (carbon nanotubes, buckycorns, etc). I will demonstrate that process in fullerene-based systems for photoinduced inactivation of pathogens can be described with the same «language».

ThS2E-02 Invited **09:20-09:40**

Organic nanoparticles for tissue diagnostics and PDT

R. Steiner[1,4], C. Scalfi-Happ[1], R. Wittig[1], A. Ryabova[2,4], S. Graefe[3], V. Loschenov[2,4]; 1 - Inst. of Laser Technologies in Medicine and Metrology at the Univ. of Ulm, Germany, 2 - Prokhorov General Physics Inst. RAS, Russia, 3 - Biolitec Research GmbH, Germany, 4 - National Research Nuclear Univ. (MEPhI), Russia

Organic crystalline nanoparticles (NPs) are prepared from AlPC and mTHPc raw material. Such NPs are non-fluorescent. After cellular uptake molecules are dissolved into the cells, fluoresce and are photoactive. This process and the role of macrophages are evaluated and will be presented. Therefore, such crystalline NPs can be used for tissue diagnostics and PDT.

ThS2E-03 Invited **09:40-10:00**

Direct laser excitation of oxygen molecules: application to studies of oxygen photonics in systems of biomedical

A.A. Krasnovsky; Bach Inst. of Biochemistry RAS, Russia

Oxygenation rates of singlet oxygen traps were compared upon direct laser excitation of dissolved oxygen molecules using continuous and pulse laser radiation and under photosensitization by porphyrins. Novel procedure of data processing was developed and accurate absorption coefficients were obtained for the main IR absorption maxima of molecular oxygen under ambient conditions. Biomedical importance of the data is discussed.

ThS2E-04 Invited **10:00-10:20**

Ru(II) complex mediated PDT for bladder cancer, biology and dosimetry

P. Kaspler[1], S. Lazic[1], S. Forward[2], Y. Arenas[1], A. Mandel[1], L. Lilge[2]; 1 - Theralase Inc., 2 - Univ. Health Network, Canada

We present data showing that premixing the Ru2+-complex TLD14331,2 ([Ru(II)(4,4'-dimethyl-2,2'-bipyridine(dmb))2(2-(2',2":5",2"'-terthiophene)-imidazo[4,5-f][1,10]phenanthroline)]2+) with transferrin increases the molar extinction coefficient, including longer activation wavelengths, reduces photobleaching rates, reduces the toxicity of the complex and improving overall PDT efficacy demonstrated in Human (HT1376) and rat (AY27) bladder cancer cells.

ThS2E-05 Invited **10:20-10:40**

Nanophotosensitisers for theranostics

V.B. Loschenov; Prokhorov General Physics Inst., National Research Nuclear Univ. MEPhI, Russia

The limits of tumor detection by means of nuclear medicine do not exceed: 3 mm for X-Ray tomography and MRI; 4 mm for PET; 1.5 in diameter in average by clinical investigation among the United States citizens. Thus at least 3 problems remain unsolved: diagnostics and consequent treatment of the one third of all malignant tumors', i.e. their early states, squamous cell carcinoma of mucous tissue; and the third one problem: 'a long way and expensive'. The limit of tumor detection by methods of optical spectroscopy is around 1-2 mm, although in principle it is possible to reach pathologies 5-10 μm in diameter. The problem formation: it is possible to diagnose and conduct treatment of those types of pathologies which could be reached by irradiation or could selectively accumulate a photosensitiser (PS).

ThS2E-06 Invited **10:40-11:00**

Completed characterization of detonation nanodiamond and cancer chemotherapy using nanodiamond as drug delivery platform

E. Osawa[1], D. Ho[2], T. Minagawa[3]; 1 - Shinshu Univ., Japan, 2 - UCLA, United States, 3 - Shinshu Univ. School of Medicine, Japan

We finished characterization of the primary particles of detonation nanodiamond (PPDND, 2.8 nm) in highly purified and monodisperse state. In parallel we have well progressed in evaluating PPDND for drug carrier platform, beginning from cell toxicity tests, to safety and chemotherapy examinations on small to large animals. Now we are preparing for preclinical safety tests on human.

- Coffee Break -

Location: Rihter Room, floor 3, 11:30 – 13:25

Photodynamic processes in biology and medicine II

Session Chair: Lothar Lilge, Univ. Health Network, Canada

ThS2E-07 Invited **11:30-11:50**

Photothermal effects of nanoparticles in liquid media

B. Eberle, C. Hege, M. Körber, A. Azarian, S. Dengler; Fraunhofer IOSB, Germany

We evaluate a variety of different kinds of nanoparticles suspended in various solvents regarding their nonlinear attenuation characteristics with respect to nanosecond laser pulses.

ThS2E-08 Invited **11:50-12:10**

mTHPC-based photoactive nanoparticles: basic and pre-clinical research

L. Bezdetnaya[1,2], H.-P. Lassalle[1,2], S. Marchal[1,2], G. Dolivet[1,2], V. Zorin[3]; 1 - Univ. de Lorraine, France, 2 - Inst. de Cancérologie de Lorraine, France, 3 - Belarussian State Univ., Belarus

Tumor selectivity of mTHPC could be enhanced using drug delivery systems or carriers, like liposomes and cyclidextrins (CDs). Rapid accumulation of liposomal mTHPC in the xenografted tumors and reduced damage to normal tissues was inherent to liposomal formulations. CDs accelerate mTHPC mobility increasing its bioavailability. Injection of mTHPC-CD complexes resulted in reduced mTHPC accumulation in skin along with its better accumulation in the tumor.

ThS2E-09 Invited **12:10-12:30**

Ultrafast photothermal action in nano dimensions

A. Ronchi[1], S. Peli[1], M. Chiari[2], C. Finetti[2], M. Rocci[3], C. Giannetti[1], F. Banfi[1], G. Ferrini[1]; 1 - Univ.` Cattolica del Sacro Cuore, 2 - Inst. of Chemistry of Molecular Recognition, CNR, 3 - NEST, Scuola Normale Superiore, Italy

The thermomechanical dynamics of complex biologically-related systems is investigated with ultrafast optical techniques. The extraction of information from experiments is accomplished through data mining techniques. Singular value decomposition (SVD) and a Hierarchical Cluster Analysis provide the basis for the analysis of both a single and ensemble of nano-objects. Paradigmatic examples are shown where ultrafast optoacoustic traces allow to discriminate the dimensions and predict the influence of the environment on nanoparticles bonded to surface chemical complexes, without previous knowledge of the investigated system. These techniques bear great potential as screening platform, to evidence casual or systematic errors and reveal patterns hidden in the data.

ThS2E-10 Invited **12:30-12:50**

Photodynamic inactivation of enveloped virus in protein plasma preparations by solid-phase fullerene-based photosensitizer

I.M. Belousova[1], I.M. Kislyakov[1], T.D. Muraviova[1], A.M. Starodubtsev[1], T.K. Kris'ko[1], E.A. Selivanov[2], N.P. Sivakova[2], I.S. Golovanova[2], S.D. Volkova[2], A.A. Shtro[3], V.V. Zarubaev[3]; 1 - Vavilov State Optical Inst., 2 - Inst. of Hematology and Transfusiology, 3 - Influenza Research Inst., Russia

The ability of fullerene to inactivate influenza virus in protein fraction of donor blood when irradiated with visual light has been studied. The complete inactivation was achieved after 30 min of irradiation. This process did not lead to the toxicity of albumin. The data suggest that the method described is prospective for inactivation of viruses in the preparations of donor blood.

ThS2E-11 Invited **12:50-13:10**

Design and optimization of molecular photoacoustic contrast agents (MPACs) for in vivo imaging of breast cancer tumors

M. Hatami, M. Frenettete, S. Buckley-Bollinger, J. Rochford, Ch.S. Yelleswarapu; Univ. of Massachusetts Boston, United States

Design and characterization of BODIPY inspired molecules as photoacoustic contrast agents is reported. Chemical modification to the pristine BODIPY enabled fine-tuning its absorption properties towards the NIR biologically transparent region. Further, modification permitted increase of excited state absorption and vibrational relaxation resulting in enhanced photoacoustic emission.

ThS2E-12 **13:10-13:25**

Photodynamic theranostics

A. Akopov, G. Papayan, N. Petrishchev; Pavlov First State Medical Univ., Russia

Demonstrate the possibility of photodynamic theranostics with various methodological improvements in experimental and clinical studies: the use of tumour specific conjugates with biological nanocarriers; two-wavelength excitation; fluorescence image-guided surgery; stereotactic fluorescent biospectroscopy; using the near-infrared light to detect the tumour and sentinel lymph nodes; photodynamic irradiation in a pulsed mode. Fluorescent visualization in radiation therapy improves the tumor treatment efficacy.

- Lunch Break -

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2E. PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE

Location: Rihter Room, floor 3, 15:00 – 17:00

Photodynamic processes in biology and medicine III

Session Chair: Alexander A. Krasnovsky, Bach Inst. of Biochemistry RAS, Russia

ThS2E-13 **15:00-15:15**

Photophysical properties of porphyrin photosensitizers

A.V. Dadeko[1,2], T.D. Murav'eva[1], I.M. Belousova[1,2]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., Russia

The photodynamic properties of a new photosensitizer—dimegin (disodium salt of 2,4-di(α-methoxyethyl)-deuteroporphyrin-IX)—are studied in comparison with the properties of photosensitizers used in medical practice, namely, Photoditazine (dimethylglucamine salt of chlorin e6) and Radachlorin (trisodium salt of chlorin e6). The spectral characteristics, singlet oxygen generation ability, luminescence efficiency, and photostability of these photosensitizers are studied upon irradiation by light-emitting diode arrays in different spectral ranges.

ThS2E-14 **15:15-15:30**

Multimode lasers as analogues of complex biological systems

O.B. Danilov[1], N.N. Rosanov[1,2], N.A. Solovyov[3], L.N. Soms[1,2]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., 3 - NPO «Prombezopzsnost' - Sever - Zapad», Russia

Modeling of operation of complex biological systems and, in particular, a human brain, is a topical problem to be solved both for a brain functioning understanding, and for the development of new classes of computers based on principles of operation of brain. Some specific features and analogues in operation of laser systems and brain are discussed that can be useful in design of new generation of computers. An appropriateness of such analogies is justified by a fact that both laser systems and brain belong to opened (interacting with an environment) dissipative space-distributed nonlinear systems. Thereby, laser systems and, in particular, systems with dissipative optical solitons, afford an opportunity to an experimental and theoretical modeling of some important cognitive functions of brain. One of special features of an activity of brain is its capability to operate by images. So some problems of generation, amplification and transformation of space-inhomogeneous patterns of electromagnetic field (images) in multimode lasers are discussed, as well as interaction of proper laser modes with weak external signals.

ThS2E-15 **15:30-15:45**

Use of hypothermia during PDT treatment of malignant gliomas

C.J. Fisher[1], C. Niu[2], Y. Chen[2], S. Ng[2], L. Lilge[1,2]; 1 - Department of Medical Biophysics, 2 - Univ. Health Network, Canada

The ability to improve the selectivity of ALA mediated Photodynamic Therapy in mixed Glioma with normal brain structures using 32 degree C Hypothermia is presented. Hypothermia increases ALA synthesis in most glioma cells and improves normal brain structure resistance to the PDT generated cytotoxic shock.

ThS2E-16 **15:45-16:00**

The method of laser forming of nanocarbon biocompatible coatings for artificial ligaments

A.Yu. Gerasimenko[1], E.M. Eganova[2], L.P. Ickitidze[1], U.E. Kurilova[1], V.M. Podgaetsky[1], V.V. Zar[3], N.N. Zhurbina[1], S.V. Selishchev[1]; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Nanotechnology of Microelectronics RAS, 3 - Moscow Regional Research Clinical Inst., Russia

The work is devoted to laser method of biocompatible coatings forming to create implants of the human body ligaments. Coating is a carbon nanotubes scaffold formed in the water-protein dispersion by the electric field of the laser radiation. Study has been conducted on the structure and properties of carbon nanotubes coatings and proliferative activity of biological cells on its surface.

ThS2E-17 **16:00-16:15**

Increasing the conductivity of the carbon nanotube-based layers by laser radiation

A.Yu. Gerasimenko[1], L.P. Ickitidze[1], V.M. Podgaetsky[1], S.V. Selishchev[1], E.V. Blagov[2], A.A. Pavlov[2], Y.P. Shaman[2], D.N. Klypin[3]; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Nanotechnology of Microelectronics RAS, 3 - Omsk State Technical Univ., Russia

The 5-50 μm-thick layers of a nanomaterial consisting of acrylic paint and multilayer carbon nanotubes (~3 mass.%) are investigated. It is shown that laser radiation and heat treatment enhance the conductivity of the layers by a few orders of magnitude. The layers remain stable in water for over 200 h and exhibit a conductivity of ~ (100–1000) S/m, which make them promising for application in biomedical electrodes and wearable electronics.

ThS2E-18 **16:15-16:30**

Self-organizing structures in aqueous dispersions of shungite carbon nanoparticles affected by laser impulses of different durations

N.N. Rozhkova[1], A.O. Kucherik[2], A.S. Goryunov[3], S.S. Rozhkov[1]; 1 - Inst. of Geology Karelian Research Center RAS, 2 - Vladimir State Univ., 3 - Inst. of Biology Karelian Research Center RAS, Russia

Nanosecond and femtosecond laser impulses applied to the stable aqueous dispersion of shungite carbon nanoparticles brought to increase in the average size of clusters and to drastic changes in structure of shungite carbon that were obtained from its Raman spectra decomposition.

ThS2E-19 **16:30-16:45**

Investigation of interactions between albumin and fullerenol and their transport properties by laser correlation spectroscopy

E.A. Savchenko, E.K. Nepomnyashchaya, E.T. Aksenov, T.A. Bogomaz; Peter the Great St, Petersburg Polytechnic Univ., Russia

The methods and results of investigation of interactions between albumin and fullerenol by laser correlation spectroscopy are discussed. The possibilities of the method in study of biomolecular transport properties are considered.

ThS2E-20 **16:45-17:00**

Rare-earth doped nanocrystals as an active medium for terahertz stimulated emission

Yu.V. Orlovskii[1,2], V.V. Hizhnyakov[2], V.B. Loschenov[1,3]; 1 - Prokhorov General Physics Inst., Russia, 2 - Univ. of Tartu, Estonia, 3 - National Research Nuclear Univ. MEPhI, Russia

We discuss the novel idea for direct terahertz pulse stimulated emission in the MPO4 (M = Nd3+, Dy3+) rare-earth doped nanocrystals as a result of transitions between crystal-field (Stark) levels of the Nd3+ and Dy3+ manifolds.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2D. PHOTONICS AND NANOBIOTECHNOLOGY

ThS2D-p01 **15:00-19:00**

Determination of nanorods aspect ratio using depolarized light scattering

S.A. Dolgushin[1], I.S. Burnaevskiy[1], V.A. Deshabo[2], P.V. Shalaev[1], I.K. Yudin[2], B.N. Khlebtsov[3], S.A. Tereshchenko[1]; 1 - National Research Univ. of Electronic Technology, 2 - Oil and Gas Research Inst. RAS, 3 - Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, Russia

The method for a determination of geometric parameters of nanorods in liquid dispersions based on the depolarized light scattering is described. There is presented a model for randomly oriented cylindrical nanoparticles. The model describes the dependence of depolarization ratio for the scattered light on the aspect ratio. A number of experiments was carried out to verify the proposed model. The results of experimental studies are presented.

ThS2D-p02 **15:00-19:00**

Biosensors based on magnetic nanolabels: optimization with spectral interferometry and highly-sensitive electronic registration

A.V. Orlov[1], V.A. Bragina[1], S.L. Znoyko[1], K.G. Shevchenko[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

A new rapid method based on immunochromatographic assay in combination with the electronic registration of nanolabels by their non-linear magnetization has been developed. The method is designed to provide highly accurate measurements of the concentration of protein molecules (e.g. markers, which indicate the onset or development of a disease) in various samples, including opaque solutions or strongly colored liquids. The optimization of the assay parameters is carried out using real-time monitoring of all the immunoassay steps with the spectral-correlation interferometry.

ThS2D-p03 **15:00-19:00**

Real-time sensitive detection of low molecular weight compounds by optical immunosensors

A.V. Orlov[1], A.G. Burenin[2], N.V. Guteneva[2], B.G. Gorshkov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

Highly sensitive label-free methods have been developed for detection of low molecular weight compounds. The methods are based on real-time detection of biomolecular interactions on the surface of standard microscopic cover glass slips used as affordable single-used sensor chips. The assay performance was successfully validated for detection of antibiotic chloramphenicol which is used in medicine and veterinary as well as for determination of natural toxins in real samples. The proposed methods are an attractive solution for medical monitoring of antibiotics in the organism and for toxicological control of food.

ThS2D-p04 **15:00-19:00**

Luminescence method to study the growth of CuInS2 quantum dots in real time

A.A. Skaptsov, A.S. Novikova, A.H.M. Mohammed, V.V. Galushka, I.Yu. Goryacheva, V.I. Kochubey; Saratov National Research State Univ., Russia

Developed luminescence method to study the growth mechanism of CuInS2 quantum dots in real time is demonstrated.

ThS2D-p05 **15:00-19:00**

Spectral method of real-time monitoring of gold nanorods growth

A.A. Skaptsov, O.A. Savenko, V.I. Kochubey; Saratov National Research State Univ., Russia

The developed spectral method of real-time monitoring the growth mechanism of gold nanorods is demonstrated.

ThS2D-p06 **15:00-19:00**

Silanized liposomes loaded with luminescent quantum dots as label for mycotoxin detection

O.A. Goryacheva[1], N.V. Beloglazova[2], S. De Saeger[2], I.Y. Goryacheva[1]; 1 - Saratov National Research State Univ., 2 - St. Petersburg State Univ., Russia

Silanized liposomes loaded with luminescent quantum dots was developed as a perspective label for immunoaasay. Silica coverage ensures the stability of the liposomes against fusion and internal leakage and also simplifies bioconugation.

ThS2D-p07 **15:00-19:00**

Non-enzymatic glucose and hydrogen peroxide sensors based on metal structures produced by laser-induced deposition from solution

E.M. Khairullina, A.V. Smikhovskaia, S.V. Safonov, M.S. Panov, L.S. Logunov, S.S. Ermakov, V.A. Kochemirovsky; St. Petersburg State Univ., Russia

The method of laser-induced metal deposition was applied to synthesize nano- and microstructured metal electrodes for non-enzymatic glucose and hydrogen peroxide sensing. These electrodes were characterized by SEM, EDX, SIMS, XRD and EIS. Copper electrodes have a linear dependence of the current-concentration in the range of 10-100 μmol/L for hydrogen peroxide and 0.6 - 3.0 mmol/L for D-glucose.

ThS2D-p08 **15:00-19:00**

Near infrared luminescent-magnetic nanoparticles for bimodal imaging in vivo

I.V. Zelepukin[1,2,3], M.P. Nikitin[1,2,4], A.V. Nechaev[5], A.V. Zvyagin[3,6], P.I. Nikitin[4], S.M. Deyev[1]; 1 - Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia, 3 - Lobachevsky Nizhny Novgorod State Univ., Russia, 4 - Prokhorov General Physics Inst. RAS, Russia, 5 - Moscow State Univ. of Fine Chemical Technologies, Russia, 6 - Macquarie Univ., Australia

The methods of multimodal imaging are very attractive for a variety of applications in the field of life sciences. Here, we report synthesis of luminescent magnetic nanostructures based on upconversion nanophosphors and superparamagnetic iron oxide nanoparticles for their bimodal detection in vivo. Poly(lactic-co-glycolic acid) copolymer matrix was used for stabilization of nanoparticles in physiological pH and influence of reaction conditions on final size of nanoagents was investigated. The particles were studied by dynamic light scattering and transmission electron microscopy methods. The obtained particles are attractive for biomodal imaging inside small animals in vivo by the methods of optical tomography and magnetic particle quantification methods.

ThS2D-p09 **15:00-19:00**

Stimuli-responsive nano- and microstructures based on gold nanoparticles

K.G. Shevchenko[1], V.R. Cherkasov[1,2], I.L. Sokolov[1], M.P. Nikitin[1,2]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia

Gold nanoparticles (GNPs) is a well established tool for a wide range of applications in different research fields. Here, we demonstrate the possibility for their effective use in stimuli-responsive enzyme-based logic-gated systems. Such smart materials can be the promising as a base for novel nanorobotic devices that employ changes of physical properties of the environment (light, temperature, etc.) as logical inputs.

ThS2D-p10 **15:00-19:00**

Optical method for studying self-assembly of various nanoparticles in liquids

V.R. Cherkasov[1,2], K.G. Shevchenko[1], P.I. Nikitin[2,3]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, 3 - National Research Nuclear Univ., Russia

We demonstrate that the localized surface plasmon resonance applied for studying the colloid noble metal particle interactions can be also used for investigation of metal/non-metal nanoparticle interactions. Using the spectral shift of resonance as a criterion of colloid complex formation, the method can be adapted for exploration of bio-modulated self-assembly processes to be used in life science, for development of smart materials, etc.

ThS2D-p11 **15:00-19:00**

Colloidal gold nanoparticles change energy transfer standard scheme of a photosensitiser

M.N. Kholodtsova[1,2,3], V.I. Makarov[1], I.D. Romanishkin[1], W.C.P.M. Blondel[2,3], V.B. Loschenov[1,4]; 1 - Prokhorov General Physics Inst. RAS, Russia, 2 - Univ. de Lorraine, France, 3 - CNRS, CRAN, France, 4 - National Research Nuclear Univ. 'MEPhI', Russia

In this contribution the use of nanoparticles to change energy transfer scheme in fluorophore is investigates by means of lifetime measurements. It was shown that in the vicinity of gold nanoparticle, lifetime drastically decrease, thus leaving less probability to energy relaxation from singlet to triplet level and reducing consequent transfer to singlet oxygen, which drives PhotoDynamic Therapy (PDT) effect.

ThS2D-p12 **15:00-19:00**

The plasmonic photothermal therapy of transplanted tumors in rats using gold nanorods

A.B. Bucharskaya[1], G.N. Maslyakova[1], N.I. Dikht[1], N.A. Navolokin[1], G.S. Terentyuk[1,2], A.N. Bashkatov[2,5], E.A. Genina[2,5], B.N. Khlebtsov[2,4], N.G. Khlebtsov[2,4], V.V. Tuchin[2,3,5]; 1 - Razumovsky Saratov State Medical Univ., 2 - Saratov National Research State Univ., 3 - Inst. of Precision Mechanics and Control RAS, 4 - Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, 5 - Tomsk National Research State Univ., Russia

The study of morphological changes in transplanted liver tumors of rats after plasmonic photothermal therapy (PPTT) was conducted. The gold nanorods (GNs) functionalized with polyethylene glycol were injected by one-, two- and three-step intravenous administration. A day after injection tumors were irradiated by the NIR 808-nm diode laser. The most pronounced damage effect of PPTT was observed after triple intravenous injection of GN.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2D. PHOTONICS AND NANOBIOTECHNOLOGY

ThS2D-p13 **15:00-19:00**

Spectroscopic assessment of biological tissue temperature using upconversion particles

E.K. Volkova[1,2], I.Yu. Yanina[1,2], A.P. Popov[1], A.A. Skaptsov[2], Ju.G. Konyukhova[2], V.I. Kochubey[2], V.V. Tuchin[2,3], I.V. Meglinski[1]; 1 - Univ. of Oulu, Finland; 2 - Saratov National Research State Univ., Russia, 3 - Precise Mechanics and Control Inst. RAS, Russia

The optimum pair of bands in the fine structure of nanoparticles luminescence spectra used for measuring local temperature of biological tissue had been determined.

ThS2D-p14 **15:00-19:00**

The modeling of local distribution of the temperature photo-induced by ensemble of nanoparticles

Yu.A. Avetisyan[1], A.N. Yakunin[1], A.A. Bykov[2], V.V. Tuchin[1,2,3]; 1 - Inst. of Precise Mechanics and Control RAS, 2 - Chernyshevsky Saratov National Research State Univ., 3 - Tomsk State National Research Univ., Russia

In this paper we consider the laser irradiation of the ensemble of absorbing nanoparticles localized in macroscopically-sized area of the tissue sample. The simple formula for estimation of distribution of the local temperature is presented.

ThS2D-p15 **15:00-19:00**

Laser nanosolder characteristics effect on tensile strength and structure of biotissue seam weld

A.Yu. Gerasimenko[1], L.P. Ickitidze[1], D.I. Ryabkin[1], S.V. Selishchev[1], E.S. Pyankov[1], M.V. Mezentseva[2], I.A. Suetina[2], I.B. Rimshan[1], V.M. Podgaetsky[1]; 1 - National Research Univ. of Electronic Technology, 2 - Gamalei Federal Research Centre for Epidemiology and Microbiology, Russia

This work is concerned with studying the technique of dissected tissue laser welding using specific facility and nanosolder. The technique perfomance was studied on the hog stomach mucous membrane samples. Laser solder compositions that allow maximal durability of the tissue welding seam were revealed and its 3D structure was studied using x-ray microtomography. Biocompatibility of the laser nanosolder was proved.

ThS2D-p16 **15:00-19:00**

Investigation of nucleobases optical properties by molecular modeling

I.L. Plastun, A.N. Bokarev; Gagarin Saratov State Technycal Univ., Russia

Optical properties of nucleobases and nanoparticles are studied by numerical simulations and in experiments. The polarizability, IR and Raman spectrums are analyzed in various conditions for different compounds of nucleobases and compared with experimental data.

ThS2D-p17 **15:00-19:00**

Suspended microcapillary resonators in air for liquid density measurements

O. Malvar, D. Ramos, C.M. Domínguez, P. Kosaka, J. Tamayo, M. Calleja; Inst. de Microelectrónica de Madrid CSIC, Spain

We demonstrate in this work that commercially available microcapillaries can be used as highly sensitive density sensors. The capillary vibration is detected here by measuring the optical forward scattering of a laser beam. The results of this work open the door to novel advances for miniaturized total analysis systems based on microcapillaries with the add-on of mechanical transduction.

4TH INTERNATIONAL SYMPOSIUM «LASERS IN MEDICINE AND BIOPHOTONICS» SECTION S2E. PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE

ThS2E-p01 **15:00-19:00**

Determination of the luminescence spectrum of Radachlorin photosensitizer

M.A. Petrov[1,2], V.P. Belik[1], M.V. Petrenko[1], I.V. Semenova[1], O.S. Vasyutinskii[1]; 1 - Ioffe Inst., 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia

The entire luminescence spectrum of Radachlorin photosensitizer in water is determined. The spectrum contains the fluorescence peak centered at 660 nm, the phosphorescence band centered at 940 nm and a low intensity band centered at about 1300 nm. The interpretation of the data obtained is presented.

ThS2E-p02 **15:00-19:00**

Photodynamic and photocatalytic activity of Fe2O3 nanoparticles

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The photodynamic and photocatalytic activity of the Fe2O3 and Fe2O3-TiO2 nanoparticles were compared.

ThS2E-p03 **15:00-19:00**

Kinetics of laser induced bleaching of Radachlorin photosensitizer

D.M. Beltukova[1,2], I.V. Semenova[1], A.G. Smolin[1], O.S. Vasyutinskii[1]; 1 - Ioffe Inst., 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia

Experimental monitoring of the fluorescence kinetics of Radachlorin photosensitizer is presented. Data fitting using the derived theoretical expressions allowed determining the photosensitizer bleaching rate constant. The results obtained may be of use for photodynamic therapy and diagnostics.

ThS2E-p04 **15:00-19:00**

The development of fiber-optic scaffold for the glioblastoma diagnosis and prevention

Yu.S. Maklygina[1], A.V. Borodkin[1], G.M. Yusubalieva[2], V.B. Loschenov[1,3]; 1 - Prokhorov Inst. of General Physics RAS, 2 - Serbskij State Research Center of Forensic and Social Psychiatry, 3 - National Research Nuclear Univ. MEPHI, Russia

The main goal of the research is creation of the unique fiber-optical multipurpose system created on the basis of porous optical fibers. The fiber-optical scaffolds would perform the role of the structure which is promoting and setting the of glial cells growth. Also this system acts as a port for delivery of a photosensitizers and laser radiation for the purpose of cellular processes monitoring. So developed system allows to carry out a regular fluorescent diagnostics and timely photodynamic therapy of the probed area.

ThS2E-p05 **15:00-19:00**

Dy3+ doped YPO4 nanocrystals for laser induced hyperthermia

I.D. Romanishkin[1], A.S. Vanetsev[2], A.V. Ryabova[1,3], Yu.V. Orlovskii[1,2]; 1 - Prokhorov General Physics Ins. RAS, Russia, 2 - Univ. of Tartu, Estonia, 3 - National Research Nuclear Univ. MEPhI, Russia

In this work we investigate the effectiveness of pulse laser heating of Dy3+ doped phosphate nanoparticles by the effect of multiphonon relaxation. The results have shown rapid rise and fall of nanoparticle powder temperature suggesting their potential application as hyperthermia agents.

ThS2E-p06 **15:00-19:00**

Laser pulse mode irradiation to improved photodynamic therapy efficiency

V.V. Klimenko, N.A. Knyazev, A.A. Bogdanov, M.V. Dubina; St. Petersburg Academic Univ., Russia

Photodynamic therapy (PDT) is an effective treatment for cancer. Laser irradiation parameters strongly influence the singlet oxygen generation during PDT. However, the influence of pulsed and continuous wave (CW) irradiation modes on the type of cell death in terms of increasing the oxygen supply rate to the cells was not analyzed. We found a pattern between the pulsed radiation parameters and the molecular oxygen supply in cells allows increasing the cumulative singlet oxygen concentration compared to CW irradiation during PDT. It was shown that the pulsed irradiation mode of 662nm with a photosensitizer «Radachlorin» in a broad range of irradiation doses lead to apoptotic cell death k562, rather than necrosis, as in the CW mode. Our results show how the selection of parameters of pulsed irradiation mode into account the oxygen flow can change the cell death type.

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