18th International Conference on Laser Optics

ICLO 2018

Technical Program

St. Petersburg, Russia

4 - 8 June, 2018

18^{th} International Conference on Laser Optics

ICLO 2018

Professor Arthur A. Mak (1930-2016) was the founder and for many years the Chair of the Laser Optics Conference. We dedicate the conference to his memory.

Saint Petersburg
2018

CONTENTS

General Information ... 3-9
Program at a Glance ... 10-13

TECHNICAL PROGRAM

June 4, Monday
Plenary Session ... 16-19

June 5, Tuesday
R1. Solid-State Lasers ... 20
R2. High Power Lasers: Fiber, Solid State, Gas and Hybrid ... 22
R3. Semiconductor Lasers, Materials and Applications ... 23
R5. Super-Intense Light Fields and Ultra-Fast Processes ... 24
R8. Nonlinear Photonics: Fundamentals and Applications ... 25
R9. Optical Nanomaterials ... 26
R10. Free Electron Lasers ... 28
Poster Session ... 30

June 6, Wednesday
R1. Solid-State Lasers ... 36
R2. High Power Lasers: Fiber, Solid State, Gas and Hybrid ... 37
R3. Semiconductor Lasers, Materials and Applications ... 38
R4. Laser Beam Control ... 40
R5. Super-Intense Light Fields and Ultra-Fast Processes ... 41
R6. Lasers for Satellite Ranging Systems, Space Geodesy, and Global Navigation ... 43
R7. Lasers in Environmental Monitoring ... 44
R8. Nonlinear Photonics: Fundamentals and Applications ... 45
R11. Nonlinear and quantum integrated optics ... 57
Poster Session ... 48

June 7, Thursday
R1. Solid-State Lasers ... 59
R2. High Power Lasers: Fiber, Solid State, Gas and Hybrid ... 61
R3. Semiconductor Lasers, Materials and Applications ... 62
R4. Laser Beam Control ... 63
R7. Lasers in Environmental Monitoring ... 64
R8. Nonlinear Photonics: Fundamentals and Applications ... 65
Poster Session ... 67

5Th International A.M. Prokhorov Symposium on Lasers in Medicine and Biophotonics ... 79

Exhibition ... 102
Author Index ... 108

THE 18TH INTERNATIONAL CONFERENCE ON LASER OPTICS

ICLO 2018

IS ORGANIZED BY FUND FOR LASER PHYSICS,

TECHNICALLY CO-SPONSORED BY IEEE PHOTONICS SOCIETY,

SUPPORTED BY:
ITMO UNIVERSITY,
THE UNION OF INDUSTRIALISTS AND ENTREPRENEURS (EMPLOYERS) OF ST. PETERSBURG,
INSTITUTE PHOOLIOS RC "VAVILOV SOI",

AND SPONSORED BY:
RUSSIAN FOUNDATION FOR BASIC RESEARCH.

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

The Ministry of Education and Science of Russian Federation

The Ministry of Industry and Trade of the Russian Federation

St.Petersburg Government

Prokhorov General Physics Institute of RAS

Laser Association

OES Specpostavka

Holiday Inn St. Petersburg Moskovskiye Vorota

«Photonika» Magazine

«RITM» Magazine

COMMITTEES

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Anastasiya A. Mirzaeva, Vavilov State Optical Institute, Russia, **Secretary**

TOPICAL COMMITTEES

R1 SOLID-STATE LASERS

U. Griebner, Max-Born-Inst., Germany

M.J. Lederer, European XFEL GmbH, Germany

U. Morgner, Ultrafast Laser Optics Inst. für Quantenoptik Leibnitz Univ., Germany

R2 HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID

S.G. Garanin, Russian Federal Nuclear Center – The All-Russian Research Inst. of Experimental Physics, Russia

S.V. Garnov, Prokhorov General Physics Inst. of RAS, Russia

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

A.A. Ionin, Lebedev Physical Inst. of RAS, Russia

F.A. Starikov, Russian Federal Nuclear Center – The All-Russian Research Inst. of Experimental Physics, Russia

R3 SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

R. Hogg, Univ. of Glasgow, UK

E.U. Rafailov, Aston Univ., UK

G.S. Sokolovskii, Ioffe Inst., Russia

R4 LASER BEAM CONTROL

P. Artal, Univ. of Murcia, Spain

S. Bonora, Ist. di Fotonica e Nanotecnologie CNR, Italy

V.Yu. Venediktov, St. Petersburg Electrotechnical Univ. “LETI”, Russia

R5 SUPER-INTENSE LIGHT FIELDS AND ULTRA-FAST PROCESSES

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

P. McKenna, Univ. of Strathclyde, UK

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

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

B. Greene, EOS Space Systems, Australia

V.D. Shargorodskiy, OJSC «RPC «Precision Systems and Instruments», Russia

R7 LASERS IN ENVIRONMENTAL MONITORING

A.A. Cheremisin, Irkutsk State Univ. of Railway Engineering, Russia

Ch. Janssen, UPMC Sorbonne Univ., France

I.N. Melnikova, Saint Petersburg State Univ., Russia

A.P. Zhevlakov, ITMO Univ., Russia

R8 NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

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

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

D.V. Skryabin, Univ. of Bath, UK

S.K. Turitsyn, Aston Univ., UK

R9 OPTICAL NANOMATERIALS

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

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

R10 FREE ELECTRON LASERS

M. Kiskinova, FERMI Elettra-SincrotroneTrieste, Italy

S.L. Molodtsov, European XFEL, Germany

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

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

R11 NONLINEAR AND QUANTUM INTEGRATED OPTICS

M. Kues, Univ. of Glasgow, UK

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

B. Wetzel, School of Mathematical and Physical Sciences, Univ. of Sussex, UK

5TH INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON LASERS IN MEDICINE AND BIOPHOTONICS

Ivan A. Shcherbakov,
Prokhorov General Physics Inst. of RAS, Russia, **Chair**

Boris I. Denker,
Prokhorov General Physics Inst. of RAS, Russia, **Program Committee Chair**

Vladimir I. Pustovoy,
Prokhorov General Physics Inst. of RAS, Russia, **Organizing Committee Chair**

Natalia P. Khakamova,
Prokhorov General Physics Inst. of RAS, Russia, **Symposium Secretary**

PROGRAM COMMITTEE

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

A.V. Priezzhev, Lomonosov Moscow State Univ., Russia

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

TOPICS FOR ICLO 2018

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: Fiber, Solid State, Gas and Hybrid

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

R3 Semiconductor Lasers, Materials and Applications

Quantum-well, wire, dash and dot lasers and devices • Laser dynamics • MID-IR and Quantum Cascade lasers • Ultrashort pulse lasers • VCSELs, VECSELs and superlattice structures • Semiconductor disk lasers • UV and Visible diode lasers and LEDs • Compact THz sources and applications • Nonlinear phenomenon • Silicon photonics • Group IV Photonics • Optical coherent tomography • Multiphoton imaging • Novel semiconductor-based devices and emerging applications • Biophotonics 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 debris monitoring • Atmospheric effects in laser ranging • Retroreflector systems and their interaction with laser radiation • Single-electron laser radiation photodetectors and methods of laser radiation processing • Lasers for one-way laser ranging and time transfer • Optical clocks for global navigation satellite systems

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 and frequency comb generation • Nonlinear nanophotonics • Nonlinear meta-optics • Fiber optics and telecommunications

TOPICS FOR ICLO 2018

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

R11 Nonlinear and Quantum Integrated Optics

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

5TH INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON LASERS IN MEDICINE AND BIOPHOTONICS

New medical applications and advanced laser medical systems for ophthalmology, dermatology, urology, endoscopic and micro surgery, dentistry, and other specialties • Optical clearing and light transport in cells and tissues • Laser trapping and manipulation of biological particles • Nonlinear interactions of light and tissues • Speckle phenomena in tissues • Quantification and imaging of cells, blood and lympth flows • Terahertz waves interaction with cells and tissues, autofluorescence and photodynamic diagnosis • Optical coherence tomography and diffuse optical imaging • New developments in non-invasive optical technologies, laser microscopy and spectroscopy of tissues • Analytical biophotonics • Chemical and biosensing principles and instrumentation • nanomaterials, methods and systems for diagnostics and therapy • Photosensitizers for biology and medicine • Direct optical single oxygen generation • Photodynamic therapy • Photothermal action of laser radiation on bio-objects • Protection of organs and tissues against powerful and laser radiation • Photodynamic diagnosis • New photosensitizers for theranostic • Photodynamic action on pathogenic microflora

MONDAY, 4 JUNE	
11.00-13.30	**PLENARY SESSION** *MOSKOVSKY CONGRESS HALL*
15:00-18:00	**A1. ROUND TABLE DISCUSSION DEDICATED TO THE MEMORY OF PROF. ARTUR A. MAK (1930-2016)** *PIEMONTE HALL*
18.30-21.30	**WELCOME RECEPTION** *MOSKOVSKY CONGRESS HALL*

TUESDAY, 5 JUNE					
9.00-11.00			***R1*** NIR / MIR LASERS ***PETROV-VODKIN 2+3*** *P. 20*	***R9*** OPTICAL NANOMATERIALS I ***DEYNEKA*** *P. 26*	***R10*** HARD X-RAY FELS ***RIHTER*** *P. 28*
11.00-11.30	COFFEE BREAK				
11.30-13.30		**SMA** ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES I ***PETROV-VODKIN 1*** *P. 81*	***R1*** NLO / OPA ***PETROV-VODKIN 2+3*** P. 20	***R9*** OPTICAL NANOMATERIALS II ***DEYNEKA*** *P. 26*	***R10*** SOFT X-RAY AND THZ FELS ***RIHTER*** *P. 28*
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION** **R5** ***MOSKOVSKY CONGRESS HALL*** *P. 30*	**SMA** ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES II ***PETROV-VODKIN 1*** *P. 81*	***R1*** HIGH POWER, THIN DISK, FIBER I ***PETROV-VODKIN 2+3*** *P. 21*	***R9*** OPTICAL NANOMATERIALS III ***DEYNEKA*** *P. 27*	***R10*** SCIENCE AT FELS I ***RIHTER*** *P. 29*
17.00-17.30	COFFEE BREAK				
17.30-19.30	**POSTER SESSION** **R9** ***MOSKOVSKY CONGRESS HALL*** *P. 32*				***R10*** SCIENCE AT FELS II ***RIHTER*** *P. 29*

WEDNESDAY, 6 JUNE					
9.00-11.00		**SMA** ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES IV ***PETROV-VODKIN 1*** *P. 88*	***R1*** HIGH POWER, THIN DISK, FIBER II ***PETROV-VODKIN 2+3*** *P. 36*	***R3*** VERTICAL-CAVITY AND DISK LASERS ***DEYNEKA*** *P. 38*	***R11*** INTEGRATED NONLINEAR AND QUANTUM PHENOMENA ***RIHTER*** *P. 47*
11.00-11.30	COFFEE BREAK				
11.30-13.30	**POSTER SESSION** **R8** ***MOSKOVSKY CONGRESS HALL*** *P. 52*	**SMA** ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES V ***PETROV-VODKIN 1*** *P. 88*	***R1*** MODE-LOCKED LASERS I ***PETROV-VODKIN 2+3*** *P. 36*	***R3*** PHOTONICS MATERIALS, DEVICES AND APPLICATIONS I ***DEYNEKA*** *P. 39*	***R11*** FREQUENCY COMBS AND NONLINEAR INTERACTIONS IN INTEGRATED SYSTEMS ***RIHTER*** *P. 47*
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION** **R1,R11** ***MOSKOVSKY CONGRESS HALL*** *P.48, 58*	**SMC** PHOTONICS AND NANOBIOTECHNOLOGY I ***PETROV-VODKIN 1*** *P. 92*	***R8*** THZ OPTICS ***PETROV-VODKIN 2+3*** *P. 45*	***R3*** LONG-WAVELENGTH MATERIALS AND DEVICES ***DEYNEKA*** *P. 39*	***R7*** LASERS IN ENVIRONMENTAL MONITORING I ***RIHTER*** *P. 44*
17.00-17.30	COFFEE BREAK				
17.30-19.30		**SMC** PHOTONICS AND NANOBIOTECHNOLOGYII ***PETROV-VODKIN 1*** *P. 92*	***R8*** PHOTONIC CRYSTALS ***PETROV-VODKIN 2+3*** *P. 46*		***R7*** LASERS IN ENVIRONMENTAL MONITORING II ***RIHTER*** *P. 44*
19.40-21.00	**POSTDEADLINE SESSION** ***DEYNEKA***				

MONDAY, 4 JUNE

PLENARY SESSION
MOSKOVSKY CONGRESS HALL

A1. ROUND TABLE DISCUSSION DEDICATED TO THE MEMORY OF PROF. ARTUR A. MAK (1930-2016)
PIEMONTE HALL

WELCOME RECEPTION
MOSKOVSKY CONGRESS HALL

TUESDAY, 5 JUNE

	R3 SINGLE-FREQUENCY AND MODE-LOCKED LASERS ***STENBERG 2*** *P. 23*	***R5*** RELATIVISTIC LASER PLASMA OPTICS ***PUDOVKIN*** *P. 24*		SMP PLENARY SESSION ***PIEMONTE*** *P. 80*
COFFEE BREAK				
	R3 THZ PHOTONICS ***STENBERG 2*** *P. 23*	***R5*** LASER ION ACCELERATION ***PUDOVKIN*** *P. 24*	**SMB** LASER INTERACTION WITH CELLS AND TISSUES I ***LEVINSON*** *P. 82*	
LUNCH BREAK				
R8 FIBERS I ***STENBERG 1+2*** *P. 25*		***R2*** DIODE PUMPED ALKALI LASERS ***PUDOVKIN*** *P. 22*	**SMB** LASER INTERACTION WITH CELLS AND TISSUES II ***LEVINSON*** *P. 83*	
COFFEE BREAK				
R8 FIBERS II ***STENBERG 1+2*** *P. 25*		***R2*** GAS AND HYBRID LASERS ***PUDOVKIN*** *P. 22*		

WEDNESDAY, 6 JUNE

R4 LASER BEAM CONTROL I ***STENBERG 1*** *P. 40*	***R5*** LASER ELECTRON ACCELERATION AND INTENSE RADIATION GENERATION ***STENBERG 2*** *P. 41*	***R2*** ULTRASHORT HIGH-POWER LASERS ***PUDOVKIN*** *P. 37*	**SMB** LASER INTERACTION WITH CELLS AND TISSUES IV ***LEVINSON*** *P. 89*	**A2.** ADVANCED LASER TECHNOLOGY AND EQUIPMENT... ***PIEMONTE***
COFFEE BREAK				
R4 LASER BEAM CONTROL II ***STENBERG 1*** *P. 40*	***R5*** GENERATION OF INTENSE FIELDS AND GAMMA-RAYS IN LASER PLASMAS ***STENBERG 2*** *P. 41*	***R2*** HIGH-POWER SOLID-STATE LASERS ***PUDOVKIN*** *P. 37*	**SMB** LASER INTERACTION WITH CELLS AND TISSUES V ***LEVINSON*** *P. 89*	**A2.** ADVANCED LASER TECHNOLOGY AND EQUIPMENT... ***PIEMONTE***
LUNCH BREAK				
R6 LASERS FOR SATELLITE RANGING SYSTEMS, SPACE GEODESY, AND GLOBAL NAVIGATION ***STENBERG 1*** *P. 43*	***R5*** STRUCTURED LASER PLASMAS ***STENBERG 2*** *P. 42*	***R2*** HIGH-POWER LASERS I ***PUDOVKIN*** *P. 38*	**SMB** LASER INTERACTION WITH CELLS AND TISSUES VI ***LEVINSON*** *P. 90*	**A2.** ADVANCED LASER TECHNOLOGY AND EQUIPMENT... ***PIEMONTE***
COFFEE BREAK				
			SMB LASER INTERACTION WITH CELLS AND TISSUES VII ***LEVINSON*** *P. 91*	
POSTDEADLINE SESSION ***DEYNEKA***				

THURSDAY, 7 JUNE					
9.00-11.00		**SMC** PHOTONICS AND NANOBIOTECHNOLOGY III ***PETROV-VODKIN 1*** *P. 96*	***R1*** LASER MATERIALS, SPECTROSCOPY I ***PETROV-VODKIN 2+3*** *P. 59*	***R3*** HIGH-PERFORMANCE LASER DIODES AND LEDS ***DEYNEKA*** *P. 62*	
11.00-11.30	COFFEE BREAK				
11.30-13.30	**POSTER SESSION R2,R4,R6** ***MOSKOVSKY CONGRESS HALL*** *P. 67, 73, 76*	**SMC** PHOTONICS AND NANOBIOTECHNOLOGY IV ***PETROV-VODKIN 1*** *P. 96*	***R1*** LASER MATERIALS, SPECTROSCOPY II ***PETROV-VODKIN 2+3*** *P. 59*	***R3*** PHOTONICS MATERIALS, DEVICES AND APPLICATIONS II ***DEYNEKA*** *P. 62*	
13.30-15.00	LUNCH BREAK				
15.00-17.00	**POSTER SESSION R3,R7** ***MOSKOVSKY CONGRESS HALL*** *P. 70, 76*	**SMC** PHOTONICS AND NANOBIOTECHNOLOGY V ***PETROV-VODKIN 1*** *P. 97*	***R1*** MODE-LOCKED LASERS II ***PETROV-VODKIN 2+3*** *P. 60*	***R2*** HIGH-POWER LASERS II ***DEYNEKA*** *P. 61*	
17.00-17.30	COFFEE BREAK				
17.30-19.30		**SMC** PHOTONICS AND NANOBIOTECHNOLOGY VI ***PETROV-VODKIN 1*** *P. 98*		***R2*** HIGH-POWER LASERS III ***DEYNEKA*** *P. 61*	

FRIDAY, 8 JUNE	
10:00-12:30	**A3** OPEN MEETING OF THE TECHNICAL COMMITTEE FOR STANDARDIZATION 296 "OPTICS AND PHOTONICS" ***PIEMONTE HALL***

The Exhibition «Lasers and Photonics»
Moskovsky Congress Hall
June 5, 2018 12:00 – 19:00
June 6, 2018 10:00 – 19:00
June 7, 2018 10:00 – 18:00

SIDE-EVENT WORKSHOPS:

A1. Round Table Discussion Dedicated to the Memory of Prof. Artur A. Mak (1930-2016)

Official Language: Russian
Piemonte Hall, floor 3
June 4, 2018 15:00 – 18:00
Chair: Inna M. Belousova, Vavilov State Optical Inst., Russia

A2. Advanced laser technology and equipment in industrial applications

Official Language: Russian
Piemonte Hall, floor 3
June 6, 2018 10:30 – 17:30
Registration for the Event: 10:00 – 10:30 near Piemonte Hall
Chair: Sergey G. Gorny, Laser Center Ltd., Russia

THURSDAY, 7 JUNE					
	R8 FAST OPTICS ***STENBERG 2*** *P. 65*		**SMD** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE I ***LEVINSON*** *P. 99*		**A3.** OPEN MEETING OF THE TECHNICAL COMMITTEE... ***PIEMONTE***
COFFEE BREAK					
R7 LASERS IN ENVIRONMENTAL MONITORING III ***STENBERG 1*** *P. 64*	***R8*** OPTICAL SOLITONS ***STENBERG 2*** *P. 65*		**SMD** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE I ***LEVINSON*** *P. 99*		**A3.** OPEN MEETING OF THE TECHNICAL COMMITTEE... ***PIEMONTE***
LUNCH BREAK					
R4 LASER BEAM CONTROL III ***STENBERG 1*** *P. 63*	***R8*** NANO- AND METAOPTICS ***STENBERG 2*** *P. 66*		**SMD** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE I ***LEVINSON*** *P. 100*		**A3.** OPEN MEETING OF THE TECHNICAL COMMITTEE... ***PIEMONTE***
COFFEE BREAK					
R4 LASER BEAM CONTROL IV ***STENBERG 1*** *P. 63*	***R8*** NONLINEAR PHOTONICS APPLICATIONS ***STENBERG 2*** *P. 66*		**SMD** PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE I ***LEVINSON*** *P. 100*		**A3.** OPEN MEETING OF THE TECHNICAL COMMITTEE... ***PIEMONTE***

FRIDAY, 8 JUNE
A3 OPEN MEETING OF THE TECHNICAL COMMITTEE FOR STANDARDIZATION 296 "OPTICS AND PHOTONICS" ***PIEMONTE HALL***

Industry Presentations at the Exhibition

Moskovsky Congress Hall

Session 1: In English June 6, 2018 11:30 - 13:15

Session 2: In Russian June 7, 2018 11:30 - 13:20

Moderator: Vadim M. Polyakov, GK "R-Aero" ltd Co, Russia

SIDE-EVENT WORKSHOPS:

A3. Open meeting of the Technical committee for Standardization 296 "Optics and photonics"

Official Language: Russian

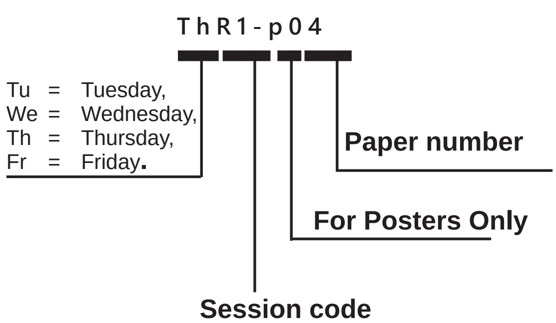
Piemonte Hall, floor 3

June 7, 2018 10:00 - 18:00

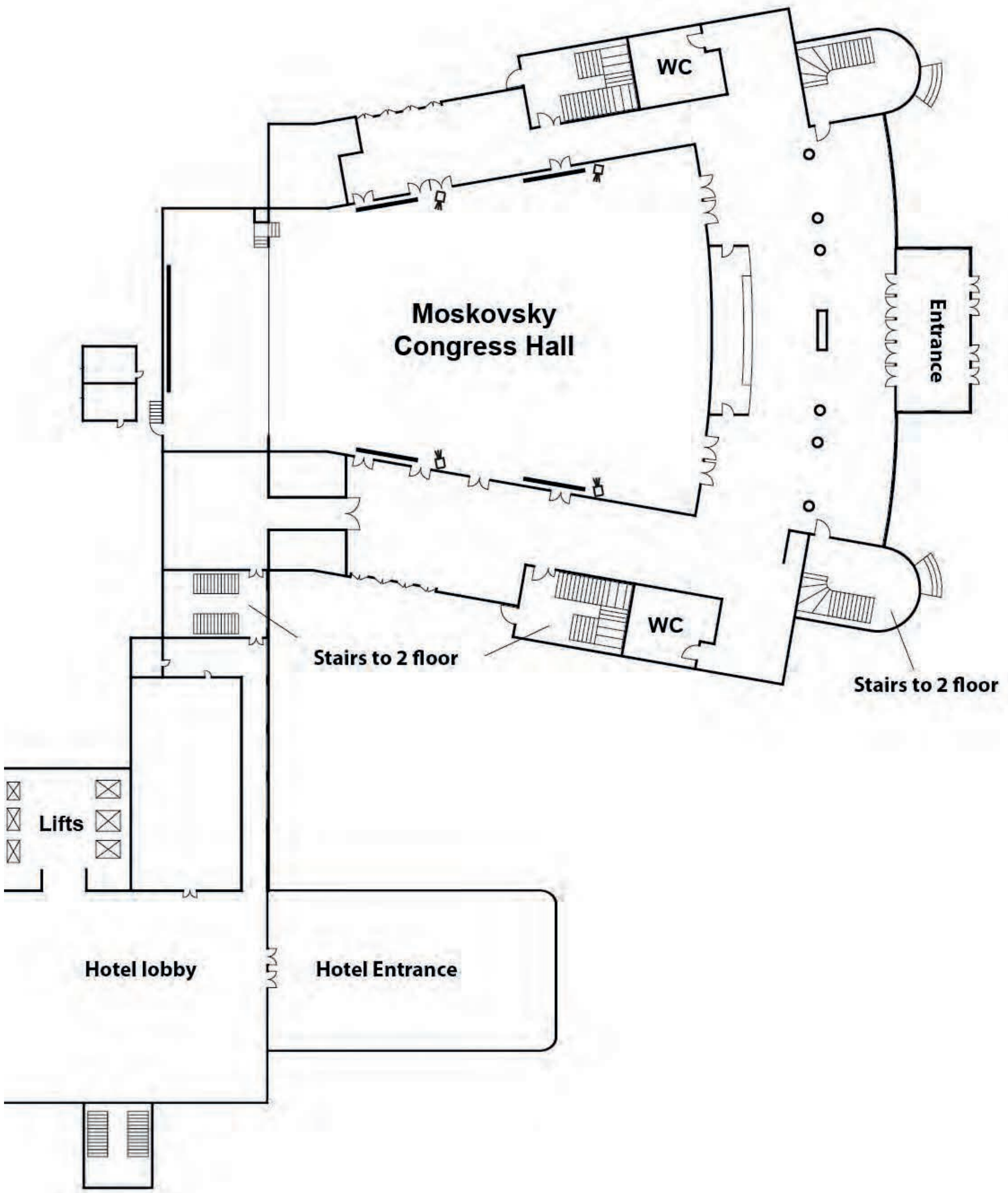
June 8, 2018 10:00 - 12:30

Registration for the Event: 09:30 – 10:00 near Piemonte Hall

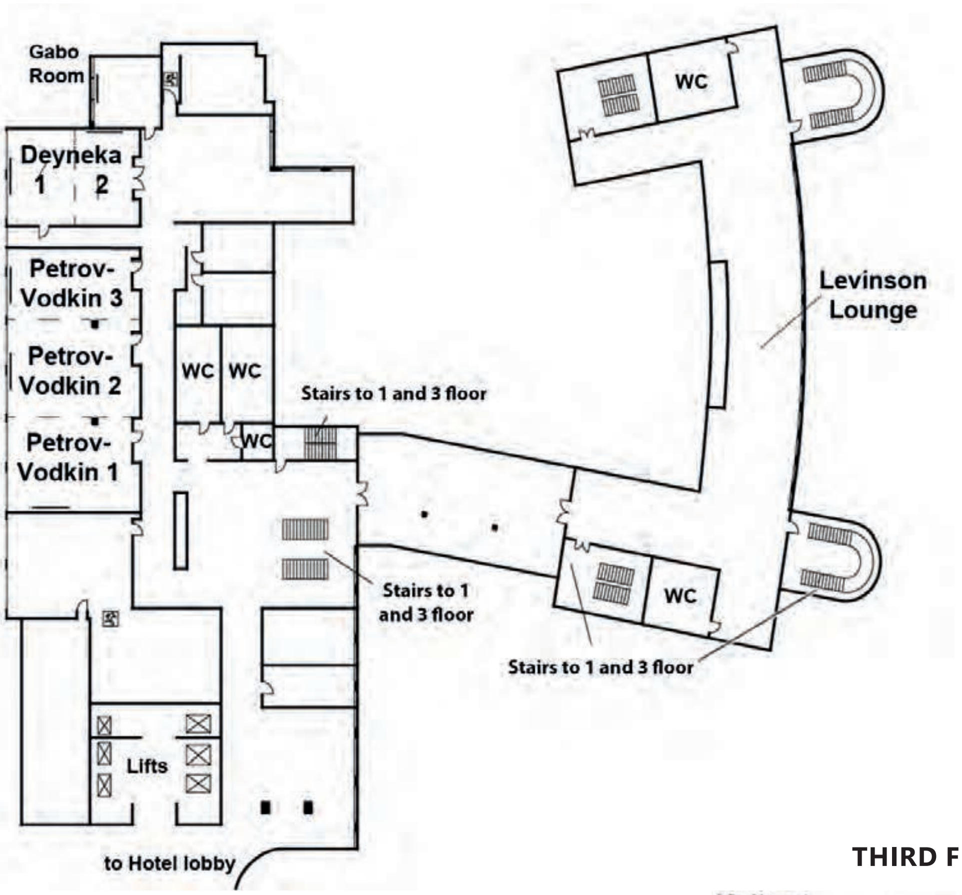
Chair: Evgeny A. Iosep, Technical committee 296 "Optics and photonics"



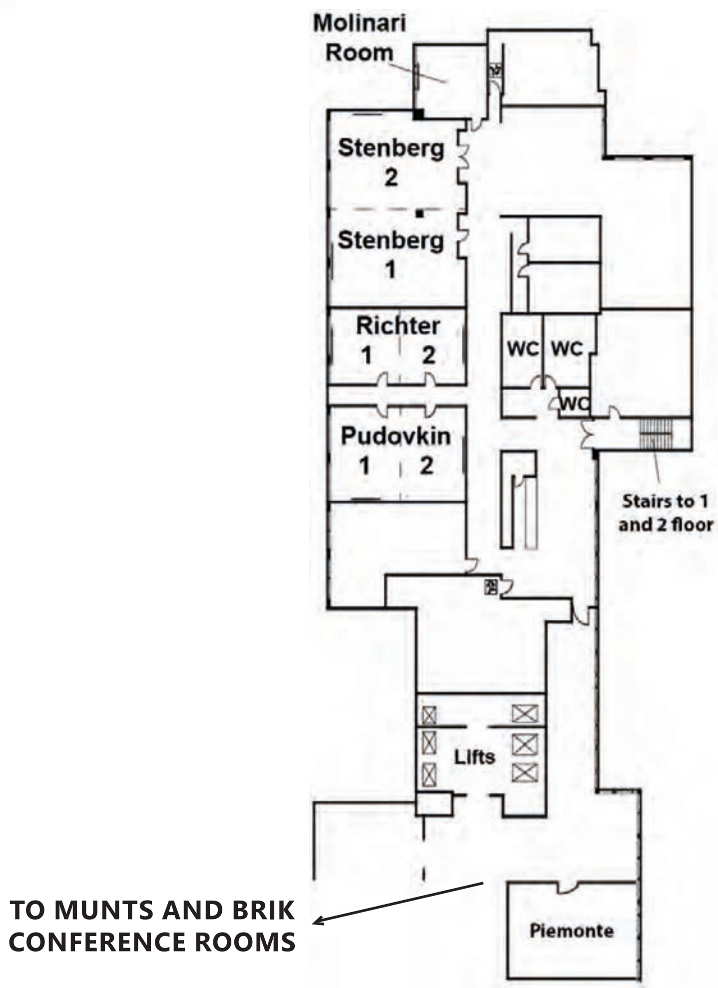
FIRST FLOOR


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

SECOND FLOOR



THIRD FLOOR



PLENARY SESSION

LASERS & PHOTONICS INTERNATIONAL CONGRESS 2018
Saint Petersburg, Russia
June 04-08

ITMO UNIVERSITY

11:00-11:15

OPENING AND WELCOME REMARKS

11:15-12:00

PROGRESS IN QUANTUM DOTS FOR LASERS AND SINGLE PHOTON SOURCES

Yasuhiko Arakawa; Inst. for Nano Quantum Information Electronics, Univ. of Tokyo, Japan

12:00-12:45

EUROPEAN XFEL – NEW OPPORTUNITIES FOR X-RAY SCIENCE

Robert Feidenhans'l; European XFEL, Germany

12:45-13:30

TOPOLOGICAL PHOTONICS AND TOPOLOGICAL INSULATOR LASERS

Mordechai (Moti) Segev; Technion, Israel

YASUHIKO ARAKAWA

INSTITUTE FOR NANO QUANTUM INFORMATION ELECTRONICS, THE UNIVERSITY OF TOKYO, JAPAN

PROGRESS IN QUANTUM DOTS FOR LASERS AND SINGLE PHOTON SOURCES

Since the first proposal of the concept of the quantum dot by Arakawa et al., in 1982, the quantum dots have been intensively investigated for both fundamental solid state physics and device applications. Advances of self-assembling crystal growth technology of quantum dots enabled realization of high performance semiconductor lasers and quantum information devices such as single photon sources. The quantum dots can also be applied to solar cells with a predicted conversion efficiency over 75%. Moreover, implementing a single quantum dot within an optical nanocavity provides a new platform for solid-state cavity quantum electronics (QED).

In this presentation, we discuss progress in quantum dot photonics such as quantum dot lasers and single photon sources. Recent advances in quantum dot cavity-QED are also reviewed.

SHORT BIO

Yasuhiko Arakawa received his B.S. and PhD degree in E.E. from The University of Tokyo in 1975 and 1980, respectively, and became a full professor at the University of Tokyo in 1993. He is now Director of both the Institute for Nano Quantum Information Electronics and the IIS-Center for Photonics and Electronics Convergence at the University of Tokyo. He has received several major honores, including Leo Esaki Award, IEEE/LEOS William Streifer Award, Prime Minister Award, Medal with Purple Ribbon, IEEE David Sarnoff Award, C&C Award, Heinrich Welker Award, OSA Nick Holonyak Jr. Award, and Japan Academy Prize. He is a foreign member of U.S. National Academy of Engineering (NAE).

ROBERT FEIDENHANS'L

EUROPEAN XFEL, GERMANY

EUROPEAN XFEL – NEW OPPORTUNITIES FOR X-RAY SCIENCE

The European X-ray Free Electron Laser is the brightest X-ray free electron in the world due to its superconducting accelerator that allows the delivery of up 27000 intense, ultrashort pulses per second. The accelerator started commissioning end 2016. First lasing at hard x-ray energies was observed in May 2017 and the photons systems started commissioning mid-2017. The facility went into operation July 1 2017. First user experiments were started September 14 2017.

It is the world's first hard X-ray laser facility based on superconducting accelerator technology and will deliver an unprecedented X-ray beam to the user community. The first two instruments open for user experiments are the FXE instrument for ultra-fast x-ray spectroscopy and x-ray scattering and on the SPB/SFX instrument for diffractive imaging and structural determination for single particles, clusters and biomolecules. In 2018/2019 four more instruments will be taken into operation covering a wide range of scientific fields. In the talk a description of the facility will be given including a report of the status of the operation and a glimpse into results from the first experiments.

SHORT BIO

Robert Feidenhans´l received his Master's degree in Physics in 1983 and his PhD in 1986 both from the University of Aarhus. He worked as a staff scientist in the Physics Department at Risø National Laboratory from 1986-2001, where he became Head of the Materials Department also at Risø. In 2005 he became professor at the Niels Bohr Institute at University of Copenhagen, where he was vice institute leader 2007-2012 and Head of the Institute 2012-2017. January 2017 he became Managing Director of the European XFEL in Hamburg. Robert Feidenhans'l has been working in the field of X-ray Synchrotron Radiation and Free Electron Laser nearly all his career and has also been Chairman of Council at the European X-ray Radiation Facility in Grenoble and also at European XFEL.

MORDECHAI (MOTI) SEGEV

TECHNION, ISRAEL

TOPOLOGICAL PHOTONICS AND TOPOLOGICAL INSULATOR LASERS

The past few years have witnessed the emergence of the new field of Topological Photonics. The first pioneering papers were intended to transfer the concepts of topological insulators from the electronic condensed matter systems to the electromagnetic and photonics settings. This meant transforming fermionic concepts into the bosonic nature of photons. But in the years that followed, many new ideas have emerged, some are universal - making immediate impact of fields beyond photonics, and some are unique to photonic systems. The natural progress in this field is now exemplified by the recent discovery of topological insulator lasers, an idea that started as a quantum simulator and developed all the way to a promising application.

SHORT BIO

Moti Segev is the Robert J. Shillman Distinguished Professor of Physics, at the Technion, Israel. He received his BSc and PhD from the Technion in 1985 and 1990. After postdoc at Caltech, he joined Princeton as Assistant Professor (1994), becoming Associate Professor in 1997, and Professor in 1999. Subsequently, Moti went back to Israel, and in 2009 was appointed as Distinguished Professor.

Moti's interests are mainly in nonlinear optics, solitons, sub-wavelength imaging, lasers and quantum electronics, although he finds entertainment in more demanding fields such as basketball and hiking. He is a Fellow of OSA and APS. He has won numerous awards, among them the 2007 Quantum Electronics Prize of the EPS, the 2008 Landau Prize (Israel), the 2009 Max Born Award of the OSA, and the 2014 Arthur Schawlow Prize of the APS. In 2011, he was elected to the Israel Academy of Sciences and Humanities, and in 2014 he won the Israel Prize in Physics (highest honor in Israel). In 2015, Moti was elected to the National Academy of Science (USA) as a foreign associate.

However, above all his personal achievements, he takes pride in the success of his graduate students and postdocs, among them are currently 19 professors in the USA, Germany, Taiwan, Croatia, Italy, India and Israel, and many holding senior R&D positions in the industry.

TECHNICAL SESSION

R1. SOLID-STATE LASERS

Location: Petrov-Vodkin 2+3 Room, floor 2. 09:00 - 11:00

NIR / MIR Lasers

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

TuR1-01 09:00-09:30

Sub-120 fs Kerr-lens mode-locked Tm:Sc2O3 laser at 2.1 μm wavelength range *(Invited paper)*

M. Tokurakawa[1], E. Fujita[1], A. Suzuki[1], Ch. Krankel[2,3]; 1 - Univ. of Electro-Communications, Japan; 2 - Leibniz-Inst. für Kristallzüchtung, 3 - Univ. Hamburg, Germany

We demonstrate a Kerr-lens mode-locked Tm3+:Sc2O3 laser in-band pumped by a 1611 nm fiber laser. 115 fs pulses with 420 mW output power and 298 fs pulses with 1 W output power are obtained.

TuR1-02 09:30-09:45

Efficient gain-switched operation around 3 μm in Cr2+:CdSe single-crystal laser pumped by repetitively-pulsed Ho3+:YAG lasers

O.L. Antipov[1,2], I.D. Eranov[1,2], M.P. Frolov[3], D.O. Kalyanov[2], Yu.V. Korostelin[3], V.I. Kozlovsky[3,4], Ya.K. Skasyrsky[3]; 1 - Inst. of Applied Physics RAS, 2 - Nizhny Novgorod State Univ., 3 - Lebedev Physical Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia

Efficient gain-switched output at 3.12 μm was achieved from the Cr2+:CdSe laser pumped at 2.1 μm by the repetitively-pulsed Ho3+:YAG laser. Two lasing regimes were registered, with the output wavelength centered at 3.12 μm or 2.7 μm, depending on the concentration of Cr2+ ions, crystal temperature, and Q-factor of a resonator. A high beam quality was maintained up to 2.5 W of an output power. The maximum output power reached 5 W.

TuR1-03 09:45-10:00

Degenerate optical parametric amplifier driven by Cr:Forsterite laser

E.A.Migal, F.V.Potemkin; Lomonosov Moscow State Univ., Russia

We present femtosecond parametric amplification of ultra-broadband (1.8 – 2.5 μm) seed radiation produced by near-IR BBO OPA in relatively novel nonlinear LiGaS2 (LGS) crystal. The mixed BBO/LGS OPA shows 11% efficiency with 70 μJ output and 250-nm bandwidth near degeneracy (2.5 μm).

TuR1-04 10:00-10:15

High-efficiency high repetition rate gain-switched lasers at 2.4-2.7 μm based on polycrystalline Cr2+:ZnSe slabs with undoped end-cups pumped at 2.1 μm by Ho3+:YAG laser

O.L. Antipov[1,2], I.D. Eranov[1,2], S.S. Balabanov[3]; 1 - Inst. of Applied Physics RAS, 2 - Nizhny Novgorod State Univ., 3 - Inst. of Chemistry of High-Purity Substances RAS, Russia

Efficient gain-switched laser operation at 2.4-2.7 μm was achieved in polycrystalline Cr2+:ZnSe slabs (with rectangular or zig-zag optical path configurations) pumped at 2.1 μm by the pulsed Ho3+:YAG laser with the repetition rate of 5-30 kHz. The lasing occurred at 2.4-2.6 μm or 2.65-2.7 μm, depending on the cavity mirror reflections, temperature, and resonator design. The average oscillation power reached 2.7 W (at 2.65-2.7 μm) with a slope efficiency of ~40%, or 3.4 W (at 2.4-2.6 μm) with a slope efficiency of ~50%.

TuR1-05 10:15-10:30

Laser system master oscillator and power amplifiers Ho:YAG with a pulse repetition rate of 2 kHz

K.V. Vorontsov, S.D. Velikanov, V.A. Garyutkin, N.A. Egorov, N.G. Zakharov, V.I. Lazarenko, G.M. Mishchenko, G.N. Nomakonov, E.A. Polezhaev, Yu.N. Frolov; RFNC–VNIIEF, Russia

The experimental investigation of a double-micron pulse periodic laser system have been done on Ho:YAG crys-tals. The generation was obtained with a pulse repetition rate of 2 kHz. The laser system was done on the master oscillator and two power amplifiers scheme. The pump conversion efficiency in the system was 44 %.

TuR1-06 10:30-10:45

All solid-state source of coherent radiation in far IR spectral region

N.G. Zakharov, S.D. Velikanov, K.V. Vorontsov, V.B. Kolomeets, V.I. Lazarenko, A.S. Nadezhin, N.I. Nikolaev, G.N. Nomakonov, S.N. Sin'kov, Yu.N. Frolov; RFNC–VNIIEF, Russia

All solid-state laser source of coherent radiation in far IR spectral region based on ZnGeP2 optical parametric oscillator pumped by holmium laser is presented. Quantum efficiency of parametric conversion as high as 35%, slope efficiency 20% and energy conversion efficiency 8,5% are demonstrated. Far IR pulse length was meas-ured to be 21 ns FWHM.

TuR1-07 10:45-11:00

Cr:ZnMnSe diode-pumped laser

A. Říha[1], H. Jelínková[1], M. Němec[1], R. Švejkar[1], M.E. Doroshenko[2], V.V. Osiko[2], N.O. Kovalenko[3], A.S. Gerasimenko[3]; 1 - Czech Technical Univ. in Prague, Czech Republic; 2 - General Physics Inst. RAS, Russia; 3 - Inst. for Single Crystals NASU, Ukraine

This study presents tunable laser oscillator based on diode-pumped Cr:ZnxMn1-xSe single crystals. Pulsed oscillations in tunable ranges 2290–2578 nm and 2353–2543 nm were demonstrated for Cr:Zn0.95Mn0.05Se and Cr:Zn0.70Mn0.30Se and the peak output power up to 177 mW and 94 mW, respectively. Pulse repetition rate was 10 Hz with the pulse duration of ~2 ms.

- Coffee Break -

Location: Petrov-Vodkin 2+3 Room, floor 2. 11:30 - 13:30

NLO / OPA

Session Chair: Maximilian Lederer, European XFEL GmbH, Germany

TuR1-08 11:30-12:00

High power wavelength conversion of picosecond pulses at 1030 nm from deep-UV to mid-IR *(Invited paper)*

O. Novak; Inst. of Physics CAS, Czech Republic

A 100-kHz picosecond high-power thin-disk laser was developed. The wavelength conversion spanning from deep-ultraviolet into mid-infrared extends the application potential. The fundamental wavelength (1030 nm) was converted into the second (515 nm), third (343 nm), fourth (257.5 nm), and fifth (206 nm) harmonics. Longer wavelengths tunable between 1700 nm and 2600 nm were obtained by optical parametric generation and amplification.

TuR1-09 12:00-12:15

Generation of 1 W blue light at 438 nm by frequency tripling of Raman fiber laser in PPsLT crystal

A.A. Surin[1], A.A. Molkov[1,2], T.E. Borisenko[1], K.Y. Prusakov[1,2]; 1 - NTO "IRE-Polus", 2 - Moscow Inst. of Physics and Technology, Russia

We present high power linearly polarized single mode blue laser with output power more than 1 W at 438 nm, obtained by single pass frequency tripling of fiber Raman laser in periodically polled stoichiometric lithium tantalite.

TuR1-10 12:15-12:30

Neodymium lasers with intracavity Raman conversion for yellow spectral region

G.V. Shilova[1], A.A. Sirotkin[1,2], P.G. Zverev[1], Z.J. Liu[3], Z.H. Cong[3]; 1 - Prokhorov General Physics Inst. RAS, 2 - National Research Nuclear Univ. MEPHI, Russia; 3 - Shandong Univ., China

Two approaches for developing of pulsed yellow neodymium diode pumped lasers with intracavity Raman conversion in barium nitrate and second or sum frequency oscillation for medical applications were investigated. The first one used Nd3+:YVO4 laser with intracavity SHG in LBO and first Stokes oscillation in Ba(NO3)2. The second scheme utilized Nd3+:YVO4/Ba(NO3)2 Raman laser with sum-frequency conversion in KTP crystal.

TuR1-11 12:30-12:45

Non-phasematched sum frequency generation from tightly focused high gain parametric down conversion

D.A. Kopylov[1], K.Yu. Spasibko[2,3], G. Leuchs[2,3], T.V. Murzina[1], M.V. Chekhova[1,2,3]; 1 - Lomonosov Moscow State Univ., Russia; 2 - Max Planck Inst. for the Science of Light, 3 - Univ. of Erlangen-Nürnberg, Germany;

We study the sum frequency generation from high gain parametric down conversion with broadband spectrum in the absence of the phase matching. In the case of strong focusing, a set of interference spectral peaks in the spectrum of the second harmonic appear without the phase matching. Experimental data supported by theoretical modeling reveal the influence of correlation effects on non-phase matched sum frequency generation.

TuR1-12 12:45-13:00

Efficient generation of the sixth harmonic at 224 nm using a temperature gradient applied to BBO

A.M. Rodin[1,2], E. Kuodys[1], A. Michailovas[1,2]; 1 - Center for Physical Sciences and Technology, 2 - Ekspla Ltd, Lithuania

The fundamental radiation of picosecond NIR Nd: YVO4 laser was converted to the sixth harmonics at 224 nm with an average power of ~ 1 W by optimizing the temperature gradient applied to BBO. The developed laser also provides 1342, 671 and 442 nm wavelengths with an output power of 10 W, 6 W and 4 W at 300 kHz.

TuR1-13 13:00-13:15

Scalable to 60 mJ, 1.1 ps Output Pulses at 100 Hz from Cost-effective Yb: YAG CPA for 1 TW-class OPCPA

A.M.Rodin[1,2], P.Mackonis[1], A.Petrulenas[1]; 1 - Center for Physical Sciences and Technology, 2 - Ekspla Ltd, Lithuania

A two-stage double-pass chirped pulse amplifier based on Yb: YAG rods provides pulses with an output energy of ~ 20 mJ, a pulsewidth of 1.1 ps at a repetition rate of 100 Hz and excellent beam quality. It forms a cost-effective and scalable to 60 mJ pumping source for 1 TW-class OPCPA.

TuR1-14 13:15-13:30

Raman fiber laser based on dual-core fiber with fiber Bragg grating inscribed by femtosecond radiation

M.I. Skvortsov[1,2], I.A. Lobach[1,2], S.R. Abdullina[1], A.A. Wolf[1,2], A.V. Dostovalov[1,2], A.A. Vlasov[1], S. Wabnitz[2,3], S.A. Babin[1,2]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Novosibirsk State Univ., Russia; 3 - Univ. di Brescia, Italy

Application of femtosecond point-by-point inscription technique make it possible to form fiber Bragg gratings (FBGs) in different cores of multicore fibers as mirrors of laser cavity. In this paper, we present various configurations of Raman laser based on dual-core fiber.

- Lunch Break -

Location: Petrov-Vodkin 2+3 Room, floor 2. 15:00 - 17:00

High Power, Thin Disk, Fiber I

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

TuR1-15 15:00-15:30

Thin-Disk regenerative amplifiers and optical parametric chirped pulse amplifiers *(Invited paper)*

P. Kroetz[1], C.Y. Teisset[1], S. Prinz[1,3], C. Wandt[1], S. Klingebiel[1], C. Grebing[1], A. Budnicki[2], M. Schultze[1], S. Stark[1], C. Wandt[1], K. Michel[1], T. Metzger[1]; 1 - TRUMPF Scientific Lasers GmbH + Co. KG, 2 - TRUMPF Laser GmbH, Germany

We present our results on intra-cavity stabilized, high pulse energy and high power regenerative amplifiers that can be used for the pumping of optical parametric chirped pulse amplifiers to generate CEP-stable ultrashort pulses.

TuR1-16 15:30-15:45

Low quantum defect actively Q-switched and frequency doubled Yb3+: LuAlO3 laser

A.S. Rudenkov[1], V.E. Kisel[1], A.S. Yasukevich[1], K.L. Hovhannesyan[2], A.G. Petrosyan[2], N.V. Kuleshov[1]; 1 - Belarusian National Technical Univ., Belarus, 2 - Inst. for Physical Research, NAS Armenia, Armenia

Compact diode-pumped actively Q-switched Yb3+:LuAlO3 (Yb3+:LuAP) laser is demonstrated at the central wavelength of 999.6 nm. Output power of 4.9 W with pulse repetition frequency (PRF) up to 50 kHz and pulse duration of (11.5–24) ns was obtained. The maximum pulse energy of 333 μJ and peak power of 29 kW were achieved. 97 μJ pulse energy at 10 kHz PRF was demonstrated at 499.8 nm wavelength.

TuR1-17 15:45-16:00

946nm Nd:YAG regenerative power amplifier

A.F. Kornev[1], A.S. Kovyarov[1,2], V.P. Pokrovskiy[1]; 1 - Lasers and optical systems, 2 - ITMO Univ., Russia

0.4 J X 50 Hz, 3 ns, 946 nm Nd:YAG regenerative power amplifier was developed. The amplifier was based on two tandem Ø10 X 140 mm laser rods. Relay optics provided reimaging of the uniform distribution of input beam during multi-pass amplification. Image-rotation allowed to obtain divergence of 1.25 X DL compared to 5 X DL without the rotation.

TuR1-18 16:00-16:30

Towards few-cycle pulses from ultrafast thin-disk lasers *(Invited paper)*

N. Modsching, C. Paradis, M. Gaponenko, F. Labaye, V. J. Wittwer, Th. Südmeyer; Univ. de Neuchâtel, Switzerland

Ultrafast thin-disk lasers (TDL) generate higher average powers and pulse energies than any other femtosecond oscillator technologies. In this presentation, we discuss performance scaling and the ongoing race towards shorter pulse durations. Kerr lens mode-locked (KLM) TDLs can operate with nearly transform-limited soliton pulses in a strongly self-phase modulation (SPM) broadened regime, featuring an optical bandwidth several times larger than the bandwidth of the employed gain material. Recently, we achieved pulses as short as 30 fs, which is equal to the shortest pulses demonstrated by Yb-doped bulk oscillators. Further optimization of this approach using broadband gain materials should ultimately lead to the direct generation of few-cycle pulses from Yb-based diode-pumped solid-state lasers.

TuR1-19 16:30-16:45

107-kW-peak-power 2-ns pulse tapered Er-doped fiber amplifier

M.M. Khudyakov[1,2], A.E. Levchenko[2], V.V. Velmiskin[2], K.K. Bobkov[2], D.S. Lipatov[3], A.N. Guryanov[3], M.M. Bubnov[2], M.E. Likhachev[2]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Fiber Optics Research Center RAS, 3 - Inst. of High Purity Substances RAS, Russia

A novel tapered Er3+-doped fiber design for high peak power amplification has been developed and tested. The core diameter was changing along 2.5 meters from 22.5 um (single-mode operation) to 86 um. Amplification of 2 ns pulses has resulted in peak power of 105 kW (0.25 mJ) with nearly diffraction-limited beam quality (M2<1.27).

TuR1-20 16:45-17:00

18 mJ 1.3 ns single-frequency 946 nm Nd: YAG laser based on LD radiation amplification

A.F. Kornev[1], A.S. Kovyarov[1,2], V.P. Pokrovskiy[1]; 1 - Lasers and optical systems, 2 - ITMO Univ., Russia

946nm Nd:YAG laser based on regenerative amplification was developed. The source of single-frequency radiation was CW laser diode with the output power of 12 mW. Pulse slicer cut pulses with duration of 1.3 ns and energy of ~10-11J from the CW radiation. The regenerative amplifier output energy was 18 mJ at repetition rate of 50 Hz. Output beam quality M2<1.3.

- Coffee Break -

R2. HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID

Location: Pudovkin Room, floor 3. 15:30 - 17:00

Diode Pumped Alkali Lasers

Session Chair: Michael Heaven,
Emory Univ., USA

TuR2-01 15:30-16:00

Basic processes in DPALs: experimental and theoretical studies *(Invited paper)*

S. Rosenwaks, I. Auslender, E. Yacoby, K. Waichman, B.D. Barmashenko; Ben-Gurion Univ. of the Negev, Israel

Experimental and theoretical parametric studies of the influence of the pump-to-laser beam overlap, the alkali cell length and composition of the buffer gas on the laser power, slope efficiency and the laser beam quality factor M2 of static Cs DPALs is reported.

TuR2-02 16:00-16:15

Modeling of lasing in static DPALs:intensity and wave-optics based approaches

B.D. Barmashenko, I. Auslender, K. Waichman, S. Rosenwaks; Ben-Gurion Univ. of the Negev, Israel

Intensity and wave-optics based models of the lasing in static DPALs are reported. The first model describes multi-transverse mode operation of the DPALs, whereas the second predicts dependence the laser beam quality factor M2 on the refractive index gradients.

TuR2-03 16:15-16:30

3D CFD modeling of flowing-gas diode pumped alkali laser

E. Yacoby, K. Waichman, O. Sadot, B.D. Barmashenko, S. Rosenwaks; Ben Gurion Univ., Israel

Recently, flowing-gas K diode-pumped alkali lasers (DPALs) are studied extensively and there is interest in developing multi-kilowatt DPALs. To study the possibility of scaling up the K DPAL, we present 3-Dimensional computational fluid dynamics modeling of flowing-gas K DPALs with different pumping geometries. The model is applied to 100-kW class device with transverse and end pumping geometry.

TuR2-04 16:30-17:00

Investigation of diode-pumped alkali lasers and their computational model calculations *(Invited paper)*

M. Endo[1], R. Nagaoka[2], H. Nagaoka[2], T. Nagai[2], F. Wani[2]; 1 - Tokai Univ., 2 - Kawasaki Heavy Industries, Ltd., Japan

We are investigating diode pumped alkali lasers (DPAL) as a potential high-energy laser source. A 10-W class cesium DPAL has been developed. Since DPAL involves problems such as chemical reactions and thermodynamics, computational fluid dynamics (CFD) is necessary for precise modeling. We have developed a numerical simulation of cesium DPAL by combining a wave-optics optical resonator simulation code and a simplified CFD code. The consistency between simulation results and experimental results are satisfactory. An idea of the scalable pump beam arrangement for DPAL is discussed with the aid of the simulation.

- Coffee Break -

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

Gas and Hybrid Lasers

Session Chair: Boris Barmashenko,
Ben-Gurion Univ., Israel

TuR2-06 17:30-18:00

Development of a high-pressure discharge for diode-pumped rare gas lasers *(Invited paper)*

P.A. Mikheyev[1,2], M.C. Heaven[2,3], V.N. Azyazov[1,2]; 1 - Lebedev Physical inst. RAS, Samara Branch, 2 - Samara Univ., Russia; 3 - Emory Univ., USA

Recently suggested optically pumped rare gas lasers have a potential for scaling to a cw high-power systems with good beam quality. Metastable atoms of heavier rare gases that are the lasing species are to be produced in an electric discharge at near atmospheric pressure. The key problem for this class of lasers is the development of a suitable discharge system.

TuR2-07 18:00-18:15

High-pressure electron beam-optically pumped He-Ar laser and collisional quenching of 4s levels of ArI.

D.A. Zayarnyi, A.E.Drakin, A.A. Ionin, I.V. Kholin, A.A.Kozlov, A.Yu. L'dov, D.V.Sinitsyn, N.N. Ustinovskii; Lebedev Physical Inst. RAS, Russia

The experimental modeling of high-pressure He-Ar gas laser with transverse pumping by a diode laser array was carried out. The plasma-chemical rate constants of collisional quenching of 4s argon levels with argon and helium atoms in high-pressure laser mixtures were for the first time obtained.

TuR2-08 18:15-18:30

IR laser on transitions of neutral Xe atoms pumped by a pulsed longitudinal inductive discharge of a transformer type

A.M. Razhev[1,2], D.S. Churkin[1,3], E.S. Kargapoltsev[1], I.A. Trunov[1,2]; 1 - Inst. of Laser Physics SB RAS, 2 - Novosibirsk State Technical Univ., 3 - Novosibirsk State Univ., Russia

For the first time, it has been reported that laser radiation is observed when pumping xenon-containing gas mixtures with a pulsed longitudinal inductive discharge of a transformer type. The lasing spectrum was recorded in the region of 190 - 1150 nm and consisted of two lines 904.5 nm and 979.8 nm. The intensity ratio strongly depended on the pressure of the active medium.

TuR2-09 18:30-18:45

Intracavity frequency conversion of multiline CO laser radiation in nonlinear crystal BaGa2GeSe6

Yu.M. Klimachev[1], V.V. Badikov[2], D.V. Badikov[2], A.A. Ionin[1], I.O. Kinyaevskiy[1], A.A. Kotkov[1], A.Yu.Kozlov[1], A.M. Sagitova[1], D.V. Sinitsyn[1]; 1 - Lebedev Physical Inst. RAS, 2 - Kuban State Univ., Russia

The sum frequencies generation of multiline CO laser radiation in a new nonlinear crystal BaGa2GeSe6 for the intracavity version of frequency conversion is realized for the first time.

TuR2-10 18:45-19:00

Modeling of gas-flow slab RF-discharge oxygen-iodine laser

A.A. Ionin[1], I.V. Kochetov[1,2], A.Yu. Kozlov[1], O.A. Rulev[1], D.V. Sinitsyn[1], N.P. Vagin[1], N.N. Yuryshev[1]; 1 - Lebedev Physical Inst. RAS, 2 - Troitsk Inst. for Innovation and Fusion Research, Russia

Modeling of the possibility to obtain lasing in gas-flow slab RF-discharge oxygen-iodine setup, when gas mixture CF3I: O2: He is excited under various conditions, was performed. Reactions involving iodide CF3I and photon balance equation were added to the model for this purpose. Calculations showed that the laser action is achievable with additional cooling of the gas channel walls in proposed experimental conditions.

TuR2-11 19:00-19:15

O2(a1->X3) radiation induced by collisions with He and Ne

A.P. Torbin[1,2], P.A. Mikheyev[1,2], V.N. Azyazov[1,2]; 1 - Samara National Research Univ., 2 - Lebedev Physical Inst. RAS (Samara Branch), Russia

The collision-induced radiative transition of singlet oxygen O2(a1) was studied with He and Ne as collisional partners. The rate constant for the process with Ne was measured. It was shown that He does not increase the intensity of spontaneous emission.

TuR2-12 19:15-19:30

Temperature dependent rate constants for O2(b) deactivation by O2(X)

G.I. Tolstov[1], M.V. Zagidullin[1,2], N.A. Khvatov[1,2], A.M. Mebel[1], P.A. Mikheyev[1,2], V.N. Azyazov[1,2]; 1 - Samara National Research Univ., 2 - Lebedev Physical Inst. (Samara Branch), Russia

Rate constants for the deactivation of O2(b) by collisions with O2(X) have been determined in the temperature range from 297 to 800 K. O2(b) was excited by pulses from a tunable dye laser, and the deactivation kinetics were followed by observing the temporal behavior of the b1Σg - X3Σg transition fluorescence. The deactivation rate constants for O2 can be represented by the expression kO2=7.4×10^(-17)×T0.5×exp(-1104.7±53.3/T).

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

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

Single-Frequency and Mode-Locked Lasers

Session Chair: Grigorii Sokolovskii,
Ioffe Inst., Russia

TuR3-01 09:00-09:30

Single frequency semiconductor laser exploiting the concept of Parity-Time symmetry *(Invited paper)*

V. Brac de la Perrière[1], Q. Gaimard[1], H. Benisty[2], A. Ramdane[1], A.Lupu[1]; 1 - Univ. Paris-Sud, Univ. Paris-Saclay, 2 - Univ. Paris Saclay, France

The principle of gain-loss modulation lying in the heart of Parity-Time symmetric optics is exploited for realization of single frequency DFB lasers. Due to the "unidirectional" gain discrimination mechanism induced by the complex refractive index Bragg grating, it is expected that the coherence of such a laser would be highly tolerant with respect to the optical feedback.

TuR3-02 09:30-10:00

Quantum-dot laser assisted spiking neural networks *(Invited paper)*

D. Syvridis, C. Mesaritakis; National & Kapodistrian Univ. of Athens, Greece

We report on our recent findings regarding a photonic neuron based on a semiconductor quantum dot laser. The experimental investigation sheds light on the similarities of our scheme with biological neurons, whereas the merits provided by isomorphic neurons to photonic neural networks, are discussed.

TuR3-03 10:00-10:30

Addressing and manipulation of localized structures in passively mode-locked semiconductor lasers *(Invited paper)*

P. Camelin[1], M. Marconi[1], S. Balle[2], J. Javaloyes[2], M. Giudici[1]; 1 - Univ. Côte d'Azur, Inst. de Physique de Nice, France; 2 - Univ. de les Illes Baleares, Spain

Temporal Localized Structures are short pulses travelling back and forth in a nonlinear cavity which can be individually addressed and manipulated. Hence, they can be used as fundamental information bits, thus enabling data buffering and processing. They can also be used for generating arbitrary patterns of picosecond laser pulses at arbitrary low rate. In this contribution we review the results obtained in Vertical Cavity Surface-Emitting Lasers coupled to an external Saturable Absorber Mirror.

TuR3-04 10:30-11:00

Direct-diode-pumped fs Ti: sapphire lasers and their applications in microscopy *(Invited paper)*

B. Resan[1], A. Rohrbacher[2], O. E. Olarte[3], P. Loza-Alvarez[3]; 1 - Univ. of Applied Sciences and Arts Northwestern Switzerland, 2 - Lumentum Switzerland AG, Switzerland; 3 - ICFO - Inst. de Ciencies Fotoniques, The Barcelona Inst. of Science and Technology, Spain

We will present the new blue diode pumped TiSa oscillator and its application in multiphoton imaging. The SESAM modelcoked laser generated 460 mW average power at 92 MHz pulse repetition rate, wavelength was centered at 784.5 nm, and pulse duration was 82 fs, i.e. 5 nJ pulse energy. The calculated peak power was 61 kW. To our knowledge, this is the highest pulse energy achieved, about 5 times higher than previously published, and the highest peak power reported for direct diode pumped Ti: Sapphire lasers. Such a laser is ideally suited for biomedical imaging and nanostructuring applications. We demonstrate its application in three-color two-photon excitation fluorescence (TPEF) imaging of a section of mouse intestine and BPAE cells; and 3D SHG microscopy images of collagen type-I from a commercial tendon sample.

- Coffee Break -

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

THz Photonics

Session Chair: Edik Rafailov,
Ason Univ., UK

TuR3-05 11:30-12:00

THz and multy-THz lasers based on HgCdTe quantum well nanostructures *(Invited paper)*

S. Morozov; Inst. for Physics of Microstructures RAS, Russia

We report on stimulated emission at wavelengths up to 19.5μm from HgTe/HgCdTe quantum well heterostructures with wide-gap HgCdTe dielectric waveguide, grown by molecular beam epitaxy on GaAs(013) substrates. The mitigation of Auger processes in structures under study is exemplified, and the promising routes towards 20–50μm wavelength range, where HgCdTe lasers may be competitive to the prominent emitters, are discussed.

TuR3-06 12:00-12:30

Generation of continuous terahertz wave with wide tunable range *(Invited paper)*

O. Kojima[1], T. Kita[1], R. Hogg[2]; 1 - Kobe Univ., Japan; 2 - Univ. of Glasgow, UK

We realize a continuous THz electromagnetic wave demonstrating wide frequency tunability from 0.1 to 18 THz. Due to excitation of two exciton states in the GaAs/AlAs multiple quantum well using two continuous wave lasers, THz waves are emitted as a result of differential-frequency-mixing. Using the inhomogeneous broadening width of exciton lines, wide frequency tunability without phonon effects is achieved.

TuR3-07 12:30-13:00

Intense THz-assisted modulation of semiconductor optical properties *(Invited paper)*

H. Kim, J. Hunger, E. Cánovas, M. Karakus, Z. Mics, M. Grechko, D. Turchinovich, S. H. Parekh, M. Bonn; Max Planck Inst. for Polymer Research, Germany

We use intense THz pulses of different generation schemes to excite optical phonons or to induce acceleration of electrons in methylammonium lead halide perovskites. THz induced transient spectra over a broad visible range including the band gap are detected by femtosecond visible pulses. We observe both resonant and non-resonant modulations of optical transmittance near the band gap. We model both contributions in time- and probe frequency domain.

TuR3-08 13:00-13:15

The investigation of temperature degradation in THz quantum cascade lasers based on resonant-phonon design

R.A. Khabibullin[1], N.V. Shchavruk[1], D.S. Ponomarev[1], D. V. Ushakov[2], A.A. Afonenko[2], O.Yu. Volkov[3], V.V. Pavlovskiy[3]; 1 - Inst. of Ultra-High Frequency Semiconductor Electronics RAS, Russia; 2 - Belarusian State Univ., Belarus; 3 - Inst. of Radio-Engineering and Electronics RAS, Russia

We have designed and fabricated terahertz quantum cascade lasers (THz QCL) based on GaAs/Al0.15Ga0.85As three and four-quantum well active module with resonant-phonon depopulation scheme. Three-well and four-well THz QCLs have a lasing frequencies of 3.2 and 2.3 THz, respectively. We investigate the dependence of threshold current and lasing output power on temperature. The investigation of temperature degradation in THz QCLs shows that the thermally activated longitudinal optical-phonon scattering is the dominant mechanism.

TuR3-09 13:15-13:30

Terahertz continuous-wave solid immersion imaging with spatial resolution beyond the Abbe limit

N.V. Chernomyrdin[1,2,3], A.S. Kucheryavenko[1], G.S. Kolontaeva[1], G.A. Komandin[3], M.A. Shchedrina[2], I.E. Spektor[3], I.V. Reshetov[2], K.I. Zaytsev[1,2,3]; 1 - Bauman Moscow State Technical Univ., 2 - Sechenov First Moscow State Medical Univ., 3 - Prokhorov General Physics Inst. RAS, Russia.

We have proposed an approach to improve the resolution of terahertz (THz) imaging using the effect of solid immersion. We have designed a solid immersion lens (SIL) and we have combined numerical simulations and experimental studies to demonstrate the advanced 0.2 wavelengths spatial resolution of the proposed THz SIL - it is beyond the 0.5 wavelengths Abbe limit.

- Lunch Break -

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

5 June, Tuesday

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

Relativistic Laser Plasma Optics

Session Chair: Paul McKenna,
Univ. of Strathclyde, UK

TuR5-01 09:00-09:30

Relativistic Optic using laser-controlled plasma mirrors *(Invited paper)*

F. Quéré, A. Borot, Ph. Martin; CEA, CNRS, Univ. Paris-Saclay, France

In this talk, we will demonstrate that perfectly controlled ultra-high intensity lasers focused on plasma mirrors can be used produce intense sources of light and particles.

TuR5-02 09:30-10:00

Plasma optics using scale length control *(Invited paper)*

D. Neely[1,2] G.G. Scott[1], R. Wilson[2], P McKenna[2]; 1 - Central Laser Facility, Rutherford Appleton Laboratory, STFC, 2 - Univ. of Strathclyde, UK

Simulations demonstrate that if the scale length of a plasma mirror at the critical density surface can be optimised then much higher reflectivities can be obtained. Experimental evidence demonstrating 96% reflectivities will be reviewed and wave-front stability will be explored. The potential for plasma optics to enable new geometries for transporting, focusing and compressing pulses will be examined.

TuR5-03 10:00-10:15

Backward Raman compression in plasma under nonlinear detuning at plasma wave-breaking threshold

A.A. Balakin[1], G.M. Fraiman[1], Q. Jia[2], N.J. Fisch[2]; 1 - Inst. of Applied Physics RAS, Russia; 2 - Princeton Univ., USA

From the first principles, we derive equations for Raman interaction in plasma taking into account the influence of nonlinear dispersion of plasma wave. It result in nonlinear detuning, which limits plasma wave amplitude much below the generally recognized wave-breaking threshold. The results of direct particle-in-cell simulations well agree with the scaling laws of these estimations. The methods for counteract this nonlinear detuning is suggested. Meanwhile, noise seeded Raman signals have small amplitudes, which negligibly deplete pump power.

TuR5-04 10:15-10:30

Developing picosecond-pumped OPCPA system for relativistic atto-science

V.E. Leshchenko[1,2], A. Kessel[1,2], M. Krueger[1,2], O. Lysov[1,2], A. Muenzer[1,2], S.A. Trushin[1,2], Zs. Major[1,2], F. Krausz[1,2], S. Karsch[1,2]; 1 - Max-Planck-Inst. für Quantenoptik, 2 - Ludwig-Maximilians-Univ. München, Germany

key design aspects of an OPCPA system for relativistic laser-matter interaction experiments are discussed as well as the first results of its application to the high harmonics generation.

TuR5-05 10:30-10:45

Amplification of a train of attosecond pulses in active medium of a plasma-based x-ray laser dressed by an optical laser field

T. Akhmedzhanov[1], V. Antonov[2,3], K.Ch. Han[1], O. Kocharovskaya[1]; 1 - Texas A&M Univ., USA; 2 - Inst. of Applied Physics RAS, Russia; 3 - Prokhorov General Physics Inst. RAS, Russia

In the present contribution we discuss a possibility to amplify a train of attosecond x-ray pulses produced via HHG of an optical laser fieldin active medium of plasma-based x-ray laser dressed by a replica of the laser field used for generation of harmonics. In particular, amplification of attosecond pulses by two orders of magnitude in «water window» is shown.

TuR5-06 10:45-11:00

Self photopumped X-ray laser near 13.4 nm driven by intense pump laser interacting with nanostructured Sn target as promising radiation source for nanolithography

E.P. Ivanova; Inst. of Spectroscopy RAS, Russia

A theoretical model is presented of a highly efficient source of monochromatic radiation at λ=13.4 nm, intended for industrial nanolithography. The creation of high-energy sources in this area is an actual problem, since for this region multilayer mirrors with high reflection coefficients (> 60%) have been developed. The basis of the source is an x-ray laser on the 3d94f [J = 1] - 3d94d [J = 1] transition in Ni-like tin (Sn22 +) ions in a plasma formed by interaction of a nanostructured tin target with an intense pump laser. The mechanism of inversion of self-photo pumped lasers is due to the reabsorption of photons in optically dense plasma. The following results are discussed: calculations of the gain and quantum yield of a laser with a wavelength of 13.4 nm, the principle of a target production, the scheme of an experimental setup.

- Coffee Break -

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

Laser Ion Acceleration

Session Chair: Alexander Andreev,
St. Petersburg State Univ., Russia; ELI-ALPS Inst., Hungary

TuR5-07 11:30-12:00

Ion acceleration by ultra-intense lasers beyond 10^20 W/cm^2 *(Invited paper)*

J. Fuchs; LULI, CNRS, Ecole Polytechnique, France; Inst. of Applied Physics RAS, Russia

We will present results we recently obtained investigating the behaviour of the most commonly employed laser-based ion acceleration mechanism, namely Target Normal Sheath Acceleration (TNSA), at laser intensities beyond 10^20 W/cm^2. This has been done using a refocusing elliptical plasma mirror (EPM) in order to increase the laser intensity of a given laser by tightly focusing the laser beam.

TuR5-08 12:00-12:30

Laser acceleration of optimized electron and proton beams from low-density targets *(Invited paper)*

V.Yu. Bychenkov; Lebedev Physical Inst. RAS, Center of Fundamental and Applied Research (CFAR), VNIIA, ROSATOM, Russia

Laser-driven charged particle acceleration mechanisms with relativistically intense pulses of ultrashort duration are reviewed for innovative low-density targets of near critical and near relitivistically critical densities. Applications of the generated high-energy electron and proton beams to nuclear and radiation sources are discussed.

TuR5-09 12:30-13:00

Ultrashort PW laser plasma interaction and ion acceleration *(Invited paper)*

S. Ter-Avetisyan; ELI-ALPS, Hungary

This presentation is closely related to recent development or imminently anticipated development of laser technology to bring the existing laser systems to a multi-PW level. Recent findings pave a way to achieving an ion source and beam desire parameters and they encourage further activities for optimisation of laser plasma-based accelerators.

TuR5-10 13:00-13:15

High energy protons via a laser-driven hybrid acceleration scheme in an ultra-thin foil

P. McKenna[1], A. Higginson[1], R. J. Gray[1], M. King[1], R. J. Dance[1], S.D.R. Williamson[1], N.M.H. Butler[1], R. Wilson[1], R. Capdessus[1], C. Armstrong[1,2], J.S. Green[2], S. J. Hawkes[2,1], P. Martin[3], W.Q. Wei[4], S.R. Mirfayzi[3], X.H. Yuan[4], S. Kar[3,2], M. Borghesi[3], R. J. Clarke[2], D. Neely[2,1]; 1 - Univ. of Strathclyde, 2 - STFC Rutherford Appleton Laboratory, 3 - Queens Univ. Belfast, UK; 4 - Shanghai Jiao Tong Univ., China

We show experimental and numerical results on the interaction of a linearly polarized, picosecond-duration, ultra-intense laser pulses with an expanding ultrathin foil, in which near-100 MeV proton energies are achieved. This occurs via a hybrid radiation pressure-sheath acceleration scheme, boosted by super-thermal heating of plasma electrons during relativistic self-induced transparency. The parameter range over which this scheme works is discussed.

TuR5-11 13:15-13:30

Laser-ion acceleration at ELI-NP

O. Budrigă[1], E. d'Humières[2], L.E. Ionel[1], M. Budrigă[1], M. Carabaş[3]; 1 - National Inst. for Laser, Plasma and Radiation Physics, Romania; 2 - Univ. de Bordeaux - CNRS - CEA, CELIA, France; 3 - Univ. POLITEHNICA of Bucharest, Romania

We investigate the interaction of an ultra-high intensity laser pulse with plastic flat-top cone targets coated inside with nanospheres. We find the dimensions of the flat-top foil cone and the nanospheres to have accelerated ions in monoenergetic beams with low angular divergence. This study will allow one to prepare and optimize first laser-ion acceleration experiments on ELI-NP using micro-cone targets.

- Lunch Break -

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

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

Fibers I

Session Chair: Sergei K. Turitsyn, Aston Univ., UK

TuR8-01 15:00-15:30

Spatiotemporal pulse shaping with multimode nonlinear guided waves *(Invited paper)*

S. Wabnitz[1,2,3]; K. Krupa[1], D. Modotto[1], G. Millot[4], D.S. Kharenko[3,5], V.A. Gonta[3], E.V. Podivilov[3,5], S. Babin[3,5], A. Tonello[6], A. Barthélémy[6], V. Couderc[6]; 1 - Univ. of Brescia, 2 - INO-CNR, Italy; 3 - Novosibirsk State Univ., Russia; 4 - Bourgogne Franche-Comté Univ., France; 5 - Inst. of Automation and Electrometry, Russia; 6 - Univ. of Limoges, France

We experimentally and theoretically investigate complex temporal pulse reshaping that accompanies Kerr beam self-cleaning in multimode optical fibers. We also study the output beam shape dependence on initial conditions.

TuR8-02 15:30-15:45

Coherent propagation of laser pulses in optical multi-core fiber

A.A.Balakin[1,2], A.G. Litvak[1,2], S.A. Skobelev[1]; 1 - Inst. of Applied Physics RAS, 2 - Univ. of Nizhny Novgorod, Russia

Analytical and numerical studies of the coherent propagation of laser radiation in a small-sized system of weakly coupled fibers are carried out. Configurations of the wave field in a multi-core fiber are found to ensure coherent propagation of radiation with a power exceeding the critical for self-focusing in a homogeneous medium. Analogous solutions in form of temporal solitons are found in such a small-sized discrete system for pulsed laser radiation.

TuR8-03 15:45-16:00

High energy femtosecond pulse shaping, contrast enhancement and compression using nonlinear multicore fiber

A.V. Andrianov[1], M.Yu. Koptev[1], N.A. Kalinin[1,2], O.N. Egorova[3], A.V. Kim[1], A.G. Litvak[1]; 1 - Inst. of Applied Physics RAS, 2 - Nizhny Novgorod State Univ., 3 - Fiber Optics Research Center RAS, Russia

Nonlinear spatiotemporal dynamics of femtosecond pulses in a hexagonal 7-core silica fiber pumped by a sub-uJ 370 fs Er: fiber CPA system was studied. Two orders of magnitude contrast enhancement of the pulses trapped in the central core of a multicore fiber was obtained. Further compression of pulses spectrally broadened in the multicore fiber down to 53 fs was demonstrated.

TuR8-04 16:00-16:30

Real-time measurements of transient nonlinear dynamics in optical fibers *(Invited paper)*

P. Ryczkowski[1], M. Närhi[1], C. Billet[2], J.M. Merolla[2], J.M. Dudley[2], G. Genty[1]; 1 - Tampere Univ. of Technology, Finland; 2 - Inst. FEMTO-ST, UMR6174 CNRS-Univ. Bourgogne Franche-Comté, France

We review our recent work on the real-time characterization of nonlinear instabilities dynamics in optical fiber systems.

TuR8-05 16:30-17:00

Full characterisation in phase and amplitude of the Fermi Pasta Ulam recurence process in optical fibers *(Invited paper)*

A. Mussot[1], P. Szriftgiser[1], C. Naveau[1], M. Conforti[1], A. Kudlinski[1], F. Copie[1], St. Trillo[2]; 1 - Univ. Lille, CNRS, France; 2 - Univ. of Ferrara, Italy

We report the symmetry breaking of tghe Fermi Pasta Ulam recurence in an optical fiber system by means of a new intensity and phase measurment system.

- Coffee Break -

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

Fibers II

Session Chair: Stefan Wabnitz, Univ. of Brescia, INO-CNR, Italy; Novosibirsk State Univ., Russia

TuR8-06 17:30-18:00

Revolver fiber design optimization for efficient mid-infrared gas fiber Raman lasers *(Invited paper)*

I.A. Bufetov, A.V. Gladyshev, M.S. Astapovich, A.N. Kolyadin, A.F. Kosolapov, G.K.Alagashev, A.D. Pryamikov; Fiber Optics Research Center RAS, Russia

We analyze the possibilities of improving the efficiency of gas fiber Raman lasers. Stimulated Raman conversion of 1556 nm to 4400 nm in a hydrogen-filled hollow-core fiber is considered as an example.

TuR8-07 18:00-18:15

Investigation of Kerr frequency combs generation methods in normal GVD regime

A.E.Shitikov[1,2,4], N.O.Nesterov[1,2], R.V.Terentiev[1,3], V.E.Lobanov[1], I.A.Bilenko[1,2], M.L.Gorodetsky[1,2]; 1 - Russian Quantum Center,2, 3 - Lomonosov Moscow State Univ., Russia

Frequency combs in whispering gallery mode crystalline microresonators in normal GVD regime were observed for the first time with bichromatic pump. We demonstrated two different regimes of frequency comb excitation. We also observed platicon-like frequency combs with a self-injection locked laser diode.

TuR8-08 18:15-18:45

Short cavity Tunable Brillouin Random Laser *(Invited paper)*

S.M. Popov[1], O. V. Butov[1], Y.K. Chamorovskiy[1,2], V.A. Isaev[1], A. O. Kolosovskiy[1], V. V. Voloshin[1], I. L.Vorob'ev[1], M. Yu.Vyatkin[1], P. Mégret[3], M. Odnoblyudov[2], D.A. Korobko[4], I.O. Zolotovskii[4], A.A. Fotiadi[3,4,5]; 1 - Inst. of Radio Engineering and Electronics RAS, 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia; 3 - Univ. of Mons, Belgium; 4 - Ulyanovsk State Univ., Russia; 5 - Ioffe Inst. RAS, Russia

We report on tunable random lasing realized with 85-m-long wide reflection spectrum Bi-tapered Rayleigh fiber fabricated with multiple reflection centers inscribed in the fiber core and uniformly distributed over the fiber length. Lasing tunability achieved by pumping wavelength changing. Extended fluctuation-free fragments in the oscilloscope traces highlight power behavior typical for lasing.

TuR8-09 18:45-19:00

Amplification through losses in nonlinear fiber optics

A.M. Perego[1], S.K. Turitsyn[2], K. Staliunas[3]; 1 - Aston Univ., UK; 2 - Novosibirsk State Univ., Russia; 3 - Inst. Catalana de Recerca i Estudis Avançats, Spain; 4 - Univer. Politècnica de Catalunya, Spain

We present the most recent results about a novel modulation instability of a continuous light wave in a normal dispersion nonlinear optical fiber, induced by spectrally asymmetric losses for signal and idler waves. The presence of such spectrally asymmetric losses profile causes energy transfer from the pump to both signal and idler. A variety of applications concerning both amplification of signals and generation of pulses is discussed.

TuR8-10 19:00-19:15

Elastic soliton crystals in a tunable passively mode-locked fiber laser

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

The concept of elastic optical soliton crystals, which relies on a long-range pulse-to-pulse interaction in a mode-locked laser with intracavity Mach-Zehnder interferometer, is proposed. Continuous stretching and compression by a factor of 40 of soliton crystals comprising similar or different ultrashort pulses with conserved structure have been directly observed by optical sampling.

TuR8-11 19:15-19:30

PT-symmetric bound states in the continuum

Ya.V. Kartashov[1,2], C. Milian[1], V.V. Konotop[3], L. Torner[1,4]; 1 - ICFO-Inst. de Ciencies Fotoniques, Spain; 2 - Inst. of Spectroscopy RAS, Russia; 3 - Univ. de Lisboa, Portugal

We show that 2D PT-symmetric structure built as a chain of waveguides, where all waveguides except for the central one are conservative, while the central one is divided into two halves with gain and losses, admits bound states in the continuum (BICs) whose properties vary drastically with the orientation of the line separating amplifying and absorbing domains, which sets the direction of internal energy flow.

R9. OPTICAL NANOMATERIALS

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

Optical Nanomaterials I

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

TuR9-01 09:00-09:30

Heterostructure barrier varactors for sub-THz range multipliers *(Invited paper)*

V.M. Ustinov[1,2], N.A. Maleev[3,4], A. P.Vasil'ev[1,3], A.G. Kuzmenkov[1,3], M.A. Bobrov[3], S.A. Blokhin[3], S.N. Maleev[3], M.M. Kulagina[3], V.E. Bougrov[2], E.L. Fefelova[5], V.A. Belyakov[5], I.V. Ladenkov[5], A.P. Stepanov[5], A.G. Fefelov[5]; 1 - Research and Engineering Center for Submicron Heterostructures for Microelectronics, 2 - ITMO Univ., 3 - Ioffe Inst., 4 - St. Petersburg Electrotechnical Univ. «LETI», 5 - JSC NPP «Salyut», Russia

The effect of the InAlAs/AlAs/InAlAs barrier layer design on characteristics of HBVs for sub-THz frequency multipliers has been studied. The increase in the AlAs insertion thickness and the strain compensation InGaAs layers decrease the leakage current. Under CW operation of tripler at 94 GHz output frequency the maximal output power exceeds 100 mW at the conversion efficiency of about 14%.

TuR9-02 09:30-10:00

III-V nanowire heterostructures on silicon-on-insulator for silicon photonics applications *(Invited paper)*

D.L. Huffaker[1], H. Kim[2], T.-Y. Chang[2], W.-J. Lee[1]; 1 - Cardiff Univ., UK; 2 - Univ. of California, USA

We demonstrate monolithic integration of III-V semiconductor nanowires on SOI platforms. (In)GaAs p-i-n heterostructures are formed in nanowires, and the nanowires are integrated on 3D structured SOI substrates. The proposed platform provides a promising way toward bottom-up optoelectronic devices on silicon photonic platforms.

TuR9-03 10:00-10:15

Suppression of miscibility gaps in ternary III-V nanowires grown at high supersaturations

T. Jean[1,2], V.G. Dubrovskii[2]; 1 - Univ. Clermont Auvergne, France; 2 - ITMO Univ., Russia

Miscibility gaps in ternary III-V alloys often prevent their compositional tuning required to extend the operating wavelengths of optoelectronic devices. Here, we show that, whenever present in the bulk thermodynamics, the miscibility gaps can be completely suppressed on kinetic grounds at high enough supersaturations of liquid droplets catalyzing the vapor-liquid-solid growth of ternary III-V nanowires.

TuR9-04 10:15-10:30

Modeling the morphology of self-assisted GaP nanowires grown by molecular beam epitaxy

E.D. Leshchenko[1,2], P. Kuyanov[3], R.R. LaPierre[1,3], V.G. Dubrovskii[1]; 1 - ITMO Univ., Russia; 2 - Lund Univ., Sweden; 3 - McMaster Univ., Canada

The morphologies of self-assisted GaP nanowires grown by gas source molecular beam epitaxy in regular arrays on silicon substrates under different conditions are modeled by a kinetic equation for the nanowire radius versus the position along the nanowire axis. The most important growth parameter that governs the nanowire morphology is the V/III flux ratio. Sharpened nanowires with a stable radius equal to only 12 nm at a V/III flux ratio of 6 are achieved, demonstrating their suitability for the insertion of quantum dots.

TuR9-05 10:30-10:45

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

R.R. Reznik[1,2,3,4,7], K.P. Kotlyar[1], I.P. Soshnikov[1,3,5], E.V. Nikitina[1], S.A. Kukushkin[6], A.V. Osipov[6], G.E. Cirlin[1,4,5]; 1 - St. Petersburg Academic Univ., 2 - Peter the Great St. Petersburg Polytechnic Univ., 3 - Inst. for Analytical Instrumentation RAS, 4 - ITMO Univ., 5 - Ioffe Inst., 6 - Inst. of Problems of Mechanical Engineering RAS, Russia; 7 - Durham Univ., UK

In this work, for GaN and InN nanowires growth in order to reduce the number of misfit dislocations a nanometer (about 50 nm) buffer layer of SiC was used. The intensity of radiation grown on SiC buffer layer GaN NWs is more than two times higher than the intensity of the best grown on silicon structures of GaN. Moreover, a possibility of A3B5 GaAs, AlGaAs and InAs nanowires growth on a silicon substrate with a nanoscale buffer layer of silicon carbide has been demonstrated for the first time. In addition, based on photoluminescence measurements, it was found that, in case of AlGaAs NWs growth on such substrates, nanowires have complex structure.

TuR9-06 10:45-11:00

Modeling the composition of ternary III-V nanowires and axial nanowire heterostructures

A.A. Koryakin[1,2], V. Zannier[3], F. Rossi[4], D. Ercolani[3], S. Battiato[3], L. Sorba[3], V.G. Dubrovskii[1]; 1 - ITMO Univ., 2 - St. Petersburg Academic Univ., Russia; 3 - NEST, Ist. Nanoscienze - CNR and Scuola Normale Superiore, 4 - IMEM - CNR, Italy

We present a new analytical approach for understanding and tuning the composition of ternary nanowires of III-V semiconductor compounds and interfacial abruptness of axial nanowire heterostructures. It is shown how the interfacial abruptness can be sharpened to the monolayer limit in Au-catalyzed axial InP/InAs/InP NW heterostructures.

- Coffee Break -

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

Optical Nanomaterials II

Session Chair: Diana Huffaker, Cardiff Univ., UK

TuR9-07 11:30-11:45

Length distributions of vapor-liquid-solid nanowires

Y. Berdnikov, V.G. Dubrovskii; ITMO Univ., Russia

We consider theoretically the length distributions of vapor-liquid-solid nanowires that grow by the material collection from the entire length of their sidewalls and with a delay of nucleation on the substrate. The obtained analytic length distribution is controlled by two parameters that describe the strength of surface diffusion and the nanowire nucleation rate. We discuss some implementations of this solution for analyzing the experimental data obtained for different III-V nanowires.

TuR9-08 11:45-12:00

AgBr-TlI crystals for medium and far IR optics (2 - 60 μm)

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

Phase diagram of AgBr-TlI was studied, and two regions of stable solid solutions were found in it. A series of optical crystals were grown basing on the detected homogeneity regions. Their optical properties (refractive index, transmission range, optical losses) were investigated. Slight changes in the refractive index over a wide range of compositions makes it possible to use these materials for creating 1D and 2 D structures including PCF structures.

TuR9-09 12:00-12:15

Borate glass ceramics doped with chromium ions: synthesis and spectral properties

A. Babkina, K. Zyryanova, D. Agafonova, R. Nuryev; ITMO Univ., Russia

The results of synthesis and investigation of the spectral properties of borate glasses doped by chromium and lithium ions are presented. Isothermal treatment of glasses leads to nucleation of Li (Al7B4O17): Cr3+ nanocrystals which increases the glass fluorescence quantum yield up to 36.5%.

TuR9-10 12:15-12:30

New metal-carbon composite materials for nanophotonics

A. Kucherik[1], A. Antipov[1], S. Kutrovskaya[1], A. Osipov[1], A. Povolotckii[2], A. Povolotckaia[2], S. Arakelian[1]; 1 - Vladimir State Univ., 2 - St. Petersburg State Univ., Russia

New metal-carbon composite materials, synthesized by laser irradiation of colloidal systems consisting of carbon and noble metal nanoparticles, are promising objects to realize surface-enhanced Raman scattering. The dependence of the Raman scattering intensity of the material composition has been investigated.

TuR9-11 12:30-12:45

Strong coupling in core-shell nanostructure based on silicon nanoparticle and TMDC monolayer

S. Lepeshov[1], A. Krasnok[2], O. Kotov[3], A. Alu[2]; 1 - ITMO Univ., Russia; 2 - Univ. of Texas at Austin, USA; 3 - Dukhov Research Inst. of Automatics, Russia

Here, we present our recent studies of resonance coupling in single Si nanoparticle-monolayer TMDC (WS2) core-shell nanostructures. We theoretically predict strong coupling regime in such system with coupling constant exceeding 58 meV.

TuR9-12 12:45-13:00

Fabrication of optical sensors based on porous silicon microcavities with embedded conjugated polymers for explosives detection

E.V. Osipov, I.L. Martynov, D.S. Dovzhenko, A.A. Chistyakov; National Research Nuclear Univ. MEPhI, Russia

In this study we have investigated the technological features of fabrication and photophysical properties of the optical sensors based on porous silicon microcavities for explosives detection. We have explored the problem of the optimal etching parameters selection as well as oxidation in order to obtain stable porous silicon microcavities in the visible region. Various methods for the embedding of conjugated polymers of PPV (polyphenylenevinylene) derivatives into the porous structure of microcavities have been considered. The luminescent properties of polymers embedded in porous silicon microcavities have been investigated and sensitivity to the explosives vapors has been demonstrated.

TuR9-13 13:00-13:15

Voltage controlled anisotropy of chemically synthesized silver nanorods ensembles intended for near IR applications

Y.A. Razumova[1], N.A. Toropov[1,2], T.A. Vartanyan[1], V.A. Polischuk[1]; 1 - ITMO Univ., Russia; 2 - Aston Univ., UK

The aim of this work was to develop a method for the synthesis of noble metal nanoparticles whose plasmon resonances are shifted toward larger wavelengths relative to resonances of spherical particles. On the other hand, these particles are rod-like. Under the influence of an external action for example, an electric field, these particles are able to line up in ordered ensembles.

TuR9-14 13:15-13:30

Laser-assisted reduction of graphene oxide: robust production of carbon nanomaterials

S.E. Svyakhovskiy[1], N.V. Minaev[2], S.A. Evlashin[3]; 1 - Lomonosov Moscow State Univ., 2 - Inst. of Laser and Information Technology RAS, 3 - Skolkovo Inst. of Science and Technology, Russia

The reduction of the graphene oxide by the laser treatment is the far-reaching method to produce carbon-based nanomaterials. The method has been developed for the robust production of carbon nanowalls and graphene nanoflakes with given optical, electrical and thermal properties in the wide range of parameters.

- Lunch Break -

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

Optical Nanomaterials III

Session Chair: Victor Ustinov,
Submicron Heterostructures for Microelectronics, Research & Engineering Center, RAS, Russia

TuR9-15 15:00-15:15

Enhancement of the light emission of color center containing nanodiamond structures

L. Himics[1], M. Veres[1], C. Popov[2], N. Felgen[2], T. Váczi[1], I. Rigo[1], S. Tóth[1], M. Koós[1]; 1 - Wigner Research Centre for Physics, Hungarian Academy of Sciences, Hungary; 2 - Univ. of Kassel, Germany

The effect of plasmonic structures having different shape and size on the light emission properties of color center containing nanodiamond structures was studied. The results show that these parameters are of great importance and can influence the luminescence intensity emitted by the color centers. The optimization of the plasmonic structure geometry for a specific color center can enhance efficiently the light-matter interaction, and the intensity of light emitted by the color center can be increased.

TuR9-16 15:15-15:30

Reflective properties of graphene for optical and near-infrared wavelength range

V.S. Malyi[1], V.M. Mostepanenko[1,2], G.L. Klimchitskaya[1,2], V.M. Petrov[1]; 1 - Peter the Great St. Petersburg State Polytechnical Univ., 2 - Central Astronomical Observatory at Pulkovo RAS, Russia

We derive the polarization tensor of graphene for visible and telecommunication wavelength range. The analytic and numerical calculations of reflectivities for both polarizations are presented.

TuR9-17 15:30-15:45

Absorption enhancement in laser-driven flyer plate with an Ag nano-array

X. Ji, Yu. Gao, D. Tang, Yo. Li, W. Qin, L. Wang; Inst. of Chemical Materials, CAEP, China

High reflectance of the pure Al flyer plate driven by laser resulted in low coupling efficiency. A flyer with Ag nano- rod arrays filled in anodic aluminum oxide(AAO) template was designed to increase the absorption of 1064nm wavelength laser. The effects of diameter and period on the reflection of input laser were studied by finite difference time domain (FDTD) method. An absorption peak at 1064nm wavelength was obtained when the diameter of Ag nano-rod was 40 – 400 nm and the period vs diameter was 1.5. A black flyer was prepared by alternating current electrochemical deposition of Ag in AAO template. The reflectance of the flyer at 1064nm wavelength was lower than 20%.

TuR9-18 15:45-16:00

Hybrid plasmonic nanostructures to prevent laser-induced fluctuation of SERS intensity

A.Yu. Panarin[1], A.V. Abakshonok[2], B.V. Ranishenka[3], P. Mojzes[4], S.N. Terekhov[1]; 1 - Stepanov Inst. of Physics NASB, 2 - Inst. of Chemistry of New Materials NASB; 3 - Inst. of Physical Organic Chemistry NASB, Belarus; 4 - Charles Univ. in Prague, Czech Republic

Plasmonic nanostructures based on silver nanoparticles (AgNPs)/ graphene oxide (GO) and AgNPs/hydroxyapatite were formed to improve stability of SERS spectra. The efficiency and kinetics of the SERS signal for plasmonic nanocomposites were studied. For graphene-based substrates the best stability of the SERS intensity was observed for hybrid structure GO/analyte/GO. Nanocomposite hydroxyapatite/silver demonstrated unusual behavior of the SERS intensity under the laser beam: signal rise within first 30 sec of the substrate exposure and then signal stabilization.

TuR9-19 16:00-16:15

Optical properties of Ag layers and Ag nanoparticles on Si

V.A. Tolmachev, Yu.A. Zharova; Ioffe Inst., Russia

The formation of the dielectric function ε of Ag nanolayers on the silicon surface has been studied and spectral features associated with the surface plasmon resonance (SPR) have been revealed. The real ε1 and imaginary ε2 functions, ellipsometric angles, and polarization reflection spectra Rp and Rs were calculated using the basic equation of ellipsometry, Fresnel formulas, transfer-matrix method, and Lorentz oscillator model. The Bruggeman and Maxwell-Garnett effective-medium approximation was used for the composite layer (Ag-air).

TuR9-20 16:15-16:30

Transmission of modified graphene layers on glass, sapphire and polyimide film substrates in UV, visible, NIR and THz spectral ranges

M.O. Zhukova[1], Ya.V. Grachev[1], L.V. Azina[1], A.N. Tcypkin[1], E. Kovalska[2], E.T. Alonso[2], S. Russo[2], M.F. Craciun[2], A. Baldycheva[2], V.G. Bespalov[1]; 1 - ITMO Univ., Russia; 2 - Univ. of Exeter, UK

In this work transmission characteristics of intrinsic single layer, intrinsic and FeCl3 intercalated few-layer graphene samples on three types of substrates were investigated in UV, visible, NIR and terahertz spectral ranges.

TuR9-22 16:30-16:45

High down-conversion in MF2: Yb: R (M = Ca, Sr; R = Pr, Ce, Eu) solid solution powder for photonics.

S.V. Kuznetsov[1], O.A. Morozov[2], V.G. Gorieva[2], M.N. Mayakova[1], V.Yu. Proydakova[1], M.A. Marisov[2], V.V. Pavlov[2], V.V. Voronov[1], A.D. Yapryntsev[3], V.K. Ivanov[3], A.S. Nizamutdinov[2], V.V. Semashko[2], P.P. Fedorov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Kazan Federal Univ., 3 - Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia

We synthesized MF2: Yb: R (M = Ca, Sr; R = Pr, Ce, Eu) powders by a different kind of precipitation techniques. We determined optimal compositions with a quantum efficiency of photon transfer about 190 % (quantum cutting). In finally, we approached quantum cutting phenomenon. It`s useful for increasing of crystalline silicon solar cell efficiency.

TECHNICAL SESSION

R10. FREE ELECTRON LASERS

Location: Rihter Room, floor 3. 09:30 - 11:00

Hard X-ray FELs

Session Chair: Maya Kiskinova,
FERMI Elettra-SincrotroneTrieste, Italy

TuR10-01 09:30-09:45

European XFEL in operation: status and first experiments

S.L. Molodtsov[1,2]; 1 - European XFEL GmbH, Germany; 2 - ITMO Univ., Russia

The European X-ray free electron laser (XFEL) is a new international research installation in the Hamburg area in Germany that is currently under construction, but in part already in user operation. The world-unique feature of this free electron laser is the possibility to provide per second up to 27.000 ultra-short (10 – 100 fs), ultra-high brilliance flashes that makes this facility particular suitable for multidimensional research in the range of moderate and hard X-ray photons. In this presentation, status and selected examples of experiments performed at XFEL will be given and plans for implementation of further dedicated instrumentation will be described.

TuR10-02 09:45-10:15

Burst-mode NOPA installation at the European XFEL - first user runs *(Invited paper)*

M. Pergament, M. Kellert, K. Kruse, J. Wang, G. Palmer, L. Wissmann, U. Wegner, M. Emons, D. Kane, G. Priebe, S. Venkatesan, T. Jezynski, F. Pallas, and M. J. Lederer; European XFEL, Germany

We present the design, installation and first operation results of the pump-probe laser at the SASE 1 undulator beamline of the European XFEL. Like the XFEL, the laser is designed to operate in burst-mode, providing up to millijoule level few-cycle pulses at MHz repetition rates, generated and amplified in a multi-stage parametric amplifier.

TuR10-03 10:15-10:45

In-situ imaging and control of intense soft and hard X-ray FEL beams by fluorescent detectors with submicron resolution *(Invited paper)*

S.A. Pikuz[1,2], A.Y. Faenov[1,3], T.A. Pikuz[1,4], S.S. Makarov[1,5], N. Ozaki[4], T. Matsuoka[3], K. Katagiri[4], K. Miyanishi[4], M. Nishikino[6], M. Ishino[6], Y. Fukuda[6], T. Kawachi[6], T. Yabuuchi[7], Y. Inubushi[7,8], T. Togashi[7,8], H. Yumoto[7,8], Y. Tange[8], K. Tono[8], M. Yabashi[7,8], A. Grum-Grzhimailo[5], T. Ishikawa[7,8], K.A.Tanaka[9], R. Kodama[3,4,10]; 1 - Joint Inst. for High Temperatures RAS, 2 - National Research Nuclear Univ. MEPhI, Russia;[3,] 4 - Osaka Univ., Japan; 5 - Lomonosov Moscow State Univ., Russia; 6 - Kansai Photon Research Inst. QST, 7 - RIKEN Harima Inst., 8 - JASRI/SPring-[8], Japan; 9 - Horia Hulubei National Inst. of Physics and Nuclear Engineering, Romania; 10 - Osaka Univ., Japan

Measurements of ultra-intense X-ray beam parameters with high resolution across and along focal caustic become possible with the application of photoluminescence LiF detector technique. High sensitivity and uniquely large dynamic range of the detector allows to record both the intensity profile of whole beam very far from focus (including boundary of the beam limited by mirrors aperture, where signal is very low), and the intensity profile in the best focus, where signal increases 5-7 orders of magnitude. The method is attractive for in-situ full 3D visualization of the beam profile with a submicron resolution, and consequently for optimization of focusing systems developed at FEL, synchrotron or plasma-based SXLR facilities.

TuR10-04 10:45-11:00

Probability of radiation of twisted photons in undulator

O.V. Bogdanov[1,2], P.O. Kazinski[1], G.Yu. Lazarenko[1]; 1 - Tomsk State Univ., Russia; 2 - Tomsk Polytechnic Univ., Russia

The general formula for the probability of radiation of a twisted photon by a classical current is derived. The general theory of generation of twisted photons by undulators is developed. It is proved that the probability to record a twisted photon produced by a classical current is equal to the average number of twisted photons in a given state. The general formula for the projection of the total angular momentum of twisted photons with given the energy, the longitudinal projection of momentum, and the helicity is obtained.

- Coffee Break -

Location: Rihter Room, floor 3. 11:30 - 13:30

Soft X-ray and THz FELs

Session Chair: Nikolay Vinokurov,
Budker Inst. of Nuclear Physics, Russia

TuR10-05 11:30-12:00

Frontier research at FERMI *(Invited paper)*

C. Masciovecchio; Elettra Sincrotrone Trieste, Italy

The recent advent of Free Electron Lasers (FELs) allowed to push experimental techniques peculiar of table top pulsed laser towards much shorter wavelength allowing to probe dynamical processes with an unprecedented time-space resolution. Within the portfolio of FEL based experimental methods we will discuss the new opportunities offered by the extension of non-linear spectroscopies in the vacuum ultraviolet to soft X-ray energy range. Pioneering wave mixing experiments have been successfully carried out at the FERMI FEL, signifying that second harmonic generation and four wave mixing experiments are now possible at nanometer wavelength. These results pave the way to a new class of experiments like investigation of heat transfer at the nanoscale or energy transfer in light harvesting devices.

TuR10-06 12:00-12:30

Low-energy carrier dynamics in graphene and other 2D materials *(Invited paper)*

S. Winnerl[1], J. C. König-Otto[1,2], M. Mittendorff[3], A. Pashkin[1], T. Venanzi[1], H. Schneider[1], M. Helm[1,2]; 1 - Inst. of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, 2 - Technische Univ. Dresden, 3 - Univ. Duisburg-Essen, Germany

Phonons in graphene and interexcitonic transition in transition metal dichalcogenides are examples for low-energy excitations in 2D materials. Free-electron lasers such as FELBE deliver tunable short mid-infrared pulses that are ideally suited to study the carrier dynamics in 2D materials in the energy range of these low-energy excitations. We present results on the carrier dynamics in graphene and MoSe2.

TuR10-07 12:30-13:00

Fine spectral structure and ultra-monochromatic tunable Terahertz radiation of the NovoFEL *(Invited paper)*

V.V.Kubarev[1,2]; 1 - Budker Inst. of Nuclear Physics; 2 - Novosibirsk State Univ., Russia

Laser nature of a continuous pulse-periodical radiation of the Novosibirsk free-electron laser (NovoFEL) appears in a good coherency of its many longitudinal modes. Filtration of one of the modes by a system of three resonance Fabry-Perot interferometers allows to create laser source with monochromaticity which is sufficient for typical high-resolution THz spectroscopy (≤ 2·10-7, ≤ 0.5 MHz). Features of the source compared to other alternative devices are a wide tuning range (1.5-3 THz) and much more high output power (up to 100 mW).

TuR10-08 13:00-13:30

FLASH - today and tomorrow *(Invited paper)*

S. Düsterer for the FLASH team; DESY Photon Science, Germany

The talk will review the status of FLASH, present the new instrumental developments and some selected recent achievements.

- Lunch Break -

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

Science at FELs I

Session Chair: Serguei Molodtsov, European XFEL, Germany

TuR10-09 15:15-15:45

Macromolecular Imaging using X-ray free-electron lasers *(Invited paper)*

H. N. Chapman[1,2,3]; 1 - CFEL DESY, 2 - Univ. of Hamburg, 3 - Centre for Ultrafast Imaging, Univ. of Hamburg, Germany

We have demonstrated a new method to record "single molecule" diffraction and obtain molecular images. This is achieved with a disordered crystal. Our method thus utilises commonly-occurring crystals that are usually not considered useful for measurement, overcoming a key bottleneck in structure determination. We demonstrate this technique by reconstructing images of photosystem II complexes at 3.5 Å resolution.

TuR10-10 15:45-16:15

Transport phenomena during laser induced magnetization dynamics *(Invited paper)*

J. Lüning; Sorbonne Univ., France

With the advent of X-ray free electron lasers it has become possible to apply advanced X-ray spectroscopy and scattering techniques to the investigation of ultrafast phenomena. In this paper it is demonstrated how these techniques can be used to investigate the role of superdiffusive spin transport as a mechanism of ultrafast demagnetization phenomenon.

TuR10-11 16:15-16:30

III-V nanowire heterostructures

V. G. Dubrovskii; ITMO Univ, Russia

III-V nanowire heterostructures are widely considered promising for optoelectronic device applications, including those integrated with silicon electronic platform. Here, we review recent achievements in synthesis of such heterostructures and consider them from a theoretical perspective. We also consider how the nanowires and nanowire heterostructures can be characterized using the unique FEL tools.

TuR10-12 16:30-16:45

Diffraction techniques for transformation of FEL beams*: Experiments at terahertz Novosibirsk free electron laser facility

B.A. Knyazev[1,2], V.S. Cherkassky[2], Yu.Yu. Choporova[1,2], O.E. Kameshkov[1,2], G.N. Kulipanov[1,3], N.D. Osintseva[1,3], V.S. Pavelyev[4,5], O.A. Shevchenko[1], V.A. Soifer[4,5], K.N. Tukmakov[4], N.A. Vinokurov1[,2], B.O. Volodkin[4]; 1 - Budker Inst. of Nuclear Physics SB RAS, 2 - Novosibirsk State Univ., 3 - Novosibirsk State Technical Univ., 4 - Samara National Research Univ., 5 - Image Processing Systems Inst. RAS - Branch of the FSRC "Crystallography and Photonics" RAS, Russia

Novosibirsk free electron laser is a tunable source of radiation generating high-power Gaussian beams in MIR, FIR and THz spectral ranges. In this paper we report the transformation of terahertz beams into the beams with prescribed cross-sections and phase distributions, including vector and vortex beams, using diffractive optical elements. Examples of the use of such beams in experiments are given in the paper.

- Coffee Break -

Location: Rihter Room, floor 3. 17:30 - 18:30

Science at FELs II

Session Chair: Serguei Molodtsov, European XFEL, Germany

TuR10-13 17:30-18:00

Magnon condensation and magnetic pattern formation far from equilibrium *(Invited paper)*

H.A. Dürr[1,2];[1]- SLAC National Accelerator Laboratory, USA;[2]- Uppsala Univ., Sweden

Phase transitions describe fundamental changes in the properties of matter and are typically studied in the context of static or dynamic critical phenomena. These approaches share the assumption of thermodynamic equilibrium across the phase transition. When equilibrium is not achieved, the phase transition undergoes a fast quenching process in which topological defects can arise. However, the study of the dynamic evolution of topological defects via fast quenching remains elusive, leaving a gap in the understanding of the mechanisms that stabilize or annihilate microscopic textures. In this talk I will show how the all-optical control of magnetism offers the possibility to close this gap. Using ferrimagnetic FeGdCo alloys as a test case we found that the ultrafast switching of the short-range antiferromagnetic coupling is followed by the condensation and coalescence of magnons into localized structures that display metastable character that can be probed by soft x-ray magnetic scattering experiments at LCLS.

TuR10-14 18:00-18:15

Ultrafast structural transition to the long-lived metastable state in transition metal dichalcogenide

I. Vaskivskyi[1,2,3], L. Le Guyader[4,5], J. Ravnik[6], Ya. Gerasimenko[3], D. Mihailović[3,6], H. Dürr[2,5]; 1 - Univ. of California, USA; 2 - Uppsala Univ., Sweden; 3 - CENN Nanocenter, Slovenia; 4 - European XFEL GmbH, Germany; 5 - SLAC National Accelerator Laboratory, USA; 6 - Jozef Stefan Inst., Slovenia

I will discuss interplay of different orders in transition metal dichalcogenide (1T-TaS2) and their roles in ultrafast photoinduced metal-to-insulator transition to the hidden state. Structural transition was confirmed to occur within 0.5 ps and involves change of out-of-plane order in this layered system as revealed by ultrafast electron and x-ray diffraction, making the system perspective for "orbitronics".

TuR10-15 18:15-18:30

Ultra-fast photocatalytic processes in silver bisilicate nanoclusters

M.V. Baidakova[1,2], I.I. Pronin[2], V.P. Ulin[1], N.V. Ulin[1], M.K. Rabchinskii[1], V.N. Nevedomskiy[1], P.N. Brunkov[2], D. Khakhulin[4], S.L. Molodtsov[2,3,4]; 1 - Ioffe Inst., 2 - ITMO Univ., Russia; 3 - TU Bergakademie Freiberg, Germany; 4 - European XFEL GmbH, Germany

Silver-based nanoclusters represent a family of efficient and stable photocatalysts suitable for light irradiation in nearly entire visible spectrum. The development of new photocatalysts demands studying of mechanisms governing enhanced ultra-fast processes of charge transfer in the colloid Ag6-xHxSi2O7 nanoparticles, which can be performed by X-ray emission spectroscopy (XES) and X-ray diffuse scattering (XDS) using European XFEL facilities.

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

TuR5-p01 15:00-17:00

Atto-pulse generation at the interaction of intense laser radiation with ultra-thin foils

K.Yu. Platonov[1], A.A. Andreev[2,3,4]; 1 - St. Petersburg State Technical Univ., 2 - St. Petersburg State Univ., 3 - ITMO Univ., Russia; 4 - MBI, Germany

Optimal parameters (a thickness and electron density) of a laser thin foil target are defined for maximal conversion of short relativistic intense laser pulse in a sequence of several coherent atto-pulses. The amplitude and duration of atto-pulse is found at different conditions and the factor of conversion of laser energy in the atto-pulse energy is defined. Optimal parameters (a thickness and electron density) of a laser thin foil target are defined for maximal conversion of short relativistic intense laser pulse in a sequence of several coherent atto-pulses. The amplitude and duration of atto-pulse is found at different conditions and the factor of conversion of laser energy in the atto-pulse energy is defined.

TuR5-p02 15:00-17:00

Two plasmon decay instability in inhomogeneous femtosecond laser plasma

I.N. Tsymbalov[1], K.A. Ivanov[1], S.A. Shulyapov[1], D.A. Gorlova[1], A. M. Sen'kevich[1], R.V. Volkov[1], A.B. Savel'ev[1], A.V. Brantov[2], V.Yu. Bychenkov[2]; 1 - Lomonosov Moscow State Univ., 2 - Lebedev Physical Inst. RAS, Russia

Plasma wave excitation in inhomogeneous femtosecond laser plasma due to the two plasmon decay instability is demonstrated. PIC simulation results and their experimental validation are presented.

TuR5-p03 15:00-17:00

Sub-femtosecond electron sheets from a Laguerre-Gaussian laser interaction with micro-droplets

L.-X. Hu[1], T.-P. Yu[1,2], P. Mckenna[2], F.-Q. Shao[1]; 1 - National Univ. of Defense Technology, China; 2 - Univ. of Strathclyde, UK

An all-optical scheme for generation and acceleration of relativistic electron sheets is proposed. When an intense Laguerre-Gaussian (LG) laser pulse sweeps micro-droplets, annular sub-femtosecond electron bunches with one laser wavelength spacing are dragged out by the radial component of laser electric fields, and then efficiently accelerated by the longitudinal electric fields. Once fleeing from the droplet, these bunches are squeezed into dense sheets and trapped by the potential well of the transverse ponderomotive force, which can stably propagate for several hundred femtoseconds and are potential for applications in short x/gamma-ray radiation sources.

TuR5-p04 15:00-17:00

Regular plasma microjets generation above the melted gallium surface by the powerful femtosecond laser pulse shaped with diffractive optical elements

A.S. Larkin[1], A.B. Savel'ev[1], A.P. Porfirev[1], S.N. Khonina[2]; 1 - Lomonosov Moscow State Univ., 2 - Image Processing Systems Inst. RAS – Branch of the FSRC "Crystallography and Photonics" & Samara National Research Univ., Russia

We investigated the process of microjets formation by the high-power femtosecond laser pulse with regular spatially modulated intensity profile, generated by means of different binary-phase diffractive optical elements. 3D views of plasma microjets were reconstructed. The decisive role of the inhomogeneity within transverse intensity distribution of the laser beam in the process of the microjets formation was confirmed.

TuR5-p05 15:00-17:00

Holography of biological samples driven by X-ray lasers near 3.43 and 2.62 nm in Gd36+ in plasma formed by intense pump laser interaction with a nanostructured gadolinium target

E.P. Ivanova; Inst. of spectroscopy of RAS, Russia

Theoretical model for the one-shot holography of biological samples is presented. It is based on the effective X-ray laser near 2.62 and 3.43 nm. These wavelengths correspond to the intrashell 3p-3d transitions of Ni-like germanium. We calculate gains and yields of XRLs at optimal conditions for one-shot imaging of biological samples.

TuR5-p06 15:00-17:00

Hydrodynamical processes in fused quartz induced by the laser energy absorption

V.P. Efremov, A.D. Kiverin; Joint Inst. for High Temperatures RAS, Russia

The basic physical mechanisms responsible for fused quartz fracture are demonstrated via numerical analysis of hydrodynamic processes taking place in the vicinity of laser energy absorption region. Principal scenarios of fracture wave development in the condensed matter are formulated. We also estimated the characteristic size of small-scale fragments formed in the process of solid matter destruction in high-speed regime.

TuR5-p07 15:00-17:00

Nonpertubing diagnostics of multiple filamentation and superfilamentation of powerful femtosecond laser pulses in air

E. Mitina[1], D. Pushkarev[1], D.Uryupina[1], R. Volkov[1], A. Karabytov[1,2], O.Kosareva[1], A.Savel'ev[1]; 1 - Lomonosov Moscow State Univ., 2 - National Univ. of Science and Technology MISiS, Russia

A wideband piezoelectric transducer was used to receive signals from different filaments inside a multiple filament. A technique for calculating parameters of filaments in each laser pulse has been proposed. For a regularized superfilament created using of the amplitude mask a growth of absorbed linear energy density has been observed by more than an order compared to a single filament.

TuR5-p08 15:00-17:00

Simulation of fast particles generation and line emission from microstructure targets irradiated by high intensity laser pulses

M.V. Sedov[1], K.Yu Platonov[2], A.A. Andreev[1,3]; 1 - St. Petersburg State Univ., 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia; 3 - MBI, Germany

In this work, we present the investigation of the impact of microstructuring on the X-ray and proton spectrum for different laser-plasma conditions and compare it with experimental results. At conditions that do not allow for efficient laser absorption by plane targets, i.e. too steep plasma gradients, microstructuring is found to significantly enhance line emission and the proton cutoff energy.

TuR5-p09 15:00-17:00

Resonance of the annihilation amplitude in the scattering of an electron by a positron in the field of a light wave

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

We consider the resonance of the annihilation amplitude in the scattering of an electron by a positron in a weak light field. A resonant differential cross-section is obtained in the field of a weak light wave. It is shown that the resonant differential cross-section may significantly exceed the corresponding differential cross-section without an external laser field.

TuR5-p10 15:00-17:00

Pair creation via reflection of an ultra-intense laser pulse from plasma surfaces

Zs. Lécz[1], A. Andreev[1,2]; 1 - ELI-HU Non-profit Ltd., 2 - ELI-ALPS, Szeged, Hungary

The electron-positron pair creation occurring near the laser-plasma interface is studied with the help of Particle-in-Cell 1D and 2D simulations. We present the angular distribution of positrons which can help in their detection in real experiments. This technique can be used to measure the intensity and duration of the laser pulses with higher precision.

TuR5-p11 15:00-17:00

Generation and diagnostics of mixed Ar/Kr clusters. Tunable source of dual-energy X-rays based on the clusters excitation by fs-laser.

I.A. Zhvaniya, M.S. Dzhidzhoev, V.M. Gordienko; ILC, Moscow State Univ., Russia

Rayleigh scattering technique was proposed for diagnostics of mixed Ar/Kr clusters. Clusterization of krypton fraction was observed. Dual energy X-ray source with tunable line amplitudes, based on laser excitation of the mixed clusters has been developed. It was shown that the relative line yield in dual-energy X-rays can be controlled by selecting of proper fraction of initial gas mixture components.

TuR5-p12 15:00-17:00

Resonance of exchange amplitude in process of spontaneous bremsstrahlung of an electron scattered by a nucleus in the light field

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

We study resonance of exchange amplitude in process of bremsstrahlung by an electron scattered by nucleus in the field of a plane monochromatic wave. It was shown that resonant cross section may significantly exceed the corresponding scattering cross section in the absence of an external field.

TuR5-p13 15:00-17:00

Generation of terahertz electromagnetic wave by high-intensity laser pulse interaction with solid targets

A.S. Kuratov[1], A.V.Brantov[1,2], Yu.M.Aliev[2], A. Maksimchuk[3], V.Yu.Bychenkov[1,2]; 1 - FSUE VNIIA, 2 - LPI RAS, Russia; 3 - Univ. of Michigan, USA

Thiswork reports on both theoretical study and full-wave Maxwell simulation of the terahertz (THz) electromagnetic pulse excitation during intense laser interaction with solid targets. Several mechanisms of THz broadband wave generation are proposed. Conversion efficiencies of laser radiation into THz electromagnetic pulse for these mechanisms have been compared. Surface and volumetric THz wavesgenerated from different targets have been considered.

TuR5-p14 15:00-17:00

Resonant electron-positron pair photoproduction on a nucleus in a light field under interference conditions

N.R. Larin, V.V. Dubov, S. P. Roshchupkin; Peter the Great St. Petersburg Polytechnic Univ., Russia

In the present article we study resonant electron-positron pair photoproduction on the nucleus under conditions of interference of amplitudes in the field of a plane moderately strong monochromatic wave. It is shown that the resonant cross-section significantly exceeds the corresponding cross-section without an external field.

TuR5-p15 15:00-17:00

The application of worldline instantons technics in the non-perturbative regime of QED for pair production from vacuum in the ultra-strong laser fields

Ch. Lan[1], Yi-F. Wang[2], A.A. Andreev[1,3];[1]- ELI-ALPS Research Inst., Hungary; 2 - Univ. of Cologne, Germany; 3 - St. Petersburg State Univ., Russia

In this poster, to investigate the pair production we use worldline instantons technics in various background laser fields beyond the constant field approximation, i.e. the external fields are considered to be spatially and temporally inhomogeneous functions. The factors before the Schwinger critical field have been approached analytically and numerically. The results show the possibility to get smaller threshold intensities of laser, which may allow a new experimental window in to this unexplored regime of non-perturbative QED at ELI.

TuR5-p16 15:00-17:00

Electron bunch formation under action of relativistic laser pulse onto long-scale undercritical plasma

D.A. Gorlova, I.N. Tsymbalov, A.B. Savel'ev; Lomonosov Moscow State Univ., Russia

Different regimes of hot electron generation in long-scale relativistic laser plasma are investigated. Experimental data and numerical simulation results are presented.

TuR5-p17 15:00-17:00

Generation of high-power laser pulses using nonlinear spectral compression

D.A. Korobko[1], I.O. Zolotovskii[1], D.A. Stoliarov1, A.A .Sysoliatin1[,2]; 1 - Ulyanovsk State Univ., 2 - Prokhorov General Physics Inst. RAS, Russia.

We report main features of spectral compression of parabolic pulses in nonlinear optical fibers. We propose a computational model of multistage amplifier with spectral compression segments incorporated. We also discuss a modification of the model that provides the formation of a parabolic envelope and linear frequency modulation of the output pulse.

TuR5-p18 15:00-17:00

Reflection of chirped pulse from an overdense plasma

S.K. Mishra[1], A. Andreev[1,2]; 1 - Extreme Laser Infrastructure - Attosecond Light Pulse Source (ELI-ALPS), Hungary; 2 - St. Petersburg State Univ., Russia

An analytical formula describing the temporal profile of the ultrashort chirped pulse after reflection from a preformed overdense plasma has been presented. The frequency chirp is noticed to act as damping factor which ultimately reduces the intensity (power) of the pulse after reflection.

TuR5-p19 15:00-17:00

Formation of sub-fs x-ray pulses via infrared modulation of a plasma-based x-ray laser

I.R.Khairulin[1], V.A.Antonov[1,2], O.A.Kocharovskaya[3]; 1 - Inst. of Applied Physics RAS, 2 - Prokhorov General Physics Inst. RAS, Russia; 3 - Texas A&M Univ., USA

We discuss the possibility of sub-fs x-ray pulse formation by a plasma-based x-ray laser via modulation of its active medium by a moderately strong infra-red laser field. We generalize the results of the paper [T.R. Akhmedzhanov, et al., Phys. Rev. A 96, 033825 (2017)] and discuss the possibilities of their experimental implementation.

TuR5-p20 15:00-17:00

The scattering of an electron on the nucleus in the second Born approximation in the field of a moderately-strong electromagnetic wave

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

The actual theoretical studies demonstrate the necessity of taking into account the second Born approximation in the process of scattering of a nonrelativistic electron on a nucleus in a moderately-strong electromagnetic field. The research indicates that the scattering cross section of an electron becomes extensively larger relatively to the corresponding quantity in the absence of an external field.

TuR5-p21 15:00-17:00

Laser direct particle acceleration for diagnostics of intense pulse focused by off-axis parabolic mirror

O.E. Vais[1,2], V.Yu. Bychenkov[1,2]; 1 - Lebedev Physical Inst. RAS; 2 - Center of Fundamental and Applied Research (CFAR), VNIIA, ROSATOM, Russia

A new method of intense laser pulse diagnostics via direct particle acceleration is discussed. Here we use a realistic model of laser focusing by off-axis parabolic mirror; it allows analyzing the opportunity of using characteristics of the accelerated particle for evaluation of the laser parameters.

TuR5-p22 15:00-17:00

Femtosecond filament induced x-rays under solids micromachining in air: evaluation of filament peak intensity

A.A. Garmatina[1,2]; M.M. Nazarov[1], I.A. Zhvaniya[2], V.M. Gordienko[2], V.Ya. Panchenko[1,2,3]; 1 - National Research Centre «Kurchatov Institute», 2 - Lomonosov Moscow State Univ., 3 - Inst. of Laser and Information Technologies RAS, Russia

Interaction of TiSa femtosecond laser filament with solid target positioned in air during micromachining is accompanied by x-ray bursts. X-ray yield increase up to 4 times using chirped laser pulses (500fs) in compare to 60fs pulses with the same power. Hot electron temperature derived from x-ray spectra allowed to estimate peak intensity in filament, that appeared to be about 200TW/cm2.

TuR5-p23 15:00-17:00

Generation of electron bunches by a laser pulse crossing a sharp boudary of plasma

S.V. Kuznetsov; Joint Inst. of High Temperatures of RAS, Russia

The formation of an electron bunch produced due to electron self-injection into a wake wave that is generated by a relativistic-intensity laser pulse propagating through a sharp boundary of semi-bounded plasma was studied in one-dimensional geometry. Numerical simulation was performed which confirms the results of analytical consideration.

TuR5-p24 15:00-17:00

Laser triggered X-ray and gamma-ray sources

A.V. Brantov[1], M.G. Lobok[2], D. A. Gozhev[3], and V.Yu. Bychenkov[1,2]; 1 - Lebedev Physical Inst. RAS, 2 - Center of Fundamental and Applied Research (CFAR), 3 - Lomonosov Moscow State Univ., Russia

In this paper we present multidimensional PIC simulations of short laser pulse interaction with optimal homogeneous planar target, with the best design parameters, which maximize the number of high-energy electrons and betatron radiation generated by sub-petawatt class laser system for deep gamma radiography purpose.

TuR5-p25 15:00-17:00

Absorption of ultrashort laser pulses on the hydrogen fluoride molecule

V.A. Astapenko, A.V. Yakovets; Moscow Inst. of Physics and Technology (State Univ.), Russia

The absorption of an ultrashort laser pulse (USP) by a HF molecule in the ground state is studied theoretically. The total probability of photoabsorption is calculated for all time to the action of ultrashort pulse. The dependence of the probability of absorption on the duration of the USP and its carrier frequency is analyzed.

TuR5-p26 15:00-17:00

Enhancement of the third harmonic generation during interaction of several beams

D.V. Mokrousova[1], G.E. Rizaev[1,2], A.V. Shalova[1,2], D.E. Shipilo[3], N.A. Panov[3], E.S. Sunchugasheva[1], L.V. Seleznev[1], O.G. Kosareva[3], A.A. Ionin[1]; 1 - Lebedev Physical Inst. RAS, 2 - Moscow Inst. of Physics and Technology, 3 - Lomonosov Moscow State Univ., Russia

We conducted the experiment on third harmonic generation (248 nm) in the case of several IR (744 nm) beams fusion. The third harmonic yield was dramatically higher in comparison with the single beam case. In case of nonlinear beams interaction the efficiency increased additionally.

TuR5-p27 15:00-17:00

Ultrafast kinetics of excitons in non-crystalline semiconductor illuminated by sub-gap femtosecond laser pulses

E.A. Romanova[1], Yu.S. Kuzutkina[1], A.V. Afanasiev[2], N.M. Bityurin[2], A.P. Velmuzhov[3], M.V. Sukhanov[3], V.S. Shiryaev[3]; 1 - Saratov State Univ., 2 - Inst. of Applied Physics RAS, 3 - Devyatykh Inst. of Chemistry of High Purity Substances RAS, Russia

Nonlinear optical response of glassy chalcogenide semiconductors has been studied under sub-gap illumination by using two realizations of the pump-probe method with femtosecond resolution in time. The role of exitons kinetics has been revealed.

TuR5-p28 15:00-17:00

Resonant muon pair production in electron-positron annihilation in the field of light wave

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

We study resonant muon pair production in electron-positron annihilation in a weak light field. It is shown that resonant differential cross section may be much larger than corresponding cross section without external laser field.

TuR5-p29 15:00-17:00

Preserving triangular pulse shape at second and fourth harmonic generation processes

I.V.Kuzmin, S.Yu.Mironov, E.I.Gacheva, A.K.Potemkin, E.A.Khazanov; Inst. of Applied Physics, Russia

Possibility of effective fourth harmonic generation with preserving of a shape of linearly chirped IR laser pulses with triangular temporal intensity profile has been demonstrated numerically.

R9. OPTICAL NANOMATERIALS

TuR9-p01 17:30-19:30

Solid solutions of silver and monovalent thallium halides for infrared optics

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

In this paper, we examined a part of the Ag-Tl-I-Br tetragon concentric tetrahedron in the AgBr-AgI-TlI-TlBr section and showed the regions of compositions suitable for growing single crystals from which various optical elements can be made for medium (2 to 50 μm) and far (up to 100 μm) infrared spectral area.

TuR9-p02 17:30-19:30

Crystals of AgBr - (TlBr0.46I0.54) system for the fabrication of IR photonic crystal fibers

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

In this paper we examined materials based on crystals of AgBr - (TlBr0.46I0.54) system suitable for manufacturing single mode and multimode fibers. We studied phase diagram of this system, grew the crystals and investigated their functional properties. The results obtained will serve as basic information for manufacturing Mid-IR fibers including PCFs, which will be applicable in various fields.

TuR9-p03 17:30-19:30

The doping and heat-treatment influence on spectral properties of Bi-Ge-O glasses

I.V. Stepanova, O.B. Petrova, I.Ch. Avetissov; Mendeleev Univ. of Chemical Technology, Russia

The glasses in Bi-Ge-O system doped with Cr2O3 or Nd2O3 were synthesized by melt-quenching technique. The bismuth optically active centers (Bi-centers) in the undoped and Nd3+-doped glasses were found by optical spectroscopy. The effect of initial glass compositions, doping ions nature and concentrations as soon as various heat-treatment conditions on the Bi-centers formation and destruction was revealed and discussed.

TuR9-p04 17:30-19:30

The study of homogeneous nucleation in the CaCO3-NaCl-H2O system by the dynamic light scattering method

I.A.Pochitalkina[1], P.A.Kekin[2], D.F.Kondakof[3], S.V.Makaev[4]; 1 - Mendeleev Univ. of Chemical Technology, 2 - Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia

Dynamic light scattering method was used to determine the dimensions of stable nuclei during the homogeneous nucleation of CaCO3. The effect of temperature and the initial oversaturation of solution on the kinetic parameters of the nucleation stage were studied, and energy characteristics were determined. The obtained values agree with the kinetic experiment performed by analysis of the liquid phase.

TuR9-p05 17:30-19:30

Nd/La, Er/Lu and Er/Yb/Lu-codoped transparent lead fluoroborate and fluorosilicate glass-ceramics

O.B. Petrova, A.S. Sologub, M.P. Zykova, A.V. Khomyakov; Mendeleev Univ. of Chemical Technology of Russia, Russia

Lead fluoroborate and fluorosilicate glasses codoped with Nd3+/La3+, Er3+/Lu3+ and Er3+/Yb3+/Lu3+ - have been synthesized. Glass-ceramics have been made by heat-treatment. In a glass-ceramic the rare-earth ions were located in fluoride crystal nanoparticles distributed in a glass. The changes in structural, mechanical and optical properties of the glass-ceramics were revealed in comparison with the initial glasses.

TuR9-p06 17:30-19:30

Effect of inorganic matrix composition on luminescent properties of hybrid materials

K.I. Runina[1], V.A. Shmelyova[1], O.B. Petrova[1], A.V. Khomyakov[1], A.A. Akkuzina[1], I.V. Taidakov[1,2], R.I. Avetisov[1], I.Ch. Avetissov[1]; 1 - Mendeleev Univ. of Chemical Technology of Russia, 2 - Lebedev Physical Inst. RAS, Russia

A luminescent organic-inorganic hybrid materials based on metal complexes organic phosphors and low-melting lead fluoroborate and fluoroborosilicate glasses have been synthesized. All hybrid materials showed a wide luminescence band in the range 400-700 nm. The effect of the matrix composition on the intensity and the contour of the luminescence line of hybrid materials were studied.

TuR9-p07 17:30-19:30

Influence of gold nanoparticles on the properties of stimulated emission of phenalymine 160 in the pores of anodized aluminum oxide

N.Kh. Ibrayev, A.K. Aimukhanov; Karaganda State Univ., Kazakhstan

The threshold of stimulated emission was 1.7 MW/cm2. The presence of gold nanoparticulars (Np) in porous alumina leads to an increase in fluorescence intensity and a lowering of the threshold for generation of stimulated emission of the dye.

TuR9-p08 17:30-19:30

Quantum dots - gold nanoparticles FRET based system immunoassay.

O.A. Goryacheva[1,2], N.V. Beloglazova[2], S. De Saeger[2], I.Y. Goryacheva[1]; 1 - Saratov State Univ., Russia; 2 - Gent Univ., Belgium

Forster resonance energy transfer (FRET) based on colloidal gold nanoparticles (AuNPs) and quantum dots (QDs) was used as a system for detection of deoxynivalenol (DON) mycotoxin in competitive immunoassay. An enhancement of distance between antibody and antigen in the presence of analyte cause decreasing of FRET and increasing of QDs luminescence.

TuR9-p09 17:30-19:30

Synthesis, hydrophylization and bioconjugation of core/shell alloyed CdSeZnS/ZnS quantum dots

A.M. Sobolev, D.V. Tsyupka, I.Yu. Goryacheva; Saratov State Univ., Russia

The manuscript describes synthesis, hydrophylization and bioconjugation of core/shell alloyed QDs CdSeZnS/ZnS with green luminescence.

TuR9-p10 17:30-19:30

Carbon nanoparticles with uniform properties: synthesis and fractionation

A. M. Vostrikova[1], A. A. Kokorina[1], G. B. Sukhorukov[1,2], I. Y. Goryacheva[1]; 1 - Saratov State Univ., Russia; 2 - Queen Mary Univ. of London, UK

Traditional routes for carbon nanodots (CNDs) synthesis allow synthesizing CNDs with some size and properties distribution. To obtain CNDs with uniform properties two approaches were used: separation of the hydrothermally obtained CNDs using exclusion chromatography and thermal synthesis in restricted volume of pores of CaCO3 microparticles.

TuR9-p11 17:30-19:30

Laser polarization-optical sounding of optical crystals and ceramics

Ya. Fofanov[1], V. Vetrov[2], B. Ignatenkov[2]; 1 - Inst. for Analytical Instrumentation RAS, 2 - Vavilov State Optical Inst., Russia

For the first time, a laser polarization-optical observation of the nanostructured features of a modified leucosapphire is performed. Criteria for strong and weak polarization responses are considered and quantitative studies of weak responses of high optical quality sapphire crystals and magnesium-aluminate spinel ceramic are carried out.

TuR9-p12 17:30-19:30

Magnetic fluid analysis by optical fiber method

M. Shlyagin[1], A.V. Prokofiev[2,3], I.V. Pleshakov[2,3], P.M. Agruzov[2], E.K. Nepomnyashchaya[3], E.N. Velichko[3]; 1 - CICESE, Mexico; 2 - Ioffe Inst., Russia; 3 - Inst. of Physics, Nanotechnology and Telecommunications, Russia

The method of investigation of nanostructured material – magnetic fluid (ferrofluid) is developed in present work. It is based on registration of light, reflected from the optical fiber end, placed into the liquid sample, and exposed to external magnetic field. The contributions of Fresnel reflection and back scattering are estimated. The transient effects, appeared at the field switching on and switching off are discussed.

TuR9-p13 17:30-19:30

Fluorescence response of detonation nanodiamonds interaction with calf thymus DNA and porphyrine molecules in thin films formed on the surface of monocrystalline silicon.

E.A. Boruleva[1], L.A. Butusov[2,3], G.K. Chudinova[1,2]; 1 - National Research Nuclear Univ. MEPhI, 2 - Natural Science Center General Physics Inst. RAS, 3 - Peoples' Friendship Univ., Russia

In the recent years, research involving the interaction of nanodiamonds (ND) with biological structures and biomacromolecules have gained a great importance. They are used, for example, for the treatment of tumors, in the development of biosensors and biocompatible implants.

TuR9-p14 17:30-19:30

Laser synthesis of a hybrid gold-silicon clusters with variable optical propeties

S. Kutrovskaya[1,2], A. Kucherik[1], O. Novikova[1], A. Osipov[1], V.Simonov[1]; 1 - Vladimir State Univ., 2 - Russian Quantum Center, Russia

The formation of hybrid silicon-gold NPs as a result of the laser action on a mixed colloidal solution is observed. These hybrid NPs are characterized by the amplification and broadening of the near-field photoluminescence spectra compared to pure silicon NPs. A strong sensitivity of the spectral shape of the emitted light to the intensity of the exciting white light is documented. These results may be used for the realization of functional metasurfaces consisting of randomly distributed resonant NPs. Moreover, as the synthesized NPs emit in red, green and yellow they can be used for fabrication of luminescent color screens.

TuR9-p15 17:30-19:30

Electronic structure of rare-earth ion states and forecast of configuration interaction

A.A. Kornienko[1], E.B. Dunina[1], L.A. Fomicheva[2], M.V. Grigireva[1]; 1 - Vitebsk State Technological Univ., 2 - Belarusian State Univ. of Informatics and Radioelectronics, Belarus

The wave functions of the Pr3+, Tm3+, Nd3+, Er3+ ions are calculated and the electronic structure of their states is analyzed. On the basis of the analysis, a hypothesis is proposed on the mechanisms of the effect of configuration interaction on the intensity of intermultiplet transitions. The proposed hypothesis is confirmed when describing a series of experimental data.

TuR9-p16 17:30-19:30

Features of optical properties of organometallic films of pseudoisocyanine J-aggregates and inhomogeneous ensembles of silver nanoparticles

A.A. Starovoytov, R.D. Nabiullina, I.A. Gladskikh; ITMO Univ., Russia

The organometallic films of pseudoisocyanine J-aggregates and inhomogeneous ensembles of silver nanoparticles were studied by fluorescence and adsorption spectroscopy, as well as atomic force and electron microscopy. The dip in the absorption and fluorescence spectra was observed at the maximum of J-aggregate band.

TuR9-p17 17:30-19:30

Formation and properties of arrays of Ag nanostructures and Si whisker single crystals

Yu.A. Zharova, V.A. Tolmachev, S.I. Pavlov, E.V. Gushchina; Ioffe Inst., Russia

Single-crystal silicon (c-Si) is one of the main materials used in manufacture of photovoltaic converters and electronic and other devices. The use of these semiconductor and optical properties of silicon is extended when it is formed as nanostructures. In this study, we obtained c-Si arrays by the method of metal-assisted chemical etching (MACE), which includes 3 stages, among which two are the main ones: (1) formation of a catalyst-mask from a layer of Ag nanoparticles and (2) chemical etching in which voids appear under Ag particles and nanowires are formed from the unetched part of the c-Si surface. In all the three stages, the properties of the structures were examined by scanning electron and atomic-force microscopy and also by multiple-angle spectroscopic ellipsometry.

TuR9-p18 17:30-19:30

Titanium nanotubes doped NPs of noble metals

I. Skryabin[1], A. Kucherik[1], A. Osipov[1], S. Kutrovskaya[1,2]; 1 - Vladimir State Univ., 2 - Russian Quantum Center, Russia

In this paper, the results of laser formation of nanostructures of titanium dioxide are presented. The obtained structures were modified by a nanoparticle of gold and silver. The spectra of titanium dioxide with gold and silver nanoparticles are shown.

TuR9-p19 17:30-19:30

Bi-stability of contact angle and its role in tuning the morphology of self-assisted GaAs nanowires

A.S. Sokolovskii[1], W. Kim[2], J. Vukajlovic-Plestina[2], G. Tütüncüoglu[2], L. Francaviglia[2], L. Güniat[2], H. Potts[2], M. Friedl[2], J.-B. Leran[2], A. Fontcuberta i Morral[2], V.G. Dubrovskii[1]; 1 - ITMO Univ., Russia; 2 - École Polytechnique Fédérale de Lausanne, Switzerland

We demonstrate the existence of two stable contact angles for the gallium droplet on top of self-assisted GaAs nanowires grown by MBE on patterned silicon substrates. Contact angle around 130° fosters a continuous increase in the nanowire radius, while 90° allows for the nanowire thinning, followed by the stable growth of ultra-thin tops. We develop a model that explains the observed morphological evolution under the two different scenarios.

TuR9-p20 17:30-19:30

Plasmon-enhanced fluorescence of rhodamine dye on silver island films

N. Ibrayev, E. Seliverstova, N. Zhumabay; Karaganda State Univ., Kazakhstan

The distant dependence of the plasmon effect of silver island films (SIF) on the spectral-luminescent properties of the rhodamine dye in solid films was studied. It is shown that the optimal distance for obtaining the plasmon-enhanced fluorescence of the dye is the distance equal to 6 nm to the SIF film.

TuR9-p21 17:30-19:30

Diamond-fluoride luminescent film composite.

S.V. Kuznetsov, V.S. Sedov, M.N. Mayakova, V.Yu. Proydakova, V.V. Voronov, A.A. Khomich, V.G. Ralchenko, P.P. Fedorov; Prokhorov General Physics Inst. RAS, Russia

We produced luminescent diamond films with embedded europium-contained fluorides which were synthesized by different precipitation techniques. Luminescence spectra showed a narrow orange line at 612 nm. This approach has a perspective for the preparation of luminescent diamond with wanted luminescence lines.

TuR9-p22 17:30-19:30

Narrowing the length distributions of self-assisted III-V nanowires by nucleation antibunching

V.V. Belyaev[1], N.V. Sibirev[1,2], Y.S. Berdnikov[2]; 1 - ITMO Univ., Russia; 2 - Univ. Paris-Sud, Univ. Paris-Saclay, France

Size homogeneity of nanostructures is highly desirable for improving collective properties within their ensembles and crucial for the resulting device performance. Here, we show how the length distributions of self-assisted III-V nanowires can be narrowed to sub-Poissonian shape by a specific effect of nucleation antibunching that arises due to a limited number of the group V atoms in a catalyst droplet.

TuR9-p23 17:30-19:30

Some peculiarities of quantum dots luminescence in microstructed optical fibers

P.S. Pidenko[1], S.A. Pidenko[1], N.A. Burmistrova[1], Y.S. Skibina[2], I.Y. Goryacheva[1]; 1 - Saratov State Univ., 2 - LLC SPE Nanostructured Glass Technology, Russia

The use of quantum dot arrays with different exciton peaks for optical multi-sensory elements is a challenging task. The study of transformation of semiconductor nanoparticles emissionin microstructural optical fibers is of considerable interest. The bathochromic shift phenomenon of the core-shell quantum dots CdSe/ZnS exciton peak in microstructural optical fiber is described. The maximum bathochromic shift of the emission peak is more than 10 nm.

TuR9-p24 17:30-19:30

Nonlinear optical properties of semiconductor dispersed nanosystems based on silicides and oxides in the fundamental absorption band: Cole-Cole diagrams

S.S. Volchkov[1], S.A. Yuvchenko[1,2], D.A. Zimnyakov[1,2]; 1 - Saratov State Technical Univ., 2 - Inst. of Precision Mechanics and Control RAS, Russia

Non-linear optical properties of molybdenum silicide and titanium dioxide nanoparticles are studied using a modified z-scan technique with simultaneous measurements of Rayleigh scattering.

TuR9-p25 17:30-19:30

Stimulated emission of dye molecules coupled to plasmon oscillations in silver nanoparticles

A.N. Kamalieva[1], N.A. Toropov[1,2], T.A. Vartanyan[1]; 1 - ITMO Univ., Russia; 2 - Aston Univ., UK

In this contribution lasing properties of composite structures based on organic dyes and silver nanoparticles are explored.Two basic features characteristic for the stimulated emission, namely the spectral line narrowing and the superlinear nonsaturated dependence of the luminescence intensity on the pumping energy has been observed.

TuR9-p26 17:30-19:30

Numerical simulation of steady-state optical heating of alumunum nanoparticles

S.A. Andronaki, T.A. Vartanyan; ITMO Univ., Russia

We use a numerical simulation to investigate the temperature distribution in aluminum nanoparticles subject to external illumination. We perform thermodynamic calculations for considered absorption cross-sections and compare it to the dipole approximation.

TuR9-p27 17:30-19:30

Pt (II)-based complexes with ligands of 8-hydroxyquinoline and its 2-methyl derivative for OLED

R.R. Sayfutyarov[1], I.V. Taydakov[1,2], E.P. Dolotova[1], Barkanov[1], A.V. Khomyakov[1], N.P. Datskevich[2], I.Ch. Avetissov[1]; 1 - Mendeleev Univ. of Chemical Technology, 2 - Lebedev Inst. of Physics RAS, Russia

Symmetrical Pt complexes with 8-oxyquinolinol and its 2-methyl derivative have been synthesized and purified by vacuum distillation. Preparations with point defects of the crystal structure of complexes were obtained. The OLED structures based on the above complexes have been fabricated and their electroluminescence characteristics have been studies.

TuR9-p28 17:30-19:30

Application of tris-(8-hydroxyquinoline) aluminium (III) with controlled defect structure in OLED

A.A. Akkuzina, N.N. Kozlova, R.I. Avetisov, R.R. Saifutyarov, A.V. Khomyakov, E.N. Mozhevitina, I.Ch. Avetissov; Mendeleev Univ. of Chemical Technology, Russia

A new technique for analysis of p8-Hq-T diagram was developed for the metal-organic phosphors with symmetrical ligands and corresponding diagram was studied for tris-(8-hydroxyquinoline)aluminium (III) – Alq3. We showed that for α-Alq3 prepared as single-phase crystalline samples with controlled defect structure allowed varying the cell volume, chemical activity and electrical properties of the crystalline preparation and OLED made on its basis.

TuR9-p29 17:30-19:30

Investgation SiV center optical properties in ultrasmall nanodiamonds

S.V. Bolshedvorskii[1,2,3], V.V. Vorobyov[1,3], V.V. Soshenko[1,3], A.I. Zeleneev[2,4], V.A. Davydov[5], V.N. Sorokin[3,4], A.N. Smolyaninov[1], A.V. Akimov[6,3,4]; 1 - Spin Sensor Technology, 2 - Moscow Inst. of Physics and Technology, 3 - Lebedev Physical Inst. RAS, 4 - Russian Quantum Center, 5 - Vereschagin Inst. for High Pressure Physics, Russia; 6 - Texas A&M Univ., USA

We report on high pressure high temperature (HPHT) synthesis of nanodiamonds (NDs) with sizes lower than 10 nm containing optically active single silicon-vacancy color center.

TuR9-p30 17:30-19:30

Nanoantenna influence on surface plasmon-polariton generation efficiency

L.N. Dvoretckaia[1], A.M. Mozharov[1], A.A. Bogdanov[1,2], A.V. Uskov[3], I.S. Mukhin[1,2]; 1 - St. Petersburg Academic Univ., 2 - ITMO Univ., 3 - Lebedev Physical Inst. RAS, Russia

We demonstrate theoretically that excitation of the surface plasmon-polariton is more effective with use of dielectric nanoantennas when source of the tunneling electrons is approximated with a point optical dipole.

TuR9-p31 17:30-19:30

Spectral properties of silver and gold clusters in silica matrices

I.A. Gladskikh, P.V. Gladskikh; ITMO Univ., Russia

Absorption and luminescence properties of silver and gold nanoclusters embedded in silica matrixes were studied experimentally. Thin SiO2 films with different amount of silver and gold were produced by co-deposition of metal and SiO2 onto the silica substrates in vacuum.

TuR9-p32 17:30-19:30

Laser synthesis of graphene under the action of femtosecond laser radiation in liquid nitrogen

V.A.Ilin, K.S. Khorkov, D.A. Kochuev, V.G.Prokoshev, S.M.Arakelian; Stoletovs Vladimir State Univ., Russia

The method of laser synthesis of graphene is considered. The mechanisms of obtaining graphene are shown. The prospect of using this method is suggested.

TuR9-p33 17:30-19:30

Surface plasmon polariton generation in carbon nanotube with electric current pump

I. Zolotovskii[1], S. Moiseev[1,2], Y. Dadoenkova[1,3], A. Kadochkin[1], O. Ivanov[1,2]; 1 - Ulyanovsk State Univ., 2 - Kotelnikov Inst. of Radio Engineering and Electronics RAS, Russia; 3 - Donetsk Inst. for Physics & Technology, Ukraine

We have shown the possibility of far infrared surface plasmon polariton generation in a single-walled carbon nanotube. In such a generator, the amplification is created by drift current, and the feedback is realized due to periodically profiled dielectric cladding.

TuR9-p34 17:30-19:30

Possible ways to control the luminescent properties of LaF3 nanoparticles doped with rare-earth ions

E.I. Madirov, E.V. Lukinova, M.S. Pudovkin, D. Koryakovtseva, S.L. Korableva, A.S. Nizamutdinov, V.V. Semashko; Kazan Federal Univ., Russia

Luminescence decay properties of crystalline LaF3 nanoparticles activated by 5% Sm3+ or 12% Ce3+ ions were studied. The observed effects of the variation of synthesis conditions and composite structure on luminescence properties of nanoparticles open the way to manage luminescence and energy transfer properties of the materials.

TuR9-p35 17:30-19:30

The laser-assisted synthesis of linear carbon chains stabilized by noble metal particles

A. Osipov[1], A. Kucherik[1], S. Kutrovskaya[1,2], I. Skryabin[1], S. Arakelian[1]; 1 - Vladimir State Univ., 2 - Russian Quantum Center, Russia

Metal-carbon materials realize surface-enhanced Raman scattering. Such structures were synthesized using the laser irradiation of colloidal systems consisting of carbon and noble metal nanoparticles.

TuR9-p36 17:30-19:30

Optical spectroscopy of Ag/Py based magneto-plasmonic crystals

A.R. Pomozov[1], A.L. Chekhov[1], A.N. Shaimanov[1,2], , I.A. Rodionov[2,3], A.S. Baburin[2,3], E.S. Lotkov[2,3], K.N. Afanasyev[2,4], A.V. Baryshev[2], T.V. Murzina[1]; 1 - Lomonosov Moscow State Univ., 2 - All-Russian Research Inst. of Automatics, 3 - Bauman Moscow State Technical Univ., 4 - Inst. of Theoretical and Applied Electrodynamics, Russia

Optical spectroscopy of new type of Ag/Py based magnetoplasmonic crystals reveals a pronounced spectrally-tunable magnetooptical resonance associated with the excitation of surface plasmon-polaritons.

TuR9-p37 17:30-19:30

Photoinduced toxicity of PrF3 nanoparticles and luminescence nanothermometry based on Pr3+: LaF3 nanoparticles of different size, shape, and structure

M.S. Pudovkin, P.V. Zelenikhin, V.V. Shtyreva, O.A. Morozov, D.A. Koryakovseva, E.V. Lukinova, R. Sh. Khusnutdinova, A.A. Rodionov, A.S. Nizamutdinov, V.V. Semashko; Kazan Federal Univ., Russia

Pr3+: LaF3 (CPr=1-30%) nanoparticles demonstrate temperature sensing properties into -196- 60ºC. The relative sensitivities of Pr3+: LaF3 (CPr=12%, 20%) spherical NPs (at 45ºC) were 0.5 and 0.3% °C-1, respectively. It was found that temperature dependence of luminescent spectra of Pr3+: LaF3 nanoparticles depend on their shape and structure. We did not detect formation of superoxide and hydroxyl radical by PrF3 nanoparticles under CW laser irradiation. Finally, the mechanism of photoinduced toxicity can be related to local heating of cellular components by nanoparticles.

TuR9-p38 17:30-19:30

Pt (II)-based complexes with ligands of 8-hydroxyquinoline and its 2-methyl derivative for OLED

R.R. Sayfutyarov[1], I.V. Taydakov[1,2], E.P. Dolotova[1], A.D. Barkanov[1], A.V. Khomyakov[1], N.P. Datskevich[2], I.Ch. Avetissov[1]; 1 - Mendeleev Univ. of Chemical Technology, 2 - Lebedev Inst. of Physics RAS, Russia

Symmetrical Pt complexes with 8-oxyquinolinol and its 2-methyl derivative have been synthesized and purified by vacuum distillation. Preparations with point defects of the crystal structure of complexes were obtained. The OLED structures based on the above complexes have been fabricated and their electroluminescence characteristics have been studies.

TuR9-p39 17:30-19:30

T-matrix study of optical extinction spectra of bimetallic silver-gold particles in glass

A.V. Skidanenko[1], L.A. Avakyan[1], M. Heinz[2], K.A. Yablunovski[1], J. Ihleman[3], M. Dubiel[2], L.A. Bugaev[1]; 1 - Southern Federal Univ., Russia; 2 - Martin Luther Univ. Halle-Wittenberg, Inst. of Physics, Germany; 3 - Laser-Laboratorium Göttingen e.V., Germany

The main goal of this work is the determination of the architecture of bimetallic nanoparticles (pure particles, core-shell or alloyed particles) based on optical extinction spectra. The possibility and limitations of such structural determination is shown by analysis of simulated spectra of nanoparticles with pre-defined architecture.

TuR9-p40 17:30-19:30

Saturable absorber: transparent glass-ceramics based on Co2+, Ga2O3-doped ZnO nanocrystals

V. Vitkin[1], P. Loiko[1], O. Dymshits[2], D. Shemchuk[2], A. Polishchuk[1], K. Grigorenko[1], A. Zhilin[2]; 1 - ITMO Univ., 2 - NITIOM Vavilov State Optical Inst., Russia

A saturable absorber for Er lasers - transparent glass-ceramics with nanosized (6 nm) Co2+, Ga2O3-doped ZnO crystals is developed. It exhibits a broad 4A2(4F) -> 4T1(4F) absorption band of Co2+ ions in tetrahedral sites. At ~1.54 μm, the saturation intensity is 0.7±0.1 J/cm2 and the laser damage threshold is as high as 25±2 J/cm2.

TuR9-p41 17:30-19:30

Optical and spin properties of NV centers in aggregates of detonation nanodiomonds

A.I. Zeleneev[1,3], S.V. Bolshedvorskii[3,2,4], V.V. Vorobyov[2,4], V.V. Soshenko[2,4], V.N. Sorokin[1,2], A.V. Akimov[5,2,1]; 1 - Russian Quantum Center, 2 - Lebedev Physical Inst. RAS, 3 - Moscow Inst. of Physics and Technology, 4 - Spin Sensor Technology, Russia; 5 - Texas A&M Univ., USA

Here, we investigate optical and spin properties of NV centers in aggregates of detonation nanodiamonds. We show that despite the small size of nanodiamonds forming the aggregate, the NV centers in these aggregates exhibit spin properties comparable to similar size nanodiamonds but with brightness enhanced by a factor of 2.2.

TuR9-p42 17:30-19:30

The effect of structuring of carbon nanotubes array under the action of pulsed laser radiation

A.Yu. Gerasimenko[1], M.S. Savelyev[1], N.N. Zhurbina[1], E.P. Kitsyuk[2], Yu.P. Shaman[2], R.M. Ryazanov[2], A.A. Pavlov[3]; 1 - National Research Univ. of Electronic Technology, 2 - Scientific-Manufacturing Complex «Technological Center»; 3 - Inst. of Nanotechnology of Microelectronics RAS, Russia

The interaction of an array of multilayer carbon nanotubes with high-power pulsed laser radiation of an Nd: YAG laser with a wavelength of 532 nm, a pulse duration of 16 ns, and an energy density of 0.4-2.2 J/cm2 was carried out. The effect of cleaning, thinning and straightening of arrays of carbon nanotubes was demonstrated.

TuR9-p43 17:30-19:30

Stimulated emission of phonons and plasmons by ballistic electrons in nanoscale contacts

F.A. Shuklin[1], J.B. Khurgin[2], I.V. Smetanin[3], I.E. Protsenko[3], A. Bouhelier[4], I.S. Mukhin[5], A.V. Uskov[3]; 1 - National Nuclear Research Univ. MEPhI, Russia; 2 - John Hopkins Univ., USA; 3 - Lebedev Physical Inst. RAS, Russia; 4 - Univ. Bourgogne Franche-Comte, France; 5 - ITMO Univ., Russia

We show that the rate of stimulated emission by electron, passing through nanoscale constriction, can be enhanced substantially (by several orders) with proper tailoring of the constriction shape.

R1. SOLID-STATE LASERS

Location: Petrov-Vodkin 2+3 Room, floor 2. 09:00 - 11:00

High Power, Thin Disk, Fiber II

Session Chair: Maximilian Lederer,
European XFEL GmbH, Germany

WeR1-21 09:00-09:30

kW-ps-InnoSlab Lasers *(Invited paper)*

T. Mans; Amphos GmbH, Germany

In this paper amplifier chains which are based on the InnoSlab laser concept are presented. The demonstrated pulse durations are in the ultrafast regime - reaching roughly 1ps (+/- 0.5ps) after optical compression. For continuous operation average power levels above 1kW and for burst mode operation power levels >10kW within the burst duration are presented. Single pulse energies are exceeding 10mJ but also pulse repetition rates of many MHz are demonstrated resulting in sub-mJ pulse energies.

WeR1-22 09:30-09:45

Hybrid phase locking for high-power femtosecond laser coherent beam combining

X. Liang[1], Ch. Peng[1,2], R. Liu[1,2], W. Li[1,2], R. Li[1]; 1 - Shanghai Inst. of Optics and Fine Mechanics, CAS; 2 - Univ. of CAS, China

A high-precision phase locking technique was proposed and demonstrated for coherent beam combining suitable for high-power laser pulses. It is a hybrid structure based on the near-field interference fringe technique and single-crystal balanced optical cross-correlation. Experimentally, we realized adjustable beam combining bandwidth of approximately 100 Hz and root-mean-square deviation of λ/51 for two beam channels with combining efficiency of 93%.

WeR1-23 09:45-10:00

983 nm high repetition rate second harmonic generation in a fan-out PPMgO: LN structure pumped with Tm3+: Lu2O3 ceramic laser

O. Antipov[1,2], D. Kal'yanov[2], D. Kolker[3,4,5], S. Larin[6], A. Boyko[3,4], V. Shur[7], A. Akhmatkhanov[7]; 1 - Inst. of Applied Physics RAS, 2 - Nizhniy Novgorod State Univ., 3 - Novosibirsk State Univ., 4 - Inst. of Laser Physics SB RAS, 5 - Novosibirsk State Technical Univ., 6 - NTO «IRE-Polus», 7 - Ural Federal Univ., Russia

Combination of a fan-out periodically polled MgO: LN structure and an efficient Tm3+: Lu2O3 ceramic laser was applied for a high repetition rate second harmonic generation at 983 nm. The average power reached 4.7 W at 983 nm in 40 ns pulses with the repetition rate between 15-40 Hz. The 45% conversion efficiency was achieved at 983 nm from a 1966 nm pump.

WeR1-24 10:00-10:15

Highly-Efficient Multi-Watt Lasing in 5at.%Tm: KLu(WO4)2 Mini-Slabs

S.N. Bagayev[1], V.A. Orlovich[4], S.M. Vatnik[1], N.V. Kuleshov[3], I.A. Vedin[1], E.V. Smolina[1], A.A. Pavlyuk[2], N.V. Gusakova[3], S.V. Kurilchik[3,4], A.S. Yasukevich[3], V.E. Kisel[3], K.V. Yumashev[3], P.A. Loiko[5], V.I. Dashkevich[4]; 1 - Inst. of Laser Physics SB RAS, 2 - Inst. of Inorganic Chemistry, Russia; 3 - Belarusian National Technical Univ., 4 - Inst. of Physics NASB, Belarus; 5 - ITMO Univ., Russia

We report on highly-efficient room-temperature lasing in 5at.%Tm: KLu(WO4)2 mini-slabs side-pumped by a 50W diode bar. CW output power of 16.7 W at 1910 nm has been demonstrated with optical and slope efficiencies being of 35 and 45%, respectively.

WeR1-25 10:15-10:30

High power CW and mode-locked laser performance of Yb3+: YAl3(BO3)4 crystal

V.E. Kisel[1], A.S. Rudenkov[1], K.N. Gorbachenya[1], V.V. Maltsev[2], N.I. Leonyuk[2], and N.V. Kuleshov[1]; 1 - Belarusian National Technical Univ., Belarus; 2 - Moscow State Univ., Russia

We present spectroscopic properties, high power diode-pumped continuous-wave (CW) and passively mode-locking (PMD) Yb3+:YAl3(BO3)4 (Yb3+:YAB) bulk laser operation. Maximal output power as high as 9.2 W with slope efficiency up to 74% in the CW and 195 fs pulse duration with average power up to 4 W from a PMD Yb3+:YAB laser was demonstrated.

WeR1-26 10:30-10:45

Transient evolution of mode composition of few-mode Yb-fiber amplifiers

D.A. Alekseev[1,2], V.A. Tyrtyshnyy[1], M.S. Kuznetsov[3], O.L. Antipov[3]; 1 - NTO «IRE-Polus», 2 - Moscow Inst. of Physics and Technology, 3 - Inst. of Applied Physics RAS, Russia

Transient regime of Yb-fiber amplifiers was investigated experimentally and theoretically. Within a few milliseconds after injecting the pump into fiber a transfer of power between the fundamental and high-order modes was observed, which is similar to mode instability effect. According to the developed theoretical model the transient power transfer occurs due to the dynamic population inversion grating inside active fiber.

WeR1-27 10:45-11:00

Compact pigh ynergy aemtosecond aiber дaser with a CFBG ыtretcher and CVBG compressor

T. Bartulevičius[1,2], L. Veselis[1,2], K. Madeikis[1,2], A. Michailovas[1,2], N. Rusteika[1,2]; 1 - Ekspla Ltd, 2 - Center for Physical Sciences and Technology, Lithuania

A compact 10 μJ energy and 26 MW peak power fiber chirped pulse amplification system employing matched pair of a chirped fiber Bragg grating stretcher and a chirped volume Bragg grating compressor is presented.

- Coffee Break -

Location: Petrov-Vodkin 2+3 Room, floor 2. 11:30 - 13:30

Mode-locked Lasers I

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

WeR1-28 11:30-12:00

Coherent combining architectures for ultrafast laser sources *(Invited paper)*

M. Hanna; Laboratoire Charles Fabry, Inst. d'Optique, CNRS, Univ. Paris Saclay, France

We review recent progress in coherent combining of femtosecond pulses as a way to scale the peak and average power of ultrafast sources. Different methods of achieving coherent pulse addition in space (beam combining) and time (divided pulse amplification) domains will be discussed. These architectures can be widely classified into active methods, where the relative phases between pulses are subject to a servomechanism, and passive methods, where phase matching is inherent to the geometry. Other experiments that combine pulses with different spectral contents, pulses that have been nonlinearly broadened or successive pulses from a mode-locked laser oscillator, can be considered. All these techniques allow access to unprecedented parameter range for ultrafast sources.

WeR1-29 12:00-12:15

High-power passively mode-locked thulium-doped all-fiber ring laser with nonlinearity and dispersion management

V.S.Voropaev[1], A.I. Donodin[1], A.I. Voronets[1], V.A. Lazarev[1], M.K. Tarabrin[1,2], V.E. Karasik[1], A.A. Krylov[3]; 1 - Bauman Moscow State Technical Univ., 2 - Lebedev Physical Inst. RAS, 3 - Fiber Optics Research Center RAS, Russia;

We developed a high-power dispersion-managed thulium-doped all-fiber ring laser passively mode-locked by nonlinear polarization evolution (NPE) effect. The laser generates 142.8 fs pulses at 1950 nm central wavelength with maximum average power of 370 mW and 57.4 nm spectral FWHM corresponding to the 31 nJ pulse energy and 217 kW pulse peak power.

WeR1-30 12:15-12:30

High-density well-aligned single-walled carbon nanotubes saturable absorber: novel approach of robust mode-locking launching

D.A. Dvoretskiy[1], S.G. Sazonkin[1], I.O. Orekhov[1], I.S. Kudelin[1], A.B. Pnev[1], V.E. Karasik[1], L.K. Denisov[1], S.G. Lyapin[2], V.A. Davydov[2]; 1 - Bauman Moscow State Technical Univ., 2 - Inst. for High Pressure Physics RAS, Russia

We have studied nonlinear optical properties of ultrafast saturable absorber based on high-density well-aligned single-walled carbon nanotubes.

WeR1-31 12:30-12:45

Low-noise multi-bound solitons generation in a highly-nonlinear all-fiber resonator

D.A. Dvoretskiy, S.G. Sazonkin, I.O. Orekhov, I.S. Kudelin, A.B. Pnev, V.E. Karasik, L.K. Denisov; Bauman Moscow State Technical Univ., Russia

Low-noise multi-bound solitons generation is obtained in a passive mode-locked ring laser with highly-nonlinear all-fiber resonator at the telecommunication spectral window.

WeR1-32 12:45-13:00

Wavelength-tunable drop-shaped-cavity mode-locked Er-fiber laser

B.N. Nyushkov[1,2,3], A.A. Antropov[1], N.A. Koliada[1], S.M. Kobtsev[2], D.B. Kolker[1,2,3], V.S. Pivtsov[1,3]; 1 - Inst. of Laser Physics SB RAS, 2 - Novosibirsk State Univ., 3 - Novosibirsk State Technical Univ., Russia

An ultrashort-pulse Er-fiber laser with an original drop-shaped cavity based on a dual-fiber optical collimator and a reflective diffraction grating was implemented for the first time. This new cavity allowed reliable passive mode locking as a classical all-fiber ring cavity but with an added benefit of continuous wide-range wavelength tuning. The tuning from 1527 nm to 1597 nm was demonstrated.

WeR1-33 13:00-13:15

Hybrid mode-locking of an all-fiber holmium laser.

S.A. Filatova[1,2], V.A. Kamynin[1,2], A.I. Trikshev[1,2], E.D. Obraztsova[1,3], V.B. Tsvetkov[1,3]; 1 - General Physics Inst. RAS, 2 - Ulyanovsk State Univ., 3 - National Research Nuclear Univ. «MEPhI», Russia.

We have investigated the laser radiation parameters of the hybrid mode-locked holmium-doped fiber laser. To realize this regime we have combined nonlinear polarization evolution (NPE) and carbon nanotubes (CNT) as an additional nonlinear saturable absorber.

WeR1-34 13:15-13:30

Michelson reflector for spectral range stabilization in a self-sweeping fiber laser

A.Yu. Tkachenko[1], A.D. Vladimirskaya[1], I.A. Lobach[1,2,3], S.I. Kablukov[1,2]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Novosibirsk State Univ., 3 - Perm Scientific Center UB RAS, Russia

We report on spectral range stabilization in a self-sweeping laser by adding a fiber Bragg grating (FBG) to output mirror in Michelson configuration. Optimization of the interferometer (reflector) allows us to demonstrate broadband (over 16 nm) self-sweeping operation and reduction of the start and stop wavelengths fluctuations by two and one order of magnitude for start and stop bounds respectively.

- Lunch Break -

R2. HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID

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

Ultrashort High-Power Lasers

Session Chair: Fedor Starikov, Russian Federal Nuclear Center – The All-Russian Research Inst. of Experimental Physics, Russia

WeR2-13 09:00-09:30

Future of Ti:Sapphire lasers: combining high peak and average power *(Invited paper)*

M.P. Kalashnikov[1,2], V. Chvykov[2], H. Cao[2], R.S Nagymihaly[2], N. Khodakovskiy[2], K. Osvay[2]; 1 - Max-Born-Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany; 2 - ELI-Hu Nkft., Hungary

Bandwidth of Ti:Sapphire lasers is limited by gain narrowing, while the average power by the efficiency of heat removal. A combination of the two new developments: Thin Disk Ti:Sapphire amplifiers with Extraction During Pumping (EDP-TD) and Polarization encoded Chirped Pulse Amplification (PE-CPA) is able to support laser pulses of few oscillations at hundreds of TW peak and kW average power.

WeR2-14 09:30-10:00

High contrast 20 fs, 4.2 PW laser *(Invited paper)*

S.K. Lee[1,2], Ja.H. Sung[1,2], H.W. Lee[1], Ji.W. Yoon[1,2], Ch.H. Nam[1,3]; 1 - Inst. for Basic Science, 2 - Advanced Photonics Research Inst., 3 - GIST, Republic of Korea

An ultra-high intensity 4.2 PW laser was developed at CoReLS for exploring relativistic laser-matter interactions in the unprecedented regime. The pulse duration of 20 fs was achieved by broadening a laser spectrum with XPW and OPCPA and minimizing a spectral phase error. The temporal contrast was also enhanced to 4 orders of magnitude. This 4.2 PW laser has been successfully commissioned and operated for the particle accelerations and the high field science.

WeR2-15 10:00-10:30

High energy, kilohertz repetition rate laser system at 5 µm with multi-GW peak power *(Invited paper)*

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

The generation of few-cycle millijoule pulses in the mid-wave infrared at a 1 kHz repetition rate is reported. Pulses at 5 µm with 75 fs duration and 14 GW peak power are produced via optical parametric chirped-pulse amplification.

WeR2-16 10:30-11:00

The possibilities of the output power increasing of the THL-100 laser system *(Invited paper)*

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

The latest results obtained in THL-100 hybrid femtosecond laser system operating in the visible spectral range are presented and the ways of the peak power increase of the laser beam are discussed.

- Coffee Break -

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

High-Power Solid-State Lasers

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

WeR2-17 11:30-12:00

High average and peak power laser based on Yb:YAG amplifiers of advanced geometries developed in IAP RAS *(Invited paper)*

I. I. Kuznetsov; Inst. of Applied Physics RAS, Russia

High average and peak power laser based on Yb:YAG amplifiers of different geometries is being developed. The advantages of such advanced geometries as thin tapered rods and composite disks are investigated. The signal of sub-picosecond fiber laser is amplified up to 120 W average power, >10 mJ pulse energy at diffraction-limited beam quality.

WeR2-18 12:00-12:30

Nd, Y-codoped CaF2 single crystals for ultrashort pulses generation *(Invited paper)*

V. Tsvetkov; Prokhorov General Physics Inst. RAS, National Research Nuclear Univ. MEPhI, Russia

Results of the ultrashort pulses lasing are presented while using CaF2-YF3 -NdF3 crystals with different composition. The actual pulse duration is about 100 ps.

WeR2-19 12:30-12:45

Amplifier based on Yb: YAG crystal pumped by single mode laser at 920 nm wavelength

I.V. Obronov[1,2], A.S. Demkin[1,3], D.V. Myasnikov[1]; 1 - NTO IRE-Polus, 2 - National Research Nuclear Univ. MEPHI, 3 - Moscow Inst. of Physics and Technology (State Univ.), Russia

Solid-state amplifier based on Yb: YAG crystal with single mode pump operating at 920 nm wavelength is proposed. One of the main features of the amplifier is the high achievable single-pass gain of 40 dB with excellent output beam quality. Maximum average power 14 W with high slope efficiency of 50 % is achieved.

WeR2-20 12:45-13:00

The advancement of pump channel of high peak and high average power laser system

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

Small-signal gain coefficient up to 1.2 per pass through active element is obtained experimentally in the laser multidisk amplifier of diode pumped solid state high peak and high average power laser system. The focal lengths of the thermal lenses are experimentally evaluated. Wavefront profiles are experimentally measured.

WeR2-21 13:00-13:30

High energy, high average power room-temperature Fe2+:ZnSe lasers *(Invited paper)*

K.N. Firsov; Prokhorov General Physics Inst. RAS, Russia

The problems of creating high energy, high average power room-temperature lasers in the spectral range 3.8 - 5 µm are discussed. Active elements of lasers were Fe2 +: ZnSe and Fe2+: ZnS polycrystals pumped by pulsed and repetitively pulsed electrodischarge HF, Er3+:YAG and Cr3+:Yb3+:Ho3+:YSGG lasers. The pulse generation energy for Fe2+: ZnSe and Fe2+: ZnS lasers was 1.43 J and 660 mJ correspondingly with the slope efficiencies of 53% and 36%.

- Lunch Break -

TECHNICAL SESSION

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

High-Power Lasers I

Session Chair: Pavel Mikheyev, Samara Branch of the Lebedev Inst., Russia

WeR2-22 15:00-15:30

Coherent addition of high-power laser pulses *(Invited paper)*

S. Bagayev, V. Trunov; Inst. of Laser Physics SB RAS, Russia

Ultrarelativistic intensity laser systems based on coherent multipetawatt beam addition are under discussion for confirming nonlinear quantum electrodynamics theory predictions. We present the review and original theoretical and experimental results, new methods directed to achievement of high efficiency coherent combining of parametrically amplified femtosecond pulses with a peak power from multiterawatt to multipetawatt level.

WeR2-23 15:30-16:00

High power terahertz and far infrared sources using relativistic electrons *(Invited paper)*

N.A. Vinokurov; Budker Inst. of Nuclear Physics SB RAS, Novosibirsk State Univ., Russia

Relativistic electron beams are used successfully to generate electromagnetic waves. Both narrow-band and short-pulse THz generators of such type are described with examples of the Novosibirsk free electron laser and multifoil THz generator.

WeR2-24 16:00-16:15

Generation of 17W CW visible laser radiation at 561 nm by SHG in PPsLT crystal from Raman Fiber Laser

A.A. Surin[1,2], K.Y. Prusakov[1,2], T.E. Borisenko[1], A.A. Molkov[1,2]; 1 - NTO «IRE-Polus», 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

we introduce the generation of 17.7W continuous wave single-mode yellow-green laser radiation at 561 nm with 0.06 nm spectral linewidth. It was obtained as a result of single pass second harmonic generation in 20 mm long MgO: PPsLT crystal from linearly polarized Raman fiber laser radiation.

WeR2-25 16:15-16:30

Compact CPA laser system based on Yb fiber seeder and Yb: YAG amplifier

L. Veselis[1,2], T. Bartulevičius[1,2], K. Madeikis[1,2], A. Michailovas[1,2], N. Rusteika[1,2]; 1 - Ekspla Ltd., 2 - Center for Physical Sciences and Technology, Lithuania

We presented a compact sub-ps high average power (20 W) and energy (100 μJ) laser based on the matched pair of chirped fiber Bragg grating and chirped volume Bragg grating for pulse stretching and compression.

WeR2-26 16:30-16:45

Energy effective high peak and average power picoseconds lasers

V.B. Morozov, A.N. Olenin, V.G.Tunkin, D.V. Yakovlev; Lomonosov Moscow State Univ., Russia

High-peak-power and high repetition rate picosecond lasers on Nd-doped active crystals are developed using the dynamical operation control approach and pulsed diode-end-pumping scheme. Nd: YAG laser provides 25-picosecond single near tranform-limited pulses with energy on fundamental frequency up to 5 mJ at repetition rates up to 400 Hz. Special efforts are prayed for thermal lens adequate account and effective compensation.

WeR2-27 16:45-17:00

Two-color prime laser of picosecond pulses for EUV light source

A.P. Zhevlakov[1], R.P. Seisyan[2], V.G. Bespalov[3], O.B. Danilov[1], S.V. Kascheev[3], V.V. Elizarov[3], A.S. Grishkanich[3], E.A. Makarov[3]; 1 - Vavilov State Optical Inst., 2 - Ioffe Inst. RAS, 3 - ITMO Univ., Russia

To produce hot plasma and effective EUV emission the hybrid Nd:YAG-CO_2 laser with SRS converters forming an injecting signal for CO_2 powerful amplifier is studied. EUV source power pumping is shown to be essentially decreased by replacing preamplifiers on SRS converters series in powerful CO_2 laser under conserving the efficiency of EUV emission output.

- Coffee Break -

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

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

Vertical-Cavity and Disk Lasers

Session Chair: Richard Hogg, Univ. of Glasgow, UK

WeR3-10 09:00-09:30

Recent progress in VECSEL technology and applications *(Invited paper)*

M. Guina; Tampere Univ. of Technology, Finland

We review recent progress in VECSEL technology in connection to new milestones that continue to pave the way for their practical use in emerging applications. We focus on latest advances in gain mirror technology enabling wavelength extension for both continuous-wave and ultrafast operation regimes.

WeR3-11 09:30-10:00

Self-mode-locking and nonlinear lensing in VECSELs *(Invited paper)*

A. Rahimi-Iman[1], Ch. Kriso[1], S. Kress[1], T. Munshi[1], M.M. Alvi[1], Ch. Möller[1], M. Gaafar[2,3], W. Stolz[1,4], M. Koch[1]; 1 - Philipps-Univ. Marburg, 2 - Hamburg Univ. of Technology, Germany; 3 - Menoufia Univ., Egypt; 4 - NAsP III/V GmbH, Germany

Self-mode-locked vertical-external-cavity surface-emitting lasers (VECSELs) have attracted the semiconductor laser community in recent years as promising sources of ultrashort laser pulses. While the mode-locked operation has been strongly relying on semiconductor saturable-absorber mirrors for many years, a saturable-absorber-free technique referred to as self-mode-locking (SML) emerged, being associated to nonlinear lensing effects inside the device.

WeR3-12 10:00-10:15

Edge-emitting and microdisk lasers based on hybrid quantum-well-dot structures

M.V. Maximov[1,2], A. M. Nadtochiy[1,2], S.A. Mintairov[2,1], N.A. Kalyuzhnyy[2,1], N.Yu. Gordeev[2,1], A.S. Payusov[2,1], Yu.M. Shernyakov[2,1], N.V. Kryzhanovskaya[1], E.I. Moiseev[1], M.M. Kulagina[2], A.E. Zhukov[1]; 1 - St. Petersburg Academic Univ., 2 - Ioffe Inst., Russia

We studied edge-emitting and microdisk lasers based on a novel type of the laser active region, quantum well-dot hybrid nanostructures, which possess advantages of both quantum wells and quantum dots.

WeR3-13 10:15-10:30

Strong and weak optical coupling of electrically pumped mid-infrared semiconductor disk lasers

M. A. Royz[1], A. N. Baranov[2], A. M. Monakhov[1], E. A. Grebenshchikova[1], Yu. P. Yakovlev[1]; 1 - Ioffe Inst., Russia; 2 - Univ. Montpellier[2], CNRS, France

We present concepts of strong and weak optically coupled electrically pumped disk lasers operating on collective Whispering Gallery Modes. The laser samples are based on quantum heterostructure GaInAsSb/AlGaAsSb. Emission spectra and directional patterns of the coupled disc lasers have been studied. It is shown that these lasers generate collective modes with twice as small free spectral range as a single disc laser.

WeR3-14 10:30-10:45

Measurement and analysis of local optical anisotropies in multilayer spin-VCSELs

T. Fördös[1,2,3], K. Postava[2,3], H. Jaffrès[4], M. Drong[2], J. Pištora[2,3], and H. J. Drouhin[1]; 1 - Univ. Paris-Saclay, France; 2 - Technical Univ. of Ostrava, Czech Republic; 3 - IT[4] Innovation, Technical Univ. of Ostrava, Czech Republic; 4 - Unité Mixte de Physique CNRS/Thales and Univ. Paris-Saclay, France

We present Mueller matrix ellipsometric study of InGaAs/GaAsP laser in order to disentangle surface and quantum wells (QWs) contributions to the linear optical birefringence of the structures. The measurement of full 4×4 Mueller matrix for multiple angles of incidence and in-plane azimuthal angles in combination with proper parametrization of optical functions has been used for extraction of optical permittivity tensors of surface strained layers and QWs. Such spectral dependence of optical tensor elements are crucial for modeling of spin-laser eigenmodes, resonance conditions, and also for understanding of sources of structure anisotropies.

WeR3-15 10:45-11:00

Lasing in compact injection microdisks with InAs/InGaAs quantum dots

N.V. Kryzhanovskaya[1,3], E.I. Moiseev[1], M.M. Kulagina[2], Y.Guseva[2], Yu.M. Zadiranov[2], M.V. Maximov[1,2], A.A. Lipovskii[1,3], B.I. Afinogenov[4], A.G. Nasibulin[4], A.E. Zhukov[1,3]; 1 - St. Petersburg Academic Univ., 2 - Ioffe Inst., 3 - Peter the Great St. Petersburg Polytechnic Univ., 4 - Skolkovo Inst. of Science and Technology, Russia

We present results of characterization of injection microdisk and microring lasers (diameters are within 9-31 μm) with InAs/InGaAs quantum dots grown on GaAs substrate. The microlasers operate without external cooling in continuous wave regime at room temperature and up to 100oC. In case of ring resonator geometry, a reduction of threshold current in comparison with the disk resonator is demonstrated.

- Coffee Break -

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

Photonics Materials, Devices and Applications I

Session Chair: Mircea Guina,
Tampere Univ. of Technology, Finland

WeR3-16 11:30-12:00

Recent progress in photonics-based biomedical and environmental sensing *(Invited paper)*

R.M. De La Rue[1], M. Gerken[2];1- School of Engineering, Glasgow, Scotland, UK;2- Christian-Albrechts-Univ. zu Kiel, Germany

Recent progress in photonics-based biomedical sensing will be reviewed. Similar techniques relevant to environmental sensing will also be considered. Planar device technologies such as photonic crystal structures, metasurfaces and photonic wire waveguide structures will be described and compared. The possible roles of lasers, in particular semiconductor lasers, will be examined.

WeR3-17 12:00-12:30

Control of spontaneous emission rate in Tamm plasmon structures *(Invited paper)*

A. R. Gubaidullin[1], K.M.Morozov[1], K.A. Ivanov[2], J.Belessa[3], C. Symonds[3], A. Monkman[4] and M. A. Kaliteevski[1,2], G. Pozina[5];1- Academic Univ., 2 - ITMO Univ., Russia, 3 - Univ. of Lyon, France, 4 - Univ. of Durham, UK, 5 - Univ. of Linkoping, Sweden

We have studied experimentally and theoretically spontaneous emission rate modification in Tamm plasmon structures with semiconductor(InAs/GaAs quantum dots) and organic (CBP) emitters. Time-resolved spectroscopy demonstrates that spontaneous emission rate is increased by one order in magnitude. Experimentally measured spontaneous emission pattern coincides with calculated dependence of modal Purcell factor on frequency and angle of emission.

WeR3-18 12:30-12:45

Ultrafast carrier cooling in led halide perovskite solar cells

A. Gorodetsky[1,2], T. Hopper[1], A. Bakulin[1]; 1 - Imperial College London, UK; 2 - ITMO Univ., Russia

Delocalized band states in photovoltaic materials act as the gateway for charge separation, and thorough study of such hot-state charge delocalization can be achieved by IR photon excitation. Here, we study the processes of ultrafast carrier cooling in such materials by three pulse pump-push-probe technique. The materials under study reveal subpicosecond cooling times, dependent on the push intensity. We associate the slope in the cooling time with the effect of phonon bottleneck.

WeR3-19 12:45-13:00

Generation of new coherent light states using III-V semiconductor laser technology: VORTEX, continuum, dual frequency for THz

A. Garnache[1], M. Seghilani[1], B. Chomet[1], M. Sellahi[1], R. Paquet[1], M. Myara[1], S. Blin[1], L. Legratiet[2], G. Beaudoin[2], I. Sagnes[2], P. Lalanne[3]; 1 - Univ. Montpellier, 2 - LPN - CNRS-UPR20 - Site Alcatel de Marcoussis, 3 - LP2N - IOGS-Bordeaux, France

We developed a III-V semiconductor surface emitting laser technology integrating flat-photonics for generation of new coherent states: beam carrying Orbital-Angular-Momentum, dual-frequency source for THz, modeless source. Targeted applications are: optical tweezers, sensors, telecommunications, THz, optical tomography.

WeR3-20 13:00-13:15

Fluorescence bandwidth of 280nm from broadband Ce3+ -doped silica fiber pumped with blue laser diode

A.Yadav[1], N.B. Chichkov[1], R. Gumenyuk[2], E. Zherebtsov[1], M.A. Melkumov[3], M.V. Yashkov[4], E.M. Dianov[3], E.U. Rafailov[1]; 1 - Aston Univ., UK; 2 - Tampere Univ. of Technology, Finland; 3 - Fiber Optics Research Center RAS, 4 - Inst. of Chemistry of High-Purity Substances RAS, Russia

Fluorescence properties of a Ce3+-doped silica fiber at different pump wavelengths between 405nm to 450 nm are investigated. With 405 nm pump wavelength and a fiber length of ~130-140 cm broadband fluorescence of ~280nm is achieved.

WeR3-21 13:15-13:30

Carrier redistribution in blue-cyan InGaN dichromatic light-emitting diodes

D.S. Arteev[1], A.V. Sakharov[1], A.E. Nikolaev[1], S.O. Usov[1,2], W.V. Lundin[1,3], A.F. Tsatsulnikov[2,3]; 1 - Ioffe Inst., 2 - Submicron Heterostructures for Microelectronics, Research & Engineering Center RAS, 3 - ITMO Univ., Russia

Dependence of electroluminescence spectrum shape of blue-cyan InGaN-based dichromatic double quantum well light emitting diodes on the thickness and doping level of the barrier between quantum wells was investigated numerically and experimentally.

- Lunch Break -

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

Long-Wavelength Materials and Devices

Session Chair: Richard De La Rue,
Univ. of Glasgow, UK

WeR3-22 15:00-15:30

Long-wavelength InAs/GaAs quantum dots monolithically grown on Group-IV substrates *(Invited paper)*

Hu. Liu; Univ. College London, UK

Monolithically integrating III-V lasers on Si platform is the most promising solution for light sources on silicon. We demonstrated the high-performance telecommunications-wavelength InAs/GaAs quantum-dot lasers monolithically grown on silicon, Ge and Ge/Si substrates, with potential applications for silicon photonics.

WeR3-23 15:30-16:00

Quantum cascade lasers grown on silicon *(Invited paper)*

A.N. Baranov[1], H. Nguyen-Van[1], Z. Loghmari[1], L. Cerutti[1], J.B. Rodriguez[1], J. Tournet[1], G. Narcy[1], G. Boissier[1], G. Patriarche[2], M. Bahriz[1], E. Tournié[1], R. Teissier[1]; 1 - IES, Univ. Montpellier, CNRS; 2 - Centre for Nanosciences and Nanotechnology, CNRS, Univ. Paris-Sud, France

We report the first quantum cascade lasers directly grown on a silicon substrate. These lasers are based on the InAs/AlSb material system and exhibit high performances, comparable with those of the devices fabricated on their native InAs substrate. The lasers operate near 11 μm, the longest emission wavelength of any laser integrated on Si.

WeR3-24 16:00-16:30

Vanadium oxide based mid-infrared optoelectronics devices *(Invited paper)*

A. Bousseksou, L. Boulley, P. Goulain, P. Lafaille, T. Maroutian, R. Colombelli; Center for Nanosciences and Nanotechnologies, France

In our work, we demonstrate a passive and active Vanadium-oxide based mid-infrared optoelectronic devices. We perform low temperature pulsed laser deposition on III-V based heterostructures. We study and measure the optical response of VO2 based metamaterial and quantum cascade laser in the Mid-Infraredand active Vanadium-oxide based mid-infrared optoelectronic devices. We perform low temperature pulsed laser deposition on III-V based heterostructures. We study and measure the optical response of VO2 based metamaterial and quantum cascade laser in the Mid-Infrared.

WeR3-25 16:30-16:45

In(As,Sb)/InGaAs/InAlAs QW heterostructures for efficient mid-IR emitters grown by MBE on GaAs

M.Yu. Chernov[1], V.A. Solov'ev[1], O.S. Komkov[1,2], D.D. Firsov[2], S.V. Ivanov[1]; 1 - Ioffe Inst., 2 - St. Petersburg Electrotechnical Univ. «LETI», Russia

Type-II-in-type-I InSb/InAs/InGaAs/In0.75Al0.25A QW heterostructures are grown by MBE on GaAs substrates through the convex-graded metamorphic buffer layer (MBL). A strong influence of the MBL inverse step value (Δ=2-14 mol.%) on stress balance in such heterostructures and their 3.2-3.5 μm photoluminescence (PL) efficiency has been found. Different nonradiative recombination channels are considered, which are suppressed essentially at Δ=8-10 mol.%, giving rise to the 300K internal quantum efficiency of ~ 5%.

WeR3-26 16:45-17:00

Wavelength-tunable cascade type-I quantum-well GaSb-based diode laser at 3.2 μm

N.B. Chichkov[1], A. Yadav[1], E. Zherebtsov[1], L. Shterengas[2], M. Wang[2], G. Kipshidze[2], G. Belenky[2], E.U. Rafailov[1,3]; 1 - Aston Univ., UK; 2 - Stony Brook Univ., USA; 3 - ITMO Univ., Russia

We investigate the wavelength-tuning of cascade quantum-well GaSb-based diode lasers emitting at 3.2 μm. An external-cavity setup is used to demonstrate wavelength-tuning over a range of 250 nm with a maximum output power of 8.4 mW.

- Coffee Break -

R4. LASER BEAM CONTROL

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

Laser Beam Control I

Session Chair: Vladimir Yu. Venediktov,
St. Petersburg Electrotechnical Univ. "LETI", Russia

WeR4-01 09:00-09:30

Correction of atmospheric effects on laser beams propagating through strong turbulence *(Invited paper)*

S. Gladysz[1], A. Zepp[1], M. Segel[1], K. Stein[1]; 1 - Fraunhofer Inst. of Optronics, System Technologies and Image Exploitation, Germany

Atmospheric effects limit the performance of any electro-optical system. Correction of these effects on the propagation of light can be done by adaptive optics (AO). Nevertheless, challenging scenarios like strong turbulence near the ground lead to high failure rates of the traditional AO systems. Unconventional wavefront sensors and sensing strategies are developed at Fraunhofer IOSB to provide alternatives.

WeR4-02 09:30-10:00

Adaptive image correction for long-path propagation *(Invited paper)*

V.P. Lukin, V.V. Lavrinov, E.A. Kopylov, A.A. Selin; Zuev Inst. of Atmospheric Optics SB RAS, Russia

Experiments on the phase correction of distortions in the formation of optical images of objects on urban surface paths have been performed Special algorithms were used to ensure the acceleration of the operation of the phase correction system.

WeR4-03 10:00-10:30

Scattered laser beam control using bimorph deformable mirror *(Invited paper)*

I. Galaktionov[1], Ju. Sheldakova[1], A. Kudryashov[1,2]; 1 - Inst. of Geosphere Dynamics, 2 - Moscow Polytechnic Univ., Russia

The ability to focus laser beam (λ = 0.65 nm), propagated through the scattering medium, was investigated both numerically and experimentally. Numerical estimations were performed with the Monte Carlo simulation and Shack-Hartmann technique. Experimental setup with the bimorph mirror as a laser beam corrector and two kinds of sensors as feedback devices — Shack-Hartmann sensor and far-field focal spot analyzer — was designed. Three kinds of correction algorithms were tested and compared to each other.

WeR4-04 10:30-11:00

Boosting a high-energy IR OPA for Attosecond Science with high-speed adaptive deformable lenses *(Invited paper)*

M. Quintavalla[1], A. G. Ciriolo[2], J. Mocci[3], M. Negro[2], M. Devetta[2], R. Muradore[3], C. Vozzi[2], S. Bonora[1], S. Stagira[2]; 1 - Inst. di Fotonica e Nanotecnologie, CNR, 2 - Politecnico di Milano and IFN-CNR, 3 - Univ. di Verona, Italy

We demonstrate amplitude and carrier-envelope phase stabilization of a high energy IR optical parametric amplifier designed for Attosecond Science exploiting two high speed adaptive optical systems based on multi actuator adaptive lenses.

- Coffee Break -

Location: Stenberg 1 Room, floor 3. 11:30 - 13:45

Laser Beam Control II

Session Chair: Vladimir Yu. Venediktov,
St. Petersburg Electrotechnical Univ. "LETI", Russia

WeR4-05 11:30-12:00

Wavefront sensing by single-pixel imaging techniques *(Invited paper)*

F. Soldevila[1]; V. Durán[1]; P. Clemente[1,2]; J. Lancis[1]; E. Tajahuerce[1];[1]- GROC·UJI, Inst. of New Imaging Technologies (INIT), Univ. Jaume I, 2 - Servei Central d'Instrumentació Científica (SCIC), Univ. Jaume I, Spain

We describe imaging techniques based on light structured illumination and single-pixel detection. We extend these ideas to wavefront sensing by using a position sensitive detector (PSD). Our approach is non interferometric and overcomes the limitations in spatial resolution, optical efficiency, and dynamic range of Shack-Hartmann (SH) wavefront sensors. We perform both aberration sensing and phase imaging of transparent samples.

WeR4-06 12:00-12:15

Adaptive methods of measuring powerful wide aperture laser beam characteristics

Ya.I. Malashko, A.N. Kleymenov; JSC Scientific-Production Association «Almaz», Russia

Proposed and experimentally proved methods of measuring laser characteristics using adaptive optics and its exements. Inspire of big power and wide laser beam aperture high accuracy was achieved.

WeR4-07 12:15-12:30

Measuring of the laser beam characteristics using Quadra copter

G.P. Bendersky, Ya.I. Malashko, E.N. Khmelnintsky, A.N. Kleymenov; JSC Scientific-Production Association «Almaz», Russia

The method of laser beam angular divergence measurement with the help of Quadra copter is suggested. Assumption of Gaussian angular distribution of power density was used. Experimental dates are presented. Theoretical estimations of proposed methods are confirmed by experimental results.

WeR4-08 12:30-12:45

Adaptive compensator of thermally induced lens with analyzer based on quadrant photodiode

R.V. Balmashnov, A.F. Kornev, I.G. Kuchma; ITMO Univ., Russia

We used a quadrant photodiode as a sensor of wavefront curvature in the compensator of thermally induced lens and wedge in laser rods. Sensitivity of the wavefront curvature analyzer λ/100 was achieved. Using of thermal lens compensator with such sensor provided output beam divergence <1.5×DL in 100ps 0.5J×200Hz Nd:YAG laser.

WeR4-09 12:45-13:00

Hologram filters in adaptive optics problems

M.S. Kovalev[1], G.K. Krasin[1], S.B. Odinokov[1], A.B. Solomashenko[1], V.Yu. Venediktov[2]; 1 - Bauman Moscow State Technical Univ., 2 - St. Petersburg Electrotechnical Univ. LETI, Russia

Hologram optical filters have been developed that make it possible to implement the wavefront decomposition for further analysis and calculation of aberrations. The implementation of hologram filters in both a photosensitive material and in digital form using phase spatial light modulators is considered.

WeR4-10 13:00-13:15

Correction for turbulent and thermal distortions of multichannel laser radiation

F.Yu. Kanev[1], V.P. Lukin[1], O.A. Antipov[2], I.D. Veretekhin[3]; 1 - Zuev Inst. of Atmospheric Optics, 2 - Inst. of Applied Physics RAS, 3 - National Research Tomsk State Univ., Russia

Results of numeric simulation are presented in the report characterizing multichannel laser radiation propagation in nonlinear medium and in a turbulent atmosphere. Correction for turbulent and thermal distortions on the base of the beam phase control was considered. The obtained results demonstrate dependence of correction effectiveness on number of channels and on precision of a reference beam phase reconstruction.

WeR4-11 13:15-13:30

Optical stabilization and microscanning with piezo actuators and piezoelectric motors

P.V.Karev; Industrial Metrology Co LTD, Russia

Piezomotors and piezoactuators for microscanning and Gimbals optical stabilization. Miniature gimbals weigh 190 g with a diameter 58 mm ultrasonic piezo motors L1B2 based, characterized with high density of mechanical power, fast response and direct drive. Piezo stage for two coordinates lens scanning respectively IR detector is designed to produce a clearer image. XY piezo stage based on APA- piezoactuators.

WeR4-12 13:30-13:45

Modal control of a deformable mirror via the focal spot using actuator influence functions

D.A. Yagnyatinskiy, V.N. Fedoseyev; FSUE SRI SIA "LUCH", Russia

The paper reports on modal focal-spot-based algorithms for adaptive optics, that use generalized influence functions of the deformable mirror. Mersenne matrix is used to build that special modes. One of the algorithms gives higher speed of work, another—better precision.

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

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

Laser Electron Acceleration and Intense Radiation Generation

Session Chair: Paul McKenna,
Univ. of Strathclyde, UK

WeR5-12 09:00-09:30

X-ray radiation properties of plasma under interaction of femtosecond laser pulses with ~ 10^22 W/cm2 intensities *(Invited paper)*

S.A. Pikuz[1,2], A.Ya. Faenov[1,3], T.A. Pikuz[1,4], I.Yu. Skobelev[1,2], M.A. Alkhimova[1,2], A.S. Martynenko[1,2], M. Nishiuchi[5] , H. Sakaki[5], A. S. Pirozhkov[5] , A. Sagisaka[5], N.P. Dover[5], Ko. Kondo[5], K. Ogura[5], Y. Fukuda[5], H. Kiriyama[5], M. Kando[5], Y. Sentoku[6], M. Hata[6], A. Zigler[7], K. Nishitani[9], T. Miyahara[9], Y. Watanabe[9] , R. Kodama[3,4,6,8], K. Kondo[5]; 1- Joint Inst. for High Temperatures RAS, Russia; 2- National Research Nuclear Univ. «MEPhI», Russia; 3- Osaka Univ., Japan; 4- Graduate School of Engineering, Osaka Univ., Japan; 5- Kansai Photon Science Inst. QST, Japan; 6 - Inst. of Laser Engineering, Osaka University, Japan; 7- Hebrew Univ. of Jerusalem, Israel; 8- Photon Pioneers Center, Osaka University, Japan; 9- Kyushu Univ., Japan

Study of radiation properties of solid dense plasma irradiated by ultra-intense lasers has a great interest both from fundamental physics and different application point of views. We investigate the ionization mechanisms and measure the parameters of relativistic plasma from front and rear sides of moderate (Al) and high Z (Ti, Fe) thin foil targets using recently upgraded petawatt J-KAREN-P laser together with precise focusing technique. It is experimentally demonstrated for the first time that the laser pulse of over 1e21 W/cm2 intensity is absorbed neither in the solid density plasma nor in a pre-plasma of a common critical density, but in the matter of so called relativistic critical density. 2D PIC code simulations of femtosecond laser interaction with various materials are provided and compared with experimental results.

WeR5-13 09:30-10:00

Laser triggered radiation sources (from terahertz radiation to gamma-rays) *(Invited paper)*

A.V. Brantov[1], A.C.Kuratov[2], M.G. Lobok[2], Yu. M. Aliev[1], A. Maksimchuk[3], V.Yu. Bychenkov[1,2]; 1 - Lebedev Physical Inst. RAS, 2 - Center of Fundamental and Applied Research (CFAR), VNIIA, ROSATOM, Russia, 3 - Univ. of Michigan, USA

In this report we present recent studies of emission of secondary electromagnetic radiation in the interaction of short relativistically intense laser pulses with different targets. We present numerical simulation to optimize electron sources for Bremsstrahlung radiation and discuss several schemes of terahertz radiation due to laser-induced charge separation.

WeR5-14 10:00-10:15

Loading effect in the laser wakefield acceleration

N.E. Andreev[1,2], V.E. Baranov[1]; 1 - Joint Inst. for High Temperatures RAS, 2 - Moscow Inst. of Physics and Technology, Russia

The influence of the laser nonlinear dynamics to the longitudinal bunch compression and acceleration in the plasma wakefield, and also impact of the beam loading effect (self-action of the bunch charge) to the finite energy and the energy spread of the accelerated electrons are investigated.

WeR5-15 10:15-10:30

Electrons accelerated by tightly focused relativistic laser pulse for single shot peak intensity diagnostics

K.A. Ivanov[1,2], O.E. Vais[2], I.N. Tsymbalov[1], S.G. Bochkarev[2], V.Yu. Bychenkov[2], A.B. Savel'ev[1]; 1 - Lomonosov Moscow State Univ., 2 - Lebedev Physical Inst. RAS, Russia

A novel technique of peak intensity evaluation of tightly focused femtosecond laser pulse is proposed. The method is based on numerical and experimental studies of electrons angular distribution at acceleration in the field of laser radiation interacting with low density (<10^16cm-3) Helium. The possibility of laser pulse peak intensity estimation in each shot in range from 10^18 to 10^20 W/cm^2 is demonstrated.

WeR5-16 10:30-10:45

Two-color plasma THz far-field angular distribution conversion by focal length variation

P.A. Chizhov[1], A.A. Ushakov[1,2,3,4], V.A. Andreeva[2,3], N.A. Panov[2,3], D.E. Shipilo[2,3], M. Matoba[4], N.Nemoto[4], N. Kanda[5,6], K. Konishi[7], V.V. Bukin[1], M. Kuwata-Gonokami[4], J. Yumoto[4,7], O.G. Kosareva[2,3], S.V. Garnov[1], A.B. Saveliev[2,3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Lomonosov Moscow State Univ., 3 - International Laser Center of Lomonosov Moscow State Univ., Russia; 4 - Univ. of Tokyo, 5 - RIKEN Center for Advanced Photonics,[6,] 7 - Univ. of Tokyo, Japan

We study the angular and frequency-angular distributions of the low-frequency part (0.3–3 THz) of the terahertz emission from two-color femtosecond plasma spark experimentally and in 3D + time numerical simulations. Our experiments and simulations show, that the weakening in the focusing conditions results in the squeezing of the THz angular distribution and the formation of the bright conical emission.

WeR5-17 10:45-11:00

Supersonic jet targets for generation of the laser driven electron acceleration

S.V.Avtaeva[1], K.V.Gubin[1], V.I. Trunov[1], P.V. Tuev[2]; 1 - Inst. of Laser Physics SB RAS, 2 - Budker Inst. of Nuclear Physics SB RAS, Russia

Characteristics of nitrogen and helium pulse supersonic jets serving as target for realizing the laser driven electron acceleration at interaction of a high intensity ultra-short laser pulses with a gas jet are presented. Evolution of the jets in time and effect of backing pressure and a nozzle dimensions on jet characteristics were studied.

- Coffee Break -

Location: Stenberg 2 Room, floor 3. 11:30 - 13:45

Generation of Intense Fields and Gamma-Rays in Laser Plasmas

Session Chair: David Neely,
Central Laser Facility, UK

WeR5-18 11:30-12:00

Plasma optimization for efficient gamma production at relativistic intensities *(Invited paper)*

I.Tsymbalov[1,2], S.Shulyapov[1], A.Lar'kin[1], I.Mordvincev[1,3], D.Gozhev[1,3], K.Ivanov[1,3], D.Gorlova[1,2], G.Gospodinov[1], V.Prokudin[1], A.Senkevich[1], R.Volkov[1], A.Brantov[3], V.Bychenkov[3], V.Nedorezov[2], A.Savel'ev[1]; 1 - Lomonosov Moscow State Univ., 2 - Inst. for Nuclear Research RAS, 3 - Lebedev Physical Inst. RAS, Russia

We present experimental and numerical data on different approaches for efficient electron acceleration and gamma production at slightly relativistic intensities: optimized artificial prepulse for solid or liquid-metal target and structured targets.

WeR5-19 12:00-12:30

PW laser-driven bright γ-ray emission and dense positron production from diamondlike carbon foils *(Invited paper)*

T.-P. Yu[1,2], H.-Z. Li[1], Y. Yin[1], Z.-M. Sheng[2,3], P. McKenna[2], F.-Q. Shao[1]; 1 - National Univ. of Defense Technology, China; 2 - Univ. of Strathclyde, UK; 3 - Shanghai Jiao Tong Univ., China

We propose an all-optical scheme for ultra-bright γ-ray emission and dense positron production with lasers at intensity of 10^(22-23) Wcm^(-2). The electrons in the focal region of one diamondlike foil are rapidly accelerated by the laser radiation pressure and interact with the other intense laser pulse which penetrates through the second foil, enabling efficient γ-photon emission and GeV positron beam production.

WeR5-20 12:30-12:45

Generation of magnetic fields behind the front of an electrostatic shock wave in a laser plasma

A.N. Stepanov, M.A. Garasev, V.V. Kocharovsky, A.I. Korytin, Yu.A. Mal'kov, A.A. Murzanev, A.A. Nechaev; Inst. of Applied Physics RAS, Russia

The expansion of a hot dense plasmoid through a rarefied ionized medium has been studied experimentally and numerically. The plasma was evaporated from an alumium foil by a femtosecond laser pulse and propagated through a cold and tenuous plasma, generated from the same foil by a laser precursor. A density bump associated with a collisionless electrostatic shock wave was detected. Depolarization of a probe laser beam in the region behind the bump suggests that a strong magnetic field exists there. PIC-simulations show that the bump emerges due to the presence of the background and is exposed to a continuous flow of hot electrons from the plasmoid. At about 1000 inverse plasma frequencies of the dense plasma the anisotropy of the electron temperature, arising behind the shock, leads to the Weibel instability and growth of a quasi-static inhomogeneous magnetic field up to a magnetization level of 0.1.

WeR5-21 12:45-13:00

Investigation of the structure and dynamics of an expanding laser plasma in a strong magnetic field

M.V. Starodubtsev, A.A. Soloviev, K.F. Burdonov, A.A. Shaykin, A.A. Kuzmin, V.N. Ginzburg, A.A. Kochetkov, I.A. Shaykin, A.S. Zuev, I.V. Yakovlev, A.I. Korytin, A.A. Murzanev, A.V. Romashkin, A.N. Stepanov; Inst. of Applied Physics RAS, Russia

Dynamics of a laser plasma expanding from the solid target in a strong magnetic field is investigated by interferometry and probe pulse depolarization measurements. The plasma penetrates far into the magnetic field propagating with a velocity of the order of 107 cm/s. The formation of diamagnetic cavity free of magnetic field inside a plasma is observed.

WeR5-22 13:00-13:15

Role of self-generated magnetic fields in sheath-acceleration of protons at ultra-high laser intensities

A.V. Korzhimanov[1], M. Nakatsutsumi[2,3], L. Grimellet[4], J. Fuchs[1,2]; 1 - Inst. of Applied Physics RAS, Russia; 2 - LULI — CNRS, École Polytechnique, France; 3 - European XFEL, Germany; 4 - CEA, DAM, DIF, France

Recently it has been experimentally shown that target normal sheath acceleration of protons from ultra-thin targets irradiated by sub-picosecond laser pulses of intensities above 1021 W/cm2 is suppressed compared to well-established models. This has been attributed to a strong magnetic fields generated in the target. Here we would like to present a numerical and semi-analytical investigation of the observed effect.

WeR5-23 13:15-13:30

Resonant parametric interference effect at quantum electrodynamics processes in the field of two pulsed laser waves

S.P. Roshchupkin[1], A.V. Dubov[1], A.A. Lebed'[2], E.A. Padusenko[2]; 1 - Peter the Great St. Petersburg Polytechnic Univ., Russia; 2 - Inst. of Applied Physics NASU, Ukraine

In the present work we develop a theory of resonant spontaneous bremsstrahlung of an electron scattered by a Coulomb center and resonant electron-electron scattering in presence of an external field of two pulsed electromagnetic waves. The main aim of the work is detailed analysis of resonances of the studied process within the interference region.

- Lunch Break -

Location: Stenberg 2 Room, floor 3. 15:00 - 17:00

Structured Laser Plasmas

Session Chair: Julien Fuchs,
LULI, CNRS, France

WeR5-24 15:00-15:15

Restructuring electronic landscape of transparent dielectrics through ultra-short laser excitation

E.G. Gamaly, A.V. Rode; Australian National Univ., Australia

A close look into the properties of transparent dielectric excited by powerful ultrashort laser pulses reveals the formation of transient optically active state where the real part of permittivity passes through the zero value.

WeR5-25 15:15-15:30

Interferometry of laser plasma density distribution at superfilamentation regime in ambient air

A. Murzanev[1], S. Bodrov[1], D. Kartashov[2], Z. Samsonova[2], M. Petrarca[3]; 1 - Inst. of Applied Physics RAS, Russia; 2 - Inst. für Optik und Quantenelektronik Friedrich-Schiller-Univ. Jena, Germany; 3 - La Sapienza Univ., Italy

Plasma density spatial distribution at superfilamentation regime of femtosecond laser radiation in ambient air was measured by precision interferometry technique. It was shown that at weak focusing (f-number 125) the filaments formed before the focus converged near the focus and formed superfilament without changing the plasma density while at stronger focusing (f-number 50) the plasma density in each filament increased several times.

WeR5-26 15:30-15:45

Coherent combining of multipetawatt laser beams for generation of ultrarelativistic intensity pulses

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

Requirements on the most critical pulse parameters for high efficiency coherent combining of multipetawatt laser pulses and their dependence on the number of channels are analyzed. The influence of the spatial profile of the combined pulses and its phase distortions, including experimental data, on the efficiency of coherent beam combining is discussed.

WeR5-27 15:45-16:00

Backward terahertz emission from a two-color laser induced microplasma

A.A. Ushakov[1,2,3,4], M. Matoba[4], N. Nemoto[4], N. Kanda[5,6], K. Konishi[7], P.A. Chizhov[1], N.A. Panov[2,3], D.E. Shipilo[2,3], V.V. Bukin[1], M. Kuwata-Gonokami[4], J. Yumoto[4,7], O.G. Kosareva[2,3], 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, Moscow State Univ., Russia; 4 - Univ. of Tokyo, 5 - RIKEN Center for Advanced Photonics, 6 - Photon Science Center, Univ. of Tokyo, Tokyo, 7 - Inst. for Photon Science and Technology, Univ. of Tokyo, Tokyo, Japan

We demonstrate the first experimental observation of backward terahertz emission from the two-color laser induced microplasma in air. The ratio of measured backward-to-forward terahertz radiation is close to 1/25. This result agrees with numerical simulations based on interferometric model assuming 260-300μm long plasma source.

WeR5-28 16:00-16:15

Tracing the initial electron localization dynamics in ionized liquid water

M. Woerle, R. Kienberger, H. Iglev; Technical Univ. of Munich, Germany

We used a novel phase-sensitive transient absorption spectroscopy with few-cycle pulses to study the photoionization of liquid water. The phase changes elucidate the initial localization of the excess electron, while its subsequent solvation dynamics is monitored via transient absorption.

WeR5-29 16:15-16:30

Thermal breakdown of femtosecond laser writing at heat cumulative regime in fused silica

N.N. Skryabin[1,2], M.A. Bukharin[2], D.V. Khudyakov[3]; 1 - Moscow Inst. of Physics and Technology, 2 - Optosystems Ltd, 3 - Physics Instrumentation Center of the GPI RAS, Russia

The investigation of a thermal breakdown at cumulative regime in fused silica is reported. Assumptions about the cause and method of avoidance are made.

WeR5-30 16:30-16:45

Influence of beam shaping on TLIPSS formation under femtosecond laser irradiation

A.V.Dostovalov[1,2], V.P. Korolkov[1,2], V.S. Terentyev[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 the thermochemical laser-induced periodic surface structures formation on Cr film at femtosecond irradiation with elliptical spot shape at different powers, repetition rate and scanning speeds.

WeR5-31 16:45-17:00

The control of beam filamentation under amplification and transportation of subpicosecond TW KrF laser pulses in ambient air

V.D. Zvorykin, A.A. Ionin, D.V.Mokrousova, L.V. Seleznev, I.V. Smetanin, A.V. Shutov, N.N. Ustinovskii; Lebedev Physical Inst. RAS, Russia

A number of methods has been developed to control multiple filamentation of TW-power sub-ps KrF laser pulses envisaged for HV discharge and MW radiation guiding, atmospheric air laser pumping, and filamentation suppression in target irradiation.

- Coffee Break -

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

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

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

Session Chair: Victor Shargorodskiy,
OJSC «RPC «Precision Systems and Instruments», Russia 195

WeR6-01 15:00-15:15

High average power lasers for space environment management

Y. Gao, Y. Wang, C. Smith, B. Greene; EOS Space Systems Pty Ltd, Australia

Different high average power systems are developed and evaluated for tracking and maneuvering space debris. The pulsed systems generating 6–20ns pulse width, 4.7J, M2 ~ 3, 100–200Hz have been in automated 24/7 operation for years with excellent reliability. Roadmaps for actively maneuvering space debris using ground based pulsed and CW lasers will be described with results and milestones achieved presented.

WeR6-02 15:15-15:30

The current state and trends in development of laser ranging to artificial Earth satellites

S.A. Martynov, M.A. Sadovnikov, V.D. Shargorodskiy; JC RPC «PSI», Russia

The paper studies the current trends in development of precision laser ranging to artificial Earth satellites as a fundamental measuring technology for space geodesy and navigation. It is demonstrated that in order to complete advanced tasks of space geodesy and navigation, one requires a significant improvement of technical characteristics of the modern-day SLR-stations. Through the example of the Russian new generation SLR station «Tochka» the authors provide key technical solutions enabling achievement of the required technical characteristics. Also, the paper considers and explains the require-ments for high-frequency picosecond laser transmitters, implementation of which is essential to development of new generation laser stations.

WeR6-03 15:30-15:45

Laser technology applications in moon exploration

E.V. Titov, V.V. Smashniy, P.G. Kozlov; The Affiliated Branch "Precision Navigation and Ballistic Support" of JSC RPC PSI, Russia

The paper analyses the efficient practice of laser technology applications in Moon exploration. The prospects of developing lunar laser telecommunication and navigation systems are highlighted. A mathematical model for the motion of lunar artificial satellites developed by the authors is described. An approach to the verification of the model using terrestrial laser ranging devices is presented.

WeR6-04 15:45-16:00

Laser coordinate-time support for lunar missions

E.V. Korovaitseva, A.B. Lukin, S.A. Martynov, A.A. Chubykin, V.D. Shargorodskiy; JC «RPC «PSI», Russia

The paper explains the configuration of laser aids needed for navigation and selenodetic support for lunar missions. The paper studies laser methods for determination of coordinates of the satellites moving along near-lunar orbits using the data from one- and two-way ranging to the GLONASS satellites and lunar-based reference points. The paper studies laser methods for collation of the GLONASS system time scales with the time scales of orbital near-lunar and lunar -based objects. The paper presents methods for usage of laser aids as applied to selenodetic measurements and selenodetic reference frame monitoring. The paper provides the technical requirements for laser equipment.

WeR6-05 16:00-16:15

ZY3-02 satellite laser altimeter

Y. Zheng, S. Zhao, W. Shang, J. Zhang, Z. Shen; Beijing Inst. of Space Mechanics & Electricity, China

ZY3 satellites, belonged to China Resource Satellite series, are mainly used for high-resolution stereo mapping. ZY3-02 satellite, succeeding to ZY3-01 satellite, has equipped with a laser altimeter, which is Chinese first experimental laser altimeter payload used for earth observation. ZY3-02 satellite was launched on 30th May 2016, with the orbit of 505.984km and incline angle of 97.421°. After ground geometric calibration, the absolute vertical accuracy of laser altimeter can be improved to about 1 meter in the flat area and 0.5 meter with a small amount point.

WeR6-06 16:15-16:30

The diode-pumped solid-state slab-laser design for space applications

D.A. Arkhipov, Yu.A. Rezunkov, V.I. Venglyuk; Research Inst. for Optic-Electronic Engineering, Russia

In the paper, a new design of the diode-pumped solid-state slab-laser is proposed as applied to the space laser communication and laser ranging optical systems. The laser design is based on the use of the special thermal physic and optic technologies to stabilize the laser radiation output characteristics, including output power, laser beam divergence and so on. The original laser module includes itself such optical elements as Nd: YAG slab that is pumped by a light of 400W QCW diodes, two-pass unstable optical resonator with the effect of a rotation of a beam aperture inside the resonator about its axis through 180°, output resonator mirror with a variable reflection coefficient, as well as hyper conductive thermal plate allowing removing a released heat out off the module.

WeR6-07 16:30-16:45

The new laser methods for marine geodesy

I.A. Gureeva[1], V.A. Katenin[1], A.A. Chubykin[2]; 1 - JC «GNINGI», Russia; 2 - JC «RPC «PSI», Russia

The paper studies the new laser methods for marine geodesy based on the multipurpose use of laser and radio altimeters installed on low-orbit geodetic satellites and laser system for inter-satellite measurement and data transfer. The paper presents methods for precision tie of the marine geodetic network's reference points to the ground geodetic network using both orbital and ground-based laser aids. The paper studies laser methods for highly accurate control over the distance between ground-based geodynamic and geodetic points located in hard-to-reach areas based on two-way satellite ranging data. The paper studies methods of using the laser aids for seabed mapping and cartographic survey data binding to geocentric (geodetic) reference frames. The paper provides the characteristics of the laser aids.

WeR6-08 16:45-17:00

The family of picosecond Nd: YAG lasers

A.S.Davtian[1,2], A.F.Kornev[1,2], V.V.Koval[2]; 1 - "Lasers and Optical Systems" Co. Ltd., Russia; 2 - ITMO Univ., Russia

We developed an approach that ensures high shape stability of intense Nd:YAG laser pulses, based on a "microchip laser – regenerative amplifier" scheme. High-quality laser beam (M2<1.4) at 532 nm with 100-ps 2.5 mJ (RMS<1%) pulses was obtained at the repetition rates up to 1000 Hz. The reported architecture is flexible enough to design lasers that meet different requirements.

WeR6-09 17:00-17:15

Application of state-of-the-art laser emitters for completion of advanced tasks at the Altai Optical-Laser Center

I.A. Grechukhin, E.A. Grishin, O.A. Ivlev, M.A. Sadovnikov, V.D. Shargorodskiy; JC «RPC «PSI», Russia

The multifunctional telescope system which is currently under development at JC «RPC «PSI» will be capable of not only achieving major goals in photometry and collection of coordinate information on low-orbit space objects, but also of completing a number of tasks associated with the use of powerful laser emission for determination of the parameters of ephemerides of the space objects located at the range of up to 400,000 km and determination of their coordinat information, as well as for detection of space debris elements and determination of their motion parameters.

- Coffee Break -

TECHNICAL SESSION

R7. LASERS IN ENVIRONMENTAL MONITORING

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

Lasers in Environmental Monitoring I

Session Chair: Alexandr A. Cheremisin,
Irkutsk State Univ. of Railway Engineering, Russia 321

WeR7-01 15:00-15:15

Laser-induced breakdown spectroscopy as an effective approach for study of nanocarbon materials

M.K. Rabchinskii[1], V.F. Lebedev[2], M.S. Kozlyakov[2], D.N. Stepanov[2], A.V. Shvidchenko[1], N.V. Nikonorov[2], A.Ya. Vul'[1]; 1 - Ioffe Inst., 2 - ITMO Univ., Russia

We demonstrated that functionalization parameters and presence of inorganic contaminants can be effectively determined by the use of LIBS method. Considering simplicity and versatility of this technique, LIBS method can be regarded as an effective approach for study of nanocarbon materials.

WeR7-02 15:15-15:45

Stand-off detection of explosives vapors and explosives traces using lasers *(Invited paper)*

S.M.Bobrovnikov[1,2], E.V.Gorlov[1,2], V.I.Zharkov[1], Yu.N.Panchenko[3]; 1 - Zuev Inst.of Atmospheric Optics SB RAS, 2 - National Research Tomsk State Univ., 3 - Inst. of High Current Electronics SB RAS, Russia

The possibility of remote detection of explosives vapors and traces using laser fragmentation/laser-induced fluorescence (LF/LIF) is studied. Experimental data on the remote visualization of traces of trinitrotoluene (TNT), hexogen (RDX), trotyl-hexogen (Comp B), octogen (HMX), and tetryl with a scanning lidar detector of traces of nitrogen-containing explosives at a distance of 5 m are presented.

WeR7-03 15:45-16:00

Effect of temperature on properies of explosives sensor based on porous silicon microcavity with an embedded conjugated polymer

I.L. Martynov, E.V. Osipov, G.E. Kotkovskii, A.E. Akmalov, A.A. Chistyakov; National Research Nuclear Univ. MEPhI, Russia

Effect of temperature on luminescence of the MDMO-PPV polymer embedded in a porous silicon (pSi) microcavity (MC) was studied. The contribution of different mechanisms to temperature-induced shift of MC eigenmode was examined. It was shown that heating of MC can be used to clean its surface, while cooling allows drastic reduce the response time of MDMO-PPV luminescence to TNT vapors.

WeR7-04 16:00-16:15

LIF and SFS techniques for early detection of biofilms harmful for cultural heritage

A.B. Utkin[1,2], P. Chaves[1,3], L. Fernandes[1], I.V. Pinto[4], M.J. Revez[5]; 1 - INOV-INESC Inovação; 2 - CeFEMA, Univer. de Lisboa; 3 - Escola Náutica Infante D. Henrique; 4 - Troia Resort – Investimentos Turísticos; 5 - Nova Conservação Lda, Portugal

Specific LIF (laser induced fluorescence) and SFS (spectral fluorescence signature) sensors have been developed for detecting biofilms colonizing the surface of cultural heritage artefacts. The sensors contribute to a large-scale monitoring and decision supporting system, which is being deployed for historical monument protection within the framework of the European project STORM.

WeR7-05 16:15-16:30

Pulsed laser charging of dust particles

A.Boreysho[1,2], S.Ivakin[1,2], A.Savin[1], A.Sergeev[1]; 1 - Ustinov Baltic State Technical Univ., 2 - Laser Systems LLC, Russia

As a step forward to pulsed laser charging of dust particles an experiment setup for photoionization of BaO particles on a metal grid in vacuum is demonstrated. The indused pulsed photocurrent is registrated.

WeR7-06 16:30-16:45

Flow immune photoacoustic sensor for real-time and fast sampling of trace gases

J. C. Petersen[1], D. Balslev-Harder[1], N. Pelevic[2], A. Brusch[1], S. Persijn[2], M. Lassen[1]; 1 - Danish Fundamental Metrology, Denmark; 2 - The Dutch Metrology Inst., The Netherlands

A photoacoustic (PA) sensor for fast and real-time gas sensing is demonstrated. The PA sensor will contribute to solve a major problem in a number of industries using compressed air by the detection of oil contaminants in high purity compressed air. We observe a standard deviation sensitivity of 0.4 ppb (nmol/mol) for hexane in clean air at ow rates up to 2 L/min. By simply changing the excitation wavelength (i.e. the laser source) the PA sensor is useful for many different applications where fast and sensitive trace gas measurements are needed.

WeR7-07 16:45-17:00

Laser excitation of coherent Gigahertz vibrations in plant viruses

S.M. Pershin[1], N.V. Tcherniega[2], A.F.Bunkin[1], E.K. Donchenko[3], O.V. Karpova[3], A.D. Kudryavtseva[2], T.V.Mironova[2], M.A.Strokov[2], M.A.Shevchenko[2], K.I. Zemskov[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Lebedev Physical Inst. RAS, 3 - Lomonosov Moscow State Univ., Russia

Stimulated low-frequency Raman scattering has been registered in different plant viruses, placed in water or Tris-HCl pH7.5 buffer. Frequency shifts of the scattered light components have been measured with the help of Fabri-Perot interferometers. High efficiency of the scattering is evidence of the effective excitation of gigahertz vibrations in viruses.

- Coffee Break -

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

Lasers in Environmental Monitoring II

Session Chair: Alexandr P. Zhevlakov,
ITMO Univ., Russia

WeR7-08 17:30-18:00

Diode laser spectroscopy instrument design for in situ study of atmosphere near the Martian surface *(Invited paper)*

I.I. Vinogradov[1], V.V. Barke[1], V.A. Kazakov[1,2], Yu.V. Lebedev[1], A.V. Rodin[1,2], O.Z. Roste[1], A.A. Venkstern[1], A.Yu. Klimchuk[2,1], V.M. Semenov[2], V.V. Spiridonov[3], J. Cousin[4], G. Durry[4], M. Ghysels-Dubois[4], L. Joly[4]; 1 - Space Research Inst. RAS, 2 - Moscow Inst. of Physics and Technology (MIPT), 3 - Prokhorov General Physics Inst. RAS, 4 - Univ. de Reims, France

An application of tunable diode laser absorption spectroscopy in combination with integrated cavity output spectroscopy was proposed for Martian atmosphere study as a Martian multichannel diode laser spectrometer, or M-DLS experiment. M-DLS instrument has been further modified into a compact and lightweight device for continuous in situ study of chemical and isotopic composition variations of atmosphere near the Martian surface at the ExoMars-2020 mission stationery Landing Platform.

WeR7-09 18:00-18:15

New laser studies for atmospheric, geochemical and planetary research

C. Janssen[1,2], C. Boursier[1], H. Elandaloussi[1], J. Gröbner[3], D. Jacquemart[4], P. Jeseck[1], T. Kluge[2], M. Minissale[5,6], Y. Té[1], I. Prokhorov[2], T. Zanon-Willette[1]; 1 - Sorbonne Univ., France; 2 - Heidelberg Univ., Germany; 3 - Physikalisch Meteorologisches Observatorium Davos, World Radiation Center, Switzerland; 4 - Sorbonne Univ.;[5,] 6 - Aix Marseille Univ, CNRS, France

Ozone and carbon dioxide are important trace gases in oxidative and chemical cycles of planetary atmospheres. We present new high precision spectroscopic studies on ozone using gas and solid state lasers, which will help to set up a consistent and traceable set of ozone spectroscopic data (absorption cross sections, line intensities and shifts) and spans the UV, VIS and mid-IR ranges (0.325, 0.633 and 9.54 μm). First results of a direct UV mid-IR inter-comparison study on ozone using a high resolution Fourier transform spectrometer will also be shown. Furthermore, the possibility of measuring simultaneously all six most abundant carbon dioxide isotopologues (16O12C16O, 16O13C16O,16O12C18O,16O12C17 O,16O13C18, and 16O13C17O) using a new laser spectroscopic analyzer based on IC-lasers in the mid- IR (4.4 μm) is also demonstrated. The currently reached precision of 50 ppm in 16O13C18O is sufficient for the development of an all optical isotope thermometer for geochemical applications.

WeR7-10 18:15-18:30

New-type lidar with eye-safe laser energy level: from Mars mission MPL-99 to unmanned "Google car"

S.M. Pershin[1], I. Prochazka[2], V.S. Makarov[3], D.V. Patsaev[3], A.V. Bukharin[3], A.N. Lyash[3], A.V. Turin[3]; 1 - Prokhorov General Physics Inst. RAS, Russia; 2 - Prague Technical Univ., Czech Republic; 3 - Space Research Inst. RAS, Russia

In 1991 we have developed a new-type lidar with eye-safe energy density (1 μJ.cm–2), based on a diode laser and a gated SPAD detector. In 1996 it was involved in NASA mission «Mars Polar Lander-99», winning strong competition among others. Now this lidar is widely used in different fields: unmanned cars, multilayered clouds height, ice thickness measurements and 3D-relief.

WeR7-11 18:30-18:45

Multilayered clouds sensing by microJoule lidar through strong snowstorm

S.M. Pershin[1], A.V. Bukharin[2], A.N. Lyash[2], V.S. Makarov[2], A.V. Turin[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Space Research Inst. RAS, Russia

The portable aerosol lidar with eye-safe energy density (1 μJ/cm2), based on a diode laser and a quantum counter (SPAD) was developed. The multilayered clouds through strong snowstorm were detected for the first time. Moreover the backscattering signal from the first 200-250 m along the lidar trace was so strong that the detector was overloaded.

WeR7-12 18:45-19:00

Complexed NIR laser detector and LWIR camera optical system with neural network management for UAV collision avoidance system

V.M. Polyakov, I.N. Kaliteevsky, K.S. Amelin, V.A. Smyslov, M.A. Permyakov; GK «R-Aero» Ltd Co, Russia

We developed a compact multispectral active optical system for detection of passive diffusely-reflecting and active thermal objects. The system contains an active laser detector and a passive LWIR finder. The detectors are complexed by means of neural network realized on 256 core video processor. The fast response is realized by field-programmable gate array processing of the raw signal.

WeR7-13 19:00-19:15

NIR-to-NIR thermal sensing using luminescence intensity ratio, line position and line bandwidth

I.E. Kolesnikov[1], A.A. Kalinichev[1], M.A. Kurochkin[1], E.V. Golyeva[2,3]; 1 - St. Petersburg State Univ., 2 - Peter the Great St. Petersburg Polytechnic Univ., 3 - Vavilov State Optical Inst., Russia

We report on the potential application of NIR-to-NIR Nd3+-doped yttrium vanadate nanoparticles as thermal sensors in 123-873 K temperature range. It was demonstrated that thermal sensing could be based on the luminescence intensity ratio, the spectral line position and the line bandwidth. Advantages and limitations of each sensing parameter and thermal sensitivity and thermal uncertainty were discussed.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

Location: Petrov-Vodkin 2+3 Room, floor 2. 15:00 - 17:00

THz Optics

Session Chair: Andrey A. Sukhorukov, Australian National Univ., Australia

WeR8-12 15:00-15:30

Polarization of terahertz radiation from two-color femtosecond gas breakdown plasma *(Invited paper)*

O. Kosareva[1], M. Esaulkov[2], N. Panov[1], V. Andreeva[1,3], D. Shipilo[1], P. Solyankin[1,2], A. Demircan[4], I. Babushkin[4], V. Makarov[1], U. Morgner[4], A. Shkurinov[1,2], and A. Savel'ev[1]; 1 - Lomonosov Moscow State Univ., Russia; 2 - ILIT of RAS, Branch of the FSRC "Crystallography and Photonics" RAS, Russia; 3 - Univ. of Minnesota, USA; 4 - Leibniz Univ. Hannover, Germany

We measure a linear-to-elliptical THz signal from two-color femtosecond plasma with individually controlled initial polarizations of 800 and 400 nm beams. A threshold-like appearance of THz ellipticity at the angle of ~85° between the harmonic fields' polarization directions is a result of the weak ellipticity of the second harmonic obtained during propagation.

WeR8-13 15:30-16:00

Terahertz wave generation from liquid gas *(Invited paper)*

A.V. Balakin[1,2], A.F. Bunkin[3], V.A. Makarov[1,4], I.A. Kotelnikov[5,6], N.A. Kuzechkin[1,2], A.B. Savelev[1], P.M. Solyankin[1,2], A.P. Shkurinov[1,2,4]; 1 - Lomonosov Moscow State Univ., 2 - Inst. on Laser and Information Technologies RAS, 3 - Prokhorov General Physics Inst. RAS, 4 - National Univ. of Science and Technology MISiS, 5 - Budker Inst. of Nuclear Physics, 6 - Novosibirsk State Univ., Russia.

We present results of our research on generation of THz radiation in liquid nitrogen. We used a dual-frequency scheme when emissions of the main laser frequency and its second harmonic are mixed in the same medium. The research showed a possibility of effective conversion of optical radiation into THz radiation.

WeR8-14 16:00-16:15

Generation and detection of optical-terahertz biphotons via spontaneous parametric down-conversion

K.A. Kuznetsov[1], V.V. Kornienko[1,2], Yu.B. Vakhtomin[3], I.V. Pentin[3], K.V. Smirnov[3], G.Kh. Kitaeva[1]; 1 - Lomonosov Moscow State Univ., 2 - Research Inst. of Automatics (VNIIA), 3 - Moscow State Pedagogical Univ., Russia

We study spontaneous parametric down-conversion (SPDC) in the strongly non-degenerate regime when the idler wave hits the terahertz range. By using the hot-electron bolometer, for the first time the SPDC-generated idler-wave photons were directly detected in the terahertz frequency range. Spectrum of corresponding signal photons was measured using standard technique by the CCD camera. Possible applications of correlated optical-terahertz biphotons are discussed.

WeR8-15 16:15-16:30

All-dielectric metasurface for enhanced optical-to-terahertz convertion efficiency in photoconductive antenna

S. Lepeshov[1], V. Mikhailovskii[2], D, Elets[2], A, Tsypkin[1], A. Krasnok[3], A. Gorodetsky[1,4]; 1 - ITMO Univ., 2 - St. Petersburg State Univ., Russia; 3 - Univ. of Texas at Austin, USA, 4 - Imperial College London, UK

We propose dielectric nanoantenna enhanced compact room-temperature operating hybrid photoconductive antennas (PCAs). Dielectric nanostructures in the PCA gap are deposited by focussed ion beam (FIB) and electro nanolithography methods. The resulting nanoantenna enhanced metasurfaces show 5-fold increase in pump radiation absorption, thus leading to THz generation enhancement.

WeR8-16 16:30-16:45

Toward the theory of THz laser with graphene based asymmetrical hyperbolic metamaterial

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

Theoretical model of the terahertz laser, based on graphene-multilayer asymmetric hyperbolic metamaterials, strongly coupled to terahertz radiation is present. Gain saturation was taken into account.

WeR8-17 16:45-17:00

Thermal mechanism of laser-induced THz generation from metal particles

D.A. Fadeev, I.V. Oladyshkin, V.A. Mironov; Inst. of Applied Physics RAS, Russia

Ultrafast heating of metal nanoparticles by the laser pulse found to be the source of coherent terahertz (THz) radiation due to the heat redistribution processes. Numerical modeling showed that after the femtosecond laser pulse action the time-dependent gradient of the electronic temperature induces low-frequency particle polarization with the characteristic timescale of about fractions of picosecond.

- Coffee Break -

Location: Petrov-Vodkin 2+3 Room, floor 2. 17:30 - 19:30

Photonic Crystals

Session Chair: Alexander P. Shkurinov,
Lomonosov Moscow State Univ., Inst. on Laser and Information Technologies RAS, National Univ. of Science and Technology MISiS

WeR8-18 17:30-18:00

Multi-dimensional synthetic photonic lattices *(Invited paper)*

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

We present the theoretical concepts and experimental results on the realization of multi-dimensional photonic lattices in planar optical platforms.

WeR8-19 18:00-18:30

Laser pulse spitting effect in second harmonic generation from 1D photonic crystals in the Laue geometry *(Invited paper)*

V.B. Novikov, B.I. Mantsyzov, T.V. Murzina; Lomonosov Moscow State Univ., Russia

We experimentally revealed optical second harmonic generation in 1D photonic crystal under the Bragg diffraction in the Laue geometry under the effect of diffraction induced laser pulse splitting. We demonstrated that nonlinear signal can be maximized by tuning the duration of a femtosecond laser pump pulse. Experimental results are confirmed by numerical simulation that involves the nonlinear full vectorial FDTD code executed by using the supercomputer resources.

WeR8-20 18:30-19:00

Photonic crystal microchip laser *(Invited paper)*

K. Staliunas[1], D. Gailevicius[2], V. Koliadenko[3], V. Taranenko[3], V. Purlys[2], M. Peckus[2]; 1 - Univ. Politecnica Catalunya, Spain; 2 - Vilnius Univ., Lithuania; 3 - Inst. of Applied Optics NASU, Ukraine

We show, theoretically and experimentally, that photonic crystals with spatial filtering functionality, inside of a microchip laser cavity, can substantially improve spatial characteristics of the emission of microchip laser. The angular divergence of the emitted beam is reduced, and the radiation brightness is increased.

WeR8-21 19:00-19:15

Experimental demonstration of broadband optical Tamm states in photonic crystal

S.E. Svyakhovskiy[1], R.G. Bikbaev[2,3], S.A. Myslivets[2,3], S.A. Evlashin[4], A.M. Vyunishev[2,3], P.S. Pankin[2,3], I.V. Timofeev[2,3], S.Ya. Vetrov[2,3], V.G. Arkhipkin[2,3]; 1 - Lomonosov Moscow State Univ., 2 - Kirensky Inst. of Physics, 3 - Siberian Federal Univ., 4 - Skolkovo Inst. of Science and Technology, Russia

We present the theoretical and experimental investigations of optical bound state at the interface of photonic crystal and metal film. The reflectance of the wide-gap photonic crystal can be suppressed by absorption in broadband spectral range.

WeR8-22 19:15-19:30

Purcell effect in a disordered photonic crystals

K.M. Morozov[1,2], A.R. Gubaydullin[1,2], K.A. Ivanov[2], G.P. Pozina[3], M.A. Kaliteevski[1,2,4]; 1 - St. Petersburg National Research Academic Univ., 2 - ITMO Univ., Russia; 3 - Linköping Univ., Sweden; 4 - Ioffe Inst., Russia

We demonstrate that disorder in photonic crystals could lead to a modification of spontaneous emission rate in the frequency region corresponding to a photonic band gap (PBG). Depending on the amount of disorder two different regimes of Purcell effect occurs occurs. For weak disorder Purcell enhancement of spontaneous emission occurs at PBG edges, for strong disorder at PBG centre.

R11. NONLINEAR AND QUANTUM INTEGRATED OPTICS

Location: Rihter Room, floor 3. 09:30 - 11:00

Integrated nonlinear and quantum phenomena

Session Chair: Roberto Morandotti,
Inst. National de la Recherche Scientifique-Énergie Matériaux Télécommunications, Canada

WeR11-01 09:00-09:30

Wavelength multiplexed hyper-entanglement for high channel capacity quantum communication *(Invited paper)*

P. Vergyris[1], F. Mazeas[1], E. Gouzien[1], L. Labonté[1], O. Alibart[1], F. Kaiser[1,2,3], S. Tanzilli[1]; 1 - Univ. Côte d'Azur, CNRS, France; 2 - Univ. Stuttgart, Germany; 3 - Center for Integrated Quantum Science and Technology (IQST), Germany

We present an experimental setup showing an order of magnitude increase of quantum channel capacity compared to standard entanglement distribution. Two strategies are combined: i) photon pairs are simultaneously entangled over two observables (polarization and creation time), and ii) dense wavelength de-multiplexing permits distributing entangled photons over 5 independently correlated wavelength channel pairs.

WeR11-02 09:30-09:45

Extinction ratio improvement of lithium niobate modulators for quantum communication systems

A.V. Tronev[1,2], I.V. Ilichev[2], P.M. Agruzov[2], M.V. Parfenov[2], L.V. Shamray[3], A.V. Shamray[1,2]; 1 - ITMO Univ., 2 - Ioffe Inst., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

A method for photorefractive trimming of lithium niobate integrated optical modulators was developed. An improvement in the extinction ratio in a Mach-Zehnder (MZ) modulator by photorefractive precision adjustment of its couplers was achieved. An increase in the extinction ratio by 18 dB (from 30 to 48 dB) was demonstrated.

WeR11-03 09:45-10:15

Hybrid quantum photonic integrated circuits *(Invited paper)*

A.W. Elshaari[1], I. Esmaeil Zadeh[2], A. Fognini[2], D. Dalacu[3], P. J. Poole[3], M. E. Reimer[4], V. Zwiller[1,2], K.D. Jöns[1]; 1 - Royal Inst. of Technology, Sweden; 2 - Delft Univ. of Technology, The Netherlands; 3 - National Research Council of Canada, 4 - Univ. of Waterloo, Canada

We develope a new hybrid on-chip nanofabrication approach to integrate III/V semiconductor nanowire quantum emitters into silicon-based photonics.

WeR11-04 10:15-10:30

Generation of soliton combs with multi-frequency diode laser self-injection locked to a microresonator

N.G. Pavlov[1,2], S. Koptyaev[3], G.V. Lihachev[2,4], A.S. Gorodnitskii[1,2], A.S. Voloshin[2], M.L. Gorodetsky[2,4]; 1 - Moscow Inst. of Physics and Technology, 2 - Russian Quantum Center, 3 - Samsung R&D Inst. Russia, 4 - Lomonosov Moscow State Univ., Russia

We demonstrate a transformation of a regular multi-frequency Fabry-Perot laser diode spectrum to a single-frequency ultra-narrow-linewidth source and a coherent soliton comb oscillator via self-injection locking to an optical microresonator.

WeR11-05 10:30-11:00

On-chip coherent photonic-phononic memory *(Invited paper)*

B. Stiller, M. Merklein, B.J. Eggleton; Univ. of Sydney, Australia

We store optical data in acoustic waves on a planar waveguide based on stimulated Brillouin scattering (SBS) and demonstrate multiple conversions of information between the optical and acoustic domain. We show the coherent acousto-optic transfer by retrieving multiple amplitude and phase levels with GHz bandwidth and demonstrate multi-wavelength operation.

- Coffee Break -

Location: Rihter Room, floor 3. 11:30 - 13:30

Frequency combs and nonlinear interactions in integrated systems

Session Chair: Jean Sebastien Tanzilli,
Univ. Côte d'Azur, CNRS, Inst. de Physique de Nice (INPHYNI), France

WeR11-06 11:30-12:00

Observation of super cavity solitons *(Invited paper)*

M. Erkintalo[1], M. Anderson[1,2], Y. Wang[1], F. Leo[1,3], S. Coen[1], S.G. Murdoch[1]; 1 - Univ. of Auckland, New Zealand; 2 - École Polytechnique Fédérale de Lausanne, Switzerland; 3 - Univ. libre de Bruxelles, Belgium

We describe recent experimental observations of coexisting nonlinear states, including so-called super cavity solitons, in tristable passive Kerr resonators.

WeR11-07 12:00-12:15

Semiconductor laser chip stabilization by Si3N4 microresonator and Kerr comb generation

S. Agafonova[1,2], A. Voloshin[1], A. Gorodnitskiy[1,2], A. Shitikov[1,4], M. Pfeiffer[3], T. Kippenberg[3], M. Gorodetsky[1,4]; 1 - Russian Quantum Center, 2 - Moscow Inst. of Physics and Technology, Russia, 3 - École Polytechnique Fédérale de Lausanne, Switzerland; 4 - Lomonosov Moscow State Univ., Russia

The experimental study of the InP laser diode stabilization by high-Q Si3N4 microresonator is presented. We demonstrate how this stabilized laser diode considered as a pump laser may be used for optical frequency comb generation in the same microresonator. Various properties of the stabilized laser linewidth and the optical frequency comb are measured.

WeR11-08 12:15-12:45

Microresonator frequency combs for long-haul coherent communications *(Invited paper)*

A. Fülöp[1], M. Mazur[1], A. Lorences-Riesgo[1,2], T.A. Eriksson[1,3], P.-H. Wang[4], Y. Xuan[4], D.E. Leaird[4], M. Qi[4], P.A. Andrekson[1], A.M. Weiner[4], V. Torres[1]; 1 - Chalmers Univ. of Technology, Sweden; 2 - Inst. de Telecomunicações, Portugal; 3 - National Inst. of Information and Communications Technology (NICT), Japan; 4 - Purdue Univ., USA

Microresonator frequency combs provide a promising platform as multi-wavelength light sources for WDM. The results discussed here show that microresonators can be used in long-haul optical communications systems.

WeR11-09 12:45-13:00

Figure-eight laser with an integrated nonlinear waveguide: all-optical square-wave generation

A.V. Kovalev[1], A. Aadhi[2], M. Kues[2,3], P. Roztocki[2], Ch. Reimer[2], Yo. Zhang[2], T. Wang[2,7], A. Matuhina[1], B.E. Little[4], S.T. Chu[5], D.J. Moss[6], Zh. Wang[7], E.A. Viktorov[1], R. Morandotti[1,2,7]; 1 - ITMO Univ., Russia; 2 - Inst. National de la Recherche Scientifique – Énergie Matériaux Télécommunications, Canada; 3 - Univ. of Glasgow, UK; 4 - Xi'an Inst. of Optics and Precision Mechanics, China; 5 - City Univ. of Hong Kong, China; 6 - Swinburne Univ. of Technology, Australia; 7 - Univ. of Electronic Science and Technology of China, China

We characterize the generation of square waves from a figure-eight laser that incorporates an on-chip nonlinear waveguide. By varying the gain parameters, we show multiple dynamical regimes of operation, hysteretic behavior, and the bistability of CW operation leading to square wave pulses.

WeR11-10 13:00-13:30

Flat-band states and image transmission in photonic lattices *(Invited paper)*

Sh. Xia[1], A. Ramachandran[2], Sh. Xia[1], D. Li[1], X. Liu[1], L. Tang[1], D. Song[1], S. Flach[2], Zh. Chen[1,3]; 1 - Nankai Univ., China; 2 - Inst. for Basic Science (IBS), Republic of Korea; 3 - San Francisco State Univ., USA

We present simple yet effective approaches to establish Lieb photonic lattices without the need of femtosecond laser-writing facilities. More importantly, we demonstrate experimentally localized flat-band states and distortion-free flat-band image transmission in Lieb lattices. Furthermore, we propose and demonstrate unconventional linear flat-band states (extended lines and necklaces) in truncated Lieb lattices that were never realized before.

- Lunch Break -

R1. SOLID-STATE LASERS

WeR1-p01 15:00-17:00

Effect of intensity cross-correlation in a Raman laser pumped by the multimode pulses

R. Chulkov[1], V. Markevich[1], M. El-Desouki[2], V. Orlovich[1]; 1 - Stepanov Inst. of Physics NASB, Belarus; 2 - King Abdulaziz City for Science and Technology (KACST), Saudi Arabia

The cross-correlation coefficient for the pump and Stokes intensities is found to be enhanced when an effective length of the Raman cavity is matched with that of a longitudinally multimode pump laser. The coefficient enhancement is directly related to the Raman threshold reduction, conversion efficiency increase, self-mode locking, and they all are experimentally observed.

WeR1-p02 15:00-17:00

CaF2-LaF3-PrF3 solid solutions - new promising visible range laser media

O.A. Morozov[1], V.G. Gorieva[1], V, V.A. Konyushkin[2], S.V. Kuznetsov[2], V.V. Semashko[1]; 1 - Kazan Federal Univ., 2 - General Physics Institute RAS, Russia

The spectroscopic and thermophysical prerequisites of the CaF2-LaF3-PrF3 solid solutions as visible range active media are discussed. Spectral-kinetic properties, ESA spectra and preliminary laser tests results are presented.

WeR1-p03 15:00-17:00

Parametric-light-generator-based laser system for pulsed three-wavelength Illumination

A.I. Lyashenko[1], I.V. Dmitriev[1,2], O.V. Polschikova[1,3], A.S. Machikhin[1,3], A.G. Ramazanova[1]; 1 - Scientific and Technological Center of Unique Instrumentation RAS, 2 - Bauman Moscow State Technical Univ., 3 - National Research Univ. «Moscow Power Engineering Inst.», Russia

We present the RGB laser based on the parametric light generator with KTP crystal located in the resonator of Nd:YAG laser and controlled by electro-optic modulator. It provides highly synchronized pulses with duration 5-10 ns and frequency 25 Hz. This device can be used as a source of quasi-white coherent illumination for phase imaging, color holography and other interference applications.

WeR1-p04 15:00-17:00

Single-frequency microchip Nd:YAG laser for injection seeding

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

Single-frequency 20 mW microchip 1064 nm Nd:YAG laser with long-term wavelength stability 0.3 pm and tunability of ±0.1nm was developed. 1 W laser diode with 50 µm emitter size and 808 nm wavelength was used for pumping. CW and quasi-CW regimes were investigated.

WeR1-p05 15:00-17:00

Ce,Pr:LiY1-xLuxF4 mixed crystals as perspective active media for UV lasing

V.G. Gorieva[1], S.L. Korableva[1], P.A. Ryabochkina[2], V.V. Semashko[1]; 1 - Kazan Federal Univ., 2 - National Research Mordovia State Univ., Russia

We demonstrate good prospects of using crystals Ce3+, Pr3+:LiY1-xLuxF4 as an active medium of solid-state UV laser with up-conversion pumping.

WeR1-p06 15:00-17:00

Numerical modelling of quartz heating by laser radiation in the presence of a microparticle on the surface of quartz

D.S. Timaev; RFNC-VNIIEF, Russia

In this work results of numerical 3D modeling of thermal processes are given in an optical element from glass under impact in it of the continuous laser radiation of rather high intensity, in the presence on its surface of microparticles. Conclusions for criteria of definition of a critical stream and admissible dust content are presented.

WeR1-p07 15:00-17:00

150 W ytterbium-doped a narrowband all-fiberized laser with variable bandwidth

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

This paper proposes a method of fabrication ytterbium-doped a narrowband all-fiberized laser with variable bandwidth and also gives results of experiments of the operation this laser with a spectral line in a range from 600 to 1500 MHz and a total output power of ~ 150 W.

WeR1-p08 15:00-17:00

Theoretical and experimental method to determine the effective coupling coefficients in (N+1)GTWave fibers

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

This paper presents a theoretical and experimental method to determine the effective coupling coefficients in (N+1)GTWave fibers and also gives mathematical expressions derived from analytical solutions for the pump radiation power distribution to estimate values thereof. Experimental setup intended to measure effective coupling coefficients, as well as results of these measurements are presented.

WeR1-p09 15:00-17:00

Spectroscopic characteristics of Cr:Mg2SiO4 laser crystals grown from non-stoichiometric melts

V.V. Sanina[1], K.A. Subbotin[1,2], D.A. Lis[1], V.V. Voronov[1], E.V. Zharikov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Mendeleev Univ. of Chemical Technology, Russia

The series of Cr:Mg2SiO4 laser crystals grown from non-stoichiometric melts have been studied. According to the polarized optical absorption spectra, the content of Cr4+ ions in the crystals increases with increment of MgO excess in the melt, whereas the concentration of parasitic Cr3+ ions passes through a maximum in this series.

WeR1-p10 15:00-17:00

Affect of high-temperature oxidizing annealing on spectroscopic characteristics of Cr:Mg2SiO4 laser crystals grown in different conditions

K.A. Subbotin[1,2], V.V. Sanina[1,2], D.A. Lis[1], E.V. Zharikov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Mendeleev Univ. of Chemical Technology, Russia

The evolution dynamics of spectroscopic characteristics of Cr:Mg2SiO4 laser crystals grown in different conditions under the prolonged high-temperature oxidizing annealing of these crystals have been studied and analyzed. Such annealing can substantially enhance the characteristics of the crystals; however, behavior of the crystals during the annealing drastically depends on the preliminary growth conditions.

WeR1-p11 15:00-17:00

Ho:YAG laser with acousto-optical Q-switch based on KYW crystal

A.A. Sirotkin[1,2], M.M. Mazur[3]; 1 - Prokhorov General Physics Inst. RAS, 2 - National Research Nuclear Univ. MEPhI, 3 - Research Inst. of Physicotechnical and Radiotechnical Measurements, Russia

High-efficient CW and Q-switched Ho:YAG lasers resonantly pumped by 30 W Tm-fiber lasers at 1940 nm were investigated. Active Q-switching experiments are achieved with a new type of acousto-optical Q-switch based on KYW crystal. The maximum pulse energy of 0.49 mJ was achieved at pulse repetition rate 1 kHz, with a pulse durations 32 ns and 15.7 kW peak power.

WeR1-p12 15:00-17:00

Active media engineering of Ho3+- laser operating around 3 µm region

P.G. Zverev[1], V.A. Konyushkin[1], A.A. Sirotkin[1,2], S.Ya. Rusanov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - National Research Nuclear Univ. MEPhI, Russia

Ho3+codoped single-fiber crystals Gd2O3, Y2O3 and CaF2 laser crystals was successfully grown and analyzed. The absorption and luminescence spectra of Ho3+ crystals, activation and deactivation effects were investigated under a conventional 1150 nm or 970 nm LD pump. The fluorescence lifetime of the 5I6 and 5I7 manifold were measured with Yb3+ ,Dy3+,Tb3+and Pr3+ codoped ions.

WeR1-p13 15:00-17:00

12 mJ 10 Hz diode pumped A/O Q-switched Yb:Er:glass laser

V.A. Buchenkov, A.A. Krylov, A.A. Mak; ITMO Univ., Russia

An eye-safe Yb:Er:glass laser with a repetition rate 10 Hz was developed. The device was a diode pumped Yb:Er:glass laser Q-switched by an acoustooptic gate producing 12 mJ energy and 20 ns FHWH duration pulses of 1.54 um radiation. The laser rod and laser diodes are cooled by a thermoelectric module. The laser head dimensions were 180×80×80 mm3.

WeR1-p14 15:00-17:00

Transverse pumped pulsed laser action on Nd-doped photo-thermo-refractive glass

S.A. Ivanov[1], A.A. Sergeev[2], I.S. Khakhalin[2], I.S. Pichugin[1], N.V.Nikonorov[1]; 1 - ITMO Univ., 2 - Baltic State Technical Univ., Russia

For the first-time pulsed laser oscillation on Nd doped PTR glass with diode pumping is demonstrated. Study on the influence of the photo-thermo-induced crystallization process on the laser properties was conducted.

WeR1-p15 15:00-17:00

Compact 1.5 mJ eye-safe OPO laser

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

A compact robust eye-safe laser for atmosphere lidars and rangefinders was developed. The device was a diode pumped Nd: YAG laser with a KTP OPO producing 1.5 mJ/6 ns pulses of 1.57 um radiation at 40 Hz repetition rate. The laser confirmed stable long term operation of over 10 million pulses total.

WeR1-p16 15:00-17:00

40 Hz 1.3 mJ Q-switched Yb:Er:glass laser

V. Vitkin, A. Krylov, A. Polishchuk, A. Kovalev, V. Buchenkov; ITMO Univ., Russia

We report on the development of a compact side diode pumped eye-safe A/O Q-switched Yb:Er:glass laser at repetition rates as high as 40Hz. The laser generates 1.3mJ/45ns pulses with the beam divergence 4.5mrad without collimating system. The laser diodes and laser rod are conductive thermoelectrically cooled. The high repetition rate operation with good beam quality is demonstrated.

WeR1-p17 15:00-17:00

Multilayer interference coatings with the Gaussian profile for Nd:YAG lasers

V.V. Novopashin, A.V. Shestakov; R&D Inst. «Polyus», Russia

The development of laser technologies defined the novel quality demands to optical interference coatings. However, in practice, not equal distribution take place especially for Q-switch lasers. It can be arise due to as mode structure of laser irradiation, as optical defects of rod. This paper presents the methodology of fabricating multilayer dielectric mirror with altering over surface parameters of reflectance. These mirrors are used as output coupler in the laser cavity to form radiation close to the Gaussian distribution with using radially varying thickness that have been proved the most practical. Fabrication of such mirrors used in unstable resonators of Nd:YAG laser to convert the Gaussian beam into that with flat-top profile relies on dielectric coating technologies. The permissible range of changing the maximum of mirror reflection is placed within 40-90% and reproduced from sample to sample with no more than 5% error.

WeR1-p18 15:00-17:00

Growth, spectroscopic and laser properties of heavily doped LiCaAlF6: Ce3+

A.A. Shavelev, A.S. Nizamutdinov, M.A. Marisov, I.I. Farukhshin, O.A. Morozov, N.F. Rakhimov, E.V. Lukinova, S.L. Korableva, V.V. Semashko, A.A. Shakirov; Kazan Federal Univ., Russia

The aim of this work is growth of LiCaAlF6: Ce3+ crystals by Bridgman technique and study of spectroscopic and laser characteristics. The maximum absorption coefficient of Ce3+ ions appeared to be up to 7 cm-1 and maximum of slope efficiency of laser action as high as 47% was achieved. Conclusions about interaction and distribution of cerium impurity centers are also discussed.

WeR1-p19 15:00-17:00

Experimental generating of spiral beams of light

K.V. Efimova[1], S.P. Kotova[1], N.N. Losevsky[1], D.V. Prokopova[1], S.A. Samagin[1]; 1 - Lebedev Physical Inst., SB RAS,[2]- Samara National Research Univ., Russia

Various methods of generating spiral beams of light have been analyzed. Two methods were experimentally studied: that of the amplitude-phase masks and a holographic one. They were compared by quality and efficiency of the beams formation.

WeR1-p20 15:00-17:00

0.53 J /100 ps Nd:YAG single-rod six-pass amplifier

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

We developed 106 W (0.53 J × 200 Hz) diode pumped 1064 nm Nd:YAG laser with pulse duration of 100 ps. 6-pass laser amplifier was based on a single Ø15×140 mm rod. The output beam was flat-top, the beam divergence was 1.5 times the diffraction limit. The SHG efficiency up to 54% was achieved in 17×17×7 mm3 LBO crystal.

WeR1-p21 15:00-17:00

Multiple reduction of laser flash lamp ignition threshold with 0-3 MHz pumping

A.M. Valshin[1,2], S.M. Pershin[3], G.M. Mikheev[2]; 1 - Bashkir State Univ., 2 - Inst. of Mechanics UB RAS, 3 - Prokhorov General Physics Inst. RAS, Russia

The process of laser flash lamp ignition was studied experimentally with power supply frequency varying up to 3 MHz. A reduction of the discharge threshold by a factor of 4 was achieved. The strong dependence of the threshold value on the type of cooling substance (air, oil, acetone, alcohol, glycerol and water) was observed.

WeR1-p22 15:00-17:00

Laser potential of calcium aluminate glasses

B.I. Denker[1,3], B.I. Galagan[1], S.E. Sverchkov[1], V.V. Velmiskin[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Fiber Optics Research Center RAS, 3 - Center of Laser Technology and Material Scince, Russia

Rare-earth activated calcium aluminate glasses were analyzed as potential laser materials for mid-infrared lasers. Spectroscopic properties of Tm and Ho in deeply dehydrated glasses were found attractive for fiber lasers emitting in 2-2.5 microns spectral range. Optical fiber with calcium aluminate core in silicate cladding was fabricated.

WeR1-p23 15:00-17:00

Er:YAG pumped compact Fe:ZnMnSe laser tunable in spectral range 3950 – 4500 nm at 80 K

R. Švejkar[1], J. Šulc[1], A. Říha[1], H. Jelínková[1], M.E. Doroshenko[2], N.O. Kovalenko[3], A.S. Gerasimenko[3]; 1 - Czech Technical Univ. Prague, Czech Republic; 2 - Prokhorov General Physics Inst. RAS, Russia; 3 - Inst. for Single Crystals NASU, Ukraine

The compact tunable Fe2+:Zn0.95Mn0.05Se laser at liquid nitrogen temperature (80 K) was investigated. The diode-pumped free-running Er:YAG laser at room-temperature was used for pumping of cryogenic-cooled Fe2+:Zn0.95Mn0.05Se. The slope efficiency up to 30.5% was reached in non-selective cavity. Using intracavity birefringent plate the tunable range of 3950 – 4500 nm (550 nm) was obtained.

WeR1-p24 15:00-17:00

Energy transfer between erbium and thulium ions in potassium gadolinium tungstate crystal with lattice participation at 806 nm wavelength diode pumping

I.A. Khodasevich[1], A.A. Kornienko[2], D.D. Matushevski[1], P.P. Pershukevich[1], M.A. Khodasevich[1], A.S. Grabtchikov[1], V.A. Aseev[3]; 1 - Stepanov Inst. of Physics NASB, 2 - Vitebsk State Technological Univ., Belarus, 3 - ITMO Univ., Russia

Data on observation of simultaneous up-conversion on the erbium and thulium ions in the trace concentration in KGd(WO4)2 crystal excited by IR radiation with the wavelength near 806 nm is presented. The change of excitation schemes with increase of pumping level and participation of crystal matrix in energy transfer between Erbium and Thulium ions is discussed.

WeR1-p25 15:00-17:00

Ultrashort mid-IR pulse amplification in chalcogenide fibers doped with rare-earth ions

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

We present a numerical study of ultrashort pulse amplification in the 4-5 microns range in chalcogenide gain fibers singly doped with praseodymium, dysprosium, and terbium ions. The energy of pulses with a repetition rate of 10 MHz can be increased from 10 pJ up to ~10 nJ for praseodymium and terbium and up to ~1 nJ for dysprosium.

WeR1-p26 15:00-17:00

Optical properties and lasing of YAG ceramics with losses

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]; 1 - Inst. of Laser Physics SB RAS, 2 - Inst. of Electrophysics, Ural Branch RAS, 3 - Kotel'nikov Inst. of Radio Engineering and Electronics RAS, Russia

We report on optical properties and lasing of YAG ceramics synthesized at IREE (Fryazino) and IEP (Ekaterinburg). On the best samples of ceramics lasing with the maximum slope efficiency of 40% was received. Specific losses in the ceramics are estimated. An analytical solution of the rate equations on one-pass optical amplification for laser ceramics with losses was obtained.

WeR1-p27 15:00-17:00

Thermal profiling of solid-state active media

B.N. Kazakov, O.G. Goriev, A.R. Khadiev, S.L. Korableva, V.V. Semashko; Kazan Federal Univ., Russia

The fluorescence intensity ratio technique to the thermal profiling of solid-state laser materials is developed. The temperature distribution inside the excited area of LiY0.8Yb0.2F4: Tm3+(0.2 at.%) crystals during z-scanning was studied.

WeR1-p28 15:00-17:00

Spectroscopic characterization of Er3+:LiKYF5: Judd-Ofelt analysis and emission cross sections

E.V. Vilejshikova[1], P.A. Loiko[2], K.V. Yumashev[1], S.S. Kolos[1], A.M. Malyarevich[1]; 1 - Belarusian National Technical Univ., Belarus; 2 - ITMO Univ., 3 - Kurnakov Inst. of General and Inorganic Chemistry, Russia

In the present work, we report on a spectroscopic characterization of Er3+:LiKYF5 crystals concerning their potential laser applications. The J-O parameters for these crystals are Ω2 = 0.813, Ω4 = 1.370 and Ω6 = 0.632x10-20 cm2. The radiative lifetimes of the 4I13/2 and 4I11/2 states are 12.4 ms and 31.8 ms, respectively. For the 4I13/2 → 4I15/2 transition, the maximum σSE is 0.472×10-20 cm2 at 1537.4 nm.

WeR1-p29 15:00-17:00

Noise-like pulse generation with coherence spike in all-fiber passively mode-locked Yb-doped fiber laser

E.K. Kang, H.M. Yang, M.D. Kim, M.Yo. Jeon; Chungnam National Univ., Republic of Korea

We report a noise-like pulse generation with coherence spike from an all-fiber passively mode-locked Yb-doped fiber laser in all-normal dispersion region. It is implemented by using a fiber-pigtailed spectral bandpass filter. The output pulse duration of the noise-like pulse is achieved approximately 15.77 ps and its coherence spike pulse is measured to be 120 fs.

WeR1-p30 15:00-17:00

Stable injection-seeded Q-switched Nd:YAG laser with high beam quality

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

Beam quality M2=1.05 and high temporal stability were obtained in end-pumped MOPA Nd:YAG Q-switched laser. Injection seeding in master oscillator was applied in order to obtain smooth pulse shape and reduce build-up time instability. High small-signal gain in end-pumped amplifier provided extraction efficiency ~50% in single-pass scheme. Equalization of absorbed pumping along the laser rods provided decreasing of thermal distortions.

WeR1-p31 15:00-17:00

Investigations of a compact diode-pumped femtosecond Yb:KYW laser

S.A. Kuznetsov[1], V.S. Pivtsov[1,2], A.V. Semenko[1,2], S.N. Bagayev[1]; 1 - Inst. of Laser Physics SB RAS, 2 - Novosibirsk State Technical Univ., Russia

Record high differential efficiency (64.9%) and full optical efficiency (61%) for a diode-pumped Yb:KYW laser are achieved. Preliminary results of investigations of a femtosecond laser with DBR TDL pumping are obtained. The characteristics of the laser and methods for improving its efficiency are discussed.

WeR1-p32 15:00-17:00

Passively harmonic mode-locked erbium fiber laser

A.I. Trikshev[1,2], V.A. Kamynin[1,2], V.B. Tsvetkov[1,3]; 1 - General Physics Inst. RAS, 2 - Ulyanovsk State Univ., 3 - National Research Nuclear Univ. «MEPhI», Russia

We experimentally demonstrate an Er-doped all-fiber laser with passively harmonic mode-locked (HML) based on nonlinear polarization rotation technique.

WeR1-p33 15:00-17:00

Optical repetition rate locking of ultrafast Yb doped all fiber oscillator for high intensity OPCPA systems

K. Madeikis[1,2], K. Viskontas[1], R. Danilevicius[1,2], T. Bartulevičius[1,2], L. Veselis[1,2], A. Michailovas[1,2], N. Rusteika[1,2]; 1 - Ekspla Ltd, 2 - State Research inst. Center for Physical Sciences and Technology, Lithuania

We demonstrate all-fiber ultrafast SESAM-based optically repetition rate locked oscillator concept designed for high intensity OPCPA systems. Pump induced refractive index change in the active erbium fiber for precise delay line was tested with 976 nm and 1550 nm wavelength pump. The measured jitter at the output of the system was around 1 ps.

WeR1-p34 15:00-17:00

Passive cavity dumping in the dual-polarization mode-locked laser

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

This paper presents the method of cavity dumping by the second harmonic generation in the dual-polarization mode-locked laser.

WeR1-p35 15:00-17:00

Experimental study of phenomenological model of Yb fiber amplifier

A.Yu. Kokhanovskiy, A.V. Ivanenko, S.V. Smirnov, S.M. Kobtsev; Novosibirsk State Univ., Russia

The paper compares the simplest phenomenological model of a saturable fiber amplifier based on Yb-doped fiber with experimental measurements. The numerical parameters of this model and their dependence on the optical pumping power of laser diodes are determined. It is shown that the model understudy gives an error in determining the output power from the amplifier of less than 5% in the range of input powers from 0.29 to 14 nJ in the pump power range from 0.5 to 3.5 W. The output parameters of a numerical model of a mode-locked fiber laser and its experimental realization are compared. The obtained results can be used in numerical modeling and design of fiber laser systems.

WeR1-p36 15:00-17:00

The method of precise alignment of the length of fiber-optic channels for the coherent combining of laser beams

S.V. Tyutin, T.Y. Kozhenkova, A.V. Kopalkin, F.A. Starikov; RFNC-VNIIEF, Russia

The method, allowing with enough precision to align the lengths of independent laser fiber-optic channels, is implemented. The results for coherent phase combining of laser beams using implemented iteration algorithm are demonstrated.

WeR1-p37 15:00-17:00

Multi-wavelength oscillation of diode pumped YAP: Nd laser

P.G. Zverev[1,2], I.V. Smirnov[2], G.V. Shilova[1], A.A. Sirotkin[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Power Engineering Inst., Russia

Multi frequency oscillation was observed and investigated in diode pumped Nd:YAP laser. The switching between dual wavelength oscillations at 1064 + 1072 nm and at 1072 + 1079 nm by the intracavity phase plate rotation was demonstrated.

WeR1-p38 15:00-17:00

Compact continuous wave fiber laser based on high-concentration Er3+ composite fiber

B.I. Denker[1], O.N. Egorova[2], B.I. Galagan[1], V.A. Kamynin[1], A.A. Ponosova[1], S.E. Sverchkov[1], S.L. Semjonov[2], V.B. Tsvetkov[1,3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Fiber Optics Research Center RAS, 3 - National Research Nuclear Univ. MEPhI, Russia

Characteristics of the continuous wave fiber laser based on a high-concentration Er-doped phosphate core silica cladding fiber were investigated. The laser demonstrated a maximum output power about 105 mW at 1535 nm with a fiber length of only 15 cm. The slope efficiency was about 25.5 %.

WeR1-p39 15:00-17:00

Spectroscopic and laser properties of Yb-doped SrO-2B2O3 glass

A.A. Rybak[1,3], E.N. Galashov[2], E.V. Pestryakov[1]; 1 - Inst. of Laser Physics SB RAS, 2 - Novosibirsk State Univ., 3 - Novosibirsk State Technical Univ., Russia

Spectroscopic and laser properties of Yb-doped SrO-2B2O3 (Yb:SBO) glass with composition the same as the Yb:SrB4O7 crystal, prepared by conventional melt-quenching technique, were investigated. The absorption and luminescence spectra of Yb(III) in the SBO-glass at room and cryogenic temperatures were determined. On the basis of the experimental data the absorption, emission cross sections and main laser parameters have been calculated and discussed.

WeR1-p40 15:00-17:00

Compact diode-pumped NIR and MIR lasers for non-laboratory applications

V.P. Mitrokhin[1], A.E. Dormidonov[1], A.D. Savvin[1], E.S. Safronova[1,2], A.A. Sirotkin[2], K.N. Firsov[2]; 1 - Research Inst. of Automatics, 2 - Prokhorov General Physics Inst. RAS, Russia

Compact and portable Nd3+ (1.06 µm) and Er3+ (2.9 µm) high-power nanosecond lasers have been designed. Wide temperature operation range (–50 to +50 °C) was achieved with side pumping by laser diode stacks at 808 and 970 nm for Nd3+ and Er3+ lasers respectively. Output lasers pulse parameters are stable in considered temperature range. Pulse repetition rate can be varied from single shot up to 50 Hz. Lasers diameter is 55 mm, length — 110 mm, and weight is near 500 g.

WeR1-p41 15:00-17:00

Spectroscopic and laser properties of Tm3+ ions optical centers in CaF2-YF3: Tm3+ solid solutions

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

The spectroscopic properties of different Tm3+ optical centers in CaF2-YF3: Tm3+ solid solutions at the 3F4-3H6 2um transition were investigated. Several models of newly observed optical centers are discussed.

WeR1-p42 15:00-17:00

Multi-regimes electronically controlled all-fiber PM ANDI F8 laser.

A.V. Ivanenko, S.K. Kobtsev, A.Y. Kokhanovsky, S.V. Smirnov; Novosibirsk State Univ., Russia

An all-normal dispersion figure-of-eight fiber laser which provides generation of qualitatively different pulse generation regimes (single-scale and double-scale pulses) by the electronical tuning of two laser diodes pump powers is present for the first time. Electronical tuning of the pump powers also allows one to change and control parameters of the pulse generation (pulse duration, power and energy) in a wide range for each started regime. In particular, the possibility of changing the pulse duration by a factor of 2 for each pulse generation mode is shown, and the total range of tuning by the duration of the autocorrelation function of pulses is from 30 to 100 ps. And also for the first time the possibility of an increase by a factor of 8 of the peak power of the output pulses is shown with an increase in the pulse energy from 2 to 16 nJ and at a fixed duration of the autocorrelation function of pulses of 55 ps.

WeR1-p43 15:00-17:00

On correct description of the interaction of a pump field with dipoles of Nd3+ quantum transitions in Nd:YAG-laser model

P.A. Khandokhin[1], N.D. Milovsky[2]; 1 - Inst. of Applied Physics RAS, 2 - Lobachevsky State Univ. of Nizhny Novgorod, Russia

We propose a model of a bipolarized Nd:YAG-laser based on a Fabry-Perot resonator describing the interaction of the dipoles of Nd3+ quantum transitions with a polarized pump field and with fields of elliptically polarized orthogonal modes taking into account real polarization properties of resonance transitions of nine different groups of active ions in an elementary cell of a crystal lattice.

WeR1-p44 15:00-17:00

Bi-doped glasses for tunable lasers

I.V. Tuzova, N.V. Nikonorov, I.K. Fedorov, V.A. Aseev; ITMO Univ., Russia

The luminescence properties of Bi-activated glass of various matrices are shown. A possibility of the development of tunable wideband lasers operating at a wide optical telecommunication range based on the active media of Bi-activated glasses is shown.

WeR1-p45 15:00-17:00

Numerical simulation of the broadband amplification in the Yb:YAG thin-rod active elements

O.L. Vadimova[1], I.I. Kuznetsov[1], I.B. Mukhin[1], O.V. Palashov[1], B. Lee[2], S.A. Chizhov[2], E.G. Sall[2], G.H. Kim[2], V.E. Yashin[3]; 1 - Inst. of Applied Physics RAS, Russia; 2 - Korea Electrotechnology Research Inst., Korea; 3 - Vavilov State Optical Inst., Russia

The numerical model for simulation of broadband amplification in a thin-rod and a thin-tapered-rod active elements was developed. The simulation results are verified by the experimental data.

WeR1-p46 15:00-17:00

The charge compensated Tm3+:SrMoO4 crystals for ~ 1.9 and ~2.3 μm lasers

B.I. Denker[1,2], M.E. Doroshenko[1], E.E. Dunaeva[1], B.I. Galagan[1,2], L.I. Ivleva[1], H. Jelinkova[3], J. Sulc[3], S.E. Sverchkov[1,2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Center of Laser Technology and Material Science, Russia; 3 - Czech Technical Univ., Czech Republic

The Tm3+:SrMoO4 crystals with and without charge compensation were grown by the Czochralski method and their spectroscopic properties were investigated. Tunable laser action at ~1.9 microns and ~2.3 microns under different type of pumping was obtained in charge compensated samples.

WeR1-p47 15:00-17:00

Lasing characteristics of resonators with retro-reflective elements

G. Khosrovian[1], S. Taniguchi[1], H. Yoshida[2], N. Miyanaga[2]; 1 - Inst. for Laser Technology, 2 - Inst. of Laser Engineering, Japan

Polarization properties of CCR (corner-cube retro-reflector) and AL (axicon lens with 90 degrees apex angle) retro-reflected beams have been studied experimentally and theoretically. Cryogenic Yb:YAG laser output characteristics when a flat mirror, CCR or AL is used as a high-reflection element in a resonator, have been presented and discussed.

WeR1-p48 15:00-17:00

Longitudinally diode pumped CW Er-Yb laser based on photo-thermo-refractive glass

V.F. Lebedev, S.A. Ivanov, I.S. Pichugin, N.V. Nikonorov; ITMO Univ., Russia

For the first time CW laser oscillation on Er-Yb doped PTR glass with diode pumping is demonstrated. For the monolithic laser the maximum output power of 0.47W at wavelength of laser oscillation of 1574 nm and a slope efficiency of 6% was achieved.

WeR1-p49 15:00-17:00

Pump-induced frequency jitter study in hybridly mode-locked all-fiber similariton-like erbium fiber laser

S.O. Leonov[1], V.S. Voropaev[1], S.G. Sazonkin[1], A.A. Krylov[2], V.E. Karasik[1]; 1 - Bauman Moscow State Technical Univ., 2 - Fiber Optics Research Center RAS, Russia

We present both theoretical analysis and experimental measurement of a pump-induced evolution of the repetition rate frequency of a hybridly mode-locked erbium-doped similariton-like all-fiber ring laser.

WeR1-p50 15:00-17:00

Active media based on the BaY2F8 single crystals for up-conversion lasers of different spectral ranges

T. Uvarova; Prokhorov General Physics Inst. RAS, Russia

Examples of solid-state laser media developed on the basis of a BaY2F8 single crystal activated by rare-earth ion (RE) for UV, visible and IR spectral ranges are considered. This report is a review of own works and literary data.

WeR1-p52 15:00-17:00

Passive Q-switching of a Tm-Ho: KYW microchip laser by a SWCNT

N.V. Gusakova[1], V.E. Kisel[1], A.S. Yasukevich[1], S.Y. Choi[2], F. Rotermund[2], N.V. Kuleshov[1]; 1 - BNTU, Belarus; 2 - Ajou Univ., Republic of Korea

We present a diode-pumped passively Q-switched Tm-Ho: KYW microchip laser using a single-walled carbon nanotubes (SWCNT). The pulses with 169 ns duration, 0.22 μJ energy and 518 kHz were obtained at 2070 nm.

WeR1-p53 15:00-17:00

Laser performance of Er-doped potassium double tungstate epitaxial layers

O.P. Dernovich[1], S.V. Kurilchik[2,3], V.E. Kisel[1], I.M. Kolesova[4], A.V. Kravtsov[4], S.A. Guretsky[4], N.V. Kuleshov[1]; 1 - Center for Optical Materials and Technologies, BNTU, Belarus; 2 - Univ. of Southampton, UK; 3 - Kazan Federal Univ., Russia; 4 - The Scientific and Practical Materials Research Center, NASB, Belarus

Laser operation of Er-doped epitaxial layer of monoclinic double tungstate composition grown onto undoped KYW substrate is demonstrated for the first time. Maximum output power of 16 mW with slope efficiency of 64% is achieved at 1606 nm under direct in-band pumping by a diode-pump Er,Yb-laser at 1522 nm.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

WeR8-p01 11:30-13:30

Atomic optical metamaterials for surface plasmon polariton guiding

T. Gric[1,2], A. Trofimov[1]; 1 - Vilnius Gediminas Technical Univ., 2 - Semiconductor Physics Inst., Center for Physical Sciences and Technology, Lithuania

A novel metamaterial (MM) to guide surface plasmon polariton (SPP) is considered. Specific example of three-layered nanostructured MM and its dispersion engineering are studied in details allowing the development of new devices. The metal material stands for as the limiting factor of the frequency range that SPP mode exists. The SPP mode at high frequency possesses tremendously large loss or can be cutoff with high permittivity dielectrics above metal surface. The surface mode guided by dielectric/graphene/dielectric multilayers MM has been studied based on the theory of electromagnetic field aiming to extend the frequency range of SPP mode. It is shown that, the MM guided SPP mode presents its advantages and flexibility over traditional metal one by varying the structure parameters.

WeR8-p02 11:30-13:30

Resonance scattering of picosecond laser pulses on monatomic vapor of alkali metals

V.A. Astapenko, N.N. Moroz; Moscow Inst. of Physics and Technology (State Univ.), Russia

The paper is devoted to theoretical study of resonance elastic scattering of ultrashort laser pulses on lithium and sodium doublets in monatomic vapor of alkali metals with account for Doppler and collision broadening. Analysis is made in terms of total scattering probability for all time of pulse action on a target for different parameters of the problem:carrier frequency, pulse duration, vapor pressure and temperature.

WeR8-p03 11:30-13:30

Multimodal interaction in two-Level media driven by a symmetric polychromatic field

I.K.Korshok, S.A.Pulkin, S.V.Uvarova; St. Petersburg State Univ., Russia

An interaction of two-level media with a symmetric polychromatic field is considered in the limit of small field amplitudes. Corrections of the third order and above allow us to describe a nonlinear response to the field and a multimodal interaction. The obtained absorption spectra were compared with numerical solutions of density matrix equation in the rotating wave approximation.

WeR8-p04 11:30-13:30

Nonlinear resonances in polarization spectrum of three-level atom, interacting with weak polychromatic fields

I.V.Korshok, A.G.Antipov, N.I.Matveeva, S.A.Pulkin, S.V.Saveleva, S.V.Uvarova, V.I.Yakovleva; St. Petersburg State Univ., Russia

For three-level system of atoms interacting with polychromatic fields, the system of differential equations of the density matrix is analytically solved and the polarization spectrum of the components of the probe field is calculated. Supernarrow resonances in polarization spectrum at the frequency of the test field occur at multiple harmonics, subharmonics, and on a frequency that is mirror-to-field.

WeR8-p05 11:30-13:30

Generation of 1D bright spatial soliton in a bulk of lithium niobate due pyroelectric effect

A.S. Perin, V.M. Shandarov; Tomsk State Univ. of Control Systems and Radioelectronics, Russia

The compensation of the nonlinear diffraction of a one-dimensional laser beam in a crystalline sample of lithium niobate at a wavelength of 532 nm with the contribution of the pyroelectric effect is demonstrated experimentally. The splitting of planar and phased planar light beams into two-dimensional filaments associated with the effect of spatial modulation instability is demonstrated.

WeR8-p06 11:30-13:30

Quantum metrology beyond Heisenberg limit with entangled matter wave solitons

D.V. Tsarev[1], S.M. Arakelian[2], You-Lin Chuang[3], Ray-Kuang Lee[3,4], A.P. Alodjants[1,2]; 1 - ITMO Univ., 2 - Vladimir State Univ., Russia; 3 - National Center for Theoretical Sciences, 4 - National Tsing Hua Univ., Taiwan

We propose new method to create N00N-states by means of matter wave bright solitons in Bose-Einstein condensates (BECs) and demonstrate how they can be used to obtain and even beat Heisenberg limit.

WeR8-p07 11:30-13:30

Asymmetry of temperature dependence for focused laser radiation second harmonic generation

A.L. Bondarenko[1], S.G. Grechin[2], D.G. Kochiev[3], A.N. Sharikov[3], I.A. Shcherbakov[3], P.P. Nikolaev[4]; 1 - Space Research Inst. RAS, 2 - LLC Neophotonica, 3 - Prokhorov General Physics Inst. RAS, 4 - Bauman Moscow State Technical Univ., Russia

The specificity of the temperature dependence of efficiency for angular noncritical second-harmonic generation of focused laser radiation, with revealed the asymmetry is discussed. It is shown the role of scalar and vector phase matching in forming of dependencies.

WeR8-p08 11:30-13:30

Phase-matched three-frequency interactions in PIT

S.G. Grechin[1], Yu.M. Andreev[2,3], G.V. Lanskii[2,4]; 1 - LLC Neophotonic, 2 - Inst. of Monitoring of Climatic and Ecological Systems SB RAS, 3 - Siberian Physical Technical Inst. of Tomsk State Univ., 4 - High Current Electronics Inst. SB RAS, Russia;

Systematic model study of phase-matched three- frequency interactions of IR waves in PbIn6Te10 is carried out. Phase Matched down-conversion into the mid-IR and FIR (THz) ranges is found to be possible. Calculated figure of merit for phase matching directions are presented in original graphic format.

WeR8-p09 11:30-13:30

LiGa(S1-xSex)2 in generating ultrafast mid-IR emission

J.J. Huang[1], X.L. Zhang[1], Q. Feng[1], J.F. Dai[2], S.G. Grechin[3], Yu.M. Andreev[4,5], G.V. Lanskii[5]; 1 - Tianjin Polytechnic Univ., China; 2 - Harbin Engineering Univ., China; 3 - LLC Neophotonic, 4 - Inst. of Monitoring of Climatic and Ecological Systems SB RAS, 5 - Siberian Physical Technical Inst. of Tomsk State Univ., Russia

With the renewed dispersion equations, the potential of LiGaS2: LiGaSe2->LiGa(S1-x Sex)2 (x=0-1) in frequency conversion is theoretically investigated. PM type II down-conversion in the b-a plane with perfect group velocity matching or type I in the b-c plane can be realized with part group velocity matching is developed.

WeR8-p10 11:30-13:30

Temperature noncritical phase-matching in KTP and isomorphs.

P.J. Druzhinin[1], S.V. Gagarsky[1], S.G. Grechin[2], P.P. Nikolaev[3]; 1 - ITMO Univ., 2 - LLC Neophotonica, 3 - Bauman Moscow State Technical Univ., Russia

Functional capabilities of temperature noncritical frequency conversion for KTP and isomorphs are evaluated in full range of nonlinear crystals transparency for different types of interactions.

WeR8-p11 11:30-13:30

Downconversion properties of Yb-doped scheelite-like molybdate and tungstate single crystals

K.A. Subbotin[1,2], A.I. Titov[1,2], D.A. Lis[1], V.A.Smirnov[1], O.K. Alimov[1], E.V. Zharikov[1], I.A. Shcherbakov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Mendeleev Univ. of Chemical Technology, Russia

Downconversion properties of a number of Yb-doped Scheelite-like molybdate and tungstate single crystals have been investigated. The efficient non-radiative excited state energy transfer from donor centres to Yb ions was observed. At high Yb concentrations a substantial part of this transfer runs by cooperative mechanism, that can be used for increase the efficiency of solar cells based on crystalline silicon.

WeR8-p12 11:30-13:30

Electro-optic waveguide modulators based on poled chromophore-doped polyimides

A.E. Simanchuk[1,2], A.I. Plekhanov[1], S.L. Mikerin[1,2], A.V. Yakimansky[3], N.A. Valisheva[4]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Vorozhtsov Novosibirsk Inst. of Organic Chemistry SB RAS, 3 - Inst. of Macromolecular Compounds RAS, 4 - Inst. of Semiconductor Physics SB RAS, Russia

Electro-optic modulation properties of elaborated waveguide modulators made of original chromophore-doped thermal stable polymer systems have been demonstrated.

WeR8-p13 11:30-13:30

Optical rectification in beta-BBO

D. M. Lubenko[1], V. F. Losev[1], K. A. Kokh[2], T. B. Bekker[2], N. A. Nikolaev[3], A. A. Mamrashev[3], D.M. Ezhov[4], V.A. Svetlichnyi[4], Yu.M. Andreev[5], G.V. Lanskii[5]; 1 - High Current Electronics Inst. SB RAS, 2 - Inst. of Geology and Mineralogy SB RAS, 3 - Inst. of Automation & Electrometry SB RAS, 4 - Siberian Physical Technical Inst. of Tomsk State Univ., 5 - Inst. of Monitoring of Climatic and Ecological Systems SB RAS, Russia

Optical properties of beta-BBO were studied in the range of 0.2 – 2.5 THz at RT and 81 K by THz–TDS. Recorded dispersions were approximated in the form of Sellmeier equations. Phase-matched down-conversion, as well as SHG within the THz range, are found possible. Efficient optical rectification into long wavelength region was experimentally observed.

WeR8-p14 11:30-13:30

Spontaneous and stimulated Raman scattering in tungstate and molybdate crystals at both high and low frequency anionic group vibrations

S.N. Smetanin[1], A.A. Kopalkin[1], V.E. Shukshin[1], L.I. Ivleva[1], P.G. Zverev[1], M. Frank[2], M. Jelínek[2], D. Vyhlídal[2], V. Kubeček[2]; 1 - Prokhorov General Physics Inst. RAS, Russia; 2 - Czech Technical Univ. Prague, Czech Republic

Characteristics of spontaneous and stimulated Raman scattering in different tungstate and molybdate crystals at both high and low frequency anionic group vibrations are studied. Possibilities of the strongest 24-fold pulse shortening from 36 ps down to 1.5 ps of the synchronously pumped crystalline extra-cavity SrMoO4 Raman laser due to shorter dephasing time of the low frequency shift Raman line are shown.

WeR8-p15 11:30-13:30

Stimulated Raman scattering in water excited with picosecond laser pulses

A.I. Vodchits[1], V.A. Orlovich[1], V.S. Gorelik[2]; 1 - Stepanov Inst. of Physics NASB, Belarus; 2 - Lebedev Physical Inst. RAS, Russia

Picosecond stimulated Raman scattering in light and heavy water is studied in the visible and infrared spectral ranges. Splitting the Stokes and anti-Stokes components and transient phase transition of water into ice is observed due to laser-induced plasma.

WeR8-p16 11:30-13:30

Laser ablation of materials by femtosecond laser pulses in liquid media

D.A. Kochuev, K.S. Khorkov, A.A. Voznesenskaya, R.V. Chkalov, V.G. Prokoshev; Vladimir State Univ., Russia

Investigations of the processes of interaction of ultrashort laser pulses with materials in liquid media are a promising direction [1]. With this kind of treatment, it is possible to create conditions conducive to chemical and phase modification of materials unattainable under other processing conditions [2-3].

WeR8-p17 11:30-13:30

Transient dynamics of anapole mode in dielectric particles

S.E. Svyakhovskiy[1], V.V. Ternovski[1], M.I. Tribelsky[1,2,3,4]; 1 - Lomonosov Moscow State Univ., 2 - National Research Nuclear Univ. MEPhI, 3 - Landau Inst. for Theoretical Physics RAS, Russia; 4 - RITS Yamaguchi Univ., Japan

Transient processes of resonant light scattering by dielectric particles are studied theoretically. It is shown that the anapole mode, known to be non-radiative in the steady state, successfully accepts energy from the incident wave during the initial stage of scattering process and much faster radiates it back at the final stage.

WeR8-p18 11:30-13:30

Photoreflectance spectroscopy of nonlinear photonic crystals

S.E. Svyakhovskiy, A.E. Aslanyan, P.Yu. Bokov, A.V. Chervyakov, L.P. Avakyants; Lomonosov Moscow State Univ., Russia

We present a method of an optical nonlinearity measurement in the photonic crystal by means of the photoreflectance spectroscopy. We propose that the photoreflectance is a promising, non-destructive and sensitive technique for a measurement of optical nonlinearities of photonic band gap structures.

WeR8-p19 11:30-13:30

Influence of polarization deviation in SPDC on the degree of entanglement of photon pairs

D.Frolovtsev, D. Agapov, S. Magnitskiy; Lomonosov Moscow State Univ., Russia

We analyze the impact of the polarization deviation [1] on the states of polarization-entangled photons produced via a double crystal scheme. The negative influence of polarization deviation is disclosed and characterized, and we propose the method allowing one to fully compensate the negative action of this effect and to achieve maximum degree of entanglement.

WeR8-p20 11:30-13:30

Optical spectroscory of hyperbolic plasmonic metamaterials

A.R. Pomozov, V.B. Novikov, I.A. Kolmychek, A.P. Leontiev, K.S. Napolskii, T.V. Murzina; Lomonosov Moscow State Univ., Russia

Linear and nonlinear optical spectroscopy of an array of Au nanorods, embedded in a dielectric matrix, is studied in the spectral range corresponding to specific dispersion points of such a structure. Experimental data is in a good agreement with the results of numerical modelling based on the effective medium model, as well as on linear and nonlinear FDTD simulations.

WeR8-p21 11:30-13:30

Surface modification of ZnO for solar converters by NdYag Laser

D. Redka[1,2], N. Mukhin[2], A. Grishkanich[1], E. Terukov[2,3], S Hirsch[4]; 1 - ITMO Univ., 2 - St. Petersburg State Electrotechnical Univ., 3 - Ioffe Inst., Russia; 4 - Technische Hochschule Brandenburg, Germany

Zinc oxide films are used as a photovoltaic transparent electrodes for current collection. They are a good substitute for expensive transparent electrodes on the basis of Indium tin oxide. The ZnO films fabricated with a certain morphology of the structure are able to act as a light diffuser. When passing through a layer of this material solar radiation quantum changes its trajectory, so dispersion of radiation occurs, which leads to an increase in the optical path of the particle in the photoactive structure.

WeR8-p22 11:30-13:30

Probing superfluid light in atomic vapor

Q. Fontaine, T. Bienaimé, A. Bramati, Q. Glorieux; Sorbonne Univ. – ENS – UPMC – CNRS, France

We report here the first measurement of the sound-like dispersion of density waves propagating on top of a correlated photons fluid generated by the third order Kerr non-linearity in a hot rubidium atomic vapor.

WeR8-p23 11:30-13:30

Quantum theory of laser transverse spatial solitons

Yu.M.Golubev[1], T.Yu.Golubeva[1], N.N.Rosanov[2,3], S.V.Fedorov[2,3]; 1 - St. Petersburg State Univ., 2 - Vavilov State Optical Inst., 3 - ITMO Univ., Russia

We consider the generation of laser field in the presence of active laser medium as well as the medium with saturable absorption, and construct the quantum theory of the laser spatial transverse soliton in terms of Heisenberg-Langevin equations. We show a significant change in the statistics of photons from the periphery of the soliton (below-threshold) to its central part (above-threshold).

WeR8-p24 11:30-13:30

Optical inducing of channel waveguides spatial modulated in lithium niobate with surface-doped layer

A.D. Bezpaly, A.S. Perin, V.M. Shandarov; Tomsk State Univ. of Control System and Radioelectronics, Russia

Channel optical waveguides are pointwise formed by laser radiation with wavelengths of 450 and 532 nm within lithium niobate surface layers doped with iron and copper. The characteristics of induced elements with width 60 μm or less are studied by light probing of lithium niobate samples.

WeR8-p25 11:30-13:30

Unidirection coherent radiation in Rb-atoms driving by strong femtosecond comb

I.K. Korshok[1], E.N. Borisov[1], S.A. Pulkin[1], A.A. Kalinichev[1], N.S. Pulkin[2], S.V. Uvarova[1]; 1 - St. Petersburg State Univ., 2 - ITMO Univ., Russia

Experimental researches and theoretical numerical computer simulations of spectrum of rubidium atoms in the strong femtosecond field were made. Pumping of focused radiation by train of 100-femtosecond pulses (comb) near resonance transition (780 nm) leads to the appearance of unidirectional coherent radiance in the near IR and in the blue area. Numerical simulation confirms the role of the nonlinear interference (coherent) effect.

WeR8-p26 11:30-13:30

Terahertz induced second optical harmonic generation for detection optically hidden layers in bulk of transparent materials

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

Terahertz induced second optical harmonic generation was proposed as a method for detection of optically hidden layers with thickness more or much less the optical wavelength in a bulk of both optically and terahertz transparent materials.

WeR8-p27 11:30-13:30

Temperature dependence of optical absorption of polymers used in fiber optics

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

Temperature dependence of the optical absorption of polysiloxane polymers generally used as fiber unit fillers was investigated. Absorption of the polymer measured at 1060 nm nonlinearly increased from 1.1·10-2 cm 1 to 2.1·10-2 cm 1 during heating from 20 °C to 145 °C. Thermal degradation of the polymer was observed at 160 °C.

WeR8-p28 11:30-13:30

Structure simulation of photonic crystal fibers for the 2.0-25.0 µm range

L.V. Zhukova, A.S. Korsakov, V.S. Korsakov, A.A. Lashova; Ural Federal Univ., Russia

In this work, modeling of photonic crystal infrared fibers for a range of 2-25 µm is performed. As a result, a single-mode photonic crystal fiber with a large mode field.

WeR8-p29 11:30-13:30

Modeling and fabrication of photonic crystal photonic structure fibers for a wavelength of 10 µm

L.V. Zhukova, A.S. Korsakov, V.S. Korsakov, A.A. Lashova; Ural Federal Univ., Russia

This article deals with a photonic crystal light guide computer simulation based on solid solutions of silver halide and thallium iodide. It is proposed to use it in space environment as a transmission channel and signal filter for telescopes.

WeR8-p30 11:30-13:30

Sapphire terahertz microstructured waveguides for remote sensing, intrawaveguide spectroscopy and interferometry

G.M. Katyba[1,2], N.V. Chernomyrdin[2,3,4], I.A. Shikunova[1], K.I. Zaytsev[2,3,4], V.N. Kurlov[1,3]; 1 - Inst. of Solid State Physics RAS, 2 - Bauman Moscow State Technical Univ., 3 - Sechenov First Moscow State Medical Univ., 4 - Prokhorov General Physics Inst. RAS, Russia

We have developed microstructured terahertz (THz) waveguides based on sapphire shaped crystals. These waveguides employ either the resonant (bandgap or photonic crystal) or antiresonant principles of waveguiding. They combine unique physical properties of sapphire with high quality of shaped crystals. We have performed numerical and experimental studies of the microstructured sapphire waveguides to demonstrate that they allow for solving numerous challenging problems of THz remote sensing, intrawaveguide spectroscopy and interferometry, including the THz measurements in aggressive environments.

WeR8-p31 11:30-13:30

Generating a sequence of femtosecond pulses without a carrier envelope offset phase

N.N. Golovin, N.I. Dmitrieva; Novosibirsk State Technical Univ., Russia

A method is proposed for realizing a sequence of femtosecond pulses without the frequency comb offset with the required carrier envelope offset phase using an intensity modulator and a phase shifter.

WeR8-p32 11:30-13:30

Temperature noncritical phase matching for frequency conversion of laser radiation

S.V. Gagarskiy[1], S.G. Grechin[2], P. J. Druginin[1], A.N. Sergeev[1]; 1 - ITMO Univ., 2 - LLC «NeoPhotonic», Russia

For the first time, temperature acceptance bandwidth exceeding 200 °C is experimentally achieved for second harmonic generation of 1.064 µm radiation in KTP crystal, while the conversion efficiency is 43%.

WeR8-p33 11:30-13:30

Intensity modulation response of analog fiber-optic link with dispersion compensating fiber

V.V. Shcherbakov[1], A.F. Solodkov[1], A.A. Zadernovsky[2]; 1 - JSC «Center VOSPI», 2 - Moscow Technological Univ. MIREA, Russia

We present experimental results on transmission of signals in analog fiber-optic links with direct intensity modulation and direct detection of photocurrent at the output of the fiber. Dispersion compensating fiber (DCF) is used to compensate for the dispersion accumulated over the length of transmitting fiber. Despite the presence of the residual total dispersion we have observed appreciable mitigation of the depth of signal power dips.

WeR8-p34 11:30-13:30

Harmonic distortions of signals in analog fiber-optic links

V.V. Shcherbakov[1], A.F. Solodkov[1], A.A. Zadernovsky[2]; 1 - JSC «Center VOSPI», 2 - Moscow Technological Univ. MIREA, Russia

We present experimental results on transmission of signals in analog fiber-optic links with direct and external intensity modulation and direct detection of the optical signals at the output of the fiber. We examine harmonic distortions of the signals and explore the origin of these distortions. Theoretical interpretation of the experimental results is presented.

WeR8-p35 11:30-13:30

Dynamics of the optical field in the ring cavity with the nonlinear metamaterial and time-delayed feedback

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

This paper investigates nontrivial temporal dynamics of the optical field in the nonlinear ring resonator (containing the metamaterial with the cubic nonlinearity of the Kerr type) driven by an external optical injection and subjected to a delayed feedback. Unstable periodic orbits are obtained for definite sets of parameters.

WeR8-p36 11:30-13:30

Experimental investigation of merit of forward Raman pumping for DP-QPSK coherent transmission.

D.D. Starykh[1,2], I.I. Shikhaliev[1,2], O.E. Naniy[1,2,3], V.N. Treschikov[1,3]; 1 - T[8] R&D Center, 2 - Moscow Inst. of Physics and Technology (State Univ.), 3 - Lomonosov Moscow State Univ., Russia

We demonstrate that distributed Raman amplification allow to increase margin of signal-to-noise ratio of coherent optical transmission system by 6 dB. Besides, we experimentally investigate dependence of power of noise of nonlinear interference from different parameters forward Raman amplification and propose phenomenological model for coherent transmission performance prediction.

WeR8-p37 11:30-13:30

General law of anti-Stokes wing formation in the spectrum of femtosecond light bullet

A.E.Dormidonov[1], V.P.Kandidov[1], V.O.Kompanets[2], S.V.Chekalin[2]; 1 - Lomonosov Moscow State Univ., 2 - Inst. of Spectroscopy RAS, Russia

A law determining the formation of the isolated anti-Stokes wing in the supercontinuum spectrum of a light bullet in a femtosecond filament in transparent dielectrics has been established. The dispersion equation theoretically obtained for the anti-Stokes wing shift has been confirmed by spectroscopic studies of the filamentation in the anomalous group velocity dispersion regime in various media.

WeR8-p38 11:30-13:30

Developing the nonlinear effects in chalcogenide microresonators

D. Zhivotkov[1], D. Ristić[1], M. Ivanda[1], E. Romanova[2], V.Shiryaev[3]; 1 - Inst. Ruđer Bošković, Croatia; 2 - Saratov State Univ., Russia; 3 - Inst. of Chemistry of High Purity Substances RAS, Russia

For the sensing application and investigating the nonlinear effects, microresonator structures are very suitable due to their enormous quality factor and small mode volume. These properties can be extended into the mid-infrared region by creating microresonators from chalcogenide glasses, which have large third-order optical nonlinearity. We present the analysis of the nonlinear effects observation in chalcogenide microspheres.

WeR8-p39 11:30-13:30

Limits of applicability of the concept of critical power for the self-focusing of light

S.A. Kozlov[1], M.A. Kniazev[1], D.A. Kislin[1], A.A. Drozdov[1], S. Choudhary[2], R.W. Boyd[2]; 1 - ITMO Univ., Russia; 2 - Univ. of Ottawa, Canada

An expression is derived and analyzed for the conditions under which the concept of a critical power for self-focusing loses its physical meaning due to the dominance of the process of dispersion over diffraction.

WeR8-p40 11:30-13:30

Self-assembled biomacromolecular films as a basis for nonlinear optical devices

M.A.Baranov, E.N.Velichko, E.T.Aksenov; Peter the Great St. Petersburg Polytechnic Univ., Russia

This paper is concerned with studies of protein films as a basis for nonlinear optical devices for biomolecular electronics, in particular, a molecular computer. A possibility of creation of an optical analog of a neural network based on the biomolecular film structure is considered. Some experiments on creation of specially structured films were conducted. The great influence of magnetic field on protein films structure was detected.

WeR8-p41 11:30-13:30

Experimental study of the filaments parameters at the focusing with cylindrical lens

K.S. Khorkov, D.A. Kochuev, R.V. Chkalov, V.G. Prokoshev, S.M. Arakelian; Vladimir State Univ., Russia

The article presents the results of the experimental study of the interaction of femtosecond laser radiation with transparent quartz samples. The areas of filaments formation at focusing by a cylindrical lens at different intensities are presented.

WeR8-p42 11:30-13:30

Soliton pulse dynamics in a bidirectional microcavity

V.A. Razukov, L.A. Melnikov; Saratov State Technical Univ., Russia

Using the numerical realization of "Cabaret" method the long-time spatio-temporal dynamics of the electromagnetic field in a nonlinear ring cavity with dispersion is investigated during the hundreds of round trips. It was assumed that two waves run in the opposite directions and influence each other. Formation of both the temporal cavity solitons and irregular pulse trains is demonstrated and discussed.

WeR8-p43 11:30-13:30

Technical linewidth of a self-generating magnetometer with modulated pumping

S.V. Ermak, D.M. Gorodnichev, K.A. Lejennikova, V.V. Semenov; Peter the Great St. Petersburg Polytechnic Univ., Russia

The ultimate expressions for a self-generating magnetometer with modulated pumping technical line width calculation are presented.

WeR8-p44 11:30-13:30

Two-photon absorption in ZnO-TeO2 glass

D.S. Chunaev[1], O.A. Zamyatin[2,3], A.Ya. Karasik[1], V.G. Plotnichenko[4]; 1 - Prokhorov General Physics Inst. RAS, 2 - Lobachevsky State Univ., Nizhny Novgorod, 3 - Devyatykh Inst. of Chemistry of High-Purity Substances RAS, 4 - Fiber Optics Research Center RAS, Russia

Two-photon Absorption Coefficient in Te - Zn glass of 70TeO2 - 30ZnO composition at 523nm wavelength was measured. Value of the coefficient is 3.1cm/GW.

WeR8-p45 11:30-13:30

Interaction of filaments in IR and UV spectral domains

D.V. Mokrousova[1], A.A. Ionin[1], O.G. Kosareva[2], N.A. Panov[2], L.V. Seleznev[1], D.E. Shipilo[2], E.S. Sunchugasheva[1]; 1 - Lebedev Physical Inst. RAS, 2 - Lomonosov Moscow State Univ., Russia

The interaction of four beams propagating in filamentation regime is studied in IR (744 nm) and UV (248 nm) spectral domains both experimentally and numerically. UV filaments was shown not to fuse and form a superfilament unlike IR ones.

WeR8-p46 11:30-13:30

Cooperative properties of an atomic cluster in a charged Fabry-Perot microcavity

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

We study the cooperative spontaneous decay and cooperative Lamb shift caused by the dipole-dipole interatomic interaction in an atomic cluster located in a Fabry-Perot microcavity with charged mirrors. The results are compared with the case when the mirrors are not charged as well as with the case of absence of the cavity, and the differences are discussed.

WeR8-p47 11:30-13:30

Theoretical and experimental investigation of polymer thin-film coatings on double cladding optical fibers

O.V. Ivanov[1,2,3]; 1 - Ulyanovsk Branch of Kotel'nikov Inst. of Radio Engineering and Electronics RAS, 2 - Ulyanovsk State Univ., 3 - Ulyanovsk State Technical Univ., Russia

We investigate transmission characteristics of a fiber-optic structure based on a fiber section with depressed inner cladding and thin polymer overlays. We measure transmission spectra of the structure upon changes in external refractive index and overlays thickness and compare our results with theoretical calculation. Two types of coatings are studied: polyacrylic acid, which is deposited on the fiber using layer-by-layer assembly technology, and polyvinyl alcohol.

WeR8-p48 11:30-13:30

Surface plasmon polariton generation in graphene-semiconductor structure with distributed feedback and direct current pump

I. Zolotovskii[1], S. Moiseev[1,2], Y. Dadoenkova[1,3], A. Kadochkin[1], O. Ivanov[1,2]; 1 - Ulyanovsk State Univ., 2 - Kotelnikov Inst. of Radio Engineering and Electronics RAS, Russia; 3 - Donetsk Inst. for Physics & Technology, Ukraine

The possibility of surface plasmon polaritons generation in a waveguiding system containing semiconductor film and graphene single-layer is shown. The amplification is created by fast drift current propagating in the graphene, and the feedback is realized due to a periodic change of the semiconductor film thickness.

WeR8-p49 11:30-13:30

Gold coated perforated arrays for surface enhanced Raman measurements on immobilized objects

I. Rigó[1], P. Fürjes[2], M. Veres[1]; 1 - Inst. for Solid State Physics and Optics, 2 - Inst. of Technical Physics and Materials Science, Hungary

Perforated gold coated substrates were prepared for surface enhanced Raman spectroscopy by photolithography and isotropic etching of silicon-on-insulator substrates. The geometry of the structure was designed to trap and immobilize large number of objects of certain size for surface enhanced Raman spectroscopic analysis.

WeR8-p50 11:30-13:30

Investigation of terahertz generation in water jet in dependence on parameters of excitation pulse

A.N. Tcypkin[1], S.E. Putilin[1], S.A. Shtumpf[1], S.V. Smirnov[1], Yiwen E[2], M.V. Melnik[1], E.A. Ponomareva[1], V.G. Bespalov[1], S.A. Kozlov[1], X.-C. Zhang[1,2];1- ITMO Univ., Russia; 2 - Univ. of Rochester, USA

We present experimental measurement and numerical simulation of terahertz radiation generation with respect to the duration of optical excitation pulse and the thickness of the water jet.

WeR8-p51 11:30-13:30

Unipolar THz pulse generation in nonlinear medium axcited at superluminal velocity

D.O. Zhiguleva[1,2], R.M. Arkhipov[1,3,4], M.V. Arkhipov[1], I. Babushkin[5,6], N.N. Rosanov[4,7,8]; 1 - St. Petersburg State Univ., Russia; 2 - Heinrich Heine Univ., 3 - Max Planck Inst. for the Science of Light, Germany; 4 - ITMO Univ., Russia; 5 - Max Born Inst., 6 - Leibniz Univ. Hannover, Germany; 7 - Vavilov State Optical Inst., 8 - Ioffe Inst., Russia

We study theoretically a new method of few-cycle quasi unipolar pulses generation by exciting nonlinear oscillators in a circular string. This method enables to control the pulse duration, amplitude and spectral range of the produced pulse.

WeR8-p52 11:30-13:30

Application of narrow linewidth fiber laser systems in quantum frequency standards and atom interferometers based on cold atoms.

G.V.Osipenko[1], E.V.Ivanchenko[1,2], V.N.Baryshev[1], M.S.Aleynikov[1], I.Y.Blinov[1]; 1 - FSUE VNIIFTRI, 2 - MEPHI, Russia

We report the construction and investigation of an ultra-stable laser system with a narrow spectral line of a few kHz. The system is based on frequency doubled 1560 nm fiber lasers, commonly used in telecommunications. We expect to use this system in the development of the fountain type quantum frequency standards and quantum sensors based on atom interferometry.

WeR8-p53 11:30-13:30

Spin-polarized cold cloud of thulium atoms

V.V. Tsyganok[1,2], V.A. Khlebnikov[1], D.A. Pershin[1,2], A.V. Akimov[1,3,4]; 1 - Russian Quantum Center, 2 - Moscow Inst. of Physics and Technology, 3 - Lebedev Inst. RAS, Russia; 4 - Texas A&M Univ., USA

We prepared about half-million thulium atoms at state with the lowest magnetic sublevel in optical dipole trap. A high purity of polarization of atomic cloud is well confirmed by the Stern-Gerlach-type experiment.

WeR8-p54 11:30-13:30

The influence of incoherent background illumination on the photorefractive response in doped lithium niobate

A.V. Pustozerov, V.M. Shandarov, A.S. Perin; Tomsk State Univ. of Control Systems and Radioelectronics, Russia

Influence of incoherent background on diffraction divergence of narrow light beams of He-Ne laser. Incoherent background is produced by light-emitting diodes (LED´s) and laser diode emitting. It has been experimentally demonstrated that nonlinear diffraction of coherent red beams of He-Ne laser may be totally compensated by means of assistance of incoherent background with shorter average wavelengths and lower intensity.

WeR8-p55 11:30-13:30

Microwave photonics frequency conversion of microwave signals

V.V. Valuev[1,2], S.M. Kontorov[1], V.V. Kulagin[3,4], D.A. Prokhorov[1], V.A. Cherepenin[4], A.N. Shulunov[2]; 1 - National Research Nuclear Univ. MEPhI, 2 - Research Centre «Module», 3 - Lomonosov Moscow State Univ., 4 - Kotel'nikov Inst. of Radio-Engineering and Electronics RAS, Russia

Comparative study of different architectures for microwave photonics frequency converters of microwave signals is presented. Characteristics of the receivers with different architectures are obtained with the help of numerical simulation. Experimental parameters for the prototypes of receivers show good agreement with the results of numerical simulation. It is shown that the signal-to-noise ratio can reach 60-70 for a carrier frequency of tens of gigahertz and a receiving bandwidth of several hundreds of megahertz.

WeR8-p56 11:30-13:30

Numerical modeling of the dynamics of a bidirectional long ring Raman fiber laser

S.V. Sukhanov, L.A. Melnikov, Yu.A. Mazhirina; Saratov State Technical Univ., Russia

The results of numerical investigations of opposite running waves in Raman ring fiber laser are presented. Different bidirectional regimes of this laser are demonstrated including non-reciprocity induced beat signal.

WeR8-p57 11:30-13:30

Ramsey signal of coherent population trapping resonance in optically dense atomic cloud

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

This work is devoted to the Ramsey method (by means of pulsed radiation) of detection of the coherent population trapping resonance in the cold atomic cloud. We investigate the effect of an optically dense medium on the form and light shift of Ramsey resonance. The main result is to find the optimal ratio between intensities of the frequency components of radiation which suppresses the light shift for arbitrary dipole moments of atomic transitions.

WeR8-p58 11:30-13:30

Towards all-optical encoding in nonlinear Fourier transform links

A.I. Konyukhov[1,3], L.A. Melnikov[2,3], A.A. Sysoliatin[3], K.S. Gochelashvili[3]; 1 - Saratov State Univ., 2 - Saratov State Technical Univ., 3 - Prokhorov General Physics Inst., Russia

Use of dispersion oscillation fiber for all-optical coding in nonlinear Fourier transmission links is proposed. The dispersion oscillating fiber allows to prepare predefined set of discrete eigenvalues. Real part and imaginary part of the eigenvalues can be changed due to high-order breather fission or inelastic soliton interaction. The soliton interaction can be controlled via chirp and energy of input pulses.

WeR8-p59 11:30-13:30

Investigations of metrological characteristics of the «Winters Electro-Optics, Inc.» iodine-stabilized He-Ne laser by The State Primary Standard of the Unit of Length - GET 2-2010

N.A. Kononova, Yu.G. Zackharenko, V.L. Fedorin, Z.V. Fomkina; Mendeleyev Inst. for Metrology, Russia

The report is about investigations of metrological characteristics of iodine-stabilize He-Ne laser by The State Primary Standard.

WeR8-p60 11:30-13:30

Dynamics of PT-symmetry breaking in multilayers with resonant loss and gain

D.V. Novitsky[1,2], A.V. Lavrinenko[3], A.S. Shalin[2], A.V. Novitsky[3,4]; 1 - Stepanov Inst. of Physics NASB, 2 - ITMO Univ., Belarus; 3 - Technical Univ. of Denmark, Denmark; 4 - Belarusian State Univ., Belarus

Using numerical simulations of the Maxwell-Bloch equations, PT-symmetry breaking is investigated in one-dimensional structures with resonantly absorbing and amplifying layers. We reveal the lasing-like regime and saturation of loss and gain above the exceptional point. The uniqueness of phase transition due to saturation and the direction locking of the transmitted and reflected radiation in the lasing-like regime are predicted.

WeR8-p61 11:30-13:30

Self-induced-transparency pulses in disordered resonant media

D.V. Novitsky; ITMO Univ., Russia; Stepanov Inst. of Physics NASB, Belarus

A concept of disordered resonant media, which are characterized by random change of the density of active particles along the light propagation direction, is proposed. The effect of disorder on short pulse propagation is analyzed using numerical simulations of the Maxwell-Bloch equations. The transition between self-induced-transparency and localization regimes is revealed as well as disorder-induced inelasticity of pulse collisions.

WeR8-p62 11:30-13:30

Optical spectral encoding for nanopositioning

I.G. Likhachev, V.I. Pustovoy, V.V. Svetikov; Prokhorov General Physics Inst. RAS, Russia

Methodology based on spectral encoding of broadband emission has been developed to control the position of a stage and its movement with nanometer precision. A distinctive feature of the methodology is that it allows to control the absolute position of the stage without pre-calibration.

WeR8-p63 11:30-13:30

Self-organized aggregation of a triple of resonant nanoparticles into stable structures with various shapes controlled by a laser field

V.V. Slabko[1], A.S. Tsipotan[1,2], V.S. Kornienko[2,3], V.A. Tkachenko[2]; 1 - Kirensky Institute of Physics SB RAS, 2 - Siberian Federal Univ., 3 - Inst. of Computational Modeling SB RAS, Russia

In this paper a dynamic model of self-assembly of nanoparticles under laser radiation field is proposed with the aim of investigating the possibility of a step-by-step organization of a nanostructure consisting of three particles with different shapes.

WeR8-p64 11:30-13:30

Simulation of photonic crystal fibers at a wavelength of 5.75 μm

L.V. Zhukova, A.S. Korsakov, E.A. Korsakova, A.A. Lashova; Ural Federal Univ., Russia

It is investigated fiber delivery channels for medical lasers at a wavelength of 5.75 μm in this paper. Modified silver halide photonic crystal fibers were chosen as the delivery channels. Computer simulation of these fibers was carried out.

WeR8-p65 11:30-13:35

Modulation of the effective dielectric function of nanoparticles under laser pumping

D.A. Zimnyakov[1,2], S.A. Yuvchenko[1], S.S. Volchkov[1]; 1 - Saratov State Technical Univ., 2 - Precision Mechanics and Control Inst. RAS, Russia

The effect of modulation of the effective dielectric function of laser-pumped nanoparticles is considered. Experimental data obtained for various semiconductor and semi-metallic nanoparticles are discussed.

WeR8-p66 11:30-13:30

Dispersion managed dissipative soliton in cubic-quintic nonlinear medium with frequency selective feedback

G.S. Parmar, S. Jana; Thapar Inst. of Engineering and Technology, India

Generation and dynamics of dispersion-managed dissipative soliton (DMDS) in optical fiber having cubic-quintic nonlinearity coupled with frequency selective feedback has been investigated using Variational method in association with Rayleigh dissipative function to obtain evolution equations for different pulse parameters and numerically by using split-step Fourier method (SSFM). The interaction and switching characteristics of two dispersion-managed dissipative solitons is carried out numerically to understand its nature.

WeR8-p67 11:30-13:30

Ultrafast dynamics of Chromone phototransformation by means of transient absorption spectroscopy

A.O. Ayt[1], V.A. Barachevsky[1] , S.V. Gagarskiy[2], K. Oberhofer[3], Ch. Brunner[3], Ya. Yu. Fomicheva[2], H. Iglev[3], V.V.Kiyko[2], A. N. Sergeev[2]; 1 - Photochemistry Center RAS, 2 - ITMO Univ., Russia; 3 - Technical Univ. Munich, Germany

In this work dynamics of chromone compound photo-induced transformation is investigated using ultrafast pump-probe measurements. Relaxation dynamics of transient absorption spectrum is described by two time constants of 1.5 ps and about 1.5 ns. Energy diagram of chromone photoinduced transformation dynamics is suggested.

WeR8-p68 11:30-13:30

Nonlinear stable pulses in dispersion-managed fiber-optic systems with compensated losses

V.A. Neskorniuk[1], A. Lukashchuk[2], I. Gabitov[1,3], A. Chipouline[1,4], M. Malekizandi[4], F. Küppers[4]; 1 - Skolkovo Inst. of Science and Technology, Russia; 2 - École Polytechnique Fédérale de Lausanne, Switzerland; 3 - Univ. of Arizona, USA; 4 - Technische Univ. Darmstadt, Germany

We propose a computer algorithm predicting the shape of solitary waves of dispersion-managed fiber-optic systems – DM-solitons, lower and upper branches of bisolitons in the realistic case of substantial losses. To prove the validity of our model we show that its predictions are indeed stable solutions of nonlinear Schrödinder equation and are in good agreement with the experimental data.

WeR8-p69 11:30-13:30

Structural modification of As50S50 chalcogenide film by femtosecond laser radiation

A.V. Romashkin[1], A.A. Murzanev[1], A.M. Kiselev[1], A.I. Korytin[1], M.A. Kudryashov[2], A.V. Nezhdanov[2], A.I. Mashin[2], A.N. Stepanov[1]; 1 - Inst. of Applied Physics RAS, 2 - Lobachevsky State Univ., Russia

Structural modification of 4 µm thick As50S50 chalcogenide film on a glass substrate was investigated. It was modified by Ti: Sapphire high repetition rate femtosecond laser radiation. Tight focusing onto a sample results in high intensity which leads to permanent modification of the film structure due to nonlinear absorption. The modified areas were analyzed via optical microscopy, atomic force microscopy, interferometry and Raman spectroscopy. The correlation between changes in refractive index of the film and modifications of the Raman spectra was observed.

WeR8-p70 11:30-13:30

Experimental investigation of rotation of polarization in strongly twisted optical fibers of various types

O.V. Ivanov[1,2,3]; 1 - Ulyanovsk Branch of Kotel'nikov Inst. of Radio Engineering and Electronics RAS, 2 - Ulyanovsk State Univ., 3 - Ulyanovsk State Technical Univ., Russia

Rotation of polarization in strongly twisted optical fibers of various types is investigated experimentally. The strain-optic coefficient of standard, high-NA, Yb-doped and other fibers was measured. We have found that fibers with higher refractive index of the core have higher optical activity coefficient.

WeR8-p71 11:30-13:30

Monitoring the deposited energy density by the third harmonic under two-color femtosecond micromachinig of transparent dielectrics

E.I. Mareev, F.V. Potemkin; Lomonosov Moscow State Univ., Russia

We report that the third harmonic signal generated during laser micromachining of transparent dielectrics serves as an indicator of the deposited energy density. The third harmonic signal reaches its maximum under two-color laser processing by a pair of tightly focused femtosecond laser pulses that corresponds to a maximum deposited energy density of 7 kJ / cm^3.

WeR8-p72 11:30-13:30

Laser subcarrier underwater quantum communication

V.A. Semenova[1], A.V. Gleim[1,2], S.M. Kynev[1], V.V. Chistyakov[1], S.V. Smirnov[1], V.G. Bespalov[1]; 1 - ITMO Univ., 2 - Kazan Quantum Center, Russia

In this work we present a loss model for a signal of subcarrier quantum communication system transmitted through a water channel.

WeR8-p73 11:30-13:30

Simultaneous luminescence spectroscopy - laser-induced breakdown spectroscopy for analysis of changes in structure of chromium doped potassium-aluminoborate glass

V.F. Lebedev, K.V. Pavlov, A.N. Babkina, A.I. Novogran, K.S. Zyryanova; ITMO Univ., Russia

The possibilities of LIBS technique for observation of changes of glass structure after high temperature heat treatment are demonstrated.

WeR8-p74 11:30-13:30

Nonlinear optical microscopy of spherical organic-dye microresonators

N.V. Mitetelo[1], E A. Mamonov[1], D.A. Kopylov[1], D. Venkatakrishnarao[2], R. Chandrasekar[2], T.V. Murzina[1]; 1 - Lomonosov Moscow State Univ., Russia; 2 - Univ. of Hyderabad, India

We experimentally observed the enhancement of nonlinear optical effects in spherical organic microstructures. This enhancement is related to a strong field localization due to whispering-gallery modes excitation in the two photon fluorescence spectrum.

WeR8-p75 11:30-13:30

Intrinsic fluorescence upon two-photon laser excitation in tungstate and molibdate oxide crystals

V.I. Lukanin, A.Ya. Karasik; Prokhorov General Physics Inst. RAS, Russia

Under picosecond laser excitation interband two-photon absorption in crystals PbWO4, ZnWO4, PbMoO4, CaMoO4, BaMoO4, KGd(WO4)2, CaWO4, BaWO4 is investigated.

WeR8-p76 11:30-13:30

Optimization of rotational Raman response model for simulations of filamentation in air

D.A. Urgapov[1], D.E. Shipilo[1,2], N.A. Panov[1,2], A.M. Saletsky[1], O.G. Kosareva[1]; 1 - Lomonosov Moscow State Univ., 2 - International Laser Center, Lomonosov Moscow State Univ., Russia

We discuss the application of quantum nonperturbative, quantum perturbative, and phenomenological approaches to the description of rotational Raman response in simulations of filamentation in air.

R11. NONLINEAR AND QUANTUM INTEGRATED OPTICS

WeR11-p01 15:00-17:00

Quantum statistical properties of exciton-polariton condensates

T.A. Khudaiberganov[1], I.Yu. Chestnov[1], S.S. Demirchyan[1], A.P. Alodjants[2]; 1 - Vladimir State Univ., 2 - ITMO Univ., Russia

Quantum statistical properties of the light emitted by a semiconductor microcavity with embedded quantum wells are studied. The unique quantum solution for the system of coupled excitonic and photonic modes was obtained. This solution predicts both bunching and antibunching of the photonic fraction of the condensate.

WeR11-p02 15:00-17:00

Investigation of NV-centers in diamond plates for application as high sensitive sensors

O.R. Rubinas[1,2,4], V.V. Vorobyov[2,4], V.V. Soshenko[2,4], V.N. Sorokin[2,4], V.G. Vins[3], A.V. Akimov[5]; 1 - Moscow Inst. of Physics and Technology, 2 - Lebedev Physical Inst. RAS, 3 - LLS Velman, 4 - Spin Sensor Technology, Russia; 5 - Texas A&M Univ., USA

Diamond plates with nitrogen- vacancy defects are applied as very sensitive elements in optical quantum devices,such as magnetometers, gyroscopes and termometers. In this work influence of manufacturing technology on sensitivity of diamond plates was investigated.

WeR11-p03 15:00-17:00

Gaussian entangled states formation In an array of waveguides with quadratic nonlinearity

V.O.Martynov, V.A.Mironov; Inst. of Applied Physics RAS, Russia

Formation of Gaussian entangled states in an array of optic waveguides due to spontaneous parametric down-conversion of classical pump in one of waveguides has been studied. Also the influence of phase noise in the pump on entanglement evolution has been considered.

WeR11-p04 15:00-17:00

Electro-optic broadband modulator based on lithium niobate WGM microresonator

A.S. Gorodnitskiy[1,3], A. S. Voloshin[1], N. M. Kondratiev[1], I. A. Bilenko[1,2], M. L. Gorodetsky[1,2]; 1 - Russian Quantum Center, 2 - Lomonosov Moscow State Univ., 3 - Moscow Inst. of Physics and Technology, Russia

We report an experimental investigation of electro-optic amplitude modulator based on whispering gallery mode (WGM) optical microresonators. We have analyzed in detail the limits of operating ranges and ways to extend them. The WGM resonator is a polished lithium niobate micro-disk with metal deposited ring RF electrodes. To excite the WGM modes, a coupling prism was used.

WeR11-p05 15:00-17:00

Nanoscale metallic nanostructures for photonic devices

S.V. Kutrovskaya[1,2], A.Yu. Shagurina[1], A.V. Kel'[1], A.F. Lelekova[1]; 1 - Vladimir State Univ., 2 - Russian Quantum Center, Russia

The results of the formation of planar nanostructures with relief, repeating the trajectory of movement of an AFM probe were presented. The parameters affecting their geometric dimensions were investigated. The method of induced deposition of silver/golden clusters on the silicon wafer surface was developed. This approach opens the possibility of using such structures as hybrid circuits for photoelectric transducers and photonic waveguides.

WeR11-p06 15:00-17:00

Metrology of photon statistics of pulsed low-photon light sources

S. Magnitskiy[1,2], P. Gostev[1,2], D. Agapov[1], E. Mamonov[1], A. Demin[3], E. Popova[4], A. Stifutkin[4]; 1 - Lomonosov Moscow State Univ., 2 - International Laser Center, Lomonosov Moscow State Univ., 3 - FSUE Russian Research Inst. for Optical and Physical Measurements, 4 - National Research Nuclear Univ. MEPhI, Russia

An experimental technique for measuring the statistics of photocounts for pulsed low-photon light sources using a SiPM detector is proposed.

WeR11-p07 15:00-17:00

Time domain based electronic spin state readout of NV center.

V.V. Soshenko[1,2], V.V. Vorobyov[1,2], S.V. Bolshedvorskii[1,2,3], O.R. Rubinas[1,2,3], V.N. Sorokin[1,2,4], A.N. Smolyaninov[2], A.V. Akimov[5,1,4]; 1 - Lebedev Physical Inst. RAS, 2 - Sensor Spin Technologies, 3 - Moscow Inst. of Physics and Technology, 4 - Russian Quantum Center, Russia; 5 - Texas A&M Univ., USA;

A novel method of electronic spin state readout, based on time-domain analysis of optical signal from ensemble of NV centers, is described, allowing doubling of measurement dynamic range.

WeR11-p08 15:00-17:00

Enhancing NV based sensors with a nuclear spin memory

V.V. Vorobyov[1], V.V. Soshenko[1], S. Bolshedvorksii[1], O. Rubinas[1], A.N. Smolyaninov[1], V.N. Sorokin[1], A.V. Akimov[2]; 1 - Lebedev Physical Inst., Russia; 2 - Texas A&M Univ., USA

In our work, we demonstrate several approaches to initialize quantum memory in regular magnetic fields, manipulation of quantum memory, and reading the quantum information from it.

R1. SOLID-STATE LASERS

Location: Petrov-Vodkin 2+3 Room, floor 2. 09:00 - 11:00

Laser Materials, Spectroscopy I

Session Chair: Maximilian Lederer, European XFEL GmbH, Germany

ThR1-35 09:00-09:30

Tailored crystals for solid state lasers *(Invited paper)*

C. Kränkel[1], E. Castellano-Hernández[1], A. M. Heuer[2];[1]- Leibniz Inst. for Crystal Growth,[2]- Univ. Hamburg, Germany

We report on our current research towards efficient lasers in the visible and mid-infrared spectral range using tailored active crystals. We achieved 0.45 W of direct yellow emission with Tb:LiLuF at a slope efficiency of 23 % and 0.28 W at 2856 nm at 20 % slope efficiency in Er-doped Scandia.

ThR1-36 09:30-09:45

Lasing features in annealed high-germania-core optical fibers doped with bismuth

S.V. Firstov[1,3], A.V. Kharakhordin[1], S.V. Alyshev[1], K.E. Riumkin[1], V.F. Khopin[2], M.A. Melkumov[1], A.N. Guryanov[2], E.M. Dianov[1]; 1 - Fiber Optics Research Center, RAS; 2 - Inst. of Chemistry of High-Purity Substances, RAS; 3 - Ogarev Mordovian State Univ., Russia

We report the results on lasing features in annealed bismuth-doped optical fibers. It was found that the annealed fibers present better lasing properties than the pristine ones which contain similar amount of the bismuth active centers associated with germanium.

ThR1-37 09:45-10:00

Study of laser properties of erbium and thulium doped tellurite fibers

E.A. Anashkina[1,2], V.V. Dorofeev[2,3], S.V. Muravyov[1,2], M.Y. Koptev[1], S.E. Motorin[2,3], A.V. Kim[1]; 1 - Inst. of Applied Physics RAS; 2 - Center of Laser Technology and Material Science; 3 - Inst. of Chemistry of High-Purity Substances RAS, Russia

The possibility of low-loss erbium or thulium doped tellurite fibers application for laser operation mainly in the 2-3 microns range was studied. High-purity samples were produced and characterized. Photoluminescence spectra were measured, and amplification of seeded signal was observed experimentally. Numerical simulations of laser operation showed potential applicability of the designed samples in the range of interest.

ThR1-38 10:00-10:15

Study of active media on nano- and microparticles of solid-state laser materials

N.E. Bykovsky[1], E.A. Cheshev[1], A.L. Koromyslov[1], Yu.V. Senatsky[1], B.N. Chichkov[2], A. Evlyukhin[2], K. Kurselis[2], Yu.L. Kopylov[3], V.A. Konyushkin[4]; 1 - Lebedev Physics Inst. RAS, Russia; 2 - Laser Zentrum Hannover e.V., Germany; 3 - Kotel'nikov Inst. of Radioengineering and Electronics RAS, 4 - Prokhorov General Physics Inst. RAS, Russia

Prospects of active media based on nano- and microparticles of laser crystals and glasses are discussed. Study on laser beams propagation over the index-matched mixtures of solid microparticles with liquids and results of experiments on pumping and lasing in active media with microparticles of Nd-doped glasses and fluoride crystals will be reported.

ThR1-39 10:15-10:30

Spectroscopy and laser operation of Eu3+:LiYF4

M.P. Demesh[1], E. Castellano-Hernández[2], V.E. Kisel[1], A.S. Yasukevich[1], V.I. Dashkevich[3], V.A. Orlovich[3], C. Kränkel[2,4], N.V. Kuleshov[1];[1]- Center for Optical Materials and Technologies, BNTU, Belarus;[2]- Leibniz-Inst. for Crystal Growth, Germany;[3]- Stepanov Inst. of Physics, NASB, Belarus;[4]- Univ. of Hamburg, Germany

Up to 15 mW of continuous wave deep red laser output at 702 nm is demonstrated using an Eu-(7.6 at.%):LiYF4 crystal under pumping with a frequency doubled Ti:sapphire laser at 393.5 nm.

ThR1-40 10:30-10:45

Z-scan technique to study gain properties of active media

O.R. Akhtyamov, V.V. Semashko, A.A. Shavelev, N.F. Rakhimov; Kazan Federal Univ., Russia

An opportunity of studying of optical gain properties of active media using the open aperture z-scan technique without an additional probe beam is demonstrated. The method allows evaluating pump induced photodynamic processes parameters in UV solid-state active media on the pumping and lasing wavelengths.

ThR1-41 10:45-11:00

Investigation of the magneto-optical properties of europium containing fluorides

E.A. Mironov[1], O.V. Palashov[1], D.N. Karimov[2]; 1 - Inst. of Applied Physics RAS, 2 - Federal Scientific Research Centre «Crystallography and Photonics»RAS, Russia

The magneto-optical characteristics of the europium fluoride crystal were measured. They are 100% -55% higher than the corresponding values for the popular TGG crystal. Taking into account better spectral characteristics in the mid-IR range and good thermo-optical characteristics, it can be concluded that the use of europium containing fluorides is promising in the development of Faraday isolators for mid-IR lasers.

- Coffee Break -

Location: Petrov-Vodkin 2+3 Room, floor 2. 11:30 - 13:30

Laser Materials, Spectroscopy II

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

ThR1-42 11:30-12:00

Diamond – a 'new' high performance laser material *(Invited paper)*

R.P. Mildren; Macquarie Univ., Australia

Diamond possesses a suite of properties well suited for revealing extreme optical phenomena. In this paper, the optical-related properties are surveyed to highlight those that are most distinctive. Our work at MQ Photonics Research Centre has concentrated on exploiting the several of these to develop a range of novel laser sources. Examples will be presented including concept demonstrations of high beam brightness beam generation, diamond lasers providing wavelength options in the visible and infrared, and diamond-based techniques for beam combination and beam brightness enhancement.

ThR1-43 12:00-12:15

Lasing in Er3+ doped microspheres

D. Ristić[1], D. Zhivotkov[1], M. Ferrari[2,3], A. Chiappini[2], M. Ivanda[1]; 1 - Ruđer Bošković Inst., Croatia; 2 - IFN – CNR CSMFO Lab., 3 - Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi", Italy

We have coated silica microspheres with a Er3+ doped 70SiO2-HfO2 thin layer. Upon pumping the erbium at 1480 nm lasing was observed in the 1520-1560 nm range with lasing powers up to 600 nW. The wavelengths of the laser lines were found to correspond to the eigenfrequencies of the whispering gallery modes of the silica microspheres.

ThR1-44 12:15-12:30

Tunable discrete-cavity solid-state laser for phase-sensitive OTDR

A.A. Zhirnov[1], A.B. Pnev[1], V.E. Karasik[1], K.V. Stepanov[1], K.I. Koshelev[1], D.A. Shelestov[1], C. Svelto[2]; 1 - Bauman Moscow State Technical Univ., Russia; 2 - Politecnico di Milano, Italy

We present first results archived with a widely tunable discrete cavity diode pumped solid-state laser, at around 1.55 um wavelength, for phase-sensitive optical time domain reflectometer (phi-OTDR).

ThR1-45 12:30-12:45

Saturable absorption of Cr2+: ZnS doped by hot isostatic pressing at 1.54 µm

P. Loiko[1], V. Vitkin[1], S. Balabanov[2], O. Dymshits[3], K. Grigorenko[1], A. Matuhina[1], A. Volokitina[1], X. Mateos[4], J. M. Serres[4], E. Gavrishchuk[2]; 1 - ITMO Univ., 2 - Devyatykh Inst. of Chemistry of High-Purity Substances RAS, 3 - NITIOM Vavilov State Optical Inst, Russia; 4 - FiCMA-FiCNA, Univ. Rovira i Virgili, Spain

Polycrystalline zinc sulfide (ZnS) samples doped by Cr2+ ions using hot isostatic pressing (at 100 MPa / 1250 °C) were prepared. Their structure and spectroscopic properties were studied. Absorption saturation of Cr2+:ZnS is demonstrated at 1.54 µm for ns-long pulses yielding a saturation intensity as low as 0.15 J/cm2.

ThR1-46 12:45-13:15

Solid-state powerful femtosecond mid-IR laser sources based on Fe2+ doped chalcogenides: advances and prospects *(Invited paper)*

F.V. Potemkin[1], M.P. Frolov[2,3], V.M. Gordienko[1]; 1 - Lomonosov Moscow State Univ., 2 - Lebedev Physical Inst. RAS, 3 - Moscow Inst. of Physics and Technology, Russia

Efficient chirped pulse amplification of broadband mid-IR (4-5 µm) femtosecond seed pulse (230 ps, 4µJ) generated in AgGaS2 based OPA driven by Cr:forsterite laser in multi-pass Fe2+:ZnSe amplifier optically pumped by solid-state Q-switched Cr:Yb:Ho:YSGG laser (2.85 um, 30mJ, 5Hz, 0.6 J/cm^2) has been demonstrated.

ThR1-47 13:15-13:30

7.5 J pulsed thermoelectrically cooled Fe: ZnSe laser tunable over 3.75-4.82 μm

M.P. Frolov[1,2], Yu.V. Korostelin[1], V.I. Kozlovsky[1,3], B.M. Lavrushin[1], Yu.P. Podmar'kov[1], Ya.K. Skasyrsky[1]; 1 - Lebedev Physical Inst. RAS, 2 - Bauman Moscow State Technical Univ., 3 - National Research Nuclear Univ. MEPhI, Russia

Output energy of 7.5 J at 4.3 μm and optical-to-optical efficiency of 30% have been demonstrated in single-shot operation of a thermoelectrically cooled to 220 K Fe:ZnSe laser with a 2.94-μm Er:YAG pump laser. Continuous tuning from 3.75 to 4.82 μm has been obtained.

- Lunch Break -

Location: Petrov-Vodkin 2+3 Room, floor 2. 15:00 - 16:30

Mode-locked Lasers II

Session Chair: Maximilian Lederer, European XFEL GmbH, Germany

ThR1-48 15:00-15:30

Ultrafast burst-mode fiber lasers for ablation-cooled material removal *(Invited paper)*

F.Ö. Ilday; Bilkent Univ., Turkey

This talk introduces the recently discovered regime of ablation-cooled laser-material removal, which reduces the required laser pulse energies, enormously simplifying the laser technology, increases efficiency and achieves record speeds particularly on biological tissue without heat damage. This regime requires to be laser pulses to have repetition rates in the GHz-range to minimize heat diffusion away from the processing region, thus keeping the rest of the target material cool and without damage. In order to access this regime, we have embarked on a systematic effort to develop ultrafast fiber lasers operating in the burst mode.

ThR1-49 15:30-15:45

Distributed feedback fiber laser based on fiber Bragg grating inscribed by femtosecond point-by-point technique

M.I. Skvortsov[1,2], A.A. Wolf[1,2], A.V. Dostovalov[1,2], A.A. Vlasov[1], S.A. Babin[1,2]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Novosibirsk State Univ., Russia

We present the results of fabrication and characterization of two distributed feedback fiber lasers based on 32-mm pi-phase-shifted fiber Bragg gratings, which are inscribed in non-PM CorActive EDF-L1500 and non-photosensitive CorActive SCF-ER60 fibers with a femtosecond point-by-point technique. The generation regimes, spectral and polarization characteristics of the lasers are studied depending on the fiber specifics.

ThR1-50 15:45-16:00

Dynamic grating lifetime in a self-sweeping ytterbium fiber laser

R.V. Drobyshev[1], I.A. Lobach[1,2,3], S.I. Kablukov[1,2]; 1 - Inst. of Automation and Electrometry SB RAS, 2 - Novosibirsk State Univ., 3 - Lab. of Photonics, Perm Scientific Center of UB RAS, Russia

We report on investigation of dynamic grating (DG) evolution in an Yb-doped self-sweeping fiber laser in the absence of pumping radiation. The DG is recorded in the laser active medium by the laser radiation itself and is responsible for observed frequency self-sweeping effect. Results of the investigation show that the lifetime is about 1 ms, which is in a good agreement with the lifetime of upper level in ytterbium.

ThR1-51 16:00-16:15

Low-noise Er-fiber femtosecond frequency comb

K.A. Zagorulko, A.O. Gordeev; FSUE VNIIFTRI, Russia

We report on development of a low-noise Er-fiber femtosecond frequency comb. Offset frequency signal with a minimum linewidth of about 5 kHz and a signal-to-noise ratio of more than 55 dB was obtained. Repetition rate phase noise of our frequency comb is compared with phase noise of two commercial frequency combs.

ThR1-52 16:15-16:30

Diode pumped Nd3+: YVO4 laser with intracavity SHG in LBO and SRS in Ba(NO3)2

G.V. Shilova[1], A.A. Sirotkin[1,2], P.G. Zverev[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - National Research Nuclear Univ. MEPHI, Russia

All-solid-state diode pumped Nd3+: YVO4 laser at 563 nm with output power of 100 mW and 12.4 kHz pulse repetition rate was developed. The laser included intracavity frequency doubling in LBO and intracavity Raman conversion in Ba(NO3)2.

R2. HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID

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

High-Power Lasers II

Session Chair: Vladimir Tsvetkov,
Prokhorov General Physics Inst. RAS, Russia

ThR2-28 15:00-15:30

Features of thermally induced depolarization in media with a negative optical anisotropy parameter *(Invited paper)*

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

A historical review of the work devoted to the study of thermally-induced depolarization in optical elements is made. The main attention is paid to the features of thermally-induced depolarization in materials with a negative optical anisotropy parameter, methods for its reduction and compensation. The problem of the optimal orientation of the crystallographic axes in a magneto-optical element from material with a negative optical anisotropy parameter is considered.

ThR2-29 15:30-15:45

The dynamics of high-aperture active elements thermal optical wavefront distortions

S.A. Belcov[1], I.N. Voronich[1], V.Y. Gladkiy[1], V.N. Derkach[1], I.N. Derkach[1], V.B. Tsvetkov[2]; 1 - RFNC-VNIIEF, 2 - Prokhorov General Physics Inst. RAS, Russia

The wavefront thermal distortion dynamics measured with one of the laser channels of the Luch facility. After finishing the pump pulse, the value of thermal optical wavefront distortions begins to oscillate with the frequency being about 2 KHz. We estimated the influence of the time shift between the laser pulse arrival time and amplifier flashlamps trigger pulse on the laser beam «pump induced» divergency.

ThR2-30 15:45-16:00

Rapid horizontal growth of large-size KDP/DKDP crystal with continuous filtration and machine vision

H. Qi[1], X. Xie[1,2], B. Wang[1], H. Wang[1], Ji. Shao[1];1- Shanghai Inst. of Optics and Fine Mechanics CAS, 2 - Univ. of Chinese Academy of Sciences, China

Here we introduce a rapid horizontal growth method to grow KDP/DKDP crystals with the independent design equipment. We could regulate rotational speed, circular flow rate and other growth parameters to ensure a suitable concentration distribution. The growth solution was finely filtered range from 100nm to 200nm. KDP/DKDP showed the better optical property, shorter growth time and higher utilization percentage.

ThR2-31 16:00-16:15

Survey of crystals for multiple pump parametric amplification for petawatt class laser systems

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

We present a survey of LBO, BBO, DKDP and YCOB crystals for broadband multiple beams pumped parametric amplification. We investigate such parameters as amplification efficiency, amplified pulse duration and parasitic radiation fraction as well as pump beams angular instability influence. We find that high second order nonlinearity enables high efficiency and low parasitic radiation fraction. Active angular stabilization of pump beams is demonstrated to be crucial for high coherent combining efficiency of amplified pulses.

ThR2-32 16:15-16:30

Femtosecond pulse inscription of FBGs in multicore fibers and their applications

A.A. Wolf[1,2], S.S. Yakushin[1], M.Yu. Kotyushev[1], A.V. Dostovalov[1,2], S.G. Zhuravlev[3], O.N. Egorova[3], S.L. Semyonov[3], S.A. Babin[1,2]; 1 - Novosibirsk State Univ., 2 - Inst. of Automation and Electrometry SB RAS, 3 - Fiber Optics Research Center RAS, Russia

The results on core-selective inscription of fiber Bragg gratings in different multicore fibers by femtosecond laser pulses are presented. Applications, including multiple parameters sensors and fiber lasers, are discussed.

ThR2-33 16:30-16:45

Writing of chirped fiber Bragg gratings with an arbitrary phase response

I.S. Ulyanov[1,2], A.I. Baranov[1,2], I.N. Bychkov[1,2]; 1 - Moscow Inst. of Physics and Technology (State Univ.); 2 - NTO IRE-Polus, Russia

In this work method of fabricating chirped fiber Bragg gratings with an arbitrary phase response is presented. The idea of the method is that average refractive index modification directly affects phase response of the grating. Moreover such modifications can be done by nonuniform exposure to the UV light after fiber Bragg grating writing. Experimental setup is presented.

- Coffee Break -

Location: Deyneka Room, floor 2. 17:30 - 18:15

High-Power Lasers III

Session Chair: Fedor Starikov,
Russian Federal Nuclear Center –
The All-Russian Research Inst. of Experimental Physics, Russia

ThR2-34 17:30-17:45

Stacked-actuator deformable mirror for high-power lasers

V.V. Toporovskiy[1],A.V. Kudryashov[1,2],V.V. Samarkin[2],P.N. Romanov[2],I.V. Galaktionov[2]; 1 - Moscow Polytechnic Univ., 2 - Inst. of Geosphere Dynamics RAS, Russia

Conventional high-power lasers suffer from the wavefront aberrations, that significantly decrease the radiation power during the employment of the laser complex. For compensation of the wavefront distortions and improving the quality metrics of the radiation adaptive optics approaches are used. The 121-elements and the 19-elements stacked-actuator deformable mirrors for these kind of applications were developed.

ThR2-35 17:45-18:00

New laser composite ceramic laser active media based on ceramic YAG

M. Pankov, S. Lysenko, A. Kanaev, A. Kiselev, J. Kopylov, E. Cheshev; SLPG "Raduga", Russia

Large crystals are difficult to grow for a long time, and they have optical inhomogeneities. The ceramics made of carefully mixed powders are devoid of this disadvantage making it an excellent material for active laser elements. The active laser element with slab geometry (3×3×11 mm) laser ceramics with polished parallel ends was pumped from one side with 806 nm. As a result, the dependence of the generated power on the pump power was obtained, and the threshold power was 136 W. The differential efficiency of laser generation was 0.68, with a theoretically possible value of 0.72.

ThR2-36 18:00-18:15

Double sided hybrid welding technologies for hull structures production with high power fiber lasers

N.A. Steshenkova, N.A. Nosyrev, A.G. Zhmurenkov; JSC "Shipbuilding and Shiprepair Technology Center", Russia

One of the key tasks in advancing of hull structures production technology is a minimization of welding deformations and simultaneous provision of high production performance. This task can be obtained by arc augmented laser welding technology. Presented article describes investigations in support of double sided hybrid laser-arc welding for precise production of hull structures.

TECHNICAL SESSION
R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

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

High-Performance Laser Diodes and LEDs

Session Chair: Eugene Avrutin,
Univ. of York, UK

ThR3-27 09:00-09:30

High speed micro-LED arrays for navigation, imaging and communications *(Invited paper)*

J. Herrnsdorf, A.D. Griffiths, M.D. Dawson, M.J. Strain; Univ. of Strathclyde, UK

We present a number of spatio-temporal modulation schemes for application using high speed micro-LED emitter arrays. The varying characteristic modulation rates of the schemes allows demonstration of photometric stereo imaging, autonomous robotic navigation and few photon level communications using a single micro-LED device array.

ThR3-28 09:30-10:00

High-power and high-beam quality photonic crystal lasers *(Invited paper)*

S. Noda; Kyoto Univ., Japan

Photonic-crystal lasers have attracted much attention for their unrivaled capabilities, such as broad-area, coherent resonance, tailored beam patterns, and beam steering. In this presentation, I describe the progress of photonic crystal lasers with high power and high beam quality. I also discuss a novel concept of modulated photonic-crystal lasers realizing both lasing oscillation and on demand, beam diffraction for any two-dimensional direction in free space without the need for external elements.

ThR3-29 10:00-10:30

Athermal photonic crystal laser *(Invited paper)*

L. O'Faolain[1,2,3], S. Iadanza[1,2], A.P. Bakoz[1,2], P. Singaravelu[1,2], D. Panettieri[1], S.A. Schulz[1,2], G. C.R. Devarapu[1,2], E.A. Viktorov[4,5], S. Hegarty[1]; 1 - Cork Inst. of Technology, 2 - Tyndall National Inst., Ireland; 3 - Scottish Univ. Physics Alliance (SUPA), School of Physics and Astronomy, UK; 4 - ITMO Univ., Russia; 5 - Univ. Libre de Bruxelles, Belgium

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 a silicon nitride Photonic Crystal (PhC) based resonant reflector.

ThR3-30 10:30-10:45

High-performance diode lasers based on coupled-large-optical-cavity design

N.Yu. Gordeev[1,2], A.S. Payusov[1,2,3], Yu.M. Shernyakov[1,2], S.A. Mintairov[1,2], N.A. Kalyuzhnyy[1,2], M.M. Kulagina[1], A.A. Serin[1], M.V. Maximov[2,1,3], A.E. Zhukov[2,3]; 1 - Ioffe Inst., 2 - St. Petersburg Academic Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

We discuss how to significantly reduce internal optical losses, thermal and electrical resistances in laser diodes via applying our novel approach for transverse mode engineering. The obtained experimental results make the concept promising for high-power lasers.

ThR3-31 10:45-11:00

Resonance inhibiting of high-order lateral modes in few-stripe diode lasers

A.S.Payusov[1,2], Yu.M.Shernyakov[1,2], M.M.Kulagina[1], A.A.Serin[3,1], M.V.Maximov[2,1], A.E.Zhukov[2,3] N.Yu.Gordeev[1,2]; 1 - Ioffe Inst., 2 - St. Petersburg Academic Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

We present our novel approach for promoting lateral single-mode operation in the edge-emitting lasers having broadened multi-mode stripe. The idea is based on the resonant optical tunneling of the high-order modes into the nearby passive stripes. The obtained numerical and experimental results demonstrate that this design allows broadening single-mode stripe at least by a factor of two.

- Coffee Break -

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

Photonics Materials, Devices and Applications II

Session Chair: Alexey Baranov,
Univ. of Montpellier, France

ThR3-32 11:30-12:00

Near-IR InAs/GaAs quantum-dot lasers and their application for efficient frequency conversion *(Invited paper)*

K.A. Fedorova; Philipps-Univ., Germany; Ioffe Inst., Russia

In this talk, I will review our recent results on the development of novel, compact, CW and ultrashort pulse, near-IR InAs/GaAs quantum-dot (QD) based lasers and their application for the generation of light in the visible and THz spectral regions. This will include a discussion on the recent achievements in the development of broadly-tunable InAs/GaAs QD external-cavity diode lasers in the CW and mode-locked regimes, an overview of the advances made with second-harmonic generation in periodically-poled nonlinear crystal waveguides pumped by these lasers and a discussion on application of InAs/GaAs QD-based lasers for the development of ultra-compact room-temperature THz-generating laser sources.

ThR3-33 12:00-12:30

Harmonic generation and photon management at the nanoscale *(Invited paper)*

C. De Angelis[1], D.N. Neshev[2], L. Carletti[1], L. Ghirardini[3], D. Rocco[1], V. Gili[4], G. Pellegrini[3], M. Finazzi[3], A. Locatelli[1], I. Favero[4], G. Marino[4], M. Celebrano[3], G. Leo[4]; 1 - Univ. of Brescia, Italy; 2 - Australian National Univ., Australia; 3 - Politecnico di Milano, Italy; 4 - Univ. Paris Diderot, France

In this work, we review recent advances in devices with efficient frequency conversion and tunable control of the spatial and polarization properties of the emitted photons exploiting second order nonlinear processes in AlGaAs nanoantennas. By means of both numerical and experimental approaches, we demonstrate dynamic control over the directionality of the second harmonic radiation pattern generated in nanodisks by varying the angle of incidence of the pump beam and the shape of nanoresonator. Our measurements show that this approach allows achieving both efficiency enhancement and directionality control. The angular dependence of the second harmonic collected power may be used to develop high-precision and background-free nano-goniometers, enabling chip scale instruments for differential light scattering measurements.

ThR3-34 12:30-12:45

Analysis of waveguide doping effect on losses in high power semiconductor amplifiers and lasers

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

Semi-analytical treatment of internal optical losses in high power laser diodes and optical amplifiers at high injection level is presented. The case of true continuous wave, elevated temperature operation, when the optical loss is dominated by intervalence band absorption by holes thermally escaping from the active layer, is considered. It is shown that under such conditions moderately strong n-doping of the n-side of the optical confinement layer helps significantly alleviate the optical losses.

ThR3-35 12:45-13:00

Purcell factor in periodic metal-dielectric structures

M.A. Kaliteevski[1,2,3], K.A. Ivanov[1], A.R. Gubaydullin[1,2]; 1 - ITMO Univ., 2 - St. Petersburg Academic Univ., 3 - Ioffe Inst., Russia

Enhancement of spontaneous emission rate in periodic metal-dielectric structures has been analytically and numerically studied. Previous claims of giant Purcell factor have been adjusted. The deficiencies of the Drude model for studying Purcell factor have been demonstrated.

ThR3-36 13:00-13:15

Discrete relaxation oscillation frequency hopping in delayed-feedback semiconductor lasers

A.V. Kovalev[1], P.A. Dmitriev[1], B. Tykalewicz[2,3], D. Goulding[2,3], B. Kelleher[3,4], M.J. Wishon[5,6], A. Locquet[5,6], E.A.Viktorov[1]; 1 - ITMO Univ., Russia; 2 - Cork Inst. of Technology, 3 - Tyndall National Inst., Univ. College Cork, 4 - Univ. College Cork, Ireland; 5 - Georgia Tech Lorraine, France; 6 - Georgia Inst. of Technology, USA

We study the dynamics of semiconductor lasers subject to strong delayed optical feedback. We find that the discrete nature of the external-cavity modes leads to a discrete set of relaxation oscillation frequencies observed at the onset of the first instability as the pump current is increased. This explains experimentally observed hops between the frequencies.

- Lunch Break -

R4. LASER BEAM CONTROL

Location: Stenberg 1 Room, floor 3. 14:30 - 17:00

Laser Beam Control III

Session Chair: Vladimir Yu. Venediktov,
St. Petersburg Electrotechnical Univ. "LETI", Russia

ThR4-13 14:30-15:00

2D material liquid crystals for optoelectronics and photonics *(Invited paper)*

A. Baldycheva; Univ. of Exeter, UK

The merging of the materials science paradigms of liquid crystals and 2D materials promises superb new opportunities for the advancement of the fields of optoelectronics and photonics. In this paper, we summarise the development of 2D material liquid crystals by two different methods: dispersion of 2D materials in a liquid crystalline host and the liquid crystal phase arising from dispersions of 2D material flakes in organic solvents. The properties of liquid crystal phases that make them attractive for optoelectronics and photonics applications are discussed. The processing of 2D materials to allow for the development of 2D material liquid crystals is also considered. An emphasis is placed on the applications of such materials; from the development of films, fibers and membranes to display applications, optoelectronic devices and quality control of synthetic processes.

ThR4-14 15:00-15:30

The saturable absorption and optical limiting of black phosphorus nanosheets *(Invited paper)*

S. Zhang, J. Huang, N. Dong, J. Wang; Shanghai Inst. of Optics and Fine Mechanics CAS, China

Black phosphorus nanosheet dispersions exhibited superior saturable absorption when excited with femtosecond laser pulses and good optical limiting performance with nanosecond ones. The dynamics of the effects was studied in comparison with that in Molybdenum disulfide and graphene nanosheets in view of their applications for the laser beam control purposes.

ThR4-15 15:30-15:45

Anisotropic optical interference coatings for polarization control in high-power lasers

L. Grinevičiūtė[1], L. Ramalis[1], R. Buzelis[1], A. Melninkaitis[2], T. Tolenis[1]; 1 - Center for Physical Sciences and Technology, 2 - Vilnius Univ., Lithuania

Optical anisotropy played a crucial role in development of advanced optical systems. In this study, a novel multi-layer approach of birefringent coatings was proposed and investigated. Zero-order waveplates and normal incidence polarizers based on all-silica nanostructures are fabricated by oblique angle deposition process. Low optical losses and the potential to withstand high laser fluence in nanosecond regime at 355 nm wavelength for both elements were demonstrated.

ThR4-16 15:45-16:00

Tunable modal liquid crystal spiral phase plate

S.P. Kotova[1], A.M. Mayorova[1], K.V. Efimova[1,2], S.A. Samagin[1]; 1 - Lebedev Physical Inst. (Samara Branch), 2 - Samara National Research Univ., Russia

Several configurations of compact tunable modal spiral phase plates are proposed for formation and control of optical vortexes.

ThR4-17 16:00-16:15

Electrically addressed multielement polymer network liquid crystal matrix for spatial control of broad band optical irradiation

A.V. Venediktova[1,2], I. V. Bagrov[2], I. M. Beloysova[2], V.V. Danilov[3], L.V. Visnevskaya[2], E.N. Diagtereva[2], V.M. Kiselev[2], I.M. Kislyakov[4]; 1 - St. Petersburg Electrotechnical Univ. «LETI», 2 - Vavilov State Optical Inst., 3 - St. Petersburg State Transport Univ., 4 - ITMO Univ., Russia

We report the results of investigation of optical behavior of multielement cells with polymer network liquid crystal matrix.

ThR4-18 16:15-16:30

Optical phase conjugation through stimulated scattering in presence of 2D nanostructures

I. Kislyakov[1], J.-M. Nunzi[2,1], X. Zhang.1, Ju. Wang.1; 1 - Shanghai Inst. of Optics and Fine Mechanics CAS, China; 2 - Queen's Univ., Kingston, Canada

The influence of 2D nanoparticles on optical phase conjugation was studied. A strong quenching of stimulated Brillouin scattering by 2D nanostructures was found. The effect was explained based on thermal induced scattering concept; thermal expansion coefficient and sound velocity changes were determined. The effect is applicable for undesirable stimulated scattering suppression in laser layouts and for nano-impurities detection in materials.

ThR4-19 16:30-17:00

Self-diffractive structures for light addressing and beam control *(Invited paper)*

J.M. Nunzi[1,3], L. Mazaheri[1], O. Lebel[2]; 1 - Queen's Univ., Canada; 2 - Royal Military College of Canada, Canada; 3 - Shanghai Inst. of Optics and Fine Mechanics CAS, China

Photochromic materials like azo-glasses can self-organize under light. They form self-structured surface relief gratings. As predicted by theory, the process spontaneously creates a diffraction channel into the film, and/or the substrate. This can be used to fabricate polarization addressed coupling devices. Our experiments lift some ambiguities about the origin of the large amplitude molecular migration in azo-materials. We illustrate the process with different experiments like the transfer of chirality from light to the azo-glass thin-film.

- Coffee Break -

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

Laser Beam Control IV

Session Chair: Vladimir Yu. Venediktov,
St. Petersburg Electrotechnical Univ. "LETI", Russia

ThR4-20 17:30-17:45

Special features of the acoustically distributed feedback lasers based on gyrotropic cubic crystals

V.N. Belyi[1], H.A. Daniliuk[2], G.V. Kulak[2], T.V. Nikolaenko[2], O.V. Shakin[3]; 1 - Inst. of Physics NASB, 2 - Mozyr State Pedagogical Univ., Belarus; 3 - State Univ. of Aerospace Instrumentation, Russia

The oscillation conditions were determined for the distributed feedback lasers based on gyrotropic cubic crystals. The frequencies of clockwise (counterclockwise) polarized longitudinal eigenmodes decrease (increase) by $\omega p = \rho c/n$ (ρ is the specific optical rotation of the crystal, n is the index of refraction, c is the speed of light in vacuum) relative to the Bragg frequency $\omega 0 = \pi c/\Lambda n$ (Λ is the phase grating period). The gain threshold is higher for the clockwise than for the counterclockwise polarized waves.

ThR4-21 17:45-18:00

Reflective Bragg gratings with phase coding for narrow-band spectral control of laser radiation

I.S. Khakhalin[1,2], V.M. Petrov[1], A.P. Pogoda[2]; 1 - Peter the Great St. Petersburg State Polytechnical Univ., 2 - Baltic State Technical Univ., Russia

We demonstrate the technique of fast, electro-optical control of the transfer function of reflective Bragg grating. The grating is recorded as a volume hologram in LiNbO3 crystal. We demonstrated a set of different transfer functions with controllable parameters.

ThR4-22 18:00-18:15

Polarization dependencies associated with flexoelectrical dynamic gratings in sillenite crystals

V.M. Petrov[1], A.O. Zlobin[2], S.M. Shandarov[2], N.I. Burimov[2], S.S. Shmakov[2];1- Peter the Great St. Petersburg State Polytechnical Univ., 2 - Tomsk State Univ. of Control Systems and Radioelectronics, Russia

We demonstrate the effective use of the inverse flexoelectric effect for the formation of reflective Bragg grating in sillenite crystals. The impact of the specificity of the polarization properties of the inverse flexoelectric effect is considered, the optimal orientations are presented.

ThR4-23 18:15-18:30

Simulation of transmission spectra of Bragg gratings deformed by inhomogeneous acoustic wavefront

O.V. Ivanov[1,2,3], V.L. Vesnin1, A.M. Nizametdinov[1], A.A. Chertoriyskiy[1,3]; 1 - Ulyanovsk Branch of Kotel'nikov Inst. of Radio Engineering and Electronics RAS, 2 - Ulyanovsk State Univ., 3 - Ulyanovsk State Technical Univ., Russia

Transmission of a shock wavefront through a Bragg grating is considered. The results of simulation of the reflection spectrum of a fiber-optic Bragg sensor subjected to non-uniform deformation are presented. It is shown that in the general case this spectrum is a result of interference of light reflected from the deformed and undeformed parts of the sensor.

ThR4-24 18:30-18:45

Optical dynamic reconstruction of quantized digital and computer-generated holograms

P.A. Cheremkhin, E.A. Kurbatova; National Research Nuclear Univ. «MEPhI», Russia

Compression of computer-generated and digital holograms can significantly help with storage and transmission of information about 3D-objects. Different methods of quantization were applied to the holograms. Using phase spatial light modulator compressed holograms were dynamically optically reconstructed. Results of methods application were compared.

ThR4-25 18:45-19:00

Negative longitudinal component of the Poynting vector of tightly focused optical vortex

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

we numerically investigated the tight focusing of optical vortices with wavelength λ = 532 nm and left circular polarization by a diffractive lens with a numerical aperture NA = 0.95. The simulation was carried out using the Richards-Wolf formulae and FDTD-method. It was shown that the focusing of optical vortices with topological charge m = -2 at the focus can produce intensity distribution with a negative component on the axis of the longitudinal component of the Poynting vector.

ThR4-26 19:00-19:15

Transverse structure and energy deposition control by amplitude and phase beam regularization in multifilamentation regime

D.V. Pushkarev[1], E.V. Mitina[1], D.S. Uryupina[1,2], A.S. Lar'kin[1,2], A.A. Ushakov[1], N.A. Panov[1,2], D.E. Shipilo[1,2], R.V. Volkov[1,2], S.V. Karpeev[3,4], S.N. Khonina[3,4], A.A. Karabutov[1,2], O.G. Kosareva[1,2], A.B. Savel'ev[1,2]; 1 - Lomonosov Moscow State Univ., 2 - International Lazer Center of Lomonosov Moscow State Univ., 3 - Image Processing Systems Inst. RAS, 4 - Samara State Aerospace Univ., Russia

We conducted investigation of filament spatial interactions in a weakly focused filament bundle under various types of regularization by introducing amplitude and phase modulations into the laser beam. We revealed more than 1 order of magnitude energy deposition increase in the amplitude regularized 4-filament bundle and conservation of the multifilament transverse pattern in the phase regularized regime.

ThR4-27 19:15-19:30

Holographic femtosecond comb spectroscopy in wide spectral range

D.V. Venediktov[1], V.I. Shoev[1], E.N. Borisov[1], S.A. Pulkin[1] , K. Aksenova[1], V.Yu. Venediktov[1,2];[1] – St. Petersburg State Univ.,[2] – St. Petersburg State Electrotechnical Inst. "LETI", Russia

The paper considers the use of holographic femtosecond comb spectroscopy for analysis of the so-called Rozhdestvenskiy hooks.

R7. LASERS IN ENVIRONMENTAL MONITORING

Location: Stenberg 1 Room, floor 3. 11:30 - 13:15

Lasers in Environmental Monitoring III

Session Chair: Christof Janssen,
UPMC Sorbonne Univ., France

ThR7-14 11:30-12:00

Subcarrier wave quantum networking for free space communications *(Invited paper)*

A.V. Gleim[1,3], S.M. Kynev[1], V.I. Egorov[1], V.V. Chistyakov[1], K.P. Volkova[1], A.B. Vasiliev[1], A.V. Kozubov[1], A.A. Gaidash[1], I.Z. Latypov[2], V.V. Vitkin[1], S.A. Kolubin[1], V.G. Bespalov[1], A.A. Bobtsov[1], S.A. Kozlov[1]; 1 - ITMO Univ., 2 - Kazan Physical -Technical Inst., 3 - Kazan Quantum Center KNITU-KAI, Russia

Subcarrier wave quantum networking in different media (fiber-optic lines, atmospheric free-space and underwater free-spce) is presented in this work.

ThR7-15 12:00-12:15

Performance investigation of metallic diffraction grating based surface plasmon resonance refractive index optical sensor

S. Singh, R.S. Kaler, S. Sharma; Thapar Univ., Patiala, India

We investigate the performance of metallic diffraction grating(MDG) based surface plasmon resonance fiber optic sensor for bio-sensing applications. In this sensor diffraction order negative one is used to excite plasmon waves. Sensing performance is evaluated using numerical simulations based on rigorous coupled wave analysis (RCWA) method. The reflectance amplitude, width of the SPR curve and shift in the resonant wavelength with refractive index change are considered for estimating the bio-sensing performance. Our results show that aluminum grating based SPR sensor proves to be best for sensing applications and maximum sensitivity in angular interrogation is found to be 248°/RIU which is best for excellent sensor.

ThR7-16 12:15-12:30

Application of Rayleigh and Raman lidars for the middle atmosphere research

A.A. Cheremisin[1,2], V.N. Marichev[3], V.V. Bychkov[4], N.S. Nikolashkin[5], P.V. Novikov[1]; 1 - Irkutsk State Univ. of Railway Engineering, Krasnoyarsk Railway Inst., 2 - Siberian Federal Univ., 3 - Zuev Inst. of Atmospheric Optics SB RAS, 4 - Inst. of Cosmophysical Research and Radio Wave Propagation FEB RAS, 5 - Inst. of Cosmophisical Research and Aeronomy SB RAS, Russia

Aerosol content and temperature are important parameters of the Earth's stratosphere and mesosphere. We present the results of many years and present-day investigations of this high–altitude atmospheric region using Rayleigh and Raman lidars (Tomsk, Yakutsk and Kamchatka).

ThR7-17 12:30-12:45

The transmitter-receiver system of the pure rotational Raman lidar for temperature measurements of the atmosphere

S.M Bobrovnikov[1,2], E.V. Gorlov[1,2], V.I. Zharkov[2]; 1 - National Research Tomsk State Univ., 2 - Zuev Inst. of Atmospheric Optics SB RAS, Russia

A multi-aperture transmitting-receiving system of the Raman lidar was designed and tested. The Raman lidar for temperature profiling with high spatial resolution and low blind area was created. It has the spatial resolution 3 m and operation range 5-3000 m. The measurement accuracy of temperature is ~1 K. The lidar use a pure rotational Raman technology for temperature profiling.

ThR7-18 12:45-13:00

Measurement of cryological temperature distribution via fiber optic sensors

A.O.Chernutsky[1], A.B.Pnev[1], K.V.Stepanov[1], A.A.Zhirnov[1], V.Yu. Semyonov[1,2], A.S. Krotov[1,2]; 1 - Bauman Moscow State Technical Univ., 2 - PJSC "Cryogenmash", Russia

We perform the first results of experiments aimed at design of a temperature distribution measurement system for cryogenic heat exchanger.

ThR7-19 13:00-13:15

Operating range limitations of the Phase-Sensitive Optical Time-Domain Reflectometer assisted by Raman amplifiers

D.R.Kharasov[1,2], O.E. Naniy[1,3,4], S.P. Nikitin[3], V.N. Treschikov[1,3]; 1 - T[8] R&D Center, 2 - Moscow Inst. of Physics and Technology (State University), 3 - T[8] Sensor, 4 - Lomonosov Moscow State Univ., Russia

We demonstrate the sensing distance extension of the Phase-Sensitive Optical Time-Domain Reflectometer (Φ-OTDR) by 30 km using forward Raman amplification. The influence of Raman pump level on the sensitivity and the pulse waveform is investigated both theoretically and experimentally.

R8. NONLINEAR PHOTONICS: FUNDAMENTALS AND APPLICATIONS

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

Fast Optics

Session Chair: Boris Fainberg,
Holon Inst. of Technology, Tel Aviv Univ., Israel

ThR8-23 09:00-09:30

Optical metrology of ultrashort pulses based on self-phase modulated spectra measurements *(Invited paper)*

E.A. Anashkina[1], A.V. Andrianov[1], M.Y. Koptev[1], S. Singh[2], A.V. Kim[1]; 1 - Inst. of Applied Physics RAS, Russia; 2 - Sant Longowal Inst. of Engineering & Technology, India

We demonstrate a simple fiber-implemented technique for retrieval of intensity profile and phase of ultrashort laser pulses based on processing only pulse spectrum and two self-phase modulated spectra measured after a short piece of optical fiber with Kerr nonlinearity. A Gerchberg-Saxton-like algorithm is used for processing the experimental data. The results obtained by the developed method of optical metrology are confirmed by independent FROG-measurements.

ThR8-24 09:30-10:00

Nanoscale magnetic imaging using extreme-UV high-harmonics of femtosecond laser pulses *(Invited paper)*

S. Zayko[1], O. Kfir[1], M. Heigl[2], M. Sivis[1], M. Albrecht[2], C. Ropers[1]; 1 - Univ. of Göttingen, 2 - Univ. of Augsburg, Germany

We demonstrate the first table-top magneto-optical microscope with nanometric spatial resolution. We quantitatively map magnetic domains using laser-driven circularly polarized high harmonics reaching a spatial resolution below the illuminating wavelengths of 21 nm. This work opens new opportunities for studying of ultrafast processes at the nanoscale, using compact laser systems.

ThR8-25 10:00-10:15

Efficient 1556 to 4400 nm hydrogen Raman laser based on hollow-core silica fiber

M.S. Astapovich, A.N. Kolyadin, A.V. Gladyshev, A.F. Kosolapov, A.D. Pryamikov, M.M. Khudyakov, M.E. Likhachev, I.A. Bufetov; Fiber Optics Research Center RAS, Russia

We report on the efficiency enhancement of 4400 nm hydrogen Raman laser based on revolver silica fiber. A record-high quantum efficiency of 47 % is achieved and average power as high as 260 mW at 4400 nm is demonstrated.

ThR8-26 10:15-10:30

Passive mode-locking in lasers with ultrashort cavities

R.M. Arkhipov[1,2,3], M.V. Arkhipov[1], I. Babushkin[4,5], N.N. Rosanov[3,6,7]; 1 - St. Petersburg State Univ., Russia; 2 - Max Planck Inst. for the Science of Light, Germany; 3 - ITMO Univ., Russia; 4 - Max Born Inst., Germany; 5 - Leibniz Univ. Hannover, Germany; 6 - Vavilov State Optical Inst., 7 - Ioffe Inst., Russia

The possibility of passive mode locking in a laser containing an amplifier and an absorber is theoretically analyzed in the case when the length of the laser cavity is extremely small and the duration of one light pass between the mirrors of the cavity is less than the relaxation times of the polarization of the amplifier and absorber.

ThR8-27 10:30-10:45

Conservation of the electric field area in the problems of light propagation in a resonant medium

R.M. Arkhipov[1,2,3], M.V. Arkhipov[1], N.N. Rosanov[3,4,5]; 1 - St. Petersburg State Univ., Russia; 2 - Max Planck Inst. for the Science of Light, Germany; 3 - ITMO Univ., 4 - Vavilov State Optical Inst., 5 - Ioffe Inst., Russia

In this talk, the rule of conservation of the electric field area of the pulse is tested for the absorption and amplification of light in a resonance medium. The results of numerical simulations show that, contrary to the intuitive representation, this rule is satisfied. The conservation of the electric area of the pulse makes it possible to solve qualitatively the problems of changing the parameters of the pulses in propagation problems.

ThR8-28 10:45-11:00

Two-dimensional photoacoustic imaging of femtosecond filament in water

F.V.Potemkin[1,3], E.I. Mareev[1,3], B.V. Rumiantsev[1,3], A. S. Bychkov[1,2], E. B. Cherepetskaya[2], A. A. Karabutov[2,3], V. A. Makarov[1,3]; 1 - Lomonosov Moscow State Univ., Russia; 2 - Moscow Mining Inst., the National Univ. of Science and Technology MISiS, 3 - International Laser Center, Lomonosov Moscow State Univ., Russia

We report a first-of-its-kind optoacoustic tomography of femtoseconds filament in water. Using wide-band (about 100 MHz) piezoelectric detector and back-projection reconstruction technique a filament profile was retrieved. Obtained pressure distribution induced by the femtosecond filament determines the filament location and its radial size with spatial resolution better than 10μm.

- Coffee Break -

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

Optical Solitons

Session Chair: Nikolay N. Rosanov,
Vavilov State Optical Inst., Russia

ThR8-29 11:30-11:45

Chirp-controlled soliton fission in dispersion oscillating fiber

A.I. Konyukhov[1,3], L.A. Melnikov[2,3], A.A. Sysoliatin[3], K.S. Gochelashvili[3]; 1 - Saratov State Univ., 2 - Saratov State Technical Univ., 3 - Prokhorov General Physics Inst. RAS, Russia

Manipulation of initial chirp of input pulses in dispersion oscillating fibers provides precise control of the soliton fission process. Simulations demonstrate that pre-chirp can be applied to control amplitudes and carrier frequencies of output pulses. The control of the soliton fission dynamics can be obtained through the imposition of a quadratic spectral phase modulation of initial high-order solitons.

ThR8-30 11:45-12:15

Exciton-polaritons and switching waves in organic photonics *(Invited paper)*

B.D. Fainberg; Holon Inst. of Technology, Tel Aviv Univ., Israel

We develop a mean-field electron-vibrational theory of Frenkel exciton polaritons in organic dye structures. We apply the theory to experiment on fraction of a millimeter propagation of Frenkel exciton polaritons in photoexcited organic nanofibers made of thiacyanine dye. In the second part of the paper we study transverse phenomena such as switching waves in organic thin films.

ThR8-31 12:15-12:30

Spatially-multiplexed solitons in optical microresonators

E. Lucas[1], G. Lihachev[2,3], N.G. Pavlov[2,4], M. Karpov[1], A.S. Raja[1], M.L. Gorodetsky[2,3], T.J. Kippenberg[1]; 1 - Inst. of Physics, Ecole Polytechnique Federale de Lausanne, Switzerland; 2 - Russian Quantum Center,[3]- Lomonosov Moscow State Univ., 4 - Moscow Inst. of Physics and Technology, Russia

We simultaneously create stable solitons in up to three distinct mode families of a single crystalline MgF_2 microresonator. The resulting Kerr combs are mutually coherent and have distinct repetition rates and are thus well suited for dual-comb applications.

ThR8-32 12:30-12:45

Tangle three-dimensional laser solitons and their transformations

N.A.Veretenov[1,2], S.V. Fedorov[1,2], N.N. Rosanov[1,2,3]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., 3 - Ioffe Inst., Russia

Recently, we have predicted various topological three-dimensional solitons in laser media with fast saturation and absorption. The solitons are characterized by their skeletons - arrays of unclosed and closed vortex lines. Here we present a wider collection of such solitons stable in definite overlapping domains of parameters and analyze their transformations with parameters- variation near the boundary of the domains.

ThR8-33 12:45-13:00

Structure of energy flows in tangle laser solitons

S.V. Fedorov[1,2], N.N. Rosanov[1,2,3], N.A. Veretenov[1,2]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., 3 - Ioffe Inst., Russia

Presented is the internal structure of topological dissipative light solitons in laser media with saturable absorption. The solitons include a number of closed vortex lines encircling a number of unclosed lines, jointly forming tangles. We demonstrate singular elements - pointes, lines, and surfaces - in energy flows' distribution, strong coupling of vortex lines, and mechanisms of solitons' energetic and mechanical stabilization.

ThR8-34 13:00-13:30

Ultrafast orbital rotation in femtosecond laser trapping *(Invited paper)*

L. Huang[1,2], Yu. Jin[1,3], Ya. Qin[1,4], H. Shi[1], L. Xiao[4], Yu. Jiang[1,2]; 1 - Inst. of Genetics and Developmental Biology, CAS, 2 - Univ. of CAS, 3 - South China Normal Univ., 4 - Shanxi Univ., China

We report an ultrafast orbital motion of gold nanoparticles (GNPs) trapped by a circularly polarized femtosecond laser beam in Gaussian TEM00 mode. The maximal rotating rate was more than 240 Hz, higher than any previous reports. The direction of rotation is totally dependent on the handedness of circular polarization, indicating that the orbital angular momentum arises from spin-to-orbital conversion (STOC) during the femtosecond laser trapping. This ultrafast orbital rotation reveals a novel mechanism of STOC, which is attributed to nonlinear effects in the femtosecond laser trapping, essentially different from any others.

- Lunch Break -

Location: Stenberg 2 Room, floor 3. 14:45 - 17:00

Nano- and Metaoptics

Session Chair: Dmitry V. Skryabin, Univ. of Bath, UK

ThR8-35 14:45-15:15

Flat nonlinear optics with intersubband polaritonic metasurfaces *(Invited paper)*

N. Nookala[1], J. Lee[1], Y. Liu[1], D. Palaferri[1], M. Tymchenko[1], G. Boehm.[2], M.-Ch. Amann[2], O. Wolf[3], J.F. Klem[3], I. Brener[3], A. Alu[1], M.A. Belkin[1]; 1 - Univ. of Texas at Austin, USA; 2 - Technische Univ. München, Germany; 3 - Sandia National Laboratories, USA

We will present our latest results on developing intersubband polaritonic metasurfaces, based on coupling of transitions between electron states in quantum-engineered semiconductor heterostructures with electromagnetic modes in plasmonic nanocavities, for frequency mixing, intensity modulation, and optical power limiting in the mid-infrared spectral range.

ThR8-36 15:15-15:45

Light frequency conversion with resonant silicon-based nanoparticles *(Invited paper)*

S.V. Makarov; ITMO Univ., Russia

One of the most recent conceptual shift in nanophotonics was related to the replacement of resonant metallic nanoparticles by silicon ones bringing a novel opportunities for effective light frequency conversion and manipulation at nanoscale. In particular, we review recent achievements in optical harmonics generation from silicon based nanostructures as well as broadband photoluminescence implemented in a ultrabroadband near-field optical microscope.

ThR8-37 15:45-16:00

Coherent optical cooling of rare-earth-doped nanocrystals

T.A. Vovk, A.V. Ivanov, Y.V. Rozhdestvensky; ITMO Univ., Russia

We consider the translational optical cooling of Yb3+-doped nanocrystals by Raman optical pulses. We describe the coherent interaction between the optical pulses and impurity ions and estimate the temperature corresponding to the nanocrystal's transition into the macroscopic quantum state. Our cooling scheme can be applied in the fundamental studies on the properties of solid matter.

ThR8-38 16:00-16:30

Giant AC Stark effect in a strongly-coupled light-matter system *(Invited paper)*

D. Panna[1], N. Landau[1], S. Bouscher[1], L. Rybak[1], S. Tsesses[1], G. Adler[1], S. Brodbeck[2], C. Schneider[2], S. Hoefling[2] and A. Hayat[1]; 1 - Technion - Israel Inst. of Technology, Israel; 2 - Univ. Wuerzburg, Germany

We present the first experimental observation of a giant dynamic Stark effect in strongly coupled microcavity exciton-polaritons - stronger than the Rabi splitting and over an order of magnitude stronger than previous observations. We show that in the giant dynamic Stark effect the polariton blue shift can no longer be modeled perturbatively - as a shift of the exciton energy level alone.

ThR8-39 16:30-16:45

Recent advances in high-precision optical clocks based on ultracold atoms and ions

S.N. Bagayev, A.V. Taichenachev, V.I. Yudin; Inst. of Laser Physics SB RAS, Russia

New methods and approaches in precision laser spectroscopy of forbidden transitions in ultracold atoms and ions are discussed with an emphasis on contributions of Institute of Laser Physics SB RAS.

ThR8-40 16:45-17:00

High-efficient EIT-based quantum memory in a cold atomic ensemble

A.S. Sheremet, P. Vernaz-Gris, K. Huang, M. Cao, J. Laurat; UPMC-Sorbonne Univ., CNRS, ENS-PSL Research Univ., France

Quantum memory for optical qubits is a key element for developing quantum information applications. A critical figure of merit is the overall storage-and-retrieval efficiency. Here we demonstrate a reversible qubit mapping with high storage-and-retieval efficiency. Our work provides an efficient node future tests of quantum network functionalities and advanced photonic circuits.

- Coffee Break -

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

Nonlinear Photonics Applications

Session Chair: Aleksei Taichenachev, Inst. of Laser Physics SB RAS, Russia

ThR8-41 17:30-17:45

Suppression of low-frequency acoustic resonances in integrated optic lithium niobate modulators

A.V. Varlamov[1,2], M.Yu. Plotnikov[3], A.S. Aleinik[3], P.M. Agrusov[1], I.V. Il'ichev[1], L.V. Shamray[2], A.V. Shamray[1,2]; 1 - Ioffe Inst., 2 - Peter the Great St. Petersburg Polytechnic Univ., 3 - ITMO Univ., Russia

The influence of low-frequency acoustic vibrations on optical signals in integrated optic lithium niobate modulators is considered. It is shown that acoustic vibrations can make a significant contribution to the modulator transfer function at frequencies up to one gigahertz. A method for acoustic resonance suppression is suggested and verified.

ThR8-42 17:45-18:00

PPLN OPO with Intracavity DFG in OPGaAs

A.A. Boyko[1,2,3,4], D.B. Kolker[2,4], N.Y. Kostyukova[1,2,3,4], P.G. Schunemann[5], S. Guha[6], V.L. Panyutin[1], G.M. Marchev[1], A. Schirrmacher[7], V. Petrov[1]; 1 - Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany 2 - Novosibirsk State Univ., 3 - Special Technologies, Ltd., 4 - Inst. of Laser Physics SB RAS, Russia; 5 - BAE Systems, Inc., USA; 6 - Air Force Research Laboratory, Materials and Manufacturing Directorate, Wright Patterson AFB, USA; 7 - Canlas Laser Processing GmbH, Germany

Intracavity difference-frequency generation (DFG) in orientation-patterned GaAs (OPGaAs) produces an average power of 24 mW at ~6.7 µm using a Nd: YAG laser pumped Mg-doped periodically-poled LiNbO3 (Mg: PPLN) nanosecond optical parametric oscillator (OPO) operating at 1.5 kHz.

ThR8-43 18:00-18:15

Laser writing of full-color luminescent images in the volume of an optical carriers

E.F. Martynovich[1,2], E.O. Chernova[2,3], V.P. Dresvyansky[2], A.E. Bugrov[4], A.V. Konyashchenko[4]; 1 - Irkutsk State Univ., 2 - Inst. of Laser Physics SB RAS (Irkutsk Branch), 3 - Peter the Great St. Petersburg Polytechnic Univ.; 4 - Lebedev Physical Inst. RAS, Russia

A new method for laser recording of three-dimensional color luminescent images in the volume of an optical carrier based on a lithium fluoride crystals. The mechanisms of spatially selective formation of pixels emitting in the red, green and blue regions of the spectrum by femtosecond laser radiation were investigated and realized.

ThR8-44 18:15-18:30

Kinetics of laser induced color centers writing/erasing in alkali niobo-phosphate glasses

A.V. Povolotskiy[1], A.A. Kalinichev[2], A.A. Elistratova[1], I.A. Sokolov[3]; 1 - Inst. of Chemistry, St. Petersburg State Univ., 2 - St. Petersburg State Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

The kinetics of laser induced color centers formation in niobo-phosphate glasses with different alkali ions were studied. The color centers were formed by femtosecond laser pulses as a result of multiphoton absorption. Structural features of the glasses were investigated by Raman, IR and X-Ray spectroscopies. The effect of alkali ions on the laser induced color centers writing/erasing kinetics was observed.

ThR8-45 18:30-18:45

Extremely effective air photoionization through water vapor at 248 nm laser wavelength

A.V. Shutov, I.V. Smetanin, N.N. Ustinovskii, V.D. Zvorykin; Lebedev Physics Inst. RAS, Russia

Multiphoton ionization mechanisms and ionization rates of atmospheric air and constituent gases are studied at 248-nm KrF laser wavelength. We have experimentally shown that it is photoionization of water vapor naturally contained in atmospheric air that acts as the dominant process of air ionization. Total ionization rate of O2 and N2 in atmospheric air is about an order of magnitude less than that of water vapor.

ThR8-46 18:45-19:00

Control of terahertz yield from two-color femtosecond filaments

N.A. Panov[1], V.A. Andreeva[1,2], D.E. Shipilo[1], Y. Chen[3], S.L. Chin[4], A.B. Savel'ev[1], O.G. Kosareva[1]; 1 - Lomonosov Moscow State Univ., Russia; 2 - Univ. of Minnesota, USA; 3 - Shanghai Jiao Tong Univ., China; 4 - Laval Univ., Canada

We study experimentally and numerically the dependence of the terahertz (THz) yield from two-color filament in air on the initial pulse chirp. We found experimentally and proved numerically that the largest THz yield is attained for the positively chirped two-color pulse due to compensation of ω-2ω pulse delay by 2ω pulse stretching in normally dispersive air.

ThR8-47 19:00-19:15

Narrowing of air transparency window for high-power mid-infrared femtosecond radiation

D.E. Shipilo[1,2], N.A. Panov[1,2], D.A. Urgapov[1], A.M. Saletsky[1], O.G. Kosareva[1]; 1 - Lomonosov Moscow State Univ., 2 - International Laser Center, Lomonosov Moscow State Univ., Russia

Nonlinearly enhanced linear absorption of filamenting femtosecond pulse is simulated in the vicinity of 1.36 µm water vapor absorption band. Strong dependence of the peak plasma density obtained over 10-m propagation path in humid air on the sign of detuning of the pulse central wavelength from the absorption band center is observed.

R2. HIGH POWER LASERS: FIBER, SOLID STATE, GAS AND HYBRID

ThR2-p01 11:30-13:30

Temperature calibration by interval projection to latent structures in Yb3+: CaF2 fluorescence spectra

V.A. Aseev[1], M.A. Khodasevich[2]; 1 - ITMO Univ., Russia; 2 - Stepanov Inst. of Physics NASB, Belarus

The effectiveness of variable selection methods to improve the accuracy of temperature calibration by projection to latent structures is considered using the example of Yb3+: CaF2 fluorescence spectra. Searching combination of moving windows interval projection to latent structures allows more than double improvement in accuracy of temperature calibration (0.45 °C) compared with full spectrum projection to latent structures.

ThR2-p02 11:30-13:30

Analysis of a sub-nanosecond pulses frequency modulation using the tunable fiber Bragg grating

V.A. Kamynin[1,2], A.I. Trikshev[1,2], V.B. Tsvetkov[1,3], I.O. Zolotovskii[2], D.A. Korobko[2], O.I. Medvedkov[4]; 1 - General Physics Inst. RAS, 2 - Ulyanovsk State Univ., 3 - National Research Nuclear Univ., "MEPhI", 4 - Fiber Optics Research Center RAS, Russia

Theoretical and experimental analysis of a sub-nanosecond pulses frequency modulation was demonstrated. Ytterbium fiber laser with an 200 m ring cavity was used as an investigated laser system. Pulses duration was about 500 ps.

ThR2-p03 11:30-13:30

New method of time-resolved wavefront distortion measurements

S.A. Belcov[1], I.N. Voronich[1], V.Y. Gladkiy[1], V.N. Derkach[1], I.N. Derkach[1], V.B. Tsvetkov[2]; 1 - RFNC-VNIIEF, 2 - Prokhorov General Physics Inst. RAS, Russia

We propose a method of time-resolved wavefront distortion measurement. In this work, we present the implementation of this method for measurements of dynamics of thermal optical wavefront distortions in one of the laser channels of «Luch» facility. The sensitivity of the method implementation was found to be equal to 23 nm RMS in our experiments.

ThR2-p04 11:30-13:30

Calculation of thermally induced depolarization dispersion in laser ceramics

A.G. Vyatkin, E.A. Khazanov; Inst. of Applied Physics RAS, Russia

Dispersion of thermally induced depolarization degree in laser ceramics has been calculated analytically. The results well match the numerical simulation.

ThR2-p05 11:30-13:30

Potential energy curves for excited states of Ar in He and transition rate constants in ArHe calculated by Ab initio methods

A.R. Ghildina[1,2], A.A. Pershin[1,2], A.M. Mebel[1,3], M.C. Heaven[1,4];1- Samara National Research Univ., 2 - Lebedev Physical Inst. RAS (Samara Branch), Russia; 3 - Florida International Univ., 4 - Emory Univ., USA

The potential energy curves for the excited Ar*atoms interaction with He in a ground state were built. The transition energies of argon atom levels were calculated by MRCI method with aug-cc-pV5Z basis set in MOLPRO 2010 with an approaching He atom. The procedure of "diabatization" was carried out to obtain the transition rate constants of the s- and p- levels for Ar* in He at an atmospheric pressure.

ThR2-p06 11:30-13:30

Investigation of the high-speed direct laser deposition regime parameters influence on the structure and mechanical properties of the manufactured titanium products

K.D. Babkin[1,2], P.A. Golovin[1,2], A.M. Vildanov[2], M.O. Sklyar[1,2] ; 1 - St. Petersburg State Marine Technical Univ., 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia

The article is devoted to the technology of high-speed direct laser deposition of samples from titanium alloy Ti-6Al-4V. The purpose of the work was the production of titanium blades for machining. To achieve the goal, natural experiments were conducted to select optimal process regimes ensuring the absence of defects in the form of pores, fusions, cracks; samples of various configurations for mechanical testing also were produced.

ThR2-p07 11:30-13:30

Kinetics of O2(a1Δ, v) formed in flush photolysis of ozone at 266 nm

A.A. Pershin[1,2], A.P. Torbin[1,2], V.N. Azyazov[1,2]; 1 - Samara Univ., 2 - Lebedev Physical Inst. RAS, Russia

Experimental studies of reactions with vibrationally excited singlet oxygen have been performed. The rate constants were found from experimental results.

ThR2-p08 11:30-13:30

Influence of powder fraction on mechanical properties of the products made from titanium alloy Ti-6Al-4V produced by Direct Laser Deposition

G.A.Turichin[1,2], M.O. Sklyar[1,2], O.G. Klimova-Korsmik[1,2], S.A. Shalnova[2], A.M. Vildanov[2], R.V. Mendagaliyev[1]; 1 - St. Petersburg State Marine Technical Univ., 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia

In the paper present results of powder fraction influence on the samples mechanical properties produced by Direct Laser Deposition. Were investigate two fraction composition - is 45-90 mkm and 106-180 mkm.

ThR2-p09 11:30-13:30

A model for predicting shape of laser metal deposited parts

S.Yu. Ivanov, E. A. Valdaytseva, S. L. Stankevich, G. A. Turichin; Peter the Great St. Petersburg Polytechnic Univ., Russia

A model for predicting temperature field and shape of deposited parts is proposed. The model allowed to determine relationship between process conditions and shape of deposited part. Comparison of simulated and experimentally obtained shape of wall cross section revealed good agreement. It was shown that power distribution of laser beam considerable effects on clad shape and roughness of deposited part.

ThR2-p10 11:30-13:30

Manufacture of a high-pressure centrifugal fan made of 316L by the method of high-speed direct laser deposition

K.D. Babkin[1,2], I.K. Topalov[1,2], N.G. Iun[2], P.A. Golovin[1,2]; 1 - Peter the Great St. Petersburg Polytechnic Univ., Inst. of Laser and Welding Technologies, Russia; 2 - St. Peterburg State Marine Technical Univ., Russia

The article deals with the technology of manufacturing the impeller of a high-pressure centrifugal fan by the method of high-speed direct laser deposition. Defects were found in the manufacture of the product and methods of combating them were developed.

ThR2-p11 11:30-13:30

Optimization of active medium composition for Q-switched slab RF-discharge CO laser

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

An influence of different gases addition to the active medium of slab RF-discharge cryogenic Q-switched CO laser on its output parameters was studied. Maximal laser pulse peak power was obtained for the gas mixture containing air.

ThR2-p12 11:30-13:30

Gain in the visible spectral range on the triatomic Kr2F* molecules in the discharge plasma

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

The results of experimental and numerical studies of the possibility of formation of an active medium on a Kr2F trimers in the discharge plasma, are presented. It is demonstrated that the trimer fluorescence includes three spectral bands corresponding to wavelengths of 414, 456 and 503 nm. It is shown that the experimentally measured gain of the active medium on the Kr2F trimers is g = 3.14x10-4 cm-1.

ThR2-p13 11:30-13:30

Measurement of temperature and positive gain of oxygen-iodine laser active medium

Yu.A. Adamenkov; RFNC-VNIIEF, Russia

Measurements of temperature and small gain of active medium have been conducted at supersonic chemical Oxygen-Iodine laser facility. All measurements were carried out at supersonic part of gas flow. A hyperfine electron transition of Iodine atom was employed to observe small gain. The temperature of active medium was achieved from analysis of gain line.

ThR2-p14 11:30-13:30

Hybrid Yb:Y2O3 ceramic thin-rod femtosecond amplifier

J.W. Kim[1], S. Chizhov[1], E. Sall[1], B. Lee[1], B. Jeong[1], S.W. Park[1], Ch. Kim[1], D. Heo[1], I. Kuznetsov[2], I. Mukhin[2], O. Vadimova[2], O. Palashov[2], G.-H. Kim[1]; 1 - Korea Electrotechnology Research Inst. (KERI), Korea; 2 - Inst. of Applied Physics RAS, Russia

Hybrid Yb:Y2O3 ceramic thin-rod femtosecond amplifier is reported. By 4-pass amplification scheme, output power of 1.4 W with gain of 14 is achieved from 100 mW, 1033 nm, 30 MHz fiber seeder. The extracted gain spectrum shows gain bandwidth of about 5.0 nm centered at 1030.6 nm.

ThR2-p15 11:30-13:30

Influence of direct laser deposition regimes on mechanical properties of Inconel 718 alloy

S.S. Silchonok[1], O.G. Klimova-Korsmik[1,2], O.G. Zotov[1], G.A. Turichin[2], E.A. Norman[2]; 1 - Peter the Great St. Petersburg Polytechnic Univ., 2 - St. Petersburg State Marine Technical Univ., Russia

The article is devoted to the direct laser deposition (DLD) of Inconel718 powder. The mechanical properties of products obtained by the DLD method are studied. Optimal regimes for growing samples were selected.

ThR2-p16 11:30-13:30

The optimization of diode pumped high power multidisk laser amplifier

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

Amplification experiments in the multidisk laser amplifier of all diode-pumped cryogenically cooled all solid state laser system have been carried out. The dependency of gain coefficient on temperature of the active element was measured. The small-signal gain coefficients per pass through active element were obtained.

ThR2-p17 11:30-13:30

Thermo-optical properties of Yb: YAG disks in cryogenic amplifier of high intensity femtosecond laser system

A.V. Laptev[1], V.A. Petrov[1,2], V.V. Petrov[1,2,3], G.V. Kuptsov[1,3], A.V. Kirpichnikov[1], A.I. Nozdrina[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

Temperature distribution in cryogenic cooled diode-pumped Yb: YAG crystal of multidisks high power laser system has been numerically calculated. Experimental investigation of dioptric power of the thermal lens and wavefront distortions by use of Shack-Hartman sensor has been performed. The obtained results are used for optimization of output beam parameters of pump channel of high intensity femtosecond laser system.

ThR2-p18 11:30-13:30

Pulse-periodical super-atmospheric pressures TE-CO2 lasers with «electrical wind»

D.Q. Manh, B.A. Kozlov; Ryazan State Radio Engineering Univ., Russia

Basic interrelation forming of «electrical wind» in CO2-laser mixtures at super-atmospheric pressures (up to 12 atmospheres) are studied. Pulse-periodical regimes of TE-CO2 lasers function on pulse-repetition rates up to 50 Hz at short duration working (5 minutes working and 10 minutes pause) and 25 Hz at continuous working are realized. Maximum laser energy per pulse up to 200 mJ at pulse durations 3-10 nanoseconds are achieved. The shape of laser pulses without of the traditional «tail» can be realize CO2: N2: He mixtures with CO2: N2 = 3:1 ÷ 5:1.

ThR2-p19 11:30-13:30

Pumping conditions and cross-section laser power distribution in low-pressure nitrogen laser

B.A. Kozlov, A.P. Stepanov; Ryazan State Radio Engineering Univ., Russia

Experimentally determined presence «critical» value of pulse repetition rate after that laser radiation power in «halo» strongly decrease and distribution of radiation in central part of laser beam approaches to Gaussian.

ThR2-p20 11:30-13:30

Nanocarbon coating cathodes and energetic parameters of small-sized TEA-CO2 lasers

D.Q. Manh, B.A. Kozlov, M.Th. Nguyen; Ryazan State Radio Engineering Univ., Russia

Influence of nanocarbon coating at the working cathode surfaces on stability of volume self-sustained pumping discharges in CO2-laser mixtures and energetic parameters radiation pulses of small-sized sealed-off TEA-CO2 lasers with active volumes V = 7×0,8×0,8 - 18×0,8×0,8 cm3 was investigated. Carbon layer at cathode surface results to increase autoemissive current from cathode, pumping current, pumping energy and laser radiation energy per pulse. Maximum increase of pumping energy and laser energy per pulse achieve 30 - 60 % when we used cathodes with nanocarbon layers.

ThR2-p21 11:30-13:30

CO2-NH3 laser complex for effective generation high-power IR-radiation in range 11-13 μm

B.A. Kozlov[1,2], A.B. Yastrebkov[2]; 1 - Ryazan State Radio Engineering Univ., 2 - Ryazan State Univ., Russia

An effective optical scheme of CO2-NH3 laser with separate selective resonators for generation of high-power IR- radiation in the range of 11 - 13 μm are suggested and investigated. Optical pumping of NH3 molecules was ensured by radiation of TEA-CO2 laser with pulse energy up to 8 J on wavelengths $\lambda 1$ = 9,22 μm and $\lambda 2$ = 9,29 μm. NH3 laser pulses with discrete tunable wavelengths in range of 11 - 13 μm and maximal energy up to 1 J at pulse duration τ =150 ns were obtained.

ThR2-p22 11:30-13:30

Cr2+: ZnSe active media with inhomogeneous doping profiles: modeling and experimental results

S.V. Kurashkin[1], O.V. Martynova[2], D.V.Savin[1], E.M.Gavrishchuk[1,2], S.A.Rodin[1], A.P.Savikin[2]; 1 - Inst. of Chemistry of High-Purity Substances RAS, 2 - Nizhny Novgorod State Univ., Russia

Cr2+: ZnSe polycrystalline active elements with different distribution profiles of Cr2+ ions concentration over their thicknesses were fabricated. Dependences of the output laser powers on the incident pump power of Tm3+-laser in continuous and pulse modes were obtained. There was found to be a correlation between the generation slope efficiency and the shape of the concentration profile. There was proposed a numerical model to explain the experimental results by the influence of thermo-optical distortions caused by uneven heating of the active elements due to the pumping process.

ThR2-p23 11:30-13:30

Laser characteristics of ZnSe polycrystals co-doped with Fe and Cr ions

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 University MEPhI, 3 - Inst. of Chemistry of High-Purity Substances RAS, 4 - Lobachevski Nizhny Novgorod State Univ., Russia

The first experimental results of investigations of the spectral and energy characteristics of the room temperature Fe-Cr: ZnSe laser are presented. Several polycrystals co-doped with Fe and Cr ions were investigated. The crystals were distinguished by the doping technique. At room temperature, the maximum laser energy of 35 mJ was obtained in the spectral range 4-5 μm, the slope efficiency of the Fe-Cr: ZnSe laser was η-slope = 26%.

ThR2-p24 11:30-13:30

IR laser active elements fabricated by Solid-State Diffusion Bonding

S.S. Balabanov[1], K.N. Firsov[2], E.M. Gavrishchuk[1,3], V.B. Ikonnikov[1], S.Yu. Kazantsev[2], I.G. Kononov[2], T.V. Kotereva[1], D.V. Savin[1], N.A. Timofeeva[1], P.G. Voronin[3]; 1 - Inst. of Chemistry of High-Purity Substances RAS, 2 - Prokhorov General Physics Inst. RAS, 3 - Lobachevski Nizhny Novgorod State Univ., Russia

The experimental results of investigations while developing a new method for creating multilayer laser media based on zinc selenide doped with iron ions with the given concentration profile of dopant in bulk and with zero concentration on the surface of the active element are presented. To create the dopant layers the solid-phase diffusion bonding method was used and the formation of a given iron ions concentration profile was realized by hot isostatic pressing.

ThR2-p25 11:30-13:30

Fe2+: ZnSxSe1-x polycrystals for laser applications

K.N. Firsov[1], E.M. Gavrishchuk[2,3], V.B. Ikonnikov[2], S.Yu. Kazantsev[1], I.G. Kononov[1], T.V. Kotereva[2], D.V. Savin[2], N.A. Timofeeva[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Inst. of Chemistry of High-Purity Substances RAS, 3 - Lobachevski Nizhny Novgorod State Univ., Russia

A new method was developed and used for fabricating active elements on the basis of solid solutions of ZnSxSe1-x doped with iron ions for lasing in the spectral range of 4 to 5 μm. It was found out that the absorption band of the synthesized samples was blueshifted with respect to the absorption band of the Fe2+: ZnSe crystal, while the lasing spectra and energy parameters of the Fe2+: ZnSe and Fe2+: ZnS0.1Se0.9 lasers were almost identical.

ThR2-p26 11:30-13:30

Piezoelectric resonance laser calorimetry for an optical testing of crystal boules

G.A. Aloian[1], N.V. Kovalenko[1], I.V. Shebarshina[1], A.V. Konyashkin[1,2], O.A. Ryabushkin[1,2]; 1 - Moscow Inst. of Physics and Technology, 2 - Kotelnikov Inst. of Radio-engineering and Electronics RAS, Russia

Radio-frequency impedance spectroscopy was applied for the investigation of the interaction of lithium triborate boules with laser radiation. A theoretical model describing the processes of boule laser heating was developed.

ThR2-p27 11:30-13:30

Piezoelectric resonance laser calorimetry for measuring surface temperature of optical materials interacting with laser radiation

N.V. Kovalenko[1], G.A. Aloian[1], I.V. Shebarshina[1], A.V. Konyashkin[1,2], O.A. Ryabushkin[1,2]; 1 - Moscow Inst. of Physics and Technology, 2 - Kotelnikov Inst. of Radio-engineering and Electronics RAS, Russia

Surface temperature distribution of the silica lens heated by laser radiation was measured using tiny temperature sensors made of piezoelectric crystals. Temperature of each piezoelectric sensor is determined by measuring the frequency shift of the temperature calibrated piezoelectric resonance noncontactly excited by the probe electric field.

ThR2-p28 11:30-13:30

Metal-coated fiber sensor for laser radiation power measurement

I.O. Khramov[1], N.N. Ishmametiev[1], R.I. Shaidullin[1,2], O.A. Ryabushkin[1,2]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Kotelnikov Inst. of Radio-Engineering and Electronics RAS, Russia

A novel technique for the measurement of high-power radiation of fiber lasers presented. A copper-coated silica fiber was used as a sensor. Optical power transmitting through the sensor is obtained by measuring the change of a metal coating electric resistance induced by its heating due to the absorption of the scattered radiation.

ThR2-p29 11:30-13:30

Holmium fiber amplifier, operating in the spectral range 2016-2200 nm

I.V. Zhluktova[1], V.A. Kamynin[1,2], V.B. Tsvetkov[1,3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Ulyanovsk State Univ., 3 - National Research Nuclear Univ. «MEPhi», Russia

We present a study of the holmium-doped fiber amplifier operating in 2 microns spectral range. Maximum gain coefficient was 33 dB. The length of an active fiber was optimized for every wavelength.

ThR2-p30 11:30-13:30

Microwave excited broadband HF-DF-Xe lasers

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

The radiation characteristics of planar broadband HF, DF, HF-DF and HF-DF-Xe lasers excited by microwave (MW) discharge with diffusive cooling of the active medium and gas flow at speeds (3 – 5) m/s have been studied. As a result of our experiments we were the first to produce a generation of planar HF-DF-Xe-laser with radiation in the wide spectral range 2.0–4.0 μm. An average lasing power of 34 mW is obtained.

ThR2-p31 11:30-13:30

Optically communicated CO-lasers with unstable resonators

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

The radiation characteristics of two planar radio frequency (RF) exited carbon monoxide (CO) lasers with hybrid unstable optical resonators and with optical communication through output windows and 2 mm thick CaF2 dividing plate with different reflection in the modes of multifrequency generation have been studied. An increase in the total output power ~11 W from both lasers by 50% and an almost complete synchronization of the fields in two lasers were obtained when the fraction of the injected energy from one laser to the other was 14%.

ThR2-p32 11:30-13:30

Radio frequency and microwave excited planar N2O-lasers

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

The radiation characteristics of planar diffusion-cooled N2O-laser excited by a large-aperture RF discharge (2.5-3.5x38x485 mm) at a frequency of 40 MHz in dependence on gas mixture composition, gas pressure and input RF power have been investigated. The radiation characteristics of planar N2O-laser excited by MW discharge at a frequency of 2.45 GHz with diffusive cooling of the active medium have been investigated.

ThR2-p33 11:30-13:30

Metal vapor active elements with barier discharge formed by the semiconductor power supply

M.V. Trigub[1,2], P.P. Gugin[3]; 1 - Zuev Inst. of Atmospheric Optics SB RAS, 2 - Tomsk Polytechnic Univ., 3 - Rzhanov Inst. of Semiconductor Physics SB RAS, Russia

The results of investigation, studying and using metal vapor elements with inner electrodes pumped by the semiconductor power supply are presented in the paper. The excitation pulse generator is a transistor module consisting of 16 parallel forward converters with one common step-up transformer. The topology of the high voltage power supply allows to achieve high PRF (about 100 kHz). The maximum power of the power supply is 1 kW. The capacitance barrier discharge is used to excite the active media.

ThR2-p34 11:30-13:30

Structural anisotropy induced geometric birefringence in highly birefringence index-guiding photonic crystal fibers

Sh. Liang[1], Yo. Zhang[1], Q. Cui[1], X. Wang[2], X. Sheng[1], Sh. Lou[2], B. Lin[3], Yu. Zhang[4;1,] 2 - Beijing Jiaotong Univ., 3 - China Academy of Electronics and Information Technology, 4 - Henan College of Industry and Information Technology, China

The structural anisotropy induced geometric birefringence in highly birefringence index-guiding photonic crystal fibers (HB-IG-PCFs) are investigated, to find the relationship between the anisotropy and geometric birefringence. It is found that there are significant influences of the normalized anisotropy on the birefringence. This work is interesting and inspiring to design and improve the geometric birefringence of PCFs.

ThR2-p35 11:30-13:30

Laser induced damage threshold of high reflective dielectric coatings on absorbing substrate

R.M. Akhmadullin, S.V. Gagarskiy, A.N. Sergeev; ITMO Univ., Russia

In this work the laser induced damage (LID) of HfO2 / SiO2 and Ta2O5 / SiO2 coatings on SiC absorbing substrate is investigated. It is shown experimentally, that presence of vibration or microdisplacement of sample relatively to laser beam may lead to significant reduction of LID threshold. Numerical simulation of thermally induced stresses in silicon carbide substrate shows increase of thermally-induced stress in the presence of sample displacement.

ThR2-p37 11:30-13:30

Non-steady-state model of laser oscillator based on the solution of 3D quasi-optical wave equation

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

Physical, mathematical and numerical models of the laser oscillator for calculation of nuiltimodc laser operation based on the solution of 3D wave equation in the quasi-optical approach have been developed. Some results of calculations have been presented.

ThR2-p38 11:30-13:30

Elaboration of 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[1,2], 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 optimization of the operation mode and spatiotemporal characteristics of the pump laser of Ti:Sa-femtosecond laser system was performed, which made it possible to reduce low-frequency noise in the frequency range from 30 Hz to 2.5 MHz of the output radiation to rms amplitude value of 0.005%. This has significantly increased the stability of the envelope phase stabilization system.

ThR2-p39 11:30-13:30

Features of non-radiative processes in Yb:YAG crystals and their effect on the generation characteristics

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

The spectral characteristics of Yb:YAG crystal and their dependence on Yb concentration are investigated. The luminescence lifetime revealed abnormal increase for Yb3+ concentration in the area 20-25 at.%. This increased lifetime allows to diminish minimum pump intensity for Yb:YAG - laser with reabsorption loss.

R3. SEMICONDUCTOR LASERS, MATERIALS AND APPLICATIONS

ThR3-p01 15:00-17:00

Novel superluminescent diodes and semiconductor optical amplifiers of red spectral range

E.V. Andreeva[1], A.S. Anikeev[1], S.N. Ilchenko[1], A.Yu. Chamorovskiy[2], M.V. Shramenko[1], S.D. Yakubovich[1]; 1 - Opton Ltd, Russia, 2 - Superlum Ltd, Ireland, 3 - MTU MIREA, Russia

Highly efficient and reliable spatially single-mode superluminescent diodes (SLDs) with median wavelengths of 675 nm and CW free-space output optical power of up to 30 mW are developed. Principal parameters of light-emitting modules and optoelectronic devices based on these SLDs are presented.

ThR3-p02 15:00-17:00

Transient dynamics of intracavity difference-frequency generator pumped by a semiconductor disk laser

Yu.A. Morozov, M.Yu. Morozov; Kotel'nikov Inst. of RadioEngineering and Electronics SB RAS, Russia

The multi-mode transient power characteristics of an intracavity difference-frequency generator is described. The reason for unattainability of single-mode emission in the device without an additional frequency-selective element (e.g., a Fabry-Perot etalon) is clarified. It is shown that the dynamics of a short-wavelength emission (pump) results mainly from the nonlinear optical interaction, while that of the longer-wavelength optical fields (signal and idler) depends on selectivity of the etalon.

ThR3-p03 15:00-17:00

Theory of self-injection locking of a laser diode to a whispering gallery mode cavity

N.M. Kondratiev[1], V.E. Lobanov[1], A.V. Cherenkov[1,2], A.S. Voloshin[1], N.G. Pavlov[1,3], M.L. Gorodetsky; 1 - Russian Quantum Center (RQC), 2 - Lomonosov Moscow State Univ., 3 - Moscow Inst. of Physics and Technology, Russia

We present the analysis of the self-injection locking of a single-frequency laser diode to a high-Q whispering gallery mode (WGM) microresonator with Rayleigh backscattering. Simple analytical formulas for the width of the locking band and resulting laser linewidth are derived.

ThR3-p04 15:00-17:00

Current and temperature dependencies of internal optical loss in laser heterostructures

D.A. Veselov, Yu.K. Bobretsova, A.A. Klimov, V.V. Shamahov, A.Yu. Leshko, Z.N. Sokolova, S.O. Slipchenko, N.A. Pikhtin; Ioffe Inst., Russia

Free carrier absorption in heterostructure of an operating laser diode has been measured. The proposed technique is based on coupling probe light emission into the laser waveguide. Lasers with various heterostructures were measured at different current and temperature levels. The dependencies sufficiently describe the laser characteristics and can be used for heterostructure design comparison and optimization.

ThR3-p05 15:00-17:00

Numerical modeling of ARROW-VCSELs with oxide island

M. Dems[1], M. Więckowska[1], G. Almuneau[2]; 1 - Lodz Univ. of Technology, Poland; 2 - LAAS-CNRS, France

We study optical properties of ARROW-VCSEL, in which the anti-resonant effect is provided by an oxide island located inside the optical cavity manufactured with planar oxidation. We show how this effect alters the nature of the laser modes, by providing qualitative change in the optical field profile. Such strong change can be used to improve laser modal discrimination in order to achieve single-mode emission.

ThR3-p06 15:00-17:00

Control of structure of magnetic field by laser radiation

S.E. Logunov, V.V. Davydov, T.R. Yalunina; Peter the Great St. Petersburg Polytechnic 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.

ThR3-p07 15:00-17:00

Broadband THz pulsed spectroscopy with impedance-matched antennas

D.V. Lavrukhin[1,3], A.E. Yachmenev[1,3], A.Yu. Pavlov[1], R.A. Khabibullin[1], Yu.G. Goncharov[2], I.E. Spektor[2], G.A. Komandin[2], S.O. Yurchenko[3], K.I. Zaytsev[2,3,4], and D.S. Ponomarev[1,3]; 1 - Inst. of Ultra-High Frequency Semiconductor Electronics RAS, 2 - Prokhorov General Physics Inst. RAS, 3 - Bauman Moscow State Technical Univ., 4 - Sechenov First Moscow State Medical Univ., Russia.

We study both theoretically and experimentally an ability for shaping the spectra of the terahertz (THz) pulses, emitted by a photoconductive antennas (PCAs) with the log-spiral configuration of electrodes, by impedance matching. We select and fabricate 2 configurations of the LT-GaAs PCAs possessing different frequency-dependent impedances and THz spectra. By comparing the results of our studies, we firstly demonstrate high-to-moderate correlation between the frequency-dependent impedance matching efficiency and the THz spectra. The proposed approach makes possible optimizing the PCA performance for accommodating the needs of the THz technology use in various branches, especially in condensed matter and biomedicine.

ThR3-p08 15:00-17:00

Experimental evidence of spatial multistability in a multimode VCSEL

V.N. Chizhevsky, S.A. Kovalenko; Stepanov Inst. of Physics of NASB, Belarus

The coexistence of several spatial structures in a multimode VCSEL for fixed values of the dc current and switching between them caused by optical pulses were experimentally demonstrated. Spatial multistability shows up hysteretic behavior depending on the injection current in both integral and local measurements of the laser intensity with and without polarization resolution. The VCSEL temperature influence on the spatial multistability manifestation was studied.

ThR3-p09 15:00-17:00

Stabilization of broad-area class-B lasers by temporal pump modulation

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

We demonstrate numerically that broad-area class- B lasers can be stabilized by applying a periodic temporal modulation of the pump. It is shown that pump modulation suppress transverse instabilities inherent to homogeneously broadened class-B broad-area lasers. The stabilization effect occurs when the modulation frequency is approximately equal to the relaxation frequency and an amplitude of modulation is in a certain range.

ThR3-p10 15:00-17:00

Optical beam characteristics of quantum cascade laser with mirrors cleaned by focused ion beam

E. Pruszynska-Karbownik, A. Laszcz; Inst. of Electron Technology, Poland

This paper presents impact of front and back laser mirror ion cleaning on quantum cascade laser characteristics. Cleaning of the front mirror makes the beam more symmetric and increases external differential quantum efficiency, while cleaning of the back mirror reduces the electrical resistance, increases the threshold current and slightly affects the optical polarization of the beam.

ThR3-p11 15:00-17:00

Stabilization of semiconductor laser diode by high-Q electro-optic microresonator

A.S. Voloshin[1], A.S. Gorodnitskiy[1,2], V.I. Pavlov[1,3], N.M. Kondratiev[1], M.L. Gorodetsky[1,3]; 1 - Russian Quantum Center, 2 - Moscow Inst. of Physics and Technology, 3 - Lomonosov Moscow State Univ., Russia

The experimental research of the semiconductor laser diode self-injection locked to the electro-optic whispering gallery mode microresonator is reported. The $LiNbO_3$ and $LiTaO_3$ microresonators with Q-factor up to 108 were studied. Temperature stabilization and stabilization via electro-optic effect were considered.

ThR3-p12 15:00-17:00

Amplification of autodyne signals in a bistable VCSEL by vibrational resonance

V.N. Chizhevsky; B.I. Stepanov Inst. of Physics NAS, Belarus

It is experimentally demonstrated that vibration resonance in a vertical-cavity surface-emitting laser operating in the regime of polarization bistability can be used to increase the signal amplitudes in the autodyne detection of microvibrations of different surfaces. The gain factor can achieve the values of 10÷200 depending on the experimental conditions.

ThR3-p13 15:00-17:00

Bogatov effect in self-injection locked multimode diode laser: Theory and experiment

R. Galiev[1,2,3], N.M. Kondratiev[2], N.G. Pavlov[2,4], V.E. Lobanov[2], M.L. Gorodetsky[2,3]; 1 - Skoltech, 2 - Russian Quantum Center, 3 - Lomonosov Moscow State Univ., 4 - Moscow Inst. of Physics and Technology, Russia

We propose a self-injection locking scheme of a multimode laser to the whispering gallery mode (WGM) of an optical microresonator for investigation modes interactions in a semiconductor laser and develop a theory of this phenomenon based on Bogatov effect.

ThR3-p14 15:00-17:00

Mid-IR cathodoluminescence of zinc selenide highly-doped with iron

M.V. Chukichev[1], V.P. Chegnov[2], R.R. Rezvanov[3], O.I. Chegnova[2], V.P. Kalinushkin[4], A.A. Gladilin[4]; 1 - Lomonosov Moscow State Univ., 2 - Research Inst. of Material Science and Technology, 3 - National Research Nuclear Univ. 'MEPhI', 4 - Prokhorov General Physics Inst. RAS, Russia

The integrated intensity and kinetics of cathodolumonescense in the middle infrared region of the spectra of ZnSe: Fe crystals with varying iron concentration have been studied. Dependence of decay time on iron concentration has been demonstrated. Experiments were carried out at 77 K and room temperature.

ThR3-p15 15:00-17:00

Metamaterial for difference frequency generation in THz range

G.M. Savchenko[1], K.K. Soboleva[2], D.V. Chistiakov[3], V.E. Bugrov[3], N.S. Averkiev[1], G.S. Sokolovskii[1]; 1 - Ioffe Inst., 2 - Peter the Great St. Petersburg Polytechnic Univ., 3 - ITMO Univ., Russia

We investigate the semiconductor metamaterial, the refractive index of which can be controlled in order to provide phase-matching for efficient difference - frequency generation in THz range. The proposed structure comprises alternating semiconductor layers with intrinsic and metallic conductivity.

ThR3-p16 15:00-17:00

Low threshold organic semiconductor laser gain media using as chemosensor

X. Tang[1], H. Xu[1], H. Zhang[1], R. Xia[1,2];1- Inst. of Advanced Materials, Jiangsu National Synergetic Innovation Center for Advanced Materials, Nanjing Univ. of Posts & Telecommunications,2- South China Univ. of Technology, China

We report laser gain medium of poly(3-hexylthiophene) (P3HT) and poly(9,9-dioctylfluorene-alt-benzothiadiazole) (F8BT) blends as chemosensor. Upon analyte binding, a change in refractive index at the P3HT/F8BT film surface results in shift of the amplified spontaneous emission (ASE) wavelength and variation of ASE threshold, which demonstrated such blend gain medium as high sensitivity and high accuracy chemosensor to detect solution.

ThR3-p17 15:00-17:00

GaInAsSb-based lasers for environmental monitoring

D. Kabanau[1], Ya. Lebiadok[1], D. Shabrov[2], Yu. Yakovlev[3], E. Kunitsyna[3]; 1 - SSPA «Optics, Optoelectronics & Laser Technology» NASB, 2 - Stepanov Inst. of Physics NASB, Belarus; 3 - Ioffe Inst., Russia

The dependencies of the rates of radiative and nonradiative recombination and recombination induced by amplified luminescence and the internal quantum yield of luminescence on temperature were experimentally measured for lasers based on GaInAsSb solid solution. The value of the internal quantum yield of luminescence for GaInAsSb structure increased to 90%, when the temperature was changed from 300 to 10 K.

ThR3-p18 15:00-17:00

Structure and charge of nitrogen and gallium vacancies located in the AlN/GaN interface of quantum wells

Ya. Lebiadok[1], A. Shalayeva[1], I.Aleksandrov[2], K. Zhuravlev[2]; 1 - SSPA «Optics, Optoelectronics & Laser Technology» NASB, Belarus; 2 - Rzhanov Inst. of Semiconductor Physics SB RAS, Russia

The influence of defects (gallium, nitrogen and aluminum vacancies and corresponding interstitial atoms) on AlN/GaN heterointerface characteristics is discussed. The results of calculation are compared with experimental data obtained using EXAFS spectroscopy.

ThR3-p19 15:00-17:00

High power laser-thyristor based on InGaAs/GaAs quantum wells for optoelectronic switch operation

H. Wang, Ya. Li, H. Yu, X. Zhou, Ji. Pan; Inst. of Semiconductors, CAS, China

A new approach to optoelectronic switch operation based on InGaAs/GaAs quantum well laser heterostructure has been demonstrated. The various structure designs have been performed and the possibility of obtaining the switching voltage from 3.7 V to 8.2 V and the laser power can be 790 mW.

ThR3-p20 15:00-17:00

Electron-beam and optically pumped ZnSe-based lasers with extended asymmetrical waveguide

M.M. Zverev[1], N.A. Gamov[1], E.V. Zhdanova[1], V.B. Studionov[1], N.I. Gladyshev[1], D.E. Loktionov[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

Parameters of pulsed electron-beam and optically pumped lasers based on ZnCdSe/ZnMgSSe structures with a 2-μm-wide waveguide and an active region shifted towards the structure surface have been studied. It is shown that lasing occurs at the 3rd transverse mode of the optical cavity and the maximum output power could be increased essentially due to the decrease of the optical load on the laser mirrors.

ThR3-p21 15:00-17:00

On diagnostic capability of scattered laser radiation in internal defect analysis of conduct pipe

N. S. Myazin[1], V.A.Vologdin[1], V.V. Davydov[1,2], V.I. Dudkin[3]; 1 - Higher School of Applied Physics and Space Technologies, SPbPU, 2 - Russian Research Inst. of Phytopathology, 3 - SPbSUT, 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.

ThR3-p22 15:00-17:00

Dynamic thermal analysis of «vertical» and «face-up» high-power AlGaInN LEDs at pulse operation

A.V. Aladov[1], V.E.Bugrov[2], A.E. Chernyakov[1], V.M. Ustinov[1,2], A.L. Zakgeim1; 1 - Submicron Heterostructures for Microelectronics Research and Engineering Center RAS, 2 - ITMO Univ., Russia

The thermal properties, including thermal resistance Rth, capacitance Cth and time constant τth of high-power AlGaInN LEDs have been investigated and analyzed. The transient thermal behavior was expressed as a multiexponential function with time constants associated with a specific Rth,i and Cth,i components of LED structure.

ThR3-p23 15:00-17:00

Effect of annealing FIB-induced defects in GaAs/AlGaAs heterostructure

I.V. Levitskii[1], M.I. Mitrofanov[1], G.V. Voznyuk[2], D.N. Nikolaev[1], M.N. Mizerov[3], V.P. Evtikhiev[1]; 1 - Ioffe Inst., 2 - ITMO Univ.,3- RAS, SHM R&E Ctr, Russia

We present results of experiments concerning the loss of quantum efficiency of GaAs/AlGaAs heterostructure due to the focused ion beam-induced radiation defects. We show that 620 °C annealing in the As atmosphere can lead up to full recovery of the quantum efficiency of the luminescence.

ThR3-p24 15:00-17:00

Generation of THz radiation in the photoconductive antennas based on epitaxial InGaAs films on GaAs substrates of various crystallographic orientations

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

We study the THz wave generation by the time-domain spectroscopy method in the spiral antennas fabricated on the low-temperature grown InGaAs layers on GaAs substrates with crystallographic orientations (100) and (111). It was found that the THz wave generation is 3-4 times more effective in the case of (111)A GaAs substrates as compared to the (100) substrates. Power-voltage characteristic of the InGaAs antenna up to and beyond threshold breakdown voltage is reported.

ThR3-p25 15:00-17:00

Spatial Current Dynamics Of Turn-On Of High-Power Laser-Thyristors Based On AlGaAs/GaAs Heterostructures

O.S. Soboleva[1], A.A. Podoskin[1], V.S. Golovin[1], P.S. Gavrina[1], D.N. Romanovich[1,2], L.S. Vavilova[1], V.S. Yuferev[1], N.A. Pikhtin[1], S.O. Slipchenko[1]; 1 - Ioffe Inst., 2 - St. Petersburg Electrotechnical University «LETI», Russia;

A two-dimensional dynamic simulation of the laser-thyristor turn-on has been carried out. It has been found that the localization of the current during laser-thyristor turn-on is determined by the presence of impact ionization. Spatial current localization reduces the radiative efficiency and the peak power only in the laser pulse generation mode with a duration of few nanoseconds.

ThR3-p26 15:00-17:00

High power single mode 1550 nm AlInGaAs/InP lasers based on extremely asymmetric waveguide heterostructure

P.V. Gorlachuk, Yu.L. Ryaboshtan, M.A. Ladugin, A.A. Padalitsa, A.A. Marmalyuk, A.V.Ivanov, K.V. Kurnosov, V.D. Kurnosov, A.V. Lobintsov, V.A. Simakov; R&D Inst. Polyus, Russia

Single mode-emitting ridge laser based on highly asymmetric waveguide heterostructure has been developed. The heterostructure consisted of AlGaInAs waveguide with quantum wells positioned extremely close to the p-cladding layer. For the narrow ridge laser an output optical power of over 400 mW has been achieved.

ThR3-p27 15:00-17:00

Multifrequency source pump of CPT resonances based on a diode laser with an external resonator

A.A. Isakova[1,3], K.N. Savinov[1], N.N. Golovin[1], A.K. Dmitriev[1,2]; 1 - Novosibirsk State Technical Univ., 2 - Inst. of Laser Physics SB RAS, 3 - Siberian State Research Inst. of Metrology, Russia

A method for obtaining multifrequency radiation for pumping the CPT resonances in the case of RF modulation in a diode laser with an external resonator is proposed and implemented. The length of the laser cavity is consistent with the frequency of the clock transition.

ThR3-p28 15:00-17:00

Photoluminescence study of AlGaAs/GaAs heterostructure subsequent to Ga+ focused ion beam etching.

G.V.Voznyuk[1], I.V.Levitskii[1,2], M.I.Mitrofanov[1,2], D.N.Nikolaev[2], V.P. Evtikhiev[2];[1]- ITMO Univ., 2 - Ioffe Inst., Russia

The focused ion beam (FIB) is a potential tool in manufacturing microcircuit devices. The main downside of FIB etching process is radiation defects formation. To recover etching surface, we provide 300 C and 620 C annealing. Amount of radiation damage was determined by photoluminescence (PL) measurements.

ThR3-p29 15:00-17:00

Modelling subnanosecond pulse generation by a two-section laser-thyristor

V.S. Golovin[1], D.N. Romanovich[1,2], O.S. Soboleva[1], A.A. Podoskin[1], P.S. Gavrina[1], D.A. Veselov[1], N.V. Voronkova[1], S.O. Slipchenko[1], N.A. Pikhtin[1]; 1 - Ioffe Inst., 2 - St. Petersburg Electrotechnical Univ. «LETI», Russia

We have developed a theoretical model of lasing dynamics in a two-sectional laser-thyristor. We have demonstrated that it is possible to create short (~2 ns) high-current pulses in a laser-thyristor. Our calculations imply that incorporating an unpumped section into the laser resonator allows to generate subnanosecond (~30 ps full width at half maximum) high-power (~100 W peak power) laser pulses.

ThR3-p30 15:00-17:00

Visualization of physical fields in semiconductor materials

A.M.Grigoriev, E.V. Cherkesova; Laser Technology Center, Russia

A method of visualization of physical fields in semiconductor materials using light from fundamental absorption edge is proposed.

ThR3-p31 15:00-17:00

Two-threshold semiconductor quantum well lasers

Z.N. Sokolova[1], N.A. Pikhtin[1], L.V. Asryan[2]; 1 - Ioffe Inst., Russia; 2 - Virginia Polytechnic Inst. and State Univ., USA

Threshold and power characteristics of quantum well lasers are theoretically studied in the presence of internal optical absorption loss. Due to variation of the internal loss coefficient with electron and densities in the optical confinement layer of the laser, the light-current characteristic may have two branches, each with its own threshold. The branches merge together at the maximum operating current.

ThR3-p32 15:00-17:00

Effect of barrier doping on photoluminescence of 1550 nm range multi quantum well heterostructures

E.S. Kolodeznyi[1], S.S. Rochas[1] , I.I. Novikov[1,2], A.S. Kurochkin[1], A.V. Babichev[1,2], A.G. Gladyshev[1,2], L.Ya. Karachinsky[1,2], A.Yu. Egorov[1]; 1 - ITMO Univ., 2 - Connector Optics LLC, Russia

This paper considers the influence of barrier doping on parameters of photoluminescence of 1550 nm range multi quantum well heterostructures grown by molecular beam epitaxy. The studied heterostructures consist of seven strained InGaAs quantum wells with delta p-doped InAlGaAs barriers. Photoluminescence studies show that p-doping increases the photoluminescence intensity of heterostructures at low pumping levels and decrease the changing of the width of photoluminescence spectra with change of pumping levels.

ThR3-p33 15:00-17:00

Mode-locking and transverse mode dynamics in vertical external cavity surface-emitting lasers

A.I. Konyukhov[1], Yu.A. Morozov[2]; 1 - Saratov State Univ., 2 - Kotelnikov Inst. of Radio Engineering and Electronics SB RAS, Russia

An approach for passive mode-locking in multiple transverse-mode vertical external-cavity surface-emitting laser (VECSEL) is proposed. A definite phase relationship between the longitudinal and transverse modes in Z-cavity geometry cause the laser light to be produced a train of pulses with Gaussian transverse shape. Bifurcations responsible for the appearance and breakup of the mode locking regime are studied numerically.

ThR3-p34 15:00-17:00

Dynamics of VCSEL subjected to external optical injection under triangular current modulation

A.A. Krents[1,2], N.E. Molevich[1,2], S.V. Krestin[2]; 1 - Samara National Research Univ., 2 - Lebedev Physical Inst. RAS, Russia

We investigate the effect of external optical injection on the dynamics of VCSEL under asymmetrical triangular modulation. We demonstrate numerically that relatively weak coherent optical injection stabilizes VCSEL output and increase the averaged amplitude of generated pulses.

ThR3-p35 15:00-17:00

Quantum-cascade lasers of 8-9 µm spectral range

A.V. Babichev[1,2,3], G.S. Sokolovskii[1,2], V.M. Ustinov[1], A.G. Gladyshev[3], L.Ya. Karachinsky[1,2,3], I.I. Novikov[1,2,3], A.Yu. Egorov[2,3]; 1 - Ioffe Inst., 2 - ITMO Univ., 3 - Connector Optics LLC, Russia

We present the results on epitaxy growth of heterostructures for quantum cascade laser within 7-9 micrometer spectral range. Structural quality of grown heterostructures was studied by X-ray diffractometry and transmission electron microscopy. The lasers demonstrated lasing with wavelength of 8 µm at room temperature and of 9.6 µm at 140 K.

ThR3-p36 15:00-17:00

High-precision medium power laser diode driver with microprocessor-based control system

R.V. Chkalov, N.S. Pokryshkin, M.N. Gerke, K.S. Khorkov, D.A. Kochuev, V.G. Prokoshev; Vladimir State Univ., Russia

The structure of medium power laser diode packages and its application areas are considered. Main principles, working parameters and operation features of the laser diode driver with a microprocessor-based control system are described.

ThR3-p37 15:00-17:00

Second harmonic generation with a fractional order of periodical poling

V.V. Dudelev[1], K.A. Fedorova[2], D.V. Chistyakov[3], K.K. Soboleva[4], V.E. Bugrov[3], E.U. Rafailov[5], G.S. Sokolovskii[1]; 1 - Ioffe Inst., Russia; 2 - Philipps Univ. of Marburg, Germany; 3 - ITMO Univ., Russia; 4 - Peter the Great St. Petersburg Polytechnic Univ., Russia; 5 - Aston Univ., UK

We demonstrate second harmonic generation in a diode-pumped periodically-poled lithium niobate crystal with a fractional poling period.

ThR3-p38 15:00-17:00

Two state pulsed QW laser: turn-on dynamics

V.V. Dudelev[1], V.Yu. Mylnikov[1], A.S. Shkol'nik[2], K.K. Soboleva[3], V.I. Kuchinskii[1], D.A. Livshits[2], G.S. Sokolovskii[1], E.A. Viktorov[4]; 1 - Ioffe Inst., Russia; 2 - Innolume GmbH, Germany; 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia; 4 - ITMO Univ., Russia

We analyze, experimentally and theoretically, the pulsed generation in quantum well laser simultaneously operating from the ground (GS) and the excited (ES) states. We find that an exponential increase in the output power at the GS laser turn-on noticeably changes its timescale when the laser turns on at the ES wavelength, indicating extremely fast dynamical interaction between the lasing states.

ThR3-p39 15:00-17:00

Second harmonic generation in a PPLN high-contrast ridge waveguide

V.V. Dudelev[1], A.R. Akhmatkhanov[2], K.K. Soboleva[3], S.H. Abdulrazak[4], V.E. Bugrov[4], V.Ya. Shur[2], G.S. Sokolovskii[1]; 1 - Ioffe Inst., 2 - Ural Federal Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., 4 - ITMO Univ., Russia

We study second harmonic generation in periodically-poled lithium niobate high-contrast ridge waveguides. The waveguides were fabricated by the mechanical polishing and subsequent micro-sawing of periodically-poled lithium niobate plate glued to the lithium niobate substrate.

ThR3-p40 15:00-17:00

Generation of complex optical signals in a system of coupled VCSELs

L.A. Kochkurov[1], M.I. Balakin[1], L.A. Melnikov[1], V.V. Dedova[1], A. Chipouline[2]; 1 - Saratov State Technical Univ., Russia; 2 - Technische Univ. Darmstadt, Germany

We present a study of the features of generalized synchronization in laser models involving coupled class B lasers Information capacity of commercial channels can be doubled by a simultaneous independent phase and amplitude modulation of the same wavelength channel. Separation of the phase and amplitude modulation has been demonstrated by the use of VCSEL.

ThR3-p41 15:00-17:00

Quantitative optimization of epitaxial heterostructures for near IR high-power lasers

M.A. Ladugin, A.A. Marmalyuk; JSC Sigm Plus, Russia

In this paper, we present the results of careful analyses and calculations aimed at the development of the high power laser diodes, bars and arrays operating in near IR spectral region and based on quantum well A3B5 heterostructures with increased optical power and high wall-plug efficiency (WPE ~ 70%). An increase in the internal quantum and external differential efficiency, a decrease in the threshold current, the cut-off voltage and series resistance, together allowed improving the output parameters of the semiconductor emitters.

ThR3-p42 15:00-17:00

A flexible terahertz waveguide for transmitting radiation of quantum-cascade laser

M.M. Nazarov[1], Z.Ch. Margushev[2] , K.A. Bzheumikhov[2], A.V. Shilov[4], A.B. Sotsky[4], I.A.Ozheredov[3], A.P.Shkurinov[3]; 1 - Kurchatov Inst. National Research Center, Russia; 2 - Inst. of Computer Science and Problems of Regional Management KBSC RAS, Russia; 3 - Lomonosov Moscow State Univ., Russia; 4 - Mogilev State Univ., Belarus

A flexible hollow waveguide with a structured cladding of eight capillaries for transmitting radiation of a quantum-cascade laser at a frequency of 3 THz to a distance of 1 m with losses not more than 5 dB has been developed. The spatial distribution of the mode has been measured and low losses due to bending have been obtained.

ThR3-p43 15:00-17:00

Generation of 'Droplet' beams with laser diodes

S.N. Losev[1], S.H. Abdulrazak[2], D.V. Chistyakov[2], V.Yu. Mylnikov[3], V.V. Dudelev[1], Y.M. Zadiranov[1], N.G. Deryagin[1], V.E. Bougrov[2], G.S. Sokolovskii[1]; 1 - Ioffe Inst., 2 - ITMO Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

We study the propagation of Bessel beam, generated by an axicon with rounded tip, and find that such a defect may lead to the formation of the axially discontinuous central lobe with the structure similar to the 'droplets' of light.

ThR3-p44 15:00-17:00

Ray transfer matrix of conically refracting crystal for laser cavity analysis

V.Yu. Mylnikov[1], K.K. Soboloeva[2], E.U. Rafailov[3], G.S. Sokolovskii[1]; 1 - Ioffe Inst., 2 - Peter the Great St. Petersburg Polytechnic Univ., Russia; 3 - Aston Univ., UK

In this work, we develop the formalism of ray transfer matrices for conically refracting crystals and apply it for calculation of the cavity mode in the laser cavity featuring conically refracting element.

ThR3-p45 15:00-17:00

Closed mode structures in large rectangular closed resonators based on AlGaAs/GaAs heterostructures

D.N. Romanovich[1,2], S.O. Slipchenko[1], A.A. Podoskin[1], I.S. Shashkin[1], V.S. Golovin[1], K.V. Bakhvalov[1], D.N. Nikolaev[1], M.G. Rastegaeva[1], N.A. Pikhtin[1]; 1 - Ioffe Inst., 2 - St. Petersburg Electrotechnical Univ. «LETI», Russia

The study considers mode structure formation in large size planar rectangular cavities. Cavity samples with cleaved edges were based on AlGaAs/GaAs QW laser heterostructures at wavelengths of 1040-60 nm. Mode structure visualization and control of their spatial configuration by external optical excitation are demonstrated. A 2D model was also created that describes mode configurations formation when the resonator design is varied.

R4. LASER BEAM CONTROL

ThR4-p01 11:30-13:30

Investigation of heating laser head optical elements by radiation from high-power fiber laser

P.A. Nosov, K.I. Zaytsev, N.V. Chernomyrdin, A.O. Schadko; Bauman Moscow State Technical Univ., Russia

Quartz glass KU-1 optical elements heating experimental research results (KU-1 - Russian-made brand) under the influence of radiation of CW powerful fiber laser are presented. The dependences of optical elements maximum temperature from laser radiation power are determined.

ThR4-p02 11:30-13:30

Interferometric detection of optical vortices

F.Yu. Kanev[1], V.P. Aksenov[1], F.A. Starikov[2], Yu.V. Dolgopolov[2], A.V. Kopalkin[2], I.D. Veretekhin[3]; 1 - Zuev Inst. of Atmospheric Optics, 2 - Russian Federal Nuclear Center-VNIIEF, 3 - National Research Tomsk State Univ., Russia

The algorithm of an optical vortex coordinates and topological charge detection is considered in the report. In the algorithm a vortex is localized as a point of interference fringe branching. With application of the algorithm interference patterns obtained in laboratory and numerical experiments are analyzed and corresponding examples are presented.

ThR4-p03 11:30-13:30

The noncollinear acousto-optical filtration of polychromatic Bessel light beams in paratellurite crystals

N.S.Kazak[1], G.V. Kulak[2], G.V. Krokh[2], P.I. Ropot[1], O.V. Shakin[3]; 1 - Inst. of Physics NASB, 2 - Mozyr State Pedagogical Univ., Belarus; 3 - State Univ. of Aerospace Instrumentation, Russia

The noncollinear acousto-optic filtration of diffracted Bessel light beams in uniaxial paratellurite crystals has been investigated. With the use of the method of overlap integrals it is shown that independently of the order of Bessel light beams in the conditions of transverse phase-matching of diffracted waves in the range of optical spectrum 0.4-1.1 nm in paratellurite crystals the bandwidth of transmission ~0.52 nm is reached due to detuning from Bragg's synchronism only.

ThR4-p04 11:30-13:30

Laser imaging of physical processes in thin near-wall layer of liquid droplet by surface plasmon resonance

I.N. Pavlov, A.V. Vedyashkina, I.L. Raskovskaya, B.S. Rinkevichyus, A.V. Tolkachev; National Research Univ. «MPEI», Russia

The method of visualization of physical processes in a few hundred nanometers thick layer of liquid by surface plasmon resonance imaging is shown. The scheme of created experimental setup is described and obtained experimental results of visualization of cooling, crystallization and mixing of liquid droplets are given. The algorithm of experimental image processing for quantitative diagnostics of investigated processes is discussed.

ThR4-p05 11:30-13:30

Two models of optical limiting by ps- and ns-laser pulses in CdSe/ZnS quantum dots

V.V. Danilov[1], A.S. Kulagina[2,3], N.V. Sibirev[3], E.N. Sosnov[4]; 1 - St. Petersburg State Transport Univ., 2 - St. Petersburg Academic Univ., 3 - ITMO Univ., 4 - RTC, Russia

Two models of optical limitation for nanosecond and picosecond laser action on colloidal solutions of semiconductor quantum dots are considered by resonant excitation. We discuss the results of solutions of kinetic balance equations for 10 ns and 20 ps laser pulses and different fundamental mechanisms for each case of optical limiting effect.

ThR4-p06 11:30-13:30

Reflectometry and polarimetry in application to media structure characterization

E.A. Isaeva, D.A. Zimnyakov; Saratov State Technical Univ., Russia

The methods of reflectometry based on the analysis of the reflected components of the electromagnetic field are used to investigate the weakly and strongly scattering media. This paper lays-out an complex approach probing the a gel-like media based on technical and food gelatins containing titanium dioxide particles through using on methods of video reflectometry and polarization spectroscopy.

ThR4-p07 11:30-13:30

Multi-layer laser data coding using linear and two-dimensional codes

N.N.Davydov, N.N.Davydov; Vladimir State Univ., Russia

Considered a method of forming sub-surface multi-layer linear and two-dimensional codes in the transparent material (glass or polymers) by a focused laser beams.

ThR4-p08 11:30-13:30

Terbium-doped phosphate glass for Faraday isolators

A. Babkina, Yu. Fedorov, V. Aseev, D. Sobolev; ITMO Univ., Russia

The results of synthesis and investigation of the magneto-optical properties of phosphate glasses heavily doped by terbium ions are presented. The maximum value of Verde constant was obtained for glass with 25 mol% Tb ions and reached 0.375 min/ (Oe cm) at 632 nm and 3.2 mT magnetic field.

ThR4-p09 11:30-13:30

Direct laser deposition with transversal oscillating of laser radiation

G.A. Turichin[1], E.V. Zemlyakov[1,2], M.V. Kuznetsov[1,2], K.D. Babkin[1,2], A.I. Kurakin[1], A.M. Vildanov[1,2]; 1 - St. Petersburg State Marine Technical Univ., 2 - Inst. of Laser and Welding Technologies, Peter the Great St. Petersburg Polytechnic Univ., Russia

the objective of this research is investigation influence spot diameter, frequency and amplitude of transversal oscillating laser radiation on the efficiency and coefficient of using materials of the direct laser deposition. Efficiency and coefficient of using materials of the direct laser deposition were increased from 15 g/min up to 22.2 g/min and from 27.6% up to 44.4% accordingly at the transversal oscillating laser radiation with spot diameter 0.9 mm, frequency 100 Hz and amplitude 2.6 mm comparatively with seems indicator of the direct laser deposition with spot diameter 3.2 mm without oscillating.

ThR4-p10 11:30-13:30

Stepless control of laser output using intracavity movable mirror

A.K. Naumov, O.A. Morozov, A.V. Lovchev, R.D. Aglyamov; Kazan Federal Univ., Russia

In this work we developed stepless control technique of laser output direct from the laser resonator by using a special intracavity device. It is shown that the technique can be used for optimization of laser output for both conventional and tunable lasers. This technique is usable for pulse and CW lasers, for which reflective materials exist. This means that it can be used in lasers operating in the spectral range from far IR to VUV and x-ray. It is because in this technique only reflective materials are used. Thus radiation doesn`t pass through optical elements and it is no absorption in them. Additional capabilities using the proposed technique in laser technology has shown.

ThR4-p11 11:30-13:30

Influence of light fluence on the attenuation coefficient of nonlinear optical absorbers with nanotubes and dyes

M.S. Savelyev[1], A.Yu. Gerasimenko[1], A.Yu. Tolbin[2], P.N. Vasilevsky[1], N.N. Zhurbina[1], S.A. Tereschenko[1]; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Physiologically Active Compounds RAS, Russia

Optical absorbers can be used to attenuate laser radiation to a safe level. At the same time, it is necessary to ensure high transmission of nonhazardous low-intensity radiation and a sharply reduced transmission at high intensity. To achieve this basic requirement can be due to nonlinear optical effects. In addition, the developed absorbers can be added to the formation of three-dimensional tissue-engineered structures. Thus, it will be possible to control the thickness of the layer being formed.

ThR4-p12 11:30-13:30

Digital holography: Structural heterogeneity of a crystal lattice (D)KDP materials

A.P. Zinoviev, A.I. Pavlikov, G.A. Luchinin; Federal Research Center, Inst. of Applied Physics RAS, Russia

Digital holography method is more progressive as looking method in depth scale and transversal structure of crystal.

ThR4-p13 11:30-13:30

Evolution of spontaneous emission of a laser active medium in a resonator of an unstable geometric configuration

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

The process of propagation of a beam of spontaneous emission inside the unstable resonator is considered. Spontaneous emission of the active element is taken as the sum of spatial-delta-correlated fields from a set of point sources. The dependence of the correlation function of the output laser radiation from the number of intracavity passes explored. A relation to estimate the number of passes required to form a resonant field is derived.

ThR4-p14 11:30-13:30

Spatial-energy characteristics of a focused laser beam with random phase distortions of the field inside an unstable resonator

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

The correlation function of laser output radiation is theoretically investigated depending on the statistical characteristics of the random phase distortions of the field inside the unstable resonator. The intracavity field is considered in the optico-geometric approximation. In the Fresnel approximation, the distribution function of the radiation flux for a focused laser beam is studied.

ThR4-p15 11:30-13:30

Acoustooptical modulators for controlled frequency shift of light beams in systems of laser cooling

V.M. Epikhin, A.V. Aprelev, E.A. Lavrov; Russian National Research and Development Inst. of Physicotechnical and Radiotechnical Measurements (VNIIFTRI), Russia

A series of acoustooptical modulators-frequency-shifters on paratellurite single crystals (TeO2) for laser cooling systems in the optical frequency standard on strontium atoms was developed. Spectral range of radiation:(460-700) nm, range of frequency shift:(40-400) MHz.

ThR4-p16 11:30-13:30

All-electric laser beam control by quantum-confined Stark effect modulator with an integrated Bragg grating

I.S. Shashkin, O.S. Soboleva, P.S. Gavrina, V.V. Zolotarev, S.O. Slipchenko, N.A. Pikhtin; Ioffe inst., Russia

Fast all-electric modulation of optical characteristics (effective refractive index, absorption coefficient) of quantum-dimensional semiconductor waveguide heterostructures was studied. These studies are aimed at developing a laser beam spatial characteristics control system using a high-order Bragg grating that is integrally formed on a semiconductor heterostructure. The implementation of this study will provide an ultrafast (nanoseconds) sweep of the laser beam.

ThR4-p17 11:30-13:30

Measurement and active reduction of the coupling of counterpropagating waves due to scattering in a laser gyroscope when it operates with a frequency biasing

Yu. Yu. Broslavets, A. A. Fomichev, D. M. Ambartsumyan, J. C. Buitrago Oropeza, E. A. Polukeev; Moscow Inst. of Physics and Technology (State Univ.), Russia

In this paper we present methods of measurement and reduction of the magnitude of coupling of counterpropagating waves in a laser gyroscope when it operates with a frequency biasing. The proposed complex methods for measuring this quantity are based on the amplitude modulation of one of the waves and the phase restoration of the beat signal. The obtained values of the waves coupling magnitude were used to control piezoelectric actuators that regulate the gyroscope cavity geometry in order to minimize the counterpropagating waves coupling. The magnitude of the coupling decreased in 2-5 times.

ThR4-p18 11:30-13:30

Criterion for assessing the quality of adaptive correction, performed on the basis of predictive control algorithms

V.V. Lavrinov, L.N, Lavrinova; Zuev Inst. of Atmospheric Optics SB RAS

In the adaptive optics system, the advancing formation of the phase surface of the deformable mirror from the measurements of the Shack-Hartmann wavefront sensor makes it possible to reduce the error due to the time delay of the system. The most promising approach is the mirror control algorithm, synthesized on the basis of the Kalman filter applied to measurements of the Shack-Hartmann sensor. In this case, the criterion for estimating the efficiency of adaptive correction of turbulent distortions of optical radiation should contain a prediction component.

ThR4-p19 11:30-13:30

Analysis of methods for measuring the angles of arrival of laser radiation propagating through a turbulent atmosphere, an tilt/tip sensor

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

To calculate the control signals of a piezoceramic deflector when measuring the angles of arrival of optical radiation transmitted through atmospheric turbulence, various methods for estimating the beam image in the focal plane of the recording device can be used. The results of numerical studies of the accuracy of calculating the centroids of an image in the focal plane in several different ways are presented. These methods are used both in split photodetectors and in the Shake-Hartmann wavefront sensors.

ThR4-p20 11:30-13:30

On inverse problem for propagation of waves from inclined surfaces

R.M. Feshchenko; Lebedev Physical Inst. RAS, Russia

The inverse problem for 2D parabolic equation is considered when the initial conditions are specified on an inclined line. It is demonstrated that the problem can be reduced to a single integral equation, which in turn can be transformed to a system of linear algebraic equations and solved numerically. The existence, uniqueness and stability of solutions are studied.

ThR4-p21 11:30-13:30

Light-driven optical switch

R.D. Aglyamov, A.V. Lovchev, O.A. Morozov, A.K. Naumov; Kazan Federal Univ., Russia

We want to show an example of a useful practical application of phenomenon excited-state absorption, although this effect is generally considered negative in laser physics. We consider fluoride crystals activated by neodymium ions as a material for a light-driven optical switch.

ThR4-p22 11:30-13:30

Development of laser heating system to study phase transitions in boron rich carbons under high pressure and temperature

A.A.Bykov[1,2], P.V. Zinin[1], K.M. Bulatov[1], A.S. Machikhin[1,2], Y.V. Mantrova[1], I.B. Kutuza[1]; 1 - Scientific and Technological Center of Unique Instrumentation RAS, 2 - Research Univ. «Moscow Power Engineering Inst.», Russia

We report on the development of the laser heating system for high temperature and high pressure studies with precise in-situ control of these parameters. One of the main features of the system is an imaging acousto-optical tunable filter. We also demonstrate that the proposed system may be used for in-situ high temperature distribution measurements in boron rich carbon materials.

ThR4-p23 11:30-13:30

Laser beam focusing through the scattering medium using 14-, 32- and 48-channel bimorph mirrors

I. Galaktionov[1], Ju. Sheldakova[1], A. Kudryashov[1,2], A. Nikitin[1]; 1 - Inst. of Geosphere Dynamics, 2 - Moscow Polytechnic Univ., Russia

Efficiency of the laser beam focusing through the scattering medium with known concentration values was numerically investigated. We used the response functions of 3 kinds of bimorph deformable mirrors — with 14, 32 and 48 electrodes. The algorithm for numerical correction were programmed. The obtained results shown that 14 electrodes (2 rings) are not enough to compensate for the distortions, produced by the scattering medium with the given concentration values.

ThR4-p24 11:30-13:30

HR and AR nanostructured optical coatings for high-power applications

L. Grinevičiūtė[1], A. Melninkaitis[2], A. Jasinskas[1], R. Buzelis[1], T. Tolenis[1]; 1 - Center for Physical Sciences and Technology, 2 - Vilnius Univ., Lithuania

In this study, an attempt is made to employ sculptured thin films in order to produce durable anti- and high-reflection coatings. All-silica based multilayer coatings, produced by glancing angle deposition, were characterized by measuring optical performance and resistivity to laser radiation. Tailoring the porosity of individual layers allows to form coatings capable to withstand extremely high laser fluencies.

ThR4-p25 11:30-13:30

Nondestructive examination of composite solids in millimeter wave range

G.S. Rogozhnikov; RFNC-VNIIEF, Russia

Laser processing results are predictable in case of uniform structure of the material. Any inhomogeneity may lead to large-scale deformations. There must be a real-time instrument to control the behavior of the material in harsh environment (particle clouds, plasma, gas flows, etc). Imaging in millimeter wave range has been studied as the possible way to solve the problem.

ThR4-p26 11:30-13:30

Characteristics of controllable holographic diffractive elements in PDLC for Gaussian light beams conversion into Bessel-like ones

A.O. Semkin, S.N. Sharangovich; Tomsk State Univ. of Control Systems and Radioelectronics, Russia

A theoretical model of light beams diffraction on holographically formed diffractive optical elements (DOE) in polymer-dispersed liquid crystals (PDLC) is developed. DOEs have a special structure designed to convert the incident light fields into Bessel-like. The influence of an external electric field on the light beams conversion efficiency is studied by numerical simulations. It is shown that it is possible to create electrically controllable transformation elements in PDLCs.

ThR4-p27 11:30-13:30

Localization of controllable waveguide channels, holographically formed in photopolymer-liquid crystalline composition

A.O. Semkin, S.N. Sharangovich; Tomsk State Univ. of Control Systems and Radioelectronics, Russia

In this work the theoretical model of holographic formation of controllable waveguide channels system in photopolymer-liquid crystalline composition is developed. Special attention is paid to localization of waveguides in the media caused by light field attenuation during the formation process.

ThR4-p28 11:30-13:30

Small-size bimorph mirror with high spatial resolution of the electrodes

V.V. Toporovskiy[1], A.V. Kudryashov[1,2], V.V. Samarkin[2], A.A. Skvortsov[1], D.V. Pshonkin[1], J.V. Sheldakova[2] ; 1 - Moscow Polytechnic Univ., 2 - Inst. of Geosphere Dynamics RAS, Russia

In this work, we present two approaches for increasing spatial resolution of the deformable mirrors – one to use a multilayer bimorph mirrors and another to put higher density of control electrodes and use ultrasonic welding to make the wire connection to these electrodes.

ThR4-p29 11:30-13:30

Two-axis acousto-optic deflector for high-power laser radiation on KGW crystal

D.Yu. Velikovskii[1,2], V.E. Pozar[1], M.M. Mazur[3]; 1 - Scientific and Technological Center of Unique Instrumentation RAS, 2 - Kotelnikov Inst. of Radioengineering and Electronics RAS, Fryazino Branch,[3]- All-Russian Scientific Research Inst. of Physicotechnical and Radiotechnical Measurements, Russia

The problem of creating an acousto-optic two-axes deflector for a high-power laser radiation is considered. The two-axes deflector is a suitable device for laser technology, capable to replace the scanning module based on agile mirrors. The scanning module convenient to control a laser beam, for example, in laser engraving. It can also be used for 3D printing additive technologies.

ThR4-p30 11:30-13:30

Simulation of adaptive phase correction of incoherent multimode laser beam

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

A possibility of adaptive phase correction of incoherent multimode beam is shown to be implementable. This correction is partial in principle; however, it allows a significant increase in the narrow-beam component by means of transformation of the mode composition.

ThR4-p31 11:30-13:30

Laser mirrors and optical surfaces. Ways to reduce back scattering

V.V. Azarova; R&D Inst. Polyus, Russia.

There are formulated the requirements to the precise optical surfaces and the laser mirrors for optic electronics applications. The characteristics and the statistic parameters of the precise optical surfaces are discussed. The connection of the measured by the various metrological methods parameters with PSD function was theoretically described. The modern MRS and GCIB finish polishing methods are discussed on examples of experimental results received with help of AFM, WLI, ARS and TIS measurement methods. It is shown the correlation between of many layers coated mirrors surfaces profiles, scattering and their substrates by the comparison of PSD functions.

ThR4-p32 11:30-13:30

Thermostabilization of methane optical frequency standard

D.A. Shelestov[1], A.S. Laptev[1], K.I. Koshelev[1], A.B. Pniov[1], A.S. Shelkovnikov[2], D.A. Tyurikov[2], M.A. Gubin[2]; 1 - Bauman Moscow State Technical Univ., 2 - Lebedev Physical Inst. RAS, Russia

We report investigation of frequency response of the He-Ne laser stabilized over methane line on temperature fluctuations. Stabilization technic is based on saturated dispersion resonance registration in two-mode laser with orthogonal polarizations. Anisotropic elements of the laser cavity are sensitive to temperature fluctuations that lead to laser frequency drift for averaging time more than 10 s. We developed temperature stabilization system with 10 mK stability in the range from 20 to 45 degrees C. That makes possible to shift temperature working point and measure temperature coefficient of the stabilized frequency (TCF) for this type of optical standard.

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

ThR6-p01 11:30-13:30

Ring He-Ne lasers with magneto-optical control for navigation

Yu.D. Golyaev; R&D Inst, Polyus, Russia

The main physical principles of the operation of ring gas laser in the laser –gyroscope regime are examined. The influence of nonreciprocal effects on the operational parameters of ring gas lasers and the methods of controlling with the aid of the nonreciprocal magneto-optical Zeeman effect, the parameters of these lasers used in gyroscopes are discussed.

ThR6-p02 11:30-13:30

Improving performance of quantum frequency standard with laser pumping

N.A. Lukashev[1], A.A. Petrov[1], V.V. Davydov[1], N.M. Grebenikova[1], A.P. Valov[2]; 1 - St. Petersburg Polytechnic Univ., 2 - St. Petersburg State Univ. of Telecommunications, Russia

One of the directions of improving performance of quantum frequency standard with laser pumping is considered. A summary of performance results that make it possible is provided.

R7. LASERS IN ENVIRONMENTAL MONITORING

ThR7-p01 15:00-17:00

Direct simultaneous spectroscopic measurements of rare and doubly-substituted CO2 isotopologues using interband cascade lasers

I. Prokhorov[1], T. Kluge[1], C. Janssen[1,2]; 1 - Heidelberg Univ., Germany; 2 - Sorbonne Univ., France

A tunable infrared laser based spectrometer for clumped isotope analysis is being developed in collaboration between Heidelberg University (IUP) and Sorbonne Universite/CNRS (LERMA-IPSL). The instrument deploys two con- tinuous interband cascade lasers (ICL) tuned at 4.439 and 4.329 µm. The six most abundant CO2 isotopologues, including the doubly substituted 16O13C18O and 16O13C17O, are measured simultaneously. A Herriot-type multi-pass cell provides two dif- ferent absorption paths to compensate the abundance difference between singly- and doubly-substituted isotopologues. We have reached the sub-permil precision within the integration time of less than a minute.

ThR7-p02 15:00-17:00

The ozone absorption cross section at the 325 nm HeCd laser wavelength

C. Janssen[1], H. Elandaloussi[1], J. Gröbner[2]; 1 - Sorbonne Univ., France; 2 - Physikalisch Meteorologisches Observatorium Davos, World Radiation Center, Switzerland

Accurate and traceable spectroscopic data are primordial for remote sensing of trace gases. Recently, the absorption cross section at the reference waevelength of 253.65 nm has been measured with uncertainties at the 0.8% uncertainty level. Here we present the first room temperature (T=294.09K) measurements at the 325 nm HeCd laser position at the uncertainty level of 0.2 % (k=2). The paper is in print for publication in Atmospheric Measurement Techniques.

ThR7-p03 15:00-17:00

UAV onboard third harmonic technique laser spectrometer for near infrared atmospheric absorption lines detection

V.M. Polyakov, A.L. Pavlova, V.V. Gill; «GK R-AERO» Ltd Co, Russia

We describe the UAV onboard laser spectrometer for near infrared atmospheric absorption lines detection. We use 2 mW DFB laser with frequency modulation and InGaAs PIN photodiode to detect the backscattered laser radiation. We use the second harmonic demodulation of laser signal and peak detector to obtain the absorption line presence signal.

ThR7-p04 15:00-17:00

DDLAS remote methane gas analyzer for UAV

A.P.Mineev[1], O.M.Stelmakh[1], Ya.Ya.Ponurovsky[1], D.B.Stavrovsky[1], V.A.Kamynin[1], A.V.Trikshev[1], M.A.Melkumov[2], A.M.Hegay[2], A.A.Ermakov[3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Scientific Center of Fiber Optics RAS, 3 - «Innovante» Ltd., Russia

A compact and light weight methane gas analyzer for Unmanned Aerial Vehicle (UAV) to detect leaks on gas pipelines, storage sites and methane processing facilities has been designed. The method of operation of the gas analyzer is differential diode laser absorption spectroscopy (DDLAS). The wavelength of radiation is 1.65 µm. The output power is 400 mW. Detection range is 100 meters. The detectability is 100 ppm/m for diameter of absorption volume 2 – 3 m. The total weight of the analyzer is 5 kg. Power consumption is less than 100 W.

ThR7-p05 15:00-17:00

Raman sensor for airport security systems

V. Elizarov[1], A. Grishkanich[1,2,3,4], A. Zhevlakov[1], V Tishkov[3] ,E. Kolmakov[4]; 1 - ITMO Univ., 2 - St. Petersburg State Electrotechnical Univ., 3 - Khlopin Radium Inst., 4 - LLC Lasertreck, Russia

Laser sensing can serve as a highly effective method of searching and monitoring of explosives and drugs materisals for airport security systems. Preliminary results of investigation show the real possibility to register of 2,4,6-trinitrophenylmethylnitramine with concentration at level of 10^8-10^9 cm-3 on a safe distance 30 m from the object.

ThR7-p06 15:00-17:00

Methods for achieving the high accuracy of δ13CVPDB measurements by cavity ring down spectroscopy

L.A. Konopelko[1,2], Y.K. Chubchenko,[1], V.V. Beloborodov[1,2]; 1 - Mendeleyev Inst. for Metrology (VNIIM), 2 - ITMO Univ., Russia

The recommended by the World Meteorological Organization expanded uncertainty of δ13CVPDB measurements in atmospheric air is 0,1 ‰. To achieve such accuracy using CRDS, it is necessary to investigate in detail the factors that influence the measurement result and develop a procedure for making corrections. The methods for achieving the high accuracy of δ13CVPDB measurements by CRDS are presented.

ThR7-p07 15:00-17:00

Quantifying water OH band temperature distortion by nano/picosecond Raman spectroscopy

M.Ya. Grishin[1,2], S.M. Pershin[1], V.N. Lednev[1], S.V. Garnov[1], V.V. Bukin[1], P.A. Chizhov[1], I.A. Khodasevich[3]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia; 3 - Stepanov Inst. of Physics NASB, Belarus

Anomalously large blueshift of Raman OH band was observed while probing water by picosecond vs nanosecond pulses. Temperature distortion of OH band contour was studied by nano/picosecond Raman techniques. It was observed that OH band centroid shifted linearly with temperature for both nano- and picosecond pulses. We explain picosecond Raman spectra features by non-equilibrium dynamics of hydrogen-bonded structures in water.

ThR7-p08 15:00-17:00

Diffusing wave spectroscopy of aging foamed structures

A.A. Isaeva[1,2], S.A. Uvchenko[1,2], D.A. Zimnyakov[1,2]; 1 - Saratov State Technical Univ., 2 - Inst. of Precision Mechanics and Control RAS, Russia

This work describes the results of an analysis of mesoporous system during its structure evolution by use of multispeckal diffusion-wave spectroscopy. The main regularities controlling the dynamics of the structure formation and parameters of the model porous matrices for various external conditions are established. Such studies play an important role in the synthesis of nanostructured biomaterials and tissue engineering for emerging biomedical technologies such as scaffolding and tissue regeneration.

ThR7-p09 15:00-17:00

Spectroscopic features of laser-induced breakdown in water solutions in ultrasound field

A.V. Bulanov[1,2], I.G. Nagorny[2,3]; 1 - Il'ichev Pacific Oceanological Inst., 2 - Far Eastern Federal Univ., 3 - Inst. for Automation and Control Processes, Russia

It has been established that the action of ultrasound leads to enhancement of spectral line intensities at all concentrations of salt solutions studied, which is evidence of the effective spectroscopic excitation of the liquid by ultrasound. The obtained results show the possibility of increasing the efficiency of LIBS in ultrasonic field and applying ultrasound in related technologies.

ThR7-p10 15:00-17:00

Raman LIDAR with increased aperture for geological monitoring

V.V.Elizarov, V.G.Bespalov, A.S.Grishkanich, S.V.Kascheev, L.A.Konopel'ko, E.A.Makarov, Yu.S.Ruzankina, A.P.Zhevlakov; ITMO Univ., Russia

Application of CCD array photodetector technology is shown to provide record synchronously hundreds of spectral intervals, increase essentially the relative aperture and intensity of echo-signals in the input optical path as well as to reduce the mass – dimension parameters of hyperspectral Raman LIDAR as a whole for geoecological monitoring by aerial and underwater unmanned vehicles.

ThR7-p11 15:00-17:00

Raman spectroscopy control of archaeological copper alloy objects surfaces during laser cleaning processes

A.V. Povolotckaia, N.S. Kurganov, D.V. Pankin, A.A. Shimko, A.A. Mikhailova, A.V. Kurochkin; St. Petersburg State Univ., Russia

The pulsed laser cleaning with surface control of archeological objects was performed. The surface control is based on optical microscopy and Raman spectroscopy. For laser cleaning experimental conditions were identified, needed for successful contamination cleaning and for preservation from making damage to objects.

ThR7-p12 15:00-17:00

Development and investigation of the water pollution video detection system

A.S.Maiurova, M.A. Kustikova, E.A.Bykovskaia; ITMO Univ., Russia

The work is devoted to the development and investigation of the system of oil pollution video detection in St. Petersburg. The necessary characteristics of the cameras are investigated.

ThR7-p13 15:00-17:00

Receiver unit calibration of the optoelectronic landing system of an air drone used to monitor gas pipelines of the West Siberian gas field

A.V. Stupnikov, E.I. Klimov, A.S.Maiurova; ITMO Univ., Russia

The work is devoted to the receiver unit calibration of the optoelectronic landing system of an air drone. The optical characteristics of the receiver unit were determined, a calibration stand was developed, a calibration program was created, a calibration measurement series were carried out.

ThR7-p14 15:00-17:00

Prospects for determination of carbon isotopes in graphite reactor assemblies of nuclear power plants

Y. Chubchenko[1,2], L. Konopelko[1,2], A. Grishkanich[1,3,4,5], A. Zhevlakov[1], V. Tishkov[4]; 1 - ITMO Univ., 2 - Mendeleyev Inst. for Metrology, 3 - St. Petersburg State Electrotechnical Univ., 4 - Khlopin Radium Inst., 5 - LLC Lasertrack, Russia

The possibilities of the Raman method of radiocarbon measurements in graphite reactor assemblies of nuclear power plants are investigated. With the help of veneer gas mixtures of carbon monoxide, carbon dioxide-12, carbon dioxide-13, methane, formaldehyde, the micrometric characteristics of laser isotops sensor were found, which in most cases coincided with the claimed ones. The results of determining the coefficients for correcting the readings of carbon analyzers with the achievement of inaccuracies from various diluent gases, as well as the data of the prototype Raman sensor.

ThR7-p15 15:00-17:00

The concept of building CARS-lidar for monitoring the climatic conditions in Arctic region

A. Stupnikov[1], M. Kustikova[1], A. Kancer[1] , J. Ruzankina[1], A. Mayurova[1], V. Elizarov[1], N. Paklinov[2], A. Grishkanich[1,3,4,5], A. Zhevlakov[1], D. Redka[3,5], V. Tishkov[4], E. Kolmakov[5]; 1 - ITMO Univ., 2 - Tyumen Industrial Univ., 3 - St. Petersburg State Electrotechnical Univ., 4 - Khlopin Radium Inst., 5 - LLC Lasertrack, Russia.

Identifying methane anomalies responsible for the temperature increase, by hiking trails in the Arctic requires great human labor. It is necessary to use lidar methods for search and identification of methane from permafrost. Necessary to create a Raman lidar for monitoring of emissions of methane hydrate from the permafrost. Hyperspectral resolution would resolve the isotope shifts in the Stokes spectra, thereby to determine the isotopic composition of methane ratio C14/C12 CH_4 carbon emissions and identify the source for study (permafrost or oil deposits).

ThR7-p16 15:00-17:00

The concept of building space-based lidar for monitoring surface of Mars

L. Smirnov[1], A. Stupnikov[1], V Ryzhova[1], M. Kustikova[1], A. Kancer[1], J. Ruzankina[1], A. Mayurova[1], V. Elizarov[1], N. Paklinov[2], D. Redka[3,4], E. Kolmakov[4]; 1 - ITMO Univ., 2 - Tyumen Industrial Univ., 3 - St. Petersburg State Electrotechnical Univ., 4 - LLC Lasertrack, Russia

Within the framework of the project, substances are indicators. It is these substances that are the main constituents of a watery suspension found on the surface of Mars. According to the conducted researches, the spectral region for the study of indicator substances was chosen. The method of remote sensing of the surface and the lidar construction scheme are chosen. The results of the preliminary calculation of the system are presented.

ThR7-p17 15:00-17:00

New laser complex for optical monitoring of underwater pipelines

A.G. Zhurenkov, V.A. Yakovlev; Vavilov State Optical Inst., Russia

The technical proposal for the complex of laser equipment for remote optical monitoring of underwater pipelines, such as Nord Stream in the Baltic Sea, is explained.

ThR7-p18 15:00-17:00

Passive detection of powerful laser radiation in the Earth's atmosphere

V.I.Grigorievsky, V.P.Sadovnikov, A.V.Elbakidse, Y.A.Tesadov; Kotelnikov Inst. of Radioengineering and Electronics RAS, Russia

The possibility of locating high-power laser infrared radiation from space by passive lidars is discussed in the approximation of the isotropy of the Rayleigh scattering indicatrix of laser radiation.

ThR7-p19 15:00-17:00

Mid-IR comb of CO laser sum-frequency lines

A.A. Ionin[1], I.O. Kinyaevskiy[1], Yu.M. Klimachev[1], Yu.M. Andreev[2]; 1 - Lebedev Physical Inst. RAS, 2 - Inst. of Monitoring of Climatic and Ecological Systems SB RAS, Russia

The spectrum of sum frequency generation when converting multiline CO laser radiation in $ZnGeP_2$ under noncritical spectral phase-matching was thorougly studied. This spectrum was found to be a broadband comb of multiline groups with complicated fine substructure that is attractive for atmospheric spectroscopy.

LASER OPTICS
ОПТИКА ЛАЗЕРОВ
2018

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5TH INTERNATIONAL A.M. PROKHOROV SYMPOSIUM ON LASERS IN MEDICINE AND BIOPHOTONICS

Location: Piemonte Room, floor 2. 09:00 - 11:30

Plenary session

Session Chair: Ivan A. Shcherbakov,
Prokhorov General Physics Inst. of RAS, Russia

TuSMP-01 09:00-09:30

High power Tm fiber laser – new laser platform for endoscopic surgery and lithotripsy

G. Altshuler[1], A. Mashkin[2], D. Myasnikov[3], V. Syrin[3], S .Larin[3], V. Vinichenko[3], V. Minaev[3], N. Evtichiev[3], V. Gapontsev[4]; 1 - IPG Medical Corp., USA; 2 - IPG Laser GmbH, Germany; 3 - NTO IRE-Polus, Russia; 4 - IPG Photonics, USA

New high power Tm fiber laser with 1940 nm wavelength, average power up to 200 W, and peak power up to 1000 W has been developed. Preclinical evaluation of the new laser for soft tissue surgery and human stone ablation was carried out and performance compared to that of Ho;YAG laser. It was shown that Tm fiber laser provides better ablation efficiency for soft tissue and human stones with significantly lower retropulsion when treating stone and better coagulation when treating soft tissue. First clinical experience with the new laser confirmed advantages of Tm fiber laser in urological applications such as prostate enucleation, bladder and kidney tumor ablation, and kidney resection, and lithotripsy.

TuSMP-02 09:30-10:00

Present and futures of laser in oncology

A.D. Kaprin, E.V. Filonenko; National Medical Research Radiological Center, Russia

In oncology lasers are used as: high-intensity laser (CO2, Nd:YAG, argon) for evaporation, excision and coagulation of tissue; photodynamic therapy (PDT) and diagnosis for tumors; low-intensity laser (LIL) for rehabilitation. PDT for treatment malignant primary, recurrence or metastatic tumors has been developed and used since 1992. Methods for prevention and treatment of complications of cancer therapy with LIL are used.

TuSMP-03 10:00-10:30

Highly sensitive optical methods for life-science applications

P.I. Nikitin; Prokhorov General Physics Inst. RAS, Russia

Several original optical methods, e.g., the phase surface plasmon resonance (SPR), spectral-phase and spectral-correlation interferometry, combined SPR and SERS chemical sensing on optoelectronic Au-Si grating microstructures, etc. have been introduced and tested as powerful tools for a wide range of life science applications. These include real-time monitoring of molecular interactions, label-free and nanoparticle-based biosensing for nanorobotic developments, rapid medical in vitro diagnostics, food control, environmental monitoring and detection of biological weapons.

TuSMP-04 10:30-11:00

Usage of lasers for remote diagnosis of diseases

Z. Zalevsky; Bar-Ilan Univ., Israel

A novel concept of remote photonic sensing providing the capability to sense nano-vibrations is applied to perform bio-medical diseases diagnosis and monitoring of breast cancer, skin lesions and melanoma as well as glaucoma.

TuSMP-05 11:00-11:30

Biophotonics in neurosurgery

A.A. Potapov[1], S.A. Goryajnov[1], D. M. Chelushkin[1], K.A. Chernishov[1], T.A. Savelieva[3,4], V.B. Loschenov[3,4], V.A. Okhlopkov[1], A.N. Konovalov[1], P.V. Zelenkov[1], Sh.Sh. Eliava[1], O.D. Shehtman[1], D.Yu. Usachev[1], V.A. Lukshin[1]; 1 - Burdenko National Medical Research Center of Neurosurgery; 2 - First Moscow State Medical Univ., 3 - Prokhorov General Physics Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia

Recently, 5-aminolevulinic acid (5-ALA) has been utilized as an adjuvant to the surgical resection of primary brain tumors and metastases and indocyanine green is widely used in vascular neurosurgery. We perform our series of 784 cases, in which the neurosurgical operation was carried out with different types of fluorescence navigation.

SECTION A. ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES

Location: Petrov-Vodkin 1 Room, floor 2. 12:00 - 13:30

Advanced laser medical systems and technologies I

Session Chair: Vyacheslav M. Gordienko, Lomonosov Moscow State Univ., Russia

TuSMA-01 12:00-12:20

Optoacoustic Diagnostic Platform: Principles, Instrumentation, and Applications *(Invited paper)*

R. Esenaliev; Univ. of Texas Medical Branch, USA

Optoacoustic diagnostics is a novel imaging modality based on detection and analysis of optoacoustic waves induced in tissues. We proposed and tested in animal and clinical studies a number of important optoacoustic diagnostic applications such as diagnostics of cerebral hypoxia, circulatory shock, anemia, thermotherapy monitoring, as well as breast cancer and hematoma detection. Our initial studies were performed with OPO-based systems. Recently, we developed and built FDA-compliant, multi-wavelength, fiber-coupled, highly-compact laser diode optoacoustic systems for imaging, monitoring, and sensing. To provide optoacoustic detection with high SNR, we developed ultra-sensitive optoacoustic probes that incorporate light delivery systems and wide-band acoustic sensors. This optoacoustic instrumentation allows for sensitive detection of optoacoustic signals from small tumors, native, coagulated and frozen tissues, intracranial hematomas, cerebral blood vessels such as the superior sagittal sinus, central veins such as the internal jugular vein, peripheral veins and arteries. We demonstrated also other examples of imaging, sensing, and monitoring with the optoacoustic instrumentation developed by our group including automatic, real-time, continuous measurements of blood oxygenation with high accuracy.

TuSMA-02 12:20-12:40

Femtosecond laser cellular and embryo microsurgery accompanied with femtosecond microscopy and spectroscopy *(Invited paper)*

A.A. Osychenko, M.S. Syrchina, A.V. Aybush, A.A. Astaf'ev, A.M. Shakhov, A.D.Zalesskiy, A.S. Krivokharchenko; Semenov Inst. of Chemical Physics RAS, Russia

Changes of chemical composition and optical properties due to the femtosecond laser action on the biomaterials was characterized by multiphoton luminescence, femtosecond CARS microscopy techniques, atomic force microscopy and time of flight secondary ions mass-spectroscopy. The survival and ability to development of mammalian embryos has been studied.

TuSMA-03 12:40-13:00

Bismuth-doped fiber lasers – promising new wavelength and tunable lasers *(Invited paper)*

E.M. Dianov; Fiber Optics Research Center, Russia

We present the generation of new laser wavelengths in the spectral region 1150-1775 nm by choosing the core glass composition in Bi-doped fibers. We demonstrate Bi-doped fiber lasers with a continuous wavelength tuning within 140 nm.

TuSMA-04 13:00-13:15

Precise laser contact surgery enhanced with thermal feedback: ex vivo evaluation

K.V. Shatilova[1], G.A. Aloian[2], I.V. Yaroslavsky[3], G.B. Altshuler[3]; 1 - NTO IRE-Polus, 2 - Moscow Inst. of Physics and Technology, Russia; 3 - IPG Medical Corp., USA

Comparison of laser contact surgery in conventional CW and thermal feedback modes with pre-initiated developed optical fiber tip has been performed. It is shown that thermal feedback mode leads to less thermal damage in comparison with the conventional CW mode.

TuSMA-05 13:15-13:30

Laser-induced boiling of biological liquids and its application in medical technologies

V.M. Chudnovskii[2], V.I. Yusupov[2], V.N. Bagratashvili[2]; 1 - Il'ichev Pacific Oceanological Inst., Far Eastern Branch, RAS, 2 - Federal Scientific Research Centre 'Crystallography and Photonics' RAS, Russia

We study thermal and transport processes related to the boiling of biological liquids under the action of continuous-wave laser radiation having moderate power (1 – 10 W) in the near-IR range (0.97 – 1.94 μm) . These processes are investigated in the course of a few particular clinical procedures aimed at the modification and removal of pathological tissues.

- Lunch Break -

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

Advanced laser medical systems and technologies II

Session Chair: Gregory Altshuler, IPG Medical Corporation, USA

TuSMA-06 15:00-15:20

Aerosols in medicine - harmful and beneficial effects *(Invited paper)*

A. Czitrovszky; Wigner Research Centre for Physics, Hungarian Academy of Sciences, Hungary

Aerosol deposition and penetration were studied experimentally in realistic hollow human lung models using a complex system consisting of a respirator, laser Doppler anemometer, aerosol particle counters and sizers and other optical instruments. Real time in situ measurements of aerodynamic parameters, aerosol concentration, size distribution, deposition, etc. were performed. The results were compared with calculations made using a stochastic lung model. Optimization methods for different aerosol drugs were proposed.

TuSMA-07 15:20-15:40

Safety of laser and terahertz femtosecond pulses effect on living bioobjects *(Invited paper)*

D.S. Sitnikov[1], I.V. Ilina[1], A.A. Pronkin[1], I.M. Zurina[2,3], A.A. Gorkun[2,3], Yu. V. Khramova[4], N.V. Kosheleva[2,4]; 1 - Joint Inst. for High Temperatures RAS, 2 - FSBSI Institute of General Pathology and Pathophysiology, 3 - Inst. for Regenerative Medicine, Sechenov Univ., 4 - Lomonosov Moscow State Univ., Russia

Efficiency of using femtosecond laser pulses to perform noncontact embryo biopsy and laser-assisted hatching is shown. First results on laser marking on the surface of embryo outer shell for individual embryo tagging are presented. Experimental study of high-power THz pulses effect on living MSC cell culture is presented. No short-term damage effects are observed during first hours post cell irradiation.

TuSMA-08 15:40-16:00

Ultrasound and thermometry guidance of laser interstitial thermotherapy. Application to Baker's cyst *(Invited paper)*

A.V.Lappa[1], A.V.Zhilyakov[2], A.N.Kulikovsky[3], I.A.Abushkin[4], V.A.Privalov[5]; 1 - Chelyabinsk State Univ., 2 - New Technologies in Outpatient Medicine, 3 - Industrial Group «Metran», Russia; 4 - Center for Medical Laser Technologies, 5 - South Ural State Medical Univ., Russia

Temperature control of laser operations by means of ultrasonic sounding and contact thermometry is presented. New method and device for minimally invasive interstitial measurement of temperature in the presence of intensive radiation are suggested. Applications of the temperature control to laser-induced interstitial thermotherapy and intracavitary thermotherapy cysts are considered.

TuSMA-09 16:00-16:15

Laser microsurgery of cell spheroids: an effective tool for regeneration studying and novel test system in aesthetic medicine

N.V. Kosheleva[1,2], I.V. Ilina[3], I.M. Zurina[1,4], A.A. Gorkun[1,4], D.S. Sitnikov[3], I.N. Saburina[1]; 1 - FSBSI Inst. of General Pathology and Pathophysiology, 2 - Lomonosov Moscow State Univ., 3 - Joint Inst. for High Temperatures RAS, 4 - Inst. for Regenerative Medicine, Sechenov Univ., Russia

Technique of laser microsurgery of cell spheroids with nanosecond laser pulses was used to develop a new simple reproducible model for studying regeneration in vitro. Wound restoration accompanying the reparative processes occurred gradually over seven days due to rearrangement of surviving non-proliferating cells. Skin anti-ageing drugs can be tested on the developed model of cell spheroid's regeneration.

TuSMA-10 16:15-16:30

Thulium fiber laser enucleation of the prostate in management if giant BPH (>200 cc)

L.M. Rapoport, D.V. Enikeev, M.S. Taratkin; Sechenov First Moscow State Medical Univ., Russia

Holmium laser enucleation of the prostate is currently a viable alternative to open prostatectomy in patients with BHP over 80 cm3. However, information of Tm fiber laser enucleation efficiency for treatment of large-sized glands are lacking. The aim of our study was to demonstrate that thulium fiber laser enucleation (ThuFLEP) is a highly effective treatment modality for BPH exceeding 200 cm3.

TuSMA-11 16:30-16:45

Reducing retropulsion effect in Tm fiber laser lithotripsy through pulse-train modulation

V.A. Vinnichenko[1], A.A. Kovalenko[1], I.V. Yaroslavsky[2], G.B. Altshuler[2]; 1 - NTO IRE-Polus, Russia; 2 - IPG Medical Corp., USA

We investigated impact of temporal structure of Tm fiber laser output on retropuslion effect in laser lithotripsy. Single-pulse and pulse-train modulation regimes were tested and the laser parameters were optimized to maximize reduction of retropulsion.

TuSMA-12 16:45-17:00

Numerical modeling of thermal homeostasis of the vessel heating exposed to laser exposure in various modes

A.E. Pushkareva[1], I.V. Ponomarev[2], A.A. Isaev[2], S.V. Klyuchareva[3]; 1 - ITMO Univ., 2 - Lebedev Physics Inst. RAS, 3 - Mechnikov North-West State Medical Univ., Russia

Numerical modeling has been used for the choice of most effective and safe methods of laser treatment of VCM used in modern dermatology. The application of the multipulse CVL laser radiation with the wavelength most absorbed by the blood chromophore allows achieve the maximum clinical efficacy due to coagulation of dysplastic vessels of venous capillary malformations.

TuSMA-13 17:00-17:15

New laser radiation hydrodynamic effect in endoscopic urological surgery

V.P. Minaev[1], A.Z. Vinarov[2], A.M. Dymov[2],[1]N.I. Sorokin[2], V.YU. Lekarev[2]; 1 - NTO "IRE-Polus", 2 - Sechenov Univ., Russia

Authors describe new effect of laser radiation in endoscopic urological: two-phase jet - a result of superintensive boiling in the area of laser radiation absorption and consisting of steam-gas microbubbles and hot water. Cutting soft tissue, the jet coagulates section walls due to heat generated at steam condensation.

TuSMA-27 17:15-17:35

Automatic feedback guided retinal laser therapies (Invited paper)

R. Brinkmann[1,2]; 1-Inst. of Biomedical Optics, Univ. of Luebeck, 2-Medizinisches Laserzentrum Lübeck GmbH, Germany

Laser photocoagulation of the retina is a very well establish standard of care for several retinal diseases over more than 40 years to date. However, with new methods and emerging precision of retinal diagnostics a demand for less invasive but as effective therapies raised. Therefore two minimal invasive retinal laser therapies with real-time feedback guidance in order to compensate for inter and intra-individual variability in light scattering and absorption within the eye will be presented: Selective retina therapy (SRT) aiming to selectively damage the retinal pigment epithelium (RPE), and temperature controlled retinal stimulation and coagulation.

- Coffee Break -

SECTION B. LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY

Location: Levinson Lounge, floor 2. 12:00 - 13:30

Laser interaction with cells and tissues: clinical imaging and spectroscopy I

Session Chair: Alexander V. Priezzhev,
Lomonosov Moscow State Univ., Russia

TuSMB-01 12:00-12:20

Optical amplification of in vivo photoacoustic flow cytometry *(Invited paper)*

V.V. Tuchin[1], E.I. Galanzha[1,2], V.P. Zharov[1,2]; 1 - Saratov State Univ., Russia; 2 - Univ. of Arkansas for Medical Sciences, USA

Recent results on tissue optical clearing (TOC) technology optimization in application to in vivo photoacoustic flow cytometry (PAFC) are presented and discussed accounting for features and benefits of this technique.

TuSMB-02 12:20-12:40

Wideband optoacoustic detectors for multi-scale characterization of the vasculature *(Invited paper)*

P. Subochev, V. Perekatova, M. Kirillin, A. Orlova, E. Smolina, D. Loginova, I. Turchin; Inst. of Applied Physics RAS, Russia

The paper reviews our recent experience in multi-scale biomedical optoacoustic imaging using wideband ultrasonic detectors based on polyvinylidene fluoride films. The experimental setups for optoacoustic microscopy and tomography are presented, numerical algorithms for versatile characterization of tissue vasculature are discussed.

TuSMB-03 12:40-13:00

Development of optical monitoring of lung function in preterm infants *(Invited paper)*

S. Andersson-Engels[1,2], A.L. Pacheco[1,2], E. Dempsey[3]; 1 - Tyndall National Inst., 2 - Univ. College Cork, 3 - INFANT Center, Cork Univ. Maternity Hospital, Ireland

Gas in scattering media absorption spectroscopy (GASMAS) is a non-invasive method used to measure absolute lung oxygen volume and concentration. Its feasibility to monitor the lungs of full term babies has been demonstrated. This paper provides an overview of the work to be done to develop a clinically useful GASMAS system.

TuSMB-04 13:00-13:15

Monte Carlo simulations of the diffuse correlation spectroscopy signals for bounded biomodels

V. Kuzmin[1], A. Valkov[1,2], L. Zubkov[3]; 1 - Peter the Great St. Petersburg Polytechnic Univ., 2 - St. Petersburg State Univ., Russia; 3 - Drexel Univ., USA

The diffuse near infrared spectroscopy (DNIRS) and diffuse correlation spectroscopy (DCS) are the contemporary non-invasive optical methods. We present results of numerical simulations of the photon diffusion and temporal correlations underlying these techniques in spatially restricted bio models. The calculations are performed for multi-layered models, in particular a finite-thick scull layer localized above the semi- infinite brain model.

TuSMB-05 13:15-13:30

Nonlinear microscopy as a tool of express biopsy in breast cancer diagnostics

E.A. Sergeeva[1,]V.V. Dudenkova[2], S.S. Kuznetsov[2], M.Yu. Kirillin[1], M.V. Pavlov[2], A.V. Maslennikova[2], N.M. Shakhova[1]; 1 - Inst. of Applied Physics RAS, 2 - Nizhny Novgorod State Medical Academy, Russia

We demonstrate nonlinear microscopy (NLM) imaging of ex vivo breast tissue samples aimed at revealing pathological changes by observation of stroma reorganization. Numerical processing of NLM images is performed to evaluate the degree of collagen disorganization as the result of different pathologies.

- Lunch Break -

SECTION B. LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY

Location: Levinson Lounge, floor 2. 15:00 - 17:45

Laser interaction with cells and tissues: clinical imaging and spectroscopy II

Session Chair: Valery V. Tuchin, Saratov State Univ., Russia

TuSMB-06 15:00-15:20

Challenges in structured illumination microscopy *(Invited paper)*

H. Schneckenburger, V. Richter, M. Piper, M. Wagner; Aalen Univ., Germany

An experimental setup for super-resolution microscopy by structured illumination has been established, preliminary experiments of nanoparticles and living cells with a resolution around 100 nm are described, and further requirements for live cell imaging are discussed.

TuSMB-07 15:20-15:40

New photoconvertible protein for superresolution microscopy *(Invited paper)*

I.D. Solovyev[1,2], A.V Gavshina[2], A.P. Savitsky[1,2]; 1 - Lomonosov Moscow State Univ., 2 - Bach Inst. of Biochemistry, Research Center of Biotechnology RAS, Russia

Physicochemical characterization of photoconvertible fluorescent protein (PCFP) SAASoti – a promising candidate for the use in different super-resolution techniques.

TuSMB-08 15:40-16:00

Individual sperm cell analysis and selection for In vitro fertilization using interferometric phase microscopy *(Invited paper)*

N.T. Shaked[1], P. Ja. Eravuchira[1], S.K. Mirsky[1], M. Levi[2], M. Balberg[1,3], I. Barnea[1;1,] 2 - Tel Aviv Univ., 3 - Holon Inst. of Technology, Israel

We review our advances in developing a platform for real-time quantitative analysis and selection of individual sperm cells without staining. Our system is based on combining interferometric phase microscopy, for stain-free sperm imaging and real-time analysis based on the sperm cell morphology and contents, with a disposable microfluidic device, for sperm selection and enrichment. We believe that the presented integrated approach has the potential to make the sperm selection process for in-vitro fertilization more objective, quantitative and automatic, hence increasing success rates.

TuSMB-09 16:00-16:20

In vivo laser imaging of metabolic processes connected with the microcirculatory system *(Invited paper)*

E.A. Shirshin[1], B.P. Yakimov[1], Y.I. Gurfinkel[1], A.V. Priezzhev[1], N.P. Omelyanenko[2], J. Lademann[3], M.E. Darvin[3]; 1 - Moscow State Univ., 2 - Central Inst. for Traumathology and Orthopedics, Russia; 3 - Charite Univ. Clinics, Germany

Here we present the results of label free multiphoton imaging of metabolic processes in the human skin papillary dermis, which are connected with transcapillary diffusion and microcirculatory system. Namely, fluid retention in the perivascular zone and cells migration from the blood vessels are addressed and investigated using the fluorescence lifetime imaging technique.

TuSMB-10 16:20-16:40

Study of nanoparticles interaction with biological tissues using comparative optical-spectroscopic methods *(Invited paper)*

E.V. Perevedentseva[1,4], A.V. Karmenyan[1], Y.C. Lin[1], Ashek-I-Ahmed[1], N. Ali[2], M. Kinnunen[3], O. Bibikova[2,3], I. Skovorodkin[2], S. Vainio[2], C.L. Cheng[1]; 1 - National Dong Hwa Univ., Taiwan; 2 - Univ. of Oulu, 3 - Faculty of Information Technology and Electrical Engineering, Univ. of Oulu, Finland; 4 - Lebedev Physics Inst. RAS, Russia

Recent development of nanoparticles bio-medical applications is determined by perspectives of their use for multimodal bio-imaging and sensing. Informative and noninvasive optical-spectroscopic methods are designed for the detection and analysis of the NP interaction with target biological systems. Presented work is focused on study of nanoparticles interaction with biological tissues combining complimentary methods to obtain versatile optical-spectroscopic information.

TuSMB-11 16:40-17:00

Laser-optic studies in hemorheology *(Invited paper)*

A. Priezzhev[1,2], A. Lugovtsov[1], A. Semenov[1,2], K. Lee[2,3], S. Nikitin[1,2], V. Ustinov[4;1,] 2 - Lomonosov Moscow State Univ., 3 - Currently with Center for Soft and Living Matter, Inst. of Basic Science, Ulsan National Inst. of Science and Technology, Republic of Korea; 4 - Lomonosov Moscow State Univ., Russia

Fundamental microrheologic properties of blood mostly related to erythrocytes deformability and reversible aggregation and strongly determining blood fluidity and microcirculation are assessed in vitro with laser-optic techniques including lasers tweezers, laser diffractometry, diffuse light scattering. This allows for better understanding the basic mechanisms of the cells interaction and behavior in blood flow in norm and pathology.

TuSMB-12 17:00-17:15

Wavelet-domain denoising of OCT images of human brain malignant tissues

I.N. Dolganova[1,2,3], P.V. Aleksandrova[1], S.-I.T. Beshplav[4], I.V. Reshetov[2], A.A. Potapov[4], K.I. Zaytsev[1,2,5]; 1 - Bauman Moscow State Technical Univ.; 2 - Sechenov First Moscow State Medical Univ.; 3 - Inst. of Solid State Physics RAS; 4 - Burdenko Neurosurgery Inst.; 5 - Prokhorov General Physics Inst. RAS, Russia

We demonstrate a wavelet-domain denoising technique for imaging of human brain malignant tissues by optical coherence tomography. Among wide base of wavelet-domain filters we select appropriate ones by means of different criteria, i.e. tissue-class differentiation for brain glioma and micro-scale inclusions determination for brain meningioma. This selection allows for reducing scattering noise and retaining signal artifacts for each tissue type.

TuSMB-13 17:15-17:30

Delivery of the photodynamic agent under the nail plate using Er-laser microperforation and laser-induced hydrodynamic processes

A.V. Belikov, S.N. Smirnov, A.N. Sergeev, A.D. Tavalinskaya; ITMO Univ., Russia

The active delivery of photodynamic agent (aqueous solution of methylene blue) under a nail plate is discussed. The delivery was implemented by microperforating the nail plate using Er: YLF laser radiation and stimulating hydrodynamic processes in drug droplet on the nail surface under the action of Yb,Er: Glass laser pulses. Optimal pulse energy of Yb,Er: Glass laser radiation for effective active delivery of the photodynamic agent are determined.

TuSMB-14 17:30-17:45

Modified non-invasive diffuse reflective calibration-free method to determine optical parameters of biological tissues

A.V.Lappa, A.E.Anchugova, D.Iu.Shakaeva; Chelyabinsk State Univ., Russia

A modification of the non-invasive, calibration-free diffuse reflective method to determine optical parameters of turbid media proposed by us earlier [1] is presented. Crucial improvements of this modification are the using of a one-step non-analog Monte Carlo algorithm instead of a two-step algorithm, reducing the inverse problem to the variational problem of minimizing the functional instead of table interpolation.

- Coffee Break -

SECTION A. ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES

TuSMA-p01 17:00-19:00

Use of laser radiation for spinal degenerative diseases treatment

A.N. Zabrodskiy[1], V.N. Karp[1], S.V. Vovnenko[1], V.P. Minaev[2], D.A. Ushakov[1]; 1 - 1st Branch of the 3rd Central Military Clinical Hospital, 2 - NTO "IRE-Polus", Russia

The results of laser radiation treatment of patients with intervertebral disk hernias and facet syndrome are presented in the article. The applied techniques are based on low-invasive punction surgery, i.e. Percutaneous Laser Intervebral Disk Decompression (PLDD) and Percutaneous Laser Destruction of Facet Nerves (PLDFN), where laser radiation with wavelengths 1.06; 0.97 and 1.55 micrometers was applied. The exact choice of treatment techniques led to almost 97% positive results.

TuSMA-p02 17:00-19:00

Two-wavelength laser minimally-invasive percutaneous nephrolithotomy in the management of staghorn stones

S.A. Naryshkin[1,2], O.V. Teodorovich[1,2], G. G. Borisenko[2], D.G. Kochiev[3]; 1 - Scientific Clinical Center JSC RZhD "Russian Railways", 2 - Russian Medical Academy of Postgraduate Education, 3 - Prokhorov General Physics Inst. RAS, Russia

In the report, we reflected our experience of minimally invasive percutaneous nephrolithotomy (Mini PCNL) in the treatment of staghorn kidney calculi. Our experience demonstrated that Mini PCNL by two-wavelength laser lithotripter with microsecond pulse duration and second harmonic generation is effective and safe procedure in treatment of staghorn nephrolithiasis.

TuSMA-p03 17:00-19:00

Thermal field analysis in the process of surface-selective laser sintering of bioresorbable polymer matrixies

S.A. Minaeva, E.N. Antonov, A.N. Konovalov, N.V. Minaev, V.K. Popov; Federal Research Centre «Crystallography and Photonics» RAS, Russia

The influence of the parameters of surface-selective laser sintering of polymer particles on the spatio-temporal temperature distribution in active zone was investigated using water as the sensitizer of heating. The temperature distribution at the surface and inside the sintered particles was estimated.

TuSMA-p04 17:00-19:00

Surface-selective laser sintering as a method for mechanically inductive scaffolds with a multilayer bio-interface

V.D. Grinchenko[1], E.A. Grebenik[1], S.N. Churbanov[1,2], N.V. Minaev[2], P.A. Melnikov[4], A.I. Schpichka[1], D.V. Butnaru[1], V.N. Bagratashvili[2], Yu.A. Rochev[1,3], P.S. Timashev[1,2]; 1 - Inst. for Regenerative Medicine, Sechenov First Moscow State Medical Univ., 2 - Research Center "Crystallography and Photonics" RAS, Russia; 3 - National Univ. of Ireland, Ireland; 4 - Serbsky National Medical Research Center for Psychiatry and Narcology, Russia

Cells and 3D porous scaffolds are the key components of engineered tissues. The scaffolds provide transport of chemicals, structural support for cell migration, attachment, growth and subsequent ECM secretion and tissue development. Currently, there are variety of methods and biomaterials used for scaffold fabrication. However, optimization of their properties aiming to improve functional and structural restoration of damaged bone tissue is still an urgent task.

TuSMA-p05 17:00-19:00

Development of LEMS technology

E.S. Churbanova[1], V.I. Yusupov[1], V.S. Zhigarkov[1], V.S. Cheptsov[2], M.V. Gorlenko[2], N.V. Minaev[1], E.A. Chutko[1], V.N. Bagratashvili[1]; 1 - Federal Research Center «Crystallography and Photonics» RAS, 2 - Lomonosov Moscow State Univ., Russia

In this paper, we describe the development and application of the laser engineering technology for microbial systems (LEMS), which based on the laser-induced forward transfer method.

TuSMA-p06 17:00-19:00

Laser perforation as a method for controlling bioresorbtion of tissue engineering scaffolds

S.N. Churbanov[1,2], A.A. Antoshin[1], N.V. Minaev[2], T.I. Gromovyih[1], P.S. Timashev[1,2], D.V. Butnaru[1]; 1 - Inst. for Regenerative Medicine, Sechenov Univ., 2 - Federal State Research Center "Crystallography and Photonics" RAS, Russia

There is the effect of laser perforation on the rate of biodegradation of scaffolds was analyzed, using bacterial cellulose as a biomaterial.

TuSMA-p07 17:00-19:00

Applying LIFT-technology for vasculature formation in tissue and organ engineering

A.A. Antoshin[1], M.D. Fedyakov[1], S.N. Churbanov[1,2], N.V. Minaev[2], A.I. Shpichka[1], P.S. Timashev[1,2]; 1 - Inst. for Regenerative Medicine, Sechenov Univ., 2 - Inst. of Photon Technologies of FSRC «Crystallography and Photonics» RAS, Russia

This study aimed to develop the approach to the vasculature formation using LIFT-technology for tissue and organ engineering.

TuSMA-p08 17:00-19:00

Application of 2-micron laser radiation for endovenous laser coagulation of varicose veins: in-vitro and in-vivo experiments

S.A. Khrushchalina, S.A. Artemov, A.N. Belyaev, S.V. Kostin, O.A. Kuznetsova, A.A. Lyapin, P.A. Ryabochkina; Ogarev Mordovia State Univ., Russia

Experiments on endovenous laser coagulation (EVLC) of varicose veins in-vitro and in-vivo have been performed using radiation of a solid state laser based on the crystal LiYF4: Tm, with a wavelength of 1.885 μm. As result it was shown that effect of coagulation is provided at a radiation power of 4-5 W.

TuSMA-p09 17:00-19:00

Pulsed transverse discharge CO2 laser removal of traumatic scars

N. Gorbatova[2,3], S. Nikiforov[1], A. Pento[1], Ya. Simanovsky[1], S. Zolotov[2], A. Brynsev[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Clinical and Research Inst. of Emergency Pediatric Surgery and Trauma, 3 - Federal State Autonomous Inst. "National Medical Research Center of Children's Health", Russia

Removing children traumatic scars, resulting from various injuries and surgeries, is still actual problem. Unlike conventional laser skin resurfacing removal of sizeable amount of tissue is required for such treatment. To decrease the injury rate a special laser with the pulse duration below 20 μs was used. The data of 6 years successful method application are presented (over 250 patients).

TuSMA-p10 17:00-19:00

Pulsed transverse discharge CO2 laser mucosa ablation for the treatment of ENT diseases

N. Gorbatova[2,3], S. Nikiforov[1], Ya. Simanovsky[1], A. Pento[1], A. Brynsev[2], K. Baranov[2], N. Starshova[2], S. Zolotov[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Clinical and Research Inst. of Emergency Pediatric Surgery and Trauma, 3 - Federal State Autonomous Inst. "National Medical Research Center of Children's Health", Russia

Therapeutic effect with ENT diseases can be achieved removing the infected surface epithelial layer by laser ablation. To reduce adverse effects a CO2 laser with pulse duration below 20 μs is needed. The laser treatment significantly reduced bacteria content in the mucosa right after the procedure in 89% of 54 patients. After 6 months, 78% of patients had stable improvement.

TuSMA-p11 17:00-19:00

Evaluation of Tm fiber laser as a prospective energy source for fractional treatment in gynecological applications

K.V. Shatilova[1], V.A. Vinnichenko[1], A.A. Petrov[2], V.P. Veiko[2], I.V. Yaroslavsky[3]; 1 - NTO IRE-Polus, 2 - ITMO Univ., Russia; 3 - IPG Medical Corp., USA

We investigated regimes of Tm fiber laser suitable for non-ablative soft tissue fractional treatment in animal model ex vivo. We have compared resulting temperature fields with those produced by Er:YAG laser and identified Tm fiber laser parameters allowing to closely match temperature effects of the two lasers. These data suggest feasibility of using Tm fiber laser as energy source for a number of applications in gynecology.

TuSMA-p12 17:00-19:00

Repetitively-pulsed Mid-IR laser for precise microsurgery

V.A. Serebryakov, A.S. Narivonchik, N.A. Kalintseva, D.V. Skvortsov, S.V. Doroganov; Vavilov State Optical Inst., Russia

Smoothly tunable in Mid-IR 5.75-8 μm range solid state laser device of Tm: Ho: ZGP-OPO-OPA architecture of several watt level at 100-1000 Hz pulse repetition rate intended for the experimental precise surgery research for medical laboratory was constructed.

TuSMA-p13 17:00-19:00

Pulsed fiber based yellow laser for ophthalmology

A.A. Surin[1,2], K.Y. Prusakov[1,2], T.E. Borisenko[1], A.A. Molkov[1,2]; 1 - NTO "IRE-Polus", 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

We introduce yellow laser for ophthalmology operating in continuous wave and pulse regime.

TuSMA-p14 17:00-19:00

The first experience of the use of the multiwave laser device «Livadia» in the treatment of relapse of inflammatory diseases of the epithelial pilonidal cyst in children

A.A. Sirotkin[1], G.P. Kuzmin[1], N.E. Gorbatova[2,3], A.V. Brynsev[2], M.A. Dvornikova[3], S.A. Zolotov[2], O.V.Tikhonevich[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Clinical and Research Inst. of Emergency Pediatric Surgery and Trauma, 3 - Federal State Autonomous Inst. «National Medical Research Center of Children's Health», Russia

The results of application of a multiwave laser medical device «LIVADIA» for the treatment of inflammation of the epithelial pilonidal cyst in children are presented. The effectiveness of the technique due to the anti-inflammatory and antibacterial effect of multiwave radiation is shown. After five sessions of laser therapy, there is complete absence of inflammation and fistula closure.

TuSMA-p15 17:00-19:00

Fiber pyrometer for the control of Baker's cyst laser obliteration

A.S.Shmygalev[1], D.S. Suchkova[1], A.V.Zhilyakov[2], A.S.Korsakov[1], B.P.Zhilkin[1]; 1 - Ural Federal Univ., 2 - Ural State Medical Univ., Russia

In this work, the calibration of the temperature readings obtained with the help of infrared fibers was performed. Based on the data obtained, a model of a fiber pyrometer is proposed.

TuSMA-p16 17:00-19:00

Sapphire shaped crystals for laser-assisted cryodestruction of biological tissues

I.A. Shikunova[1], E.N. Dubyanskaya[1], A.A. Kuznetsov[2], G.M. Katyba[1], I.N. Dolganova[2], E.E. Mukhina[2], M.A. Shchedrina[3], I.V. Reshetov[3], N.V. Chernomyrdin[2,3,4], K.I. Zaytsev[2,3,4], V.V. Tuchin[5,6,7], V.N. Kurlov[1]; 1 - Inst. of Solid State Physics RAS, 2 - Bauman Moscow State Technical Univ., 3 - Sechenov First Moscow State Medical Univ., 4 - Prokhorov General Physics Inst. RAS, 5 - Saratov State Univ., 6 - Inst. of Precision Mechanics and Control RAS, 7 - Tomsk State Univ., Russia

We have developed cryoapplicators based on the sapphire shaped crystals fabricated via the edge-defined filmfed growth technique. They combine unique physical properties of sapphire - high thermal, mechanical and chemical strength, impressive thermal conductivity and optical transparency. We have applied the proposed sapphire cryoapplicators for the destruction of biotissues in vitro. The observed results highlight the prospectives of the sapphire cryoapplicators in cryosurgery.

TuSMA-p17 17:00-19:00

Fabrication of photopatterns upon collagen films with enhanced mechanical properties

K.N. Bardakova[1,2], S.N. Churbanov[1,2], L.P. Istranov[2], E.V. Istranova[2], N.V. Minaev[1], P.S. Timashev[1,2]; 1 - Inst. of Photonic Technologies, FSRC "Crystallography and Photonics" RAS, 2 - Inst. for Regenerative Medicine, Sechenov First Moscow State Medical Univ., Russia

In this paper, we report the development of a simple method to produce collagen materials with improved mechanical characteristics using laser stereolithography.

SECTION B. LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY

TuSMB-p01 17:00-19:00

Optical spectroscopy for skin fibrosis

Y.V. Chursinova, D.A.Kulikov, D.A. Rogatkin, I.A. Raznitsyna, D.V.Mosalskaya; Moscow Regional Research and Clinical Inst. «MONIKI», Russia

In modern medicine, the development of methods for rapid, non-invasive, quantitative assessment of a tissues state is extremely topical. To date, the diagnosis of skin fibrosis relies on subjective, non-quantitative methods or requires invasive procedures. The results of preliminary studies suggest that optical methods can be used as a quantitative method for diagnostics of fibrosis.

TuSMB-p02 17:00-19:00

Features of the dc component of the laser Doppler signal during arterial occlusion

D.G. Lapitan, D.A. Rogatkin; Moscow Regional Research and Clinical Inst. named after M.F. Vladimirsky (MONIKI), Russia

The dc component of the laser Doppler signal was studied experimentally during arterial occlusion. It was shown that the dc component strongly depends on the tissue blood volume. It can be used for evaluation of the tissue ischemia.

TuSMB-p03 17:00-19:00

Conformity of Monte Carlo and analytical solutions for one 2D scattering problem in biomedical optics

A.P.Tarasov[1,2], I.A. Raznitsyna[2], D.A.Rogatkin[2]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Moscow Regional Research and Clinical Inst. MONIKI, Russia

2D direct problem of light transport in turbid media in the single-scattering approximation was considered. It was shown that Monte Carlo model strongly depends on corresponding analytical solution on which it was based and, hence, should be used as a reference method very carefully.

TuSMB-p04 17:00-19:00

Low-cost laminar optical tomography: phantom study

M.A. Ansari, G.Y. Simakani; Shahid Beheshti Univ., Iran

Laminar optical tomography (LOT) is a fast and high-resolution optical imaging for superficial living tissue. Here, we introduce a low cost LOT with sub-millimeter 3D resolution that can be applied for small animal neuroimaging.

TuSMB-p05 17:00-19:00

Non-invasive measurement of hemodynamic change during transcranial ultrasound brain stimulation using near-infrared spectroscopy

E. Kim[1], E. Anguluan[2], J.G. Kim[1,2]; 1 - Gwangju Inst. of Science and Technology, 2 - Gwangju Inst. of Science and Technology, Korea

Transcranial ultrasound stimulation (tUS) is a promising non-invasive approach to modulate brain circuits. The application is gaining popularity. However the full effect of acoustic stimulation is still unclear, and further investigation is needed. This study aims to apply near-infrared spectroscopy (NIRS) to provide a non-invasive way to monitor the cerebral hemodynamic change during tUS. The results show hemodynamic alteration caused by acoustic stimulation. We believe the implementation of NIRS during tUS can provide critical information useful to the understanding of brain stimulation.

TuSMB-p06 17:00-19:00

Refractive properties of human adipose tissue at hyperthermic temperatures

I.Yu. Yanina[1,2], E.N. Lazareva[1,2], A.N. Bashkatov[1,2], E.A.Genina[1,2], V.V. Tuchin[1,2,3]; 1 - Saratov State Univ., 2 - Tomsk State Univ., 3 - Precise Mechanics and Control Inst. RAS, Russia

The refractive index (RI) of human adipose tissue (AT) in the visible and near-infrared ranges were measured at heating (from 40°C up to 50°C). For the first time, RI temperature increment was quantified for a wide wavelength range. The critical temperatures corresponding to lipid phase transitions of AT were determined.

TuSMB-p07 17:00-19:00

A subject-specific layered head model for Monte Carlo fitting in Time-domain near-infrared spectroscopy

S. Mahmoodkalayeh, M. A. Ansari; Shahid Beheshti Univ., Iran

Obtaining the absolute values of absorption coefficient in brain tissue has been a challenge in Near-infrared spectroscopy. Here a new layered head model is introduced based on the shape of each individual head surface to estimate absorption coefficient. Monte Carlo simulations are used to calculate distributed time of flight (DTOF) for each source-detector channel. These results can be used for fitting of experimental DTOFs obtained from Time-domain near-infrared spectroscopy.

TuSMB-p08 17:00-19:00

Sub-wavelength-resolution imaging of biological tissues using THz solid immersion microscopy

N.V. Chernomyrdin[1,2,3], A.S. Kucheryavenko[1], G.S. Kolontaeva[1], A.O. Schadko[1], S.-I.T. Beshplav[4], K.M. Malakhov[1], G.A. Komandin[2], V.E. Karasik[1], I.E. Spector[2], V.V. Tuchin[5,6,7], and K.I. Zaytsev[1,2,3]; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, 3 - Sechenov First Moscow State Medical Univ., 4 - Burdenko Neurosurgery Inst., 5 - Saratov State Univ., Russia; 6 - Inst. of Precision Mechanics and Control RAS, 7 - Tomsk State Univ., Russia

We have proposed a method of THz solid immersion microscopy, which yields imaging soft biological tissues with the sub-wavelength resolution. We have assembled an experimental setup and examined its resolution using numerical simulations and experimental studies. In order to highlight the prospective of the proposed THz imaging modality, we have applied the experimental setup for imaging of representative examples of biological tissues.

TuSMB-p09 17:00-19:00

In vitro terahertz spectroscopy of malignant brain gliomas embedded in gelatin slab

N.V. Chernomyrdin[1,2,3], K.M. Malakhov[1], S.T. Beshplav[4], A.A. Gavdush[1], G.A. Komandin[2], I.E. Spector[2], V.E. Karasik[1], S.O. Yurchenko[1], I.N. Dolganova[1,3], S.A. Goryaynov[4], I.V. Reshetov[3], A.A. Potapov[4], V.V. Tuchin[5,6,7], K.I. Zaytsev[1,2,3]; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, 3 - Sechenov First Moscow State Medical Univ., 4 - Burdenko Neurosurgery Inst., 5 - Saratov State Univ., 6 - Inst. of Precision Mechanics and Control RAS, 7 - Tomsk State Univ., Russia

In our work, we have performed in vitro terahertz (THz) measurements of gelatin-embedded malignant human brain gliomas using the THz pulsed spectroscopy. The gelatin embedding yields sustain the THz response of tissues close to that of the freshly-excised ones for a long time after the resection. We have observed significant differences between the THz responses of normal and pathological tissues of the brain, which highlights a potential of the THz technology in label-free intraoperative neurodiagnosis of tumors.

TuSMB-p10 17:00-19:00

Investigation of ophthalmic drug diffusion in soft contact lenses by means of laser interferometry technique

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

The present work is devoted to the creation of a technique for estimating the parameters of diffusion processes of various drugs in soft contact lenses. It is based on the use of an auxiliary sample that acts as an absorber. In the case of contact lenses a ball of transparent polyacrylamide (PAM) hydrogel is convenient as a sample object. Analysis of the mass transfer dynamics in the PAM volume was carried out using control of the wavefront distortions with radiation passing through the sample by means of laser phase-shifting interferometry. Quantitative results of diffusion parameters were obtained by comparing the experimental pattern with mathematical modeling data using finite element analysis.

TuSMB-p11 17:00-19:00

Results of the investigation of increasing the optical depth of detection of CaCO3 particles in the skin with OCT by optical clearing

S.M. Zaytsev[1], Yu.I. Svenskaya[1], E.V. Lengert[1], A.N. Bashkatov[1,2], V.V. Tuchin[1,2], E.A. Genina[1,2]; 1 - Saratov State Univ., 2 - Tomsk State Univ., Russia

We present the result of optimizing the composition of immersion solutions for optical skin clearing in order to increase the optical depth of detection of microparticles inserted into rat hair follicles ex vivo. The greatest optical depth of detection was achieved using a solution of oleic acid and PEG-400 in a ratio of 20: 80% and amounted to 404 ± 37 microns after 25 minutes of optical skin clearing.

TuSMB-p12 17:00-19:00

Confocal scanning laser ophthalmoscopy and the screening of optic nerve pathology

Zh. Yu. Alyabyeva, O.V. Agaptseva; RNRMU, Russia

Abstract: With the development of the optic coherent tomography technology the scanning laser ophthalmoscopy, though almost always present in every such device, as well as in fluorescent angiography laser systems, is not used efficiently enough. The possibility to use the scanning laser ophthalmoscopy for screening of the optic nerve pathology is analyzed.

TuSMB-p13 17:00-19:00

Spectrally selective soft X-ray microscopy in studies of biological objects

I.A.Artyukov, N.L.Popov, A.V.Vinogradov; Lebedev Physical Inst. of the RAS, Russia

The paper deals with the analysis of absorption contrast of histological and cytological images, which can be produced in soft x-ray/EUV microscopic studies using monochromatic or quazi-monochromatic radiation at the wavelengths 2-14 nm. We present also the experimental results obtained with a laser-plasma source and X-ray multilayer optics in the spectral region of high transparency of carbon-containing materials (4.5-5 nm, «carbon window»).

TuSMB-p14 17:00-19:00

Non-contact laser speckle anemometry of microcirculatory bloodstream

O.A. Golovan, E.N. Velichko, M.A. Baranov, E.T. Aksenov; Peter the Great St. Petersburg Polytechnic Univ., Russia

In the work the scheme of the differential sensor for non-invasive distant anemometry of microcirculatory bloodstream is described. The sensor is designed on base of the laser speckle theory. Some important parameters like maximal distance and time of measurement are calculated. Experimental results on blood speed determination are presented.

TuSMB-p15 17:00-19:00

Terahertz time-domain spectroscopy for non-invasive assessment of water content in biological samples

M.A. Borovkova[1,2], M.K. Khodzitsky[1], O.P. Cherkasova[1,3], A.P. Popov[2], I.V. Meglinski[1,2]; 1 - ITMO Univ., Russia; 2 - Univ. of Oulu, Finland, 3 - Inst. of Laser Physics RAS, Russia

We apply terahertz time-domain spectroscopy for quantitative non-invasive assessment of water content in biological samples: tree leafs and pork muscles. The Landau-Looyenga-Lifshitz-based model is used for calculation of water concentration within the samples. The obtained results show that water content in biological samples can be measured non-invasively, with a high accuracy, utilizing terahertz waves in transmission and reflection modes.

TuSMB-p16 17:00-19:00

Peculiarities of red blood cells aggregation and deformability in patients with arterial hypertension: assesement with optical techniques

A.E. Lugovtsov[1], A.N. Semenov[1,2], P.B. Ermolinskiy[2], A.I. Maslyanitsina[2], N.M. Povalyaev[3], L.I. Dyachuk[3], E.P. Pavlikova[3], Yu.I. Gurfinkel[3], A.V. Priezzhev[1,2]; 1 - International Laser Center, Lomonosov Moscow State Univ., 2 - Lomonosov Moscow State Univ., 3 - Medical Research and Education Center, Lomonosov Moscow State Univ., Russia

Red blood cells aggregation parameters is assessed with optical techiques: diffuse light scattering, optical trapping and manipulation and capillaroscopy. Peculiarities of the cells aggregation and its effect on capillary blood flow in patients with arterial hypertension are discussed.

TuSMB-p17 17:00-19:00

Fabrication and characterization of agar and silica gel based biotissue-mimicking phantoms in THz frequency range

E.L. Odlyanitskiy, O.A. Smolyanskaya, O.V. Kravtsenyuk; ITMO Univ., Russia

The study revealed the most promising candidates for phantoms mimicking different biological tissues in the terahertz frequency range. The tissue-like phantom consisting of agar gel and drops of silica gel was designed as a model with scattering in terahertz frequency region. Optical properties of this phantom were experimentally measured and the depth of radiation penetration was estimated. The process of terahertz beam propagation and angular distribution of transmitted radiation as well as the scattering anisotropy factor were simulated.

TuSMB-p18 17:00-19:00

Method of intraoperative spectroscopic detection of tumor tissues in neurosurgery

T.A. Savelieva[1,2], K.G. Linkov[1], A.V. Borodkin[1], V.V. Volkov[1], S.A. Goryajnov[3], A.A. Potapov[3], V.B. Loschenov[1,2];1- Prokhorov General Physics Inst. RAS, 2 - NRNU MEPhI, 3 - Burdenko National Scientific and Practical Center for Neurosurgery, Russia

The proposed method provides neurosurgical intraoperative navigation using optical spectroscopy and neurophysiological stimulation. The device contains a spectrometer, sources of optical radiation and fiber-optic probe, the working part of which is made in one body with a cannula of neurosurgical aspirator and can be used also as a monopolar stimulant for the system of intraoperative neuromonitoring.

TuSMB-p19 17:00-19:00

Temporal changes of polarization-optical properties of collagen fibers during immersion clearing process

M.E. Shvachkina, D.D. Yakovlev, A.B. Pravdin, D.A. Yakovlev; Saratov State Univ., Russia

Results of the experimental study of kinetics of average birefringence index and diattenuation of collagen fibers in the process of optical immersion clearing are reported.

TuSMB-p20 17:00-19:00

Optical coherence tomography of tissues using the recovery of depth distributions of the backscattering efficiency

E.V. Ushakova[1], S.A. Yuvchenko[1,2], E.M. Artemina[3], A.A. Isaeva[1], E.A. Isaeva[1], D.A. Zimnyakov[1,2]; 1 - Saratov State Technical Univ., 2 - Inst. of Precision Mechanics and Control RAS, 3 - Saratov State Medical Univ., Russia

We consider an approach to OCT characterization and imaging of the tissue structure using the recovery of depth distributions of the backscattering efficiency based on removal of the exponential trend in OCT signals.

TuSMB-p21 17:00-19:00

Optical clearing of brain in vitro by glycerol solution

D.K. Tuchina[1,2], A.N. Bashkatov[1,2], N.A. Navolokin[3], V.V. Tuchin[1,2,4]; 1 - Saratov State Univ., 2 - Tomsk State Univ., 3 - Saratov State Medical Univ., 4 - Inst. of Precision Mechanics and Control RAS, Russia

We report the results of in vitro brain optical clearing by glycerol solution in order to increase light penetration depth. The result can be useful for improvement the modern optical methods of diagnostic and treatment of various brain diseases.

TuSMB-p22 17:00-19:00

Nonlinear optical effects during the formation of implantation material for bone-cartilaginous joints

P.N. Vasilevsky, M.S. Savelyev, A.Yu. Gerasimenko, U.E. Kurilova, V.M. Podgaetsky; National Research Univ. of Electronic Technology, Russia

This article presents the studies results for nonlinear optical characteristics of protein aqueous dispersions (bovine serum albumin and bovine collagen) with single-walled carbon nanotubes. These characteristics were obtained using Z-scan experiments and fixed sample location experiments with a fixed position of the sample. Calculations were made using a method based on the radiation transfer equation.

TuSMB-p23 17:00-19:00

Thermal imaging by means of IR-fiber bundle for medical applications

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

In this study we proposed a thermal imaging setup with an ordered bundle of silver halide IR-fibers. This bundle allowed us to obtain thermal images of objects with linear dimensions equivalent to the diameter of an individual fiber in the bundle. We expect such bundles will be applied in surgery monitoring systems for the tissues temperature estimation during laser cutting.

SECTION A. ADVANCED LASER MEDICAL SYSTEMS AND TECHNOLOGIES

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

Advanced laser medical systems and technologies III

Session Chair: Nikolay N. Evtikhiev, NTO "IRE-Polus», Russia

WeSMA-14 09:00-09:20

Advanced laser technologies for regenerative medicine *(Invited paper)*

P.S. Timashev[1,2], N.V. Minaev[1], V.N. Bagratashvili[1]; 1 - Inst. of Photon Technologies FSRC "Crystallography and Photonics" RAS, 2 - Inst. for Regenerative Medicine, Sechenov Univ., Russia

This presentation will discusses recent studies on two photon polymerization process and examples of its application in TE.

WeSMA-15 09:20-09:40

Laser engineering of microbial systems *(Invited paper)*

N.V. Minaev[1], V.I. Yusupov[1], V.S. Zhigarkov[1], E.S. Churbanova[1], M.V. Gorlenko[2], V.N. Bagratashvili[1]; 1 - Federal Research Centre «Crystallography and Photonics» RAS, 2 - Lomonosov Moscow State Univ., Russia

The report presents the Laser Engineering Microbial System (LEMS) technology for direct isolation of pure microbial cultures and microbial consortia from soil by laser 3d printing technology. We study thermal and transport processes involved in the transfer of gel microdroplets under the conditions of microprinting by LIFT method. The specific features of the interaction of pulsed laser radiation (l = 1.064 mm, pulse duration 4 – 200 ns, energy 2 mJ – 1 mJ) with the absorbing gold film deposited on the glass donor substrate are determined.

WeSMA-16 09:40-10:00

Optical techniques for advancement of photodynamic therapy: from model experiments to clinical studies *(Invited paper)*

M.Yu. Kirillin[1], M.A. Shakhova[1,2], A.V. Khilov[1], D.A. Loginova[1], E.A. Sergeeva[1], A.E. Meller[1,2], D.A. Sapunov[1,2], V.V. Perekatova[1], I.V. Turchin[1], N.Yu. Orlinskaya[1,2], A.V. Shakhov[1,2]; 1 - Inst. of Applied Physics RAS, 2 - Nizhny Novgorod State Medical Academy, Russia

Progress in photodynamic therapy (PDT) requires development of novel protocols. We report on performance of PDT employing chlorine-based photosensitizers and irradiation at wavelengths of 405 and 660 nm with monitoring by fluorescence imaging (FI) and optical coherence tomography (OCT). The study includes numerical simulations, model and animal experiments, as well as clinical monitoring.

WeSMA-17 10:00-10:15

In vivo diffuse reflectance for bone boundary detection in orthopedic surgery

K. Komolibus[1], C. Fisher[2], K. Grygoryev[1], R. Burke[1], B. C. Wilson[2], S. Andersson-Engels[1]; 1 - Tyndall National Inst., Ireland; 2 - Univ. of Toronto, Canada

Real-time detection of tissue boundaries in orthopedic surgery could help prevent trauma, severe postoperative complications and reduce the risk of revisions. Diffuse reflectance spectroscopy is a potential candidate technique to enable tissue and boundary identification with a sufficient look ahead distance to anticipate breach. The aim of this study is to differentiate between four different types of tissue based on results from in vivo measurements.

WeSMA-18 10:15-10:30

Non-ablative fractional laser treatment for soft oral tissue regeneration

K.V. Shatilova[1], G.A. Aloian[2], M.M. Karabut[3], V.M. Ryabova[3], S.V. Tarasenko[4], I.V. Lyspak[4], I.V. Yaroslavsky[5], G.B. Altshuler[5]; 1 - NTO IRE-Polus, 2 - Moscow Inst. of Physics and Technology, 3 - Nizhny Novgorod State Medical Academy, 4 - Sechenov First Moscow State Medical Univ., Russia; 5 - IPG Medical Corp., USA

In this work, we present the first histological ex vivo (porcine gum) and in vivo (human) study of effects of fractional Er fiber laser (wavelength 1550 nm, peak power 25 W) on keratinized gum and alveolar mucosa in oral cavity.

WeSMA-19 10:30-10:45

The prospects of interventional coronary angiography with Thomson laser-electron X-ray source

I.A. Artyukov[1], E.G. Bessonov[1], N.V. Dyachkov[1,2], R.M. Feshchenko[1], M.V. Gorbunkov[1], B.S. Ishkhanov[3], Y.Y. Maslova[1], A.V. Polunina[4], N.L. Popov[1], V.I. Shvedunov[1,3], A.V. Vinogradov[1]; 1 - Lebedev Physical Inst. RAS, 2 - Moscow Inst. of Physics and Technology, 3 - Lomonosov Moscow State Univ., Skobeltsyn Inst. of Nuclear Physics, 4 - City Clinical Hospital #1[7], Moscow, Russia.

To reduce patient radiation dose and improve image quality in interventional coronary angiography the replacement of X-ray tube by Thomson laser-electron X-ray source in angiography imaging systems is suggested. This is achieved due to matching of source spectra with that of iodine dye. Other angiography technologies including catheterization, multi-projections, cine and fluoro modes, image recording and processing will be preserved.

WeSMA-20 10:45-11:00

Comparison of a blue diode laser with Ho:YAG,Tm fiber and KTP lasers for soft tissue ablation

V.A. Vinnichenko[1], A.A. Kovalenko[1], V.A. Arkhipova[1], I.V. Yaroslavsky[2], G.B. Altshuler[2]; 1 - IRE Polus, Russia; 2 - IPG Medical, USA

We compared three lasers: Ho: YAG, Tm fiber and blue diode laser in terms of their vaporization and coagulation efficiency on soft tissue in water. We compared our results with published data on performance of KTP laser. We showed, that the combination of Tm fiber and blue diode laser can provide a practical alternative to Ho: YAG and KTP lasers for surgical applications.

- Coffee Break -

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

Advanced laser medical systems and technologies IV

Session Chair: David G. Kochiev, Prokhorov General Physics Inst. of RAS, Russia

WeSMA-21 11:30-11:50

The method of excision the superficial microcystic form of lymphatic or lymphovenous malformation of the tongue in children *(Invited paper)*

D.Yu. Komelyagin[1,2], A.V. Petukhov[1], S.V. Iamatina[1], V.P. Minaev[3], S.A. Dubin[1], F.I. Vladimirov[1], A.V. Dergachenko[1], E.N. Staroverova[1], E.V. Striga[1], T.N. Gromova[1]; 1 - SBIH «Children's Municipal Clinical Hospital of St. Vladimir», 2 - SRI of Children's Surgery of Pirogov Russian National Research Medical Univ., 3 - NTO «IRE-Polus», Russia

Lymphatic malformation is representing approximately 6-18 percent of all benign (harmless) tumors in children. This paper describes the method of excision (removal) the superficial microcystic form of lymphatic and lymphovenous malformations of the tongue in children with the use of continuous or pulse-periodic laser radiation. For the pathology denotation the classification of the ISSVA is used (edition 2014).

WeSMA-22 11:50-12:10

Laser thermotherapy of vascular tumors in children under ultrasound control *(Invited paper)*

I.A. Abushkin[1], A.G. Denis[2], I.S. Vasiliev[3], A.V. Lappa[4], V.A. Privalov[3], O.A. Gavrilova[2], V.O. Lapin[1], O.A. Romanova[1], M.Y. Galiulin[1]; 1 - Center for Medical Laser Technologies, 2 - Tver State Medical Univ., 3 - South Ural State Medical Univ., 4 - Chelyabinsk State Univ., Russia

The results of treatment of vascular tumors (subcuta-neous and combined hemangiomas, kaposiform hemangioendo-thelioma) using interstitial thermotherapy with laser radiation of 0.97 and 1.56 μm are presented. The great value of ultrasonic mon-itoring of tumor coagulation is shown. It allowed us to reduce the number of repeated sessions of laser interstitial thermotherapy and to accelerate the recovery of children.

WeSMA-23 12:10-12:25

Laser mass spectrometry for biological tissue analysis and pathology identification

A.Bukharina[1], A.Pento[1,]S.Nikiforov[1], S.Alimpiev[1], Ya.Simanovsky[1], A.Grechnikov[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Vernadsky Inst. of Geochemistry and Analytical Chemistry RAS, Russia

A novel technique for real time mass spectrometric analysis of bioorganic samples at atmospheric pressure without any pretreatment based on laser ablation of the sample and ionization of the vapor plume by laser plasma radiation was developed. The potential of the method was showcased in drug screening, mass spectrometric imaging of biological tissues, tissue type and oncologic decease presence identification.

WeSMA-24 12:25-12:40

Effects of continuous wave, conventional pulse and super-pulse Tm fiber laser on tissue: a comparison study

V.A. Vinnichenko[1], A.A. Kovalenko[1], I.V. Yaroslavsky[2], G.B. Altshuler[2]; 1 - NTO IRE-Polus, Russia; 2 - IPG Medical Corp., USA

In this study we are presented the comparison of the vaporization and coagulation efficiency for blood-rich soft tissues, ex vivo, (porcine kidney) of Tm fiber laser operating in three different modes (continuous wave, conventional pulse, super-pulse).

WeSMA-25 12:40-12:55

Soft tissue ablation by a novel Mid-IR laser

V. A. Arkhipova[1], A. A. Kovalenko[1], V. A. Vinnichenko[1], V. A. Tyrtyshniy[1], I. V. Yaroslavsky[2]; 1 - IRE Polus, Russia; 2 - IPG Medical, USA

We present a novel laser emitting at wavelength 3050 nm. We analyzed its effect on soft tissue in terms of ablation and coagulation. Our preliminary data demonstrated that this system is attractive for further development of efficient device for tissue surgery.

WeSMA-26 12:55-13:10

Clinical testing of HILT for pain therapy

N.M. Chudesnikov[1], V.A. Arhipova[1], I.V. Yaroslavsky[2], G.B. Altshuler[2]; 1 - NTO IRE-Polus, Russia; 2 - IPG Medical Corp., USA

We conducted clinical testing of a double-wavelength, high power laser system for pain therapy. Group of osteoarthritis patients was tretaed. We compared therapeutic effects of high intensity laser therapy and standard-of-care therapeutic methods.

- Lunch Break -

SECTION B. LASER INTERACTION WITH CELLS AND TISSUES: CLINICAL IMAGING AND SPECTROSCOPY

Location: Levinson Lounge, floor 2. 09:00 - 11:00

Laser interaction with cells and tissues: clinical imaging and spectroscopy III

Session Chair: Irina V. Larina,
Baylor College of Medicine, USA

WeSMB-15 09:00-09:20

Probe pressure impact on optical spectra acquired on ex vivo and in vivo human skin *(Invited paper)*

G. Khairallah[1,2,3], W. Blondel[1,2], A. Delconte[2], F. Marchal[1,2,4], M. Amouroux[1,2]; 1 - Univ. de Lorraine, CRAN, 2 - Centre National pour la Recherche Scientifique, CRAN, 3 - Regional Hospital Metz-Thionville, 4 - Inst. de Cancérologie de Lorraine, France

This work investigates the impact of several levels of optical probe pressure on human skin autofluorescence (AF) and diffuse reflectance (DR) spectra acquired using spatially-resolved optical spectroscopy in vivo and on ex vivo, i.e. exsanguinated, skin samples.

WeSMB-16 09:20-09:40

Synchronous fluorescence spectroscopy of soft tissues – tool for diagnostics of malignant lesions *(Invited paper)*

E. Borisova[1,2], Ts. Genova-Hristova[1], N. Penkov[3], I. Terziev[3], P. Troyanova[3], B. Vladimirov[3], L. Avramov[1]; 1 - Inst. of Electronics, Bulgarian Academy of Sciences, Bulgaria; 2 - Saratov State Univ., Russia; 3 - Univ. Hospital «Tzaritza Yoanna – ISUL», Bulgaria

Different steady-state fluorescence spectroscopy approaches are investigated to obtain the highest quality spectral information from biological objects. Synchronous fluorescence spectroscopy (SFS) leads to improved spectral resolution in detection of multi-compound and complex systems, where several fluorophores with similar excitation and emission properties have place. In this study SFS was used to detect and differentiate normal and neoplastic skin and gastrointestinal lesions.

WeSMB-17 09:40-10:00

Two-color fluorescence monitoring in PDT treatment *(Invited paper)*

A. Khilov[1], M. Kirillin[1], D. Loginova[1], S. Gamayunov[2], I. Turchin[1]; 1 - Inst. of Applied Physics RAS, 2 - Republican Clinical Oncological Dispensary Health Ministry of Chuvashia, Russia

The device based on a fluorescence imaging for localizing the tumor in the patient's body and monitoring photobleaching of the sensitizer during laser irradiation has been created. The system includes two LED sources 402 and 662 nm for excitation of chlorine-based photosensitizer. The ratio of fluorescence signals upon excitation of these peaks provides evaluation of photosensitizer penetration depth in biotissues.

WeSMB-18 10:00-10:15

Autofluorescence emission features of normal oral mucosa and potentially malignant

N.N. Bulgakova[1], T.I. Pozdnjakova[2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow State Univ. of Medicine and Dentistry, Russia

The data base of autofluorescence images and laser-induced autofluorescence spectra of healthy oral mucosa and potentially malignant lesions have been collected and analyzed. It was shown that within 430÷700 nm spectral range autofluorescence emission of oral mucosa is sensitive to any abnormal changes that could be effectively used for detection of different diseases. Comparative study of laser-induced autofluorescence spectra (n=680) allowed to identify four basic spectral characteristics which significantly differ between normal and premalignant tissues.

WeSMB-19 10:15-10:30

Time-dependance of synchronous fluorescence signals in gastrointestinal tumours ex vivo

Ts. Genova[1], E. Borisova[1,2], N. Penkov[3], B. Vladimirov[3], Al. Zhelyazkova[1], L. Avramov[1]; 1 - Inst. of Electronics, BAS, Bulgaria; 2 - Saratov State Univ., Russia; 3 - Univ. Hospital «Tsaritsa Yoanna-ISUL», Bulgaria

Our goal is to improve autofluorescence detection of gastrointestinal cancer by developing new diagnostic techniques and parameters with higher specificity. This study explores the post excision time effects over fluorescence characteristics of tissue samples through synchronous fluorescence spectroscopy. The obtained results enlighten the tissue alterations after excision and would be useful in transitioning from ex vivo to in vivo investigations.

WeSMB-20 11:30-10:45

Estimation of beta-carotene using calibrated reflection spectroscopy method: phantom study

S. Masoumi[1], M.A. Ansari[1], E. Mohajerani[1], E.A. Genina[2,3], V.V. Tuchin[2,3,4]; 1 - Shahid Beheshti Univ., Tehran, Iran; 2 - Saratov State Univ., 3 - Tomsk State Univ., 4 - Inst. of Precision Mechanics and Control RAS, Russia

In this work, we use compression and immersion optical clearing to enhance the accuracy of reflection spectroscopy to measure the concentration of beta-carotene inside biological phantom. The estimated results are in good agreement with exact value of beta-carotene.

WeSMB-21 10:45-11:00

Spectral properties comparative analysis of normal and tumor brain tissues in the visible and near infrared optical ranges

A.S. Sharova[1,2], Yu.S. Maklygina[2], A.V. Ryabova[2], V.B. Loschenov[1,2]; 1 - National Research Nuclear Univ. MEPhI, 2 - Prokhorov General Physics Inst. RAS, Russia

Current study presents the comparative analysis results of spectral-optical properties of rat normal and tumor brain tissues. The differentiation of normal and malignant brain tissues was carried out by photodiagnostics method using 5-aminolevulinic acid photosensitive compound. The fluorescent images, fluorescence and absorption spectra were obtained.

- Coffee Break -

Location: Levinson Lounge, floor 2. 11:30 - 13:30

Laser interaction with cells and tissues: clinical imaging and spectroscopy IV

Session Chair: Sergey Yu. Nikitin,
Lomonosov Moscow State Univ., Russia

WeSMB-22 11:30-11:50

Nanodiamond–gold core shell nanoparticles for bio-imaging applications *(Invited paper)*

Yu-Ch. Lin[1], E. Perevedentseva[1], Zh.-R. Lin[1], Ch.E. Nebel[2], G. Aperanza[3], A. Karmenyan[1], Ch.-L. Cheng[1]; 1 - National Dong Hwa Univ., Taiwan; 2 - Fraunhofer Inst. for Applied Solid State Physics, Germany; 3 - Plasma Advanced Materials and Surface Engineering CMM–FBK, Italy

It has been a new trend to develop multifunctional nanoparticle (NP) for bio-medical applications. The methods to integrate diverse functionalities are developed. One of the promising approaches is synthesis of hybrid NP with synergetic properties. The paper discusses multifunctional applications of core-shell nanodiamond-gold (ND@Au) nanoparticles and demonstrates number of imaging modalities using them.

WeSMB-23 11:50-12:10

Functional optical coherence tomography for in vivo imaging of mammalian reproductive processes *(Invited paper)*

I.V. Larina; Baylor College of Medicine, USA

We developed a 3D optical imaging approach, which allows for prolonged, functional, and quantitative analysis oocyte transit, the contraction of the oviduct muscle, the frequency of cilia beat, as well as sperm behavior in the ampulla, revealing never-before-seen dynamic events.

WeSMB-24 12:10-12:30

Functional near-infrared spectroscopy as a screening tool for prodromal Alzheimer's disease *(Invited paper)*

T. Nguyen[1], M. Kim[1], J.S. Lee[3,4,5], K.H. Lee[3,4,5], K.Y. Choi[3], J.E. Park[4], B.C. Kim[4,6], J. Gwak[7], J.G. Kim[1,2;1.] 2 - Gwangju Inst. of Science and Technology, 3 - Chosun Univ., 4 - National Research Center for Dementia, 5 - Chosun Univ., 6 - Chonnam National Univ., 7 - Seoul National Univ., South Korea

Prodromal Alzheimer's disease (PAD) patients express mild cognitive impairment (MCI) including memory loss and language disturbance. Although a few techniques including PET and MRI can diagnose prodromal AD, there is no convenient method to detect MCI non-invasively. This study investigates brain functional connectivity in both healthy elderly and PAD patients to identify a feature that can be used to distinguish these two groups.

WeSMB-25 12:30-12:50

In vitro terahertz dielectric spectroscopy of human brain tumors *(Invited paper)*

K.I. Zaytsev[1,2,3], N.V. Chernomyrdin[1,2,3], K.M. Malakhov[1], Sh.-I.T. Beshplav[4], S.A. Goryaynov[4], V.N. Kurlov[5], I.V. Reshetov[3], A.A. Potapov[4], V.V. Tuchin[6,7,8]; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, 3 - Sechenov First Moscow State Medical Univ., 4 - Burdenko Neurosurgery Inst., 5 - Inst. of Solid State Physics RAS, 6 - Saratov State Univ., 7 - Inst. of Precision Mechanics and Control RAS, 8 - Tomsk State Univ., Russia

Modern progress in terahertz (THz) diagnostics of malignancies, including non-invasive, least-invasive and intraoperative techniques is briefly discussed. Special attention is paid to intraoperative diagnosis of brain tumors, which is a rapidly developing field nowadays. We discuss our recent results in this research field, which are associated with (i) in vitro studies the THz dielectric response of gelatin-embedded human brain tumors (including gliomas and meningiomas featuring different grades), (ii) analysis an ability for differentiation between normal and pathological tissues of the brain relying on the methods of THz spectroscopy and imaging, and, finally, (iii) development of novel THz instrumentation for the intraoperative detection of margins of tumors in order to guarantee its gross total resection.

WeSMB-26 12:50-13:05

Clinical application of terahertz reflectometry for sensing of corneal tissue and tear film

I.Ozheredov[1], M.Mischenko[1], M.Prokopchuk[1], T.Saphonova[2], E.Sikach[2], A.Balakin[1,3], P.Solyankin[3], A.Shkurinov[1,3]; 1 - Lomonosov Moscow State Univ., Russia 2 - Inst. of Eye Diseases RAS, Russia; 3 - Crystallography and Photonics Federal Research Center RAS, Russia

Terahertz frequency-domain reflectometry is applied for sensing of human corneal tissue hydration level and dynamical control of the tear film in clinical applications.

WeSMB-27 13:05-13:20

Terahertz sensing of protein solutions

O.P. Cherkasova[1,2], M.M. Nazarov[3], A.P. Shkurinov[4,5]; 1 - Inst. of Laser Physics of SB RAS, 2 - National Research Tomsk State Univ., 3 - Kurchatov Inst. National Research Center, 4 - Crystallography and Photonics Federal Research Center RAS, 5 - Lomonosov Moscow State Univ., Russia

Terahertz time-domain spectroscopy has been used for measuring of protein low concentrations. The transmission and the attenuated total internal reflection geometries have been combined for precise analyzing of bovine serum albumin aqueous solutions spectra at 0.07-3.2 THz. We do not confirm anomalous absorption increase at concentration below 17 mg/ml published by other teams.

WeSMB-28 13:20-13:35

Glycerol dehydration of native and diabetic animal tissues studied by THz-TDS and NMR methods

O.A. Smolyanskaya[1], E.L. Odlyanitskiy[1], I.J. Schelkanova[1], M.S. Kulya[1], A.N. Tcypkin[1], Ya.V. Grachev[1], I.S. Goryachev[1], Ya.G. Toropova[2], V.V. Tuchin[1,3,4]; 1 - ITMO Univ., 2 - Almazov National Medical Research Centre, IEM, 3 - Saratov State Univ. (National Research), 4 - Inst. of Precision Mechanics and Control RAS, Russia

Optical clearing method has been widely used for different spectral ranges where it provides tissue transparency. The aim of this research is to study the enhanced penetration of the terahertz waves inside biological tissues treated with glycerol solutions inducing changes of optical and dielectric properties. It was supported by the observed trend of free-to-bound water ratio measured by the nuclear magnetic resonance (NMR) method. The terahertz clearing efficiency was found to be less for diabetic samples than for normal ones. Results of numerical simulation proved that pulse deformation is due to bigger penetration depth caused by reduction of absorption and refraction at clearing.

- Lunch Break -

Location: Levinson Lounge, floor 2. 15:00 - 17:00

Laser interaction with cells and tissues: clinical imaging and spectroscopy V

Session Chair: Kirill V. Larin,
1 - Univ. of Houston, USA, Tomsk State Univ., Russia

WeSMB-29 15:00-15:20

Laser technologies of targeted opening of blood-brain barrier for drug brain delivery *(Invited paper)*

O.V.Semyachkina-Glushkovskaya[1], E.U. Rafailov[2], S.G. Sokolovsky[2], E.G. Borisova[3], V. Mantareva[4], I. Angelov[4], A. Shirokov[5], N. Navolokin[6], N.A. Shushunova[1], A.P. Khorovodov[1], A.V. Terskov[1], A.A. Bodrova[1], M.V. Ulanova[1], E. Shrif[1], V.V. Tuchin[1,7,8], J. Kurths[1,9,10]; 1 - Saratov State Univ., Russia; 2 - Aston Univ., UK; 3 - Inst. of Electronics BAS, 4 - Inst. of Organic Chemistry with Center of Phytochemistry BAS, Bulgaria; 5 - Inst. of Bioorganic Chemistry RAS, 6 - Saratov State Medical Univ., 7 - Tomsk State Univ., 8 - Inst. of Precision Mechanics and Control RAS, Russia; 9 - Humboldt Univ., 10 - Potsdam Inst. for Climate Impact Research, Germany

Here we show the photodynamic treatment (PDT) causes significant increase in the permeability of the blood-brain barrier (BBB) in healthy mice. Using different doses of laser (635 nm, 10-40 J/cm2) and photosensitizer (5-aminole-vulinic acid – 5-ALA, 20 and 80 mg/kg, i.v.), we found the optimal PDT for the reversible opening of BBB that is 15 J/cm2 and 5-ALA, 20 mg/kg, when the brain tissues recover 3 days later. Further increase in the laser or 5-ALA doses has not amplifying effect on the BBB but associated with severe damages of brain tissues. These results can be good informative platform for the further studies of new strategies in brain drug delivery and for the better understanding of mechanisms underlying cerebrovascular effects of PD-related fluorescence guided resection of brain tumor.

WeSMB-30 15:20-15:40

New data processing algorithms for laser ektacytometry of red blood cells *(Invited paper)*

S.Yu.Nikitin; Lomonosov Moscow State Univ., Russia

The problem of measuring red blood cell deformability by laser diffractometry in a shear flow (ektacytometry) is considered. New data processing algorithm is proposed to measure the variance of the erythrocyte deformability.

WeSMB-31 15:40-16:00

Biomedical applications of sapphire shaped crystals *(Invited paper)*

V. N. Kurlov[1,2], I.A. Shikunova[1], G.M. Katyba[1,3], K.I. Zaytsev[2,3,4], N.V. Chernomyrdin[2,3,4], I.N. Dolganova[1,2,3], V.V. Tuchin[5,6,7], I.V. Reshetov[2]; 1 - Inst. of Solid State Physics RAS, 2 - Sechenov First Moscow State Medical Univ., 3 - Bauman Moscow State Technical Univ., 4 - Prokhorov General Physics Inst. RAS, 5 - Saratov State Univ., 6 - Inst. of Precision Mechanics and Control RAS, 7 - Tomsk State Univ., Russia

We have proposed novel medical instruments based on sapphire shaped crystals fabricated using the edge- defined film-fed growth (EFG) or related techniques. Due to the favorable combination of the unique properties of sapphire (high thermal strength and mechanical hardness, impressive melting point and chemical resistance, transparency in a wide spectral range) the developed instruments could help to solve numerous important problems of medical diagnosis, therapy, and surgery.

WeSMB-32 16:00-16:20

Printing brain in vitro at 3D scaffolds: materials and patterns *(Invited paper)*

S.G. Sokolovski[1], J.A Crowe[2], D. Nagel[2], E.J. Hill[2], A. El-Tamer[3], A.V. Koroleva[3], R. Parri[2], B.N. Chichkov[3], E.U. Rafailov[1]; 1 - Aston Inst. of Photonic Technologies, Aston Univ., 2 - School of Life and Health Sciences, Aston Univ., UK; 3 - Laser Zentrum Hannover e.V., Germany

Recently, advancements in human induced pluripotent stem cell (hiPSCs) technology has allowed differentiation into cortical neuronal and glial subtypes. However, most model hiPSCs-based systems focus on 2D monolayer cultures which fail to recapitulate in-vivo like 3D architecture and likely restrict cell morphology and function. The research seeks to provide fabricated reproducible scaffolds that can be produced on a large scale.

WeSMB-33 16:20-16:35

The changes of cerebral hemodynamics during ketamine induced anesthesia in a rat model

J. Bae[1], T.J. Shin[2], S. Kim[1], D.-H. Choi[1], D. Cho[1], J. Ham[1], S. Jeong[3], J.G. Kim[1]; 1 - Inst. of Integrated Technology, 2 - Gwangju Inst. of Science and Technology (GIST), 3 - Seoul National Univ., 4 - Chonnam National Univ. Medical School, South Korea

Concurrent electroencephalogram based consciousness monitoring technique is vulnerable to specific clinical conditions. However, hemodynamics is more fundamental and well-preserved parameter to evaluate under severe clinical situations. In this study, we applied near-infrared spectroscopy system in rats to measure hemodynamic change during ketamine anesthesia. The result showed a biphasic change of oxy-hemoglobin concentration during Ketamine infusion that could be explained by the mechanism of ketamine.

WeSMB-34 16:35-16:50

Quantitative tissue assessment using microstructural cross-polarization optical coherence tomography in glioma surgery

K.S. Yashin[1], E.B. Kiseleva[1], A.A. Moiseev[1,2], S.S. Kuznetsov[1], I.A. Medyanik[1], L.Ya. Kravets[1], N.D. Gladkova[1]; 1 - Nizhny Novgorod State Medical Academy, 2 - Inst. of Applied Physics RAS, Russia

Optical coherence tomography (OCT) is a promising method of glial tumors borders visualisation. Nowadays it is possible to use hand-held and microscope mounted OCT devices during tumor removal. The quantitative analysis of ex vivo biopsy specimens of brain tissue and glioma cross-polarization OCT allowed to find out differences between glioma and brain tissue.

WeSMB-35 16:50-17:05

Effect of laser-induced porogenesis in cartilage on speckle image

O.I. Baum, A.V. Yuzhakov, E.N. Sobol; Federal Scientific Research Centre "Crystallography and Photonics" RAS, Russia

Dynamics and temperature dependences of contrast and the Pearson correlation coefficient of speckle patterns of the cartilage surface in the course of laser irradiation were studied to develop a method to monitor laser-induced changes in the porous structure of costal cartilage.

- Coffee Break -

Location: Levinson Lounge, floor 2. 17:30 - 19:30

Laser interaction with cells and tissues: clinical imaging and spectroscopy VI

Session Chair: Oxana V. Semyachkina-Glushkovskaya, Saratov State Univ., Russia

WeSMB-36 17:30-17:50

Skin optical properties modifications using optical clearing agents: experimental and modelling results *(Invited paper)*

W. Blondel[1,2], P. Rakotomanga[1,2], G. Khairallah[1,2,3], C. Soussen[1,2,4], W. Feng[5,6], D. Zhu[5,6], H. Chen[1,2], C. Daul[1,2,]A. Delconte[2], F. Marchal[1,2], M. Amouroux[1,2]; 1 - Univ. de Lorraine, 2 - Centre National pour la Recherche Scientifique, 3 - Metz-Thionville Regional Hospital, 4 - Univ. Paris-Sud et Ecole Centrale Supélec, France; 5 - Univ. of Science and Technology, Wuhan, 6 - Britton Chance Center and MOE Key Laboratory for Biomedical Photonics, China

This work investigates the modifications of (i) spatially resolved diffuse reflectance and autofluorescence spectraand (ii) estimated optical properties of skin tissue resulting from optical clearing agent application.

WeSMB-37 17:50-18:10

Tissue optical clearing as a diagnostic tool for tissue pathology differentiation *(Invited paper)*

L. Oliveira[1,2], I. Carneiro[3], S. Carvalho[3], R. Henrique[3,4], D. K. Tuchina[5,6], P. A. Timoshina[5,6], A. N. Bashkatov[5,6], E. A. Genina[5,6], V. V. Tuchin[5,6,7]; 1 - Polytechnic of Porto, 2 - Centre of Innovation in Engineering and Industrial Technology, 3 - Portuguese Oncology Inst. of Porto, 4 - Inst. of Biomedical Sciences Abel Salazar – Univ. of Porto, Portugal; 5 - Saratov State Univ., 6 - Tomsk State Univ., 7 - Inst. of Precision Mechanics and Control RAS, Russia

To establish a reliable diagnosis and monitoring of disease development, a clinician needs to rely on accurate measured data. With the objective of developing a complementary diagnostic tool, we have used the immersion optical clearing method and studied normal and pathological colorectal tissues under treatment with glucose and glycerol solutions with different osmolarities. The same experimental data allowed also differentiating between the diffusion properties of optical clearing agents (OCAs) in normal and pathological tissues. These studies have demonstrated that free water content in pathological tissues is approximately 5% higher than in normal tissues. Tissue permeability for chemical agents allows for assessing the structure change of tissue, which can be used as a biomarker of tissue protein glycation degree. To prove the concept, the studies were performed for ex vivo skin and myocardium samples of Winstar white outbred male laboratory rats by using a 70%-glycerol solution as an OCA. Obtained results have showed decrease of myocardium permeability for glycerol from (11.8±6.1)×10–5cm/s to (1.04±0.65)×10–5cm/s and for skin from (1.68±0.88)×10–5 cm/s to (1.16±0.74)×10–5 cm/s in four weeks of alloxan diabetes, respectively. Thus, much slower diffusion of probe molecules for diabetic tissues is found, that can be used as a criterion of tissue pathology development of internal important for human life organs.

WeSMB-38 18:10-18:30

Dynamic optical coherence elastography of soft tissue *(Invited paper)*

K.V. Larin; Univ. of Houston, USA

Optical coherence elastography (OCE) is relatively new emerging method allowing to assess biomechanical properties of tissues in situ and in vivo in 3D. In this talk I will overview recent progress made in the quantitative assessment of viscoelasticity of ocular and cardiac tissues.

WeSMB-39 18:30-18:45

Monitoring of slow deformations in laser tissue reshaping with optical coherence elastography

V.Y.Zaitsev[1], L.A.Matveev[1], A.L. Matveev[1], A.A. Sovetsky[1], D.V. Shabanov[1], G.V. Gelikonov[1], O.I. Baum[2], A. Yuzhakov[1,2], E.N. Sobol[1,2]; 1 - Inst. of Applied Physics RAS, 2 - Inst. of Photonic Thechnologies RAS, Russia

We apply optical coherence elastography to monitor slow deformations of collagenous tissues subjected to thermo-mechanical reshaping by moderate heating with an IR laser. Insufficiently relaxed internal stresses may slowly distort the tissue shape with strain rate ~10^-4 1/s. Ability of the developed method to monitor slow strains with uncertainly ~10^-5 sufficient for intra-operational shape-stability verification of cartilaginous implants is demonstrated.

WeSMB-40 18:45-19:00

NIR hyperspectral holography applied for quantitave phase retrieval of the demodex mite

G.S. Kalenkov[1], S.G. Kalenkov[2], M.A. Karpilova[3], A.E. Shtanko[4]; 1 - Microholo Ltd., 2 - Moscow Polytechnic Univ., 3 - Research Inst. of Eye Diseases, 4 - Moscow State Univ. of Technology "STANKIN", Russia

The problem of quantitative phase retrieval in NIR (near infrared) of the demodex mite by means of hyperspectral holography is considered. It is shown that the phase distribution of the demodex can be obtained for the wavelength longer than 0.7 μm. For the shorter wavelength its structure is diffusive and phase map is covered by speckle noise.

WeSMB-41 19:00-19:15

Erythrocyte size distribution retrieval via laser diffractometry and hyperspectral holography of blood smears

A. Lugovtsov[1], S. Nikitin[1,2], V. Ustinov[3], A. Semenov[1,2], N. Zaalishvili[4], G. Kalenkov[5], A. Shtanko[6], S. Kalenkov[4], A. Priezzhev[1,2;]1- 3 - Lomonosov Moscow State Univ., 4 - Moscow Polytechnic Univ., 5 - Microholo Ltd, 6 - Moscow State Univ. of Technology "Stankin", Russia

The problem of measuring the erythrocytes size distribution on a dry blood smear by means of laser diffractometry is considered. To solve the inverse scattering problem, a new erythrocyte model is proposed. This model is developed on the basis of experimental data on three-dimensional shapes of erythrocytes obtained by the method of hyperspectral holography.

WeSMB-42 19:15-19:30

OCT-based label-free 3D mapping of lymphatic vessels and transparent interstitial-fluid-filled dislocations

L.A. Matveev[1], V.V. Demidov[2], A.A. Sovetsky[1], A.A. Moiseev[1], A.L. Matveyev[1], G.V. Gelikonov[1], V.Y. Zaitsev[1], A. Vitkin[2,3,4]; 1 - Inst. of Applied Physics RAS, Russia; 2 - Univ. of Toronto, 3 - Univ. Health Network, Princess Margaret Cancer Centre, 4 - Univ. of Toronto, Department of Radiation Oncology, Canada

Approach to OCT-lymphangiography and interstitial-fluid-filled dislocations mapping that complement SV OCT angiography is presented. OCT-LA can be extracted from the OCT raw datasets that were acquired for SV OCT. Lymphatic vessels and interstitial dislocations with transparent fluids can be separated from the blood vessels and tissue. In vivo application of the OCT-LA approach is demonstrated on mouse with BX-PC3 tumor.

SECTION C. PHOTONICS AND NANOBIOTECHNOLOGY

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

Photonics and nanobiotechnology I

Session Chair: Petr Nikitin,
Prokhorov General Physics Inst. RAS, Russia

WeSMC-01 15:00-15:25

Optical biosensors based on surface plasmons and their applications in medical diagnostics *(Invited paper)*

Jiri Homola; Inst. of Photonics and Electronics, Czech Republic

The presented research is concerned with plasmonic affinity biosensors and their applications in medical diagnostics.

WeSMC-02 15:25-15:50

Ultrasensitive plasmonic biosensing *(Invited paper)*

F. Wu[1], J.P. Singh[1], P.A. Thomas[1], O. Ivasenko[2], S. De Feyter[2], V.G. Kravets[1], P.J.R. Day[1], A.N. Grigorenko[1]; 1 - Univ. of Manchester, UK; 2 - Univ. of Leuven, Belgium

We demonstrate ultrasensitive detection of malaria aptamers performed with the help of graphene protected copper plasmonics. Using better morphology of copper surface as compared to gold, phase sensitive surface plasmon resonance schemes and graphene functionalization protocol for attaching end-tethering of DNA probes we were able to improve the detection level of malaria aptamers by an order of magnitude. This opens a way to associate a dormant bacterial population with chronic inflammatory diseases in blood samples using simple label-free optical detection.

WeSMC-03 15:50-16:10

Light induced time and site specific drug delivery *(Invited paper)*

M. Gai[1], M. Kurochkin[2], O. Sindeeva[2], J. Frueh[3], D. Luo[1], J. Gould[1], G.B. Sukhorukov[1,2]; 1 - Queen Mary Univ. of London, UK; 2 - Saratov State Univ., Russia; 3 - Harbin Inst. of Technologies, China

Delivery of bioactive compounds on precise amounts on site and time defined manner is actual task of bionanotechnology. Delivery systems can be made of polymers and nanopartiucles which harvest the light and induce release of encapsulated materials. This papers describes methods of microencapsulation and micropackaging of bioactive materials and their ability to release it in response on light inside cells and to induce cell transformation locally.

WeSMC-04 16:10-16:30

Nanophotonic functional imaging and related nanotoxicity issues *(Invited paper)*

A. Sukhanova[1,2], P. Chames[3], D. Baty[3], F. Ramos-Gomes[4], F. Alves[4], I. Nabiev[1,2]; 1 - Univ. de Reims Champagne-Ardenne, France; 2 - National Research Nuclear Univ. MEPhI, Russia; 3 - Aix Marseille Univ., CNRS, France; 4 - Max Planck Inst. for Experimental Medicine & Univ. Medical Center, Germany

Early detection of the micrometastases is still a challenge. Here, we demonstrate the use of nanoprobes engineered from the single-domain antibodies and fluorescent quantum dots for single- and two-photon detection and imaging of human micrometastases in ex vivo biological samples of breast and pancreatic metastatic tumour models and analyze the nanotoxicity issues related to their potential for in vivo applications.

WeSMC-05 16:30-16:45

Direct immobilized nanostructured myoglobin for CO detection by surface plasmon resonance

G. Dyankov[1], V. Serbezov[2], E. Borisova[2], H. Kisov[1], E. Belina[1]; 1 - Inst. of Optical Materials and Technology BAS, 2 - Inst. of Electronics BAS, Bulgaria

Announced is nanostructured myoglobin (Mb) layer directly immobilized by modified pulsed laser deposition. The biological activity of Mb nanostructured layer is proven by its CO sensing capability.

WeSMC-06 16:45-17:00

Label-free method for multiplex investigation of dynamics of protein-protein interactions

A.V. Orlov[1,2], V.A. Bragina[1], B.G. Gorshkov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

A multiplex optical label-free method has been developed for direct quantitative determination of kinetic parameters of protein-protein interactions by real-time monitoring of molecular recognition processes. The method permits simultaneous registration of dynamics of several pair-to-pair interactions on a single sensor chip with spectral-correlation interferometry. The method has been successfully demonstrated by recording interactions of several different monoclonal antibodies with antigens.

- Coffee Break -

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

Photonics and nanobiotechnology II

Session Chair: Jiri Homola,
Inst. of Photonics and Electronics, Czech Republic

WeSMC-07 17:30-17:50

SERS-based platforms for immunoassay *(Invited paper)*

B. N. Khlebtsov; Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, Russia

Focusing on several basic elements in SERS immunoassays, typical structures of SERS nanoprobes, productive optical spectral encoding strategies, and popular immunoassay platforms are highlighted. Additionally, in this report, we assumed gap enhanced Raman tags (GERTs) based on reporter molecules embedded inside Au@Au core/shell particles. The multiplex capability of the SERS dot immunoassay was illustrated by a proof-of-concept experiment involving simultaneous one-step determination of different target molecules with a mixture of fabricated GERTs conjugates.

WeSMC-08 17:50-18:10

Multifunctional nanoagents for logic-gated chemosensing, diagnostics and drug delivery *(Invited paper)*

M.P. Nikitin; Moscow Inst. of Physics and Technology (State Univ.), Prokhorov General Physics Inst. RAS, Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, Russia

Stimuli-responsive smart materials are promising for different biomedical applications ranging from in vitro diagnostics to bioimaging and drug delivery. Here we demonstrate fabrication and performance testing of multifunctional smart nanoagents capable of logic-gated processing of biochemical and physical stimuli. We show capabilities of the optically-active agents using imaging flow cytometry, SPR biosensors and microscopy.

WeSMC-09 18:10-18:30

Nanoscale luminescent labels of organic and inorganic nature for bioassay *(Invited paper)*

I.Yu.Goryacheva, A.M. Vostrikova, A.A. Kokorina, A.S. Novikova, A.M. Sobolev, D.D. Drozd, A.A.Bakal, A.N. Nikolaeva, D.V. Shpuntova, O.A. Goryacheva; Saratov State Univ., Russia

Semiconductor luminescent quantum dots and luminescent carbon nanoparticles are discussed in the term of application for bioassay: current state, perspectives, advantages and disadvantages.

WeSMC-10 18:30-18:50

Immunoassays using nanoparticle as labels: advantages and current state *(Invited paper)*

S.A. Eremin; Lomonosov Moscow State Univ., Russia

Enzyme-linked immunosorbent assay (ELISA), lateral flow immunoassay (immunochromatographic strip-test) and Fluorescence Polarization Immunoassay (FPIA) are more commonly used immunoassays for detection of mycotoxins and antibiotics in food samples. These methods could be modified by using nanoparticles and quantum dots.

WeSMC-11 18:50-19:05

Quantum Dots in basic research and practical applications: the role of size and quasi-multivalency

A.V. Salova[1], T.N. Belyaeva[1], V.V. Kosheverova[1], E.A. Leontieva[1], M.V. Kharchenko[1], E. S. Kornilova[1,2,3]; 1 - Inst. of Cytology RAS, 2 - Peter the Great St. Petersburg Polytechnic Univ., 3 - St. Petersburg State Univ., Russia

QDs are fluorophores with high quantum yield and exclusive photostability. This suggests QDs applications for multi-color staining and detection during long time in live cells. However, big size of QD and multiple binding sites for a ligand (quasi-multivalency) could affect intracellular behavior of QD-labelled ligand. We analysed in detail effect of QD implication as label for EGF on EGF-receptor endocytosis.

WeSMC-12 19:05-19:20

TAM identification by fluorescence lifetime on different models

Yu.S. Maklygina[1], G.M. Yusubalieva[2], I.D. Romanishkin[1], A.V. Ryabova[1], V.P. Chekhonin[2], V.B. Loschenov[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Serbskij State Research Center of Forensic and Social Psychiatry, Russia

Nowadays problem of cell differentiation in vivo is the topical in oncology. Laser time-resolved spectroscopy allows to evaluate the activity of different types of cells in a tumor microenvironment, in particular tumor associated macrophages (TAM), considering specific cell's features of photosensitizer (PS) accumulation. The technique is based on the fluorescence lifetime estimation, which allows one to judge the degree of PS interaction, thereby distinguishing the type of cells.

WeSMC-13 19:20-19:35

Combined method for laser selection, positioning and analysis of micron and submicron cells and particles

E.A. Savchenko, E.N. Velichko, E.T. Aksenov, E.K. Nepomnyashchaya; Peter the Great St. Petersburg Polytechnic Univ., Russia

The concept of a combined measuring system for determination of the physical and dynamical parameters of a single micron and submicron particle is proposed in this paper. The results of an experimental testing and approbation of functional parts of the suggested system are presented.

SECTION C. PHOTONICS AND NANOBIOTECHNOLOGY

WeSMC-p01 11:30-13:30

The tissue optical properties impact on measurement of luminescent particles temperature

E.A. Sagaydachnaya[1], V.I. Kochubey[1,2]; 1 - Saratov National Research State Univ., 2 - National Research Tomsk State Univ., Russia

Upconversion particles have prospects for producing a local hyperthermia of biotissue with simultaneous temperature control. Aim of the research is analysis of impact of the optical properties of different thickness tissue on measurement of temperature by upconversion particles NaYF4:Er,Yb. It is shown that the optical properties of the relatively thin tissue has little or no effect on determine particles temperature in a certain temperature range. The distort in the other temperature range make it possible to detect tissue coagulation.

WeSMC-p02 11:30-13:30

Time-resolved multiple-probe infrared spectroscopy studies of carbon monoxide migration through internal cavities in hemoglobin

S.V. Lepeshkevich[1], I.V. Sazanovich[2], M.V. Parkhats[1], S.N. Gilevich[3], B.M. Dzhagarov[1]; 1 - Stepanov Inst. of Physics NASB, Belarus; 2 - STFC Rutherford Appleton Lab., UK; 3 - Inst. of Bioorganic Chemistry NASB, Belarus

Time-resolved multiple-probe picosecond to millisecond infrared technique was applied to determine the dynamics of carbon monoxide migration via the internal cavities of human hemoglobin and its isolated chains. We succeeded in following the evolution of photodissociated CO ligand inside the protein matrix during geminate recombination. We managed to detect the photodissociated CO molecules escaped from the protein into external media.

WeSMC-p03 11:30-13:30

Cd-free quantum dots for application as biolabels

A.S. Novikova, I.Yu. Goryacheva; Saratov State Univ., Russia

We report an efficient approach to binding the targeting molecules to Cd-free quantum dots (QDs). Direct covalent binding of antibodies to active groups on the hydrophilic QDs' surface by means of cross-linker molecules was investigated.

WeSMC-p04 11:30-13:30

Detection of autoimmune disease markers by optical label-free immunosensors

V.A. Bragina[1], N.V. Guteneva[1,2], S.L. Znoyko[1], B.G. Gorshkov[1], A.V. Orlov[1,2]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

Autoimmune diseases are a significant cause of disability and mortality. We present high-sensitive immunoassay for rapid real-time detection in human blood serum of antibodies to thyroglobulin and thyroid peroxidase. The assay employs optical label-free biosensors based on spectral correlation interferometry. The developed immunosensors can be used for diagnostics and detection of various clinically relevant markers in complex biological liquids.

WeSMC-p05 11:30-13:30

Intelligent nanoparticle-based agents for biomedical applications: rapid design using a lateral flow assay

E.N. Mochalova[1,2], A.V. Pushkarev[1,2], P.I. Nikitin[2,3], M.P. Nikitin[1]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, 3 - National Research Nuclear Univ. «MEPhI», Russia

A method is developed for rapid design and easy verification of intelligent nanoparticle-based agents, which implement basic logic YES and NOT functions. The spectral-phase interferometry was used for investigation of kinetic parameters of various candidate molecules to enhance efficiency of the biomolecular interfaces responsible for logic-gating. The developed method provides a convenient powerful tool for creating theranostic agents of required performance and optimal composition before their administration to experimental animals.

WeSMC-p06 11:30-13:30

Optical properties of tableted samples containing iron oxides in THz region of spectrum

A.O. Georgieva[1], M.V. Afonin[2], N.S. Balbekin[1], G.Z. Gareev[3], K.G. Gareev[4], A.N. Gorshkov[5], D.V. Korolev[6], V.V. Luchinin[4], O.A. Smolyanskaya[1]; 1 - ITMO Univ., 2 - St. Petersburg State Inst. of Technology, 3 - Scientific and Research Center for Security of Technical Systems, 4 - St. Petersburg Electrotechnical Univ. "LETI", 5 - Research Inst. of Influenza, 6 - Almazov National Medical Research Centre, Russia

Magnetic nanoparticles are used as contrast agents in terahertz spectroscopy in vivo. In this work the terahertz spectra of refractive index and absorption index of pressed tableted samples based on iron oxide coated by silica are studied. The possibility of identifying the crystalline phase of iron oxide for both types of nanoparticles is shown.

WeSMC-p07 11:30-13:30

Nanocomplexes for in situ detection of small molecules with switchable optical properties

A.V. Babenyshev[1], K.G. Shevchenko[1], A.A. Tregubov[1], I.L. Nikitina[2], V.R. Cherkasov[1]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia

Nanoparticles are a universal tool used in broad range of various applications from constructing of smart materials to biomedicine. One of the most challenging fields is development of multifunctional theranostic agents. We developed and analysed the performance of a novel nanoparticle based smart material able to reversibly change its optical properties in response to presence of small molecules in situ.

WeSMC-p08 11:30-13:30

Raman sensor with isotopic resolution for medical applications

Y. Chubchenko[1,2], L. Konopelko[1,2], V. Elizarov[1], A. Grishkanich[1,3,4,5], A. Zhevlakov[1], V Tishkov[4] ,E. Kolmakov[5]; 1 - ITMO Univ., 2 - Mendeleyev Inst. for Metrology (VNIIM), 3 - St. Petersburg State Electrotechnical Univ., 4 - Khlopin Radium Inst., 5 - LLC Lasertrack, Russia

Raman sensor is used to measure the ratio of carbon isotopes in the exhaled carbon dioxide, which is used to diagnose the human infection of Helicobacter pylori and the influence of the Helicobacter pylori bacterium on the occurrence of gastritis, gastric and duodenal ulcers. A method for the analysis of human infection with Helicobacter pylori was developed on the basis of measurements of the ratio of 13C / 12C carbon isotopes in human exhaled air with a high level of measurement accuracy.

WeSMC-p09 11:30-13:30

Experimental investigation of the properties of pharmaceutical aerosols with laser-based optical measurement techniques

Sz. Kugler, A. Kerekes, A. Nagy, A. Czitrovszky; Wigner Research Centre for Physics of the HAS, Hungary

The goal of our study was to determine the aerosol particle deposition in the upper airways from a dry powder inhaler (DPI) measuring with an Aerosol Particle Sizer (APS) Spectrometer. Different inhalation profiles were used for the investigation and the MMAD (mass median aerodynamic diameter) was determined for each profile.

WeSMC-p10 11:30-13:30

QDs-cysteine luminescence kinetics: comparative analysis on live and fixed cells

I.K. Litvinov[1,2], T.N. Belyaeva[1], A.S. Bazhenova[2], E.A. Leontieva[1], A.O. Orlova[2], E.S. Kornilova[1,2,3]; 1 - Inst. of Cytology RAS, 2 - ITMO Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., Russia

Photophysical properties of quantum dots based on CdSe/ZnS solubilized by L-Cysteine shell, were compared in solutions of cell culture medium and in live and fixed HeLa cells. We show that the luminescence kinetics of nanocrystals in fixed cells were similar to those obtained in the case of intravital samples that is important for adequate interpretation of the data obtained.

WeSMC-p11 11:30-13:30

Modified liposomes as optical probes, magnetic labels, and drug carriers

A.V. Lunin[1], A.V. Vasilyeva[1], B.G. Gorshkov[2], I.L. Sokolov[1,2], V.R. Cherkasov[1]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia

Liposomes are a very attractive type of nanoparticles to design advanced agents for targeted drug delivery and bioimaging. We have fabricated multifunctional and multimodal liposomes. In particular, we have employed several physical and chemical methods to introduce external and internal high-affinity agents, as well as fluorescent and magnetic markers. A variety of applications is demonstrated for the constructed liposomes.

WeSMC-p12 11:30-13:30

Particularity Of Polylactide Modification By Ethylene Glycol Monomethyl Ether In Medium Of Superfluid Carbon Dioxyde

O.O. Vasilieva[1,2], N.N. Glagolev[2], N.V. Minaev[3], V.T. Shashkova[2] , I. A. Matveeva[2], P.S. Timashov[3], A.B Solovieva[2]; 1 - Moscow Inst. of Physics and Technology, 2 - Semenov Inst. of Chemical Physics RAS, 3 - Inst. of Laser and Information Technologies, Russia

Crosslinking of modificated polylactide by means of two-photon laser stereolithography.

WeSMC-p13 11:30-13:30

Synthesis of luminescent magnetic nanoparticles with controllable surface properties

I.V.Zelepukin[1,2,3], V.O. Shipunova[1,2,3], A.B. Mirkasymov[1,2], P.I. Nikitin[3,4], M.P. Nikitin[1,2,4], S.M. Deyev[1,3]; 1 - Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), 3 - National Research Nuclear Univ. MEPhI, 4 - Prokhorov General Physics Inst. RAS, Russia

Luminescent magnetic nanoparticles are attractive agents for many biomedical applications such in vivo imaging, biosensing and drug delivery. Each of these applications needs particles with specific properties. Here we synthesized a library of magnetic luminescent nanoparticles with controlled sizes and zeta-potentials using silicate chemistry. Labeling of tumor cells with these nanoparticles and studying their pharmacokinetics was also discussed.

WeSMC-p14 11:30-13:30

Detection of morphological changes in cisplatin-treated ovarian cancer cells by digital holographic microscopy

A.A. Zhikhoreva[1,2], A.V. Belashov[1], V.G. Bespalov[2,3], V.A. Romanov[2,3], A.L. Semenov[3], N.T. Zhilinskaya[3,4], I.V. Semenova[1], O.S. Vasyutinskii[1]; 1 - Ioffe Inst., 2 - ITMO Univ., 3 - Petrov National Medical Research Center of Oncology, 4 - Peter the Great St. Petersburg Polytechnic Univ., Russia

Morphological changes in cells of ascitic fluid samples from Wistar rats with ovarian cancer were analyzed using digital holographic microscopy. It was shown that cells morphology in samples taken from rats treated with cisplatin differs significantly from those taken from untreated animals.

WeSMC-p15 11:30-13:30

Real-time optical methods for development of nanoparticle-based biosensors for detection of hepatitis B surface antigen

S.L. Znoyko[1], V.A. Bragina[1], E. Alipour[2], H. Ghourchian[2], P.I. Nikitin[1,3]; 1 - Prokhorov General Physics Inst. RAS, Russia; 2 - Univ. of Tehran, Iran; 3 - National Research Nuclear Univ. MEPhI, Russia

Label-free spectral interferometric methods were employed for optimization of functionalized nanoparticles and reagents, and for development of immunochromatographic and capacitive biosensors. The immunochromatographic sensors use volumetrically detected magnetic nanolabels. In the capacitive sensors, nanoparticles amplify signal. The developed immunosensors were tested for rapid quantitative detection of hepatitis B surface antigen, which is the major marker for diagnostics of hepatitis B.

WeSMC-p16 11:30-13:30

Investigation by the DLS method of sizes of components aggregates in laser-solders during heated

D.I. Ryabkin, B.A. Kvasnov, A.Yu.Gerasimenko, A.V. Kuksin, V.M. Podgaetsky; National Research Univ. of Electronic Technology, Russia

The change in the dimensions of the aggregates of the laser solders components during their heating and subsequent denaturation has been investigated. It has been revealed that only the bovine serum albumin aggregates with a hydrodynamic radius of 4.1 ± 0.7 nm are subject to denaturation, and the aggregates of multiwalled carbon nanotubes do not affect denaturation.

WeSMC-p17 11:30-13:30

Flavin-mononucleotide-doped jelly-like gelatin as a fully biological optical material for holography and biophotonics applications

V.M.Katarkevich, T.Sh.Efendiev; Stepanov Inst. of Physics, NAS, Belarus

Jelly-like gelatin doped with flavin-mononucleotide is proposed as a novel (fully biocompatible and biodegradable) self-developing photosensitive material for volume holography and biophotonics. As an example, the use of such material for optical recording of volume phase gratings with a diffraction efficiency of ~20% and an angular selectivity of ~18 angl. min. is demonstrated with a 488 nm CW Ar laser as a light source. Due to its valuable properties, the proposed medium seems to be promising for creating nanostructured biophotonics devices including biological distributed feedback lasers.

SECTION D. PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE

WeSMD-p01 15:00-17:00

Albumin-containing solutions equalize quantum yields of porphyrinic photosensitizers

I.M. Belousova[1], T.D. Muraviova[1], T.K. Krisko[1], E.V. Kriukova[2]; 1 - Vavilov State Optical Inst., 2 - ITMO Univ., Russia

Fluorescent and singlet oxygen quantum yields of chlorin-based photosensitizer Photoditazin were compared with those of porphyrin-based preparations in the environment of phosphate buffer and albumin. The albumin addition reduced both fluorescence and sensitizing properties of all the agents under study, equalizing quantum yield values of chlorin-based and porphyrin-based preparations. Complex formation between albumin and agent molecules was supposed to be the reason of the effect.

WeSMD-p02 15:00-17:00

Absorption of dark red laser light by oxygen molecules in organic media. Results of photochemical and luminescence measurements

A.S. Benditkis, A.S. Kozlov, S.E. Goncharov, A.A. Krasnovsky Jr; Federal Center for Biotechnology, Bach Inst. of Biochemistry RAS, Russia

Absorption of dark red laser light by oxygen molecules in organic media. Results of photochemical and luminescence measurements of IR phosphorescence under direct excitation of oxygen by diode lasers.

WeSMD-p03 15:00-17:00

Generation of singlet oxygen by chlorophyll and related pigments in aqueous systems: results of photochemical and luminescence studies

A.S. Kozlov, A.A. Krasnovsky Jr; Research Center of Biotechnology RAS, Russia

Photosensitization of singlet oxygen by chlorophyll α, photoditazin (or fotoditazin) and dimegin were studied in water and aqueous detergent dispersions using the oxygenation of chemical traps of singlet oxygen and detection of IR luminescence of singlet oxygen under pulse laser excitation. Quantum yields of singlet oxygen production have been obtained. Preliminary results of application of similar technique to singlet generation by chlorophyll in chloroplast structures are reported.

WeSMD-p04 15:00-17:00

Vibrational spectroscopy of tissue-engineered structures based on chitosan and carbon nanotubes

Yu.O. Fedorova, A.A. Polokhin, D.T. Murashko, M.S. Savelyev, A.Yu. Gerasimenko; National Research Univ. of Electronic Technology, Russia

This paper presents the study of structures based on chitosan and single-walled carbon nanotubes carried out by vibrational spectroscopy methods. Volumetric structures were created by the layer-by-layer laser evaporation of aqueous dispersion. The nature of the intermolecular bonds between nanotubes and chitosan has been clarified. These structures can be used for the cellular and tissue engineering of the cardiovascular system.

WeSMD-p05 15:00-17:00

Influence of laser radiation on conductivity of a nanocomposite based on carbon nanotubes in an organic matrix

A.A. Polokhin[1], A.Yu. Gerasimenko[1], P.Yu. Privalova[1], L.P. Ichkitidze[1], A.P. Orlov[2], A.A. Pavlov[2]; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Nanotechnology of Microelectronics RAS, Russia

In this work laser radiation influence to conductivity of the nanocomposite was studied. Thin layer of the nanocomposite based on carbon nanotubes in organic matrix irradiated by laser radiation instead thermal treatment, had more the 4 times higher conductivity for continuous wave laser method and more than 2 times - for pulsed laser method. This increasing related with forming the nanotubes scaffold under laser radiation. As a result, new electrical contacts is obtained in carbon nanotubes connect places and it leads to reducing of nanocomposite resistivity and increasing of conductivity.

WeSMD-p06 15:00-17:00

Photosensitized singlet oxygen production and photophysical properties of cationic Porphyrin - Transferrin complexes

M.V. Parkhats[1], S.V. Lepeshkevich[1], A.G. Gyulkhandanyan[2], A.A. Zakoyan[2], G.V. Gyulkhandanyan[2], B.M. Dzhagarov[1]; 1 - Inst. of Physics, NASB, Belarus; 2 - Inst. of Biochemistry, NASA, Armenia

Photophysical properties of new tumor targeted photosensitizers based on cationic porphyrins and human transferrin were investigated. It was demonstrated that incorporation of the porphyrins into the protein causes slight changes of the photophysical properties of the photosensitizers. The kinetics of singlet oxygen luminescence photosensitized by porphyrin-transferrin complexes were studied.

WeSMD-p07 15:00-17:00

Optimization of selective photodestruction by laser radiation of the yellow-green range of capillary angiodysplasia of the skin

A.A. Sirotkin[1], G.P. Kuzmin[1], N.E. Gorbatova[2,3], T.E. Yushina[2], A.G. Dorofeev[2], A.V. Brynsev[2], S.A. Zolotov[2], O.V. Tikhonevich[1], D.S. Drozdov[4]; 1 - Prokhorov General Physics Inst. RAS, 2 - Clinical and Research Inst. of Emergency Pediatric Surgery and Trauma, 3 - Federal State Autonomous Inst. «National Medical Research Center of Children's Health», 4 - Moscow Inst. of Physics and Technology (State Univ.), Russia

A laser medical device has been created to conduct an exact photodestruction of the vascular formations of the skin and subcutaneous tissue. Conducted studies on model biological objects for confirmation the possibility of realizing the optimal parameters of laser radiation providing photodestruction of hemoglobin containing tissues.

WeSMD-p08 15:00-17:00

Enhancement of the thermal effect from the NIR laser radiation on bio-tissue using nanosized dielectric particles doped with Yb3+

S.A. Khrushchalina, A.N. Belyaev, O.S. Bushukina, M.A. Dvoryanchikova, O.A. Kuznetsova, P.A. Ryabochkina, I.A. Yurlov; Ogarev Mordovia State Univ., Russia

Experiments in-vitro and in-vivo on the effect of laser radiation with a wavelength of 970 nm and a power of ~ 1 W on a biotissue with preliminary deposited Yb-containing nanoparticles and without preliminary deposition of nanoparticles have been performed. It is shown that the thermal effect is more pronounced in the case of using nanoparticles than without the use of nanoparticles.

WeSMD-p09 15:00-17:00

Photothermal effect of nanoparticles in biological tissues under laser irradiation

E. M. Kasianenko[1], A. I. Omelchenko[1], P. Y. Gulyaev[2]; 1 - Federal Scientific Research Centre "Crystallography and Photonics" RAS, 2 - Ugra State Univ., Russia

The photothermal effect of nanoparticles of oxide bronzes impregnated in the porcine cartilage rib tissue during laser heating was studied. A comparison of the magnitude of the photothermal effect showed that more high value of the effect of laser radiation on the cartilaginous tissue is demonstrated by the samples impregnated with molybdenum oxide bronzes nanoparticles.

WeSMD-p10 15:00-17:00

Photosensitizing effect of curcumin on bacterial cells and animal cells in culture

A.V. Mikulich[1], L.G. Plavskaya[1], A.I. Tretyakova[1], I.A. Leusenka[1], T.S. Ananich[1], V.Yu. Plavskii[1], O.A. Kazyuchits[2], I.I. Dobysh[2], E.S. Nikolaevich[2]; 1 - Stepanov Inst. of Physics NASB, 2 - RMUE «Academpharm», Belarus

The regularities of photodynamic inactivation of various types of bacterial cells (gram-positive Staphylococcus aureus, gram-negative Escherichia coli, yeast-like fungi Candida albicans) sensitized with natural dye curcumin are studied. It is shown that the rate of photoinactivation induced by endogenous photosensitizers of porphyrin and flavin nature increases due to the photodynamic effect of curcumin in 2.8-5.2 times when exposed to laser radiation with wavelength of 445 nm and 13.5-42 times when exposed to radiation with wavelength of 405 nm. The dose of irradiation, at which the complete inhibition of the growth of strains is observed, varies in the range of 3-15 J/cm2. S. aureus and C. albicans showed higher sensitivity to photodynamic action than E. coli. The ability of curcumin to sensitize photodamage of animal cells in culture is also shown.

WeSMD-p11 15:00-17:00

Characterisation of biological smoke generated by short pulse lasers

A. Nagy, M. Veres, A. Czitrovszky; Wigner Research Centre for Physics of the HAS, Hungary

Optical aerosol instrumentation and spectroscopic tools were utilized to characterize aerosols released upon the interaction of short pulse lasers and biological tissues.

WeSMD-p12 15:00-17:00

Laser spectroscopy investigations of dark and photoinduced oxidation transformations of tetrahydrobiopterin coferments, a potential factors of melanogenesis disorder

A.S. Nizamutdinov[1], I.I. Farukhsin[1], T. A. Telegina[1,2], Yu.L. Vechtomova[1,2], E.E. Orlova[1], E.V. Lukinova[1], E.I. Madirov[1], V.V. Semashko[1]; 1 - Kazan Federal Univ., 2 - Bach Inst. of Biochemistry, Russia

The aim of this work is to study phototransformation of tetrahydrobiopterin exposed to UV laser irradiation in the process of its oxidation. A multifunctional Ce: LiCaAlF6 and Ce: LiY0,3Lu0,7F4 UV lasers were realized with wavelength tuning and pulse durations from 10 ns to 200 ps. Here we discuss role of H4Bip oxidation products and its UV irradiation on melanogenesis disorder.

WeSMD-p13 15:00-17:00

Photodamage of cells sensitized with bilirubin upon exposure to laser and LED sources

T.S. Ananich[1], V.M. Katarkevich[1], V.V. Keropyan[2], V.N. Knyukshto[1,]I.A. Leusenka[1], P.A. Mazmanyan[2], G.G. Margaryan[3], A.V. Mikulich[1], L.G. Plavskaya[1], V.Yu. Plavskii[1], A.N. Sobchuk[1], A.I. Tretyakova[1]; 1 - Stepanov Inst. of Physics, NASB, Belarus; 2 - Scientific Research Center of Maternal and Child Health Protection, 3 - Muratsan Hospital Complex, Armenia

It is shown that radiation of laser and LED sources corresponding to the absorption spectrum of bilirubin can cause damaging effect on animal cells in culture that are in the exponential growth phase and pre-incubated with bilirubin. Light-induced cell death is due to photochemical reactions involving singlet oxygen. At close wavelengths of laser radiation and LED photodynamic effect is more pronounced when exposed to non-monochromatic radiation. Photodynamic action spectrum does not correspond to the absorption spectrum of bilirubin in solution or its complexes with proteins. It is concluded that photoproducts of bilirubin are involved in sensitization effect.

WeSMD-p14 15:00-17:00

Iron oxide nanoparticles conjugated with Zn phthalocyanine for photoinduced anticancer immune response

A.V. Ryabova[1], E.A. Luk'yanets[2], A.I. Klimov[3], D.V. Pominova[1], V.I. Makarov[1], I.D. Romanishkin[1], I. Herrmann[4], R. Steiner[5,6], V.B.Loschenov[1,6]; 1 - Prokhorov General Physics Inst. RAS, 2 - State Scientific Center "Inst. of Organic Intermediates and Dyes", 3 - Lomonosov Moscow State Univ., Russia; 4 - Swiss Federal Laboratories for Materials Science and Technology (Empa), Switzerland; 5 - Inst. für Lasertechnologien in der Medizin und Meßtechnik, Germany; 6 - National Research Nuclear Univ. MEPhI, Russia

The possibility of using iron oxide (III) nanoparticles conjugated with Zn phthalocyanine for phototherapy of cancer was studied experimentally.

WeSMD-p15 15:00-17:00

Study of the toxicity of the highly specific substrate of luciferase NanoLuc for the development of deep tissue photodynamic therapy methods

V.O. Shipunova[1,2,3], P.A. Kotelnikova[2,3], O.N. Shilova[2], E.I. Shramova[2], P.I. Nikitin[1,4], M.P. Nikitin[2,3,4], S.M. Deyev[1,2], G.M. Proshkina[2]; 1 - National Research Nuclear University MEPhI, 2 - Shemyakin-Ovchinnikov Inst. of Bioorganic Chemistry RAS, 3 - Moscow Inst. of Physics and Technology (State Univ.), MIPT, 4 - Prokhorov General Physics Inst. RAS, Russia.

Bioluminescent pair of luciferase NanoLuc and its highly specific substrate furimazine is a promising platform for the development of a number of methods for photodynamic therapy of deep tissue tumors. However, no detailed studies have been carried out to study the toxicity of furimazine both in vitro and in vivo. Here, we describe a study regarding the toxicity of furimazine in vitro on several cell lines and in vivo with its multiple injections into the bloodstream of laboratory mice.

SECTION C. PHOTONICS AND NANOBIOTECHNOLOGY

Location: Petrov-Vodkin 1 Room, 09:00 - 11:00

Photonics and nanobiotechnology III

Session Chair: Vladimir P. Drachev,
Univ. of North Texas, USA, Skolkovo Inst. of Science and Technology, Russia

ThSMC-14 09:00-09:20

Nanomaterials for biosensing and phototherapy applications *(Invited paper)*

A. Rakovich; King's College London, UK

Great demand exists for the development of advanced healthcare solutions for early detection of diseases and effective methods of treatment. The immense progress of nanomaterials research over the last few decades suggests that it could be the source of such solutions and could include, for example, substrate-based optical antenna systems for improved biosensing applications and colloidal nanomaterials for photodynamic therapy.

ThSMC-15 09:20-09:40

Targeting of tumor tissues with magnetic nanoparticles *(Invited paper)*

M. Goncalves[1], R. Schwartz-Albiez[1], P.I. Nikitin[2], M.P. Nikitin[3], F. Momburg[1]; 1 - Antigen Presentation and T/NK Cell Activation Group, Clinical Cooperation Unit Applied Tumor Immunity, German Cancer Research Center, Heidelberg, Germany; 2 - Prokhorov General Physics Inst. RAS, Russia; 3 - Moscow Inst. of Physics and Technology (State Univ.), Russia

Magnet-enforced targeting of drug-loaded superparamagnetic iron oxide nanoparticles (SPIO-NP) towards malignant tumors appears to be a desirable tool. In order to make magnetic targeting feasible for non-superficial tumors we propose to create a 'magnetic interface' in the tumor microenvironment by targeting red blood cells loaded with SPIO-NP towards specific receptors on tumor endothelial cells by means of surface-bound antibodies.

ThSMC-16 09:40-10:00

Magnetic cell therapy for vascular disease *(Invited paper)*

B. Polyak; Drexel Univ. College of Medicine, USA

This study demonstrates that magnetically-mediated repopulation of endothelial cells in the injured artery prevented the development of in-stent stenosis nearly two-fold earlier and with a two-fold greater magnitude at the site of successful cell delivery. The methodology investigated here may provide the basis for designing the next generation of cell-based therapy for vascular healing after stent angioplasty.

ThSMC-17 10:00-10:15

Towards magnetoencephalography based on ultra-sensitive laser pumped non-zero field magnetic sensor

A.E. Ossadtchi[1], N.K. Kulachenkov[2], D.S. Chuchelov[3], S.P. Dmitriev[4], A.S. Pazgalev[4], M.V. Petrenko[4], A.K. Vershovskii[4]; 1 - National Research Univ. «Highter School of Economics», 2 - JSR Electropribor, 3 - Lebedev Physical Inst., 4 - Ioffe Inst., Russia

The principal possibility of creating optically pumped compact magnetic sensor for MEG operating in a wide magnetic field range is experimentally proved.

ThSMC-18 10:15-10:30

Microscopy of tunable assembly of cells in external alternating electric fields

E.V. Yakovlev[1], S.A. Korsakova[1], K.I. Zaytsev[1,2], I.N. Aliev[1], S.O. Yurchenko[1]; 1 - Bauman Moscow State Technical Univ., 2 - Prokhorov General Physics Inst. RAS, Russia

In this work, we present the results of particle-resolved studies, obtained by microscopy, of clusters and chains of red blood cells (RBCs), formed during their self-assembly in external alternating electric field. The results prove efficiency and prospectively of electric fields for manipulation with cells and their clusters.

ThSMC-19 10:30-10:45

Fluorescent superparamagnetic and paramagnetic agents for bioimaging, sensing and cell targeting

I.L. Sokolov[1,2], A.V. Vasilyeva[1], A.V. Lunin[1], A.V. Yaremenko[1], V.R. Cherkasov[1]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia

Nanocomposite materials are of great interest as a multipurpose instrument for various biomedical applications. In the presented work, we demonstrate the capability of fluorophore-modified nanoparticles based on iron oxides and oxyhydroxides crystallites to act as multimodal agents that combine specific recognition of target cells with properties of materials used for fluorescent bioimaging and MRI-contrasting.

ThSMC-20 10:45-11:00

High-sensitive analytical systems for rapid on-site detection of haptens

N.V. Guteneva[1,2], A.V. Orlov[1,2], V.A. Bragina[1], B.G. Gorshkov[1], S.L. Znoyko[1]; 1 - Prokhorov General Physics Inst. RAS, 2 - Moscow Inst. of Physics and Technology (State Univ.), Russia

Analytical systems for rapid, specific and sensitive registration of different types of haptens such as B vitamins, thyroid hormones and drugs of abuse have been developed. The limits of detection are on the level of time-consuming laboratory methods. However, the developed systems are much faster, simpler and can be use on-site. These features are due to advanced assay formats with optimal antibodies and conjugation procedures revealed by real-time characterization of binding kinetics of the reagents with the original label-free interferometric biosensors. The developed test systems are promising for medical diagnostics, criminalistics, toxicology, food quality control and environmental monitoring.

- Coffee Break -

Location: Petrov-Vodkin 1 Room, 11:30 - 13:30

Photonics and nanobiotechnology IV

Session Chair: Boris Polyak,
Drexel Univ. College of Medicine, USA

ThSMC-21 11:30-11:50

Eco-photonics: Micro-encapsulated probe as implantable sensor for monitoring the physiological state of water organisms *(Invited paper)*

A. Popov[1], A. Bykov[1], A. Gurkov[2], E. Borvinskaya[2], A. Sadovoy[3], M. Timofeev[2]; I. Meglinski[1,2,3,6]; 1 - Univ. of Oulu, Finland; 2 - Irkutsk State Univ., Russia, 3 - A*STAR, Singapore

Presently there is a highly growing interest to the natural evolutionary changes and especially those that driven by environmental pollution and climate change. Based on the developed micro-encapsulated implantable sensors we present an approach for non-invasive assessment of stress conditions felt by water organisms due to environmental variations and climatic changes.

ThSMC-22 11:50-12:10

In vivo study of cell division with stimulated Raman scattering *(Invited paper)*

M. Veres, L. Himics, I. Rigó, A. Nagy, S. Tóth, Sz. Kugler, P. Baranyai, A. Czitrovszky, T. Váczi; Wigner Research Centre for Physics HAS, Hungary

Stimulated Raman scattering (SRS) is non-linear vibrational spectroscopic technique with sub-millisecond sampling times allowing to perform video rate imaging on biological objects including even few tens of cells simultaneously. In this work SRS was used for in vivo study of cell division in zebrafish embryo in order to get insight into temporal evolution of the related processes.

ThSMC-23 12:10-12:30

Giant electromagnetic field in periodic metal-silicone metasurface and SERS sensors *(Invited paper)*

A.K. Sarychev[1], K.N. Afanasev[1], I.V. Bykov[1], I.A. Boginskaya[1], E.G. Evtushenko[2], A.V. Ivanov[1], I.N. Kurochkin[2,3], A.N. Lagarkov[1], A.M. Merzlikin[1], V.V. Mikheev[4], D.V. Negrov[4], I.A. Ryzhikov[1], M.V. Sedova[1]; 1 - Inst. for Theoretical and Applied Electrodynamics RAS, 2 - Lomonosov Moscow State Univ., 3 - Emanuel Inst. of Biochemical Physics RAS, 4 - Moscow Inst. of Physics and Technology, Russia

Anomalous optical response for the metamaterial fabricated from silicon bar resonators is investigated. The resonators are manufactured in form of two-dimensional bars and covered by semicontinuous silver film. The calculations as well as real experiments demonstrate Wood anomalies in visible and near IR spectral ranges associated with excitation of the surface waves in metamaterial by means of diffraction of the incident light on the periodic bars. The multiple metal-dielectric resonances result in much enhanced local electromagnetic fields in-between metal particles placed on the surface of dielectric bars. The resonances can be tuned by varying angle of incidence, polarization, and geometry of the dielectric bars. It opens new venue in R&D SERS substrates including sensors detecting specific substances.

ThSMC-24 12:30-12:50

Plasmonic fractal shells for drug delivery: broadband response, synthesis, and laser release *(Invited paper)*

V. P. Drachev[1,2], V. C. de Silva[1], P. Nyga[3]; 1 - Univ. of North Texas, USA; 2 - Skolkovo Inst. of Science and Technology, Russia; 3 - Military Univ. of Technology and Inst. of Optoelectronics, Poland

Gold fractal shells of 1, 2, or 4 microns are synthesized and after silica core etching preserve its shape and morphology. Light goes mostly through the epsilon-near-zero shell with approximately wavelength independent absorption rate from 0.5 to 20 microns. The shells can be open up using laser pulse light-induced changes due to the coalescence or ablation of the nanostructures.

ThSMC-25 12:50-13:05

Development of SPR based tool for monitoring of self-assembly of heterogenous nanoparticle complexes

K.G. Shevchenko[1], A.V. Babenyshev[1], A.A. Tregubov[1], I.L. Nikitina[2], V.R. Cherkasov[1]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst. RAS, Russia

Self-assembling nanomaterials are a convenient tool for various biomedical applications due to easily adjustable physical, chemical and biological properties. Here we show the use of SPR shift analysis for real-time monitoring of assembly and disassembly of various heterogenous nanoparticle complexes. Proposed instrument would be particularly suitable for constructing novel types of in situ biosensors and drug delivery systems.

ThSMC-26 13:05-13:20

Surface-enhanced infrared spectroscopy for cortisol analysis

I.A. Milekhin[1], O.P. Cherkasova[2], A.G. Milekhin[3], S.A.Kuznetsov[2], E.E. Rodyakina[3,2], V.A. Minaeva[4], A.V.Latyshev[3,2]; 1 - Novosibirsk State Univ., 2 - Inst. of Laser Physics SB RAS, 3 - Rzhanov Inst. of Semiconductor Physics, Russia; 4 - Bohdan Khmelnitsky National Univ., Ukraine

The method of nanostructuring metal surfaces by means of nanolithography was optimized and Au nanoantenna arrays with the controllable parameters on the Si surfaces were formed. The surface-enhanced infrared spectroscopy was used for analysis of steroid hormone cortisol in blood plasma.

ThSMC-27 13:20-13:35

Highly sensitive precision scanner for fluorescent and colorimetric microarrays with excitation by using single mode pigtailed semiconductor lasers

V.A. Elokhin[1], V.A. Gotlib[1], S.A. Klotchenko[2], D. A. Makarov[1], A.V. Vasin[2]; 1 - Scientific Instruments JSC, 2 - FGBU Influenza Research of Health Ministry of Russian Federation, Russia

Optical schematic, rationalities for choosing of excitation lasers, filters and imaging lenses of fluorescent and colorimetric microarrays scanner are presented. High sensitivity, excellent resolution and accuracy of this microarray scanner are show by using comparative testing with prototypes of two different modern microarrays scanners. Represented results of laboratory testing performed by using protein microarrays for interleukin markers detection.

- Lunch Break -

Location: Petrov-Vodkin 1 Room, 15:00 - 17:00

Photonics and nanobiotechnology V

Session Chair: Irina Y. Goryacheva, Saratov State Univ., Russia

ThSMC-28 15:00-15:20

Mueller polarimetry as a tool for optical biopsy of tissue *(Invited paper)*

T. Novikova[1], J. Rehbinder[1], J. Vizet[1], A. Pierangelo[1], R. Ossikovski[1], A. Nazac[2], A. Benali[3], P. Validire[3]; 1 - LPICM, CNRS, Ecole Polytechnique, 2 - Univ. Hospital of Bicêtre, 3 - Hospital IMM, France

Multi-spectral imaging Mueller polarimetry holds promise to become a new tool for optical biopsy of tissue. Significant increase in contrast between malignant lesions and healthy human tissue was observed on wide field polarimetric images acquired with in-house built Mueller polarimeter. Both theoretical and numerical studies explored the origin of the observed enhancement of polarimetric image contrast.

ThSMC-29 15:20-15:40

Composite plasmonic SERS tags with embedded Raman reporters *(Invited paper)*

N.G. Khlebtsov[1,2], B.N. Khlebtsov[1,2], D.N. Bratashov[2]; 1 - Inst. of Biochemistry and Physiology of Plants and Microorganisms RAS, 2 - Saratov National Research State Univ., Russia

Gold and composite Au@Ag layered nanoparticles, in which Raman molecules are embedded in a nanometer-sized gap between metal layers, have great potential in biomedical applications. Another type of efficient SERS tags are the tip functionalized Au@Ag nanorods operating in off-resonance mode. Here, we summarize our recent efforts in fabrication, electromagnetic simulation, and bioimaging application of both SERS probes.

ThSMC-30 15:40-16:00

Novel nanocomposite photoacoustic contrast agents *(Invited paper)*

M.V. Novoselova[1,2], D.N. Bratashov[2], M. Sarimollaoglu[3], D.A. Nedosekin[3], B. N. Khlebtsov[2,4], E.I. Galanzha[3], V.P. Zharov[3], D.A. Gorin[1,2]; 1 - Skolkovo Inst. of Science and Technology, 2 - Saratov State Univ., Russia; 3 - Univ. of Arkansas for Medical Sciences, USA; 4 - Inst. of Biochemistry and Physiology of Plants and Microorganisms, Russia

Nanostructured carriers have a good perspective for personalized and preventive medicine. However, application of such objects is hampered by absence of effective detection method for in vivo monitoring of carrier biodistribution and biodegradation processes without altering its structure. Here, we have found optimal composition and structure of carrier shell from point of view of photoacoustic signal intensity required for detection of nanostructured carriers in vitro and in vivo. The nanostructured carriers that exhibited the highest photoacoustic signal were utilized combination of gold nanorods and organic dye dispersed in the matrix of biodegradable polymers.

ThSMC-31 16:00-16:15

Holographic monitoring of cell death pathways induced by reactive oxygen species

A.V. Belashov[1], A.A. Zhikhoreva[1,2], D.A. Rogova[3], T.N. Belyaeva[4], E.S. Kornilova[3,4], A.V. Salova[4], I.V. Semenova[1], O.S. Vasyutinskii[1]; 1 - Ioffe Inst., Russia; 2 - ITMO Univ., 3 - Peter the Great St. Petersburg Polytechnic Univ., 4 - Inst. of Cytology RAS, Russia

Results of HeLa cells death monitoring by means of holographic microscopy and holographic tomography are presented. The observed dynamics of phase shift after photodynamic treatment evidences dose-dependent effect and substantially different pathways of cell death.

ThSMC-32 16:15-16:30

Optimization of upconversion nanoparticles excitation regimes for selective heating and effective thermometry in biological tissues

D.V. Pominova, A.V. Ryabova, P.V. Grachev, I.D. Romanishkin, V.Yu. Proydakova, S.V. Kuznetsov, V.V. Voronov, P.P. Fedorov, V.B. Loschenov; Prokhorov General Physics Inst. RAS, Russia

Upconversion nanoparticles have many advantages for bioimaging. Laser heating of upconversion nanoparticles and thermo sensitive luminescence bands enable to perform photothermal therapy with temperature control. However, the upconversion excitation wavelength 980 nm is well absorbed by water. Optimization of the excitation wavelength allows to ensure the selectivity of heating and an intense luminescent signal for effective thermometry.

ThSMC-33 16:30-16:45

A crystal host selection for aqueous colloidal luminescent nanocrystals doped by Nd3+ used for bioimaging in first biological window

Yu.V. Orlovskii[1,2], A.V. Popov[1], E.O. Orlovskaya[1], A.S. Vanetsev[1,2], I. Sildos[2], P.V. Grachev[1], A.V. Ryabova[1]; 1 - Prokhorov General Physics Inst. RAS, Russia; 2 - Univ. of Tartu, Estonia

Simple criteria for crystal host selection for Nd3+ doped nanocrystals using as fluorescent agents in the first biological window of wavelengths is set. It is a ratio of Judd-Ofelt intensity parameters Ω4/Ω6, which must be as large as possible to reduce the fluorescence Nd*-Nd self-quenching and Nd*-OH- quenching caused by vibrations of molecular groups positioned in the volume of nanocrystals.

7 June, Thursday

ThSMC-34 16:45-17:00

Anomalous optical response of silicon tip-shaped metasurface

A.K. Sarychev[1], K.N. Afanasev[1], I.V. Bykov[1], I.A. Boginskaya[1], A.V. Ivanov[1], I.N. Kurochkin[2,3], A.N. Lagarkov[1], I.A. Ryzhikov[1], M.V. Sedova[1]; 1 - Inst. for Theoretical and Applied Electrodynamics RAS, 2 - Lomonosov Moscow State Univ., 3 - Emanuel Inst. of Biochemical Physics RAS, Russia

Anomalous optical response for the metasurface fabricated from silicon resonators is investigated. Resonators have form of 3D micro cones - tips that are covered by semicontinuous silver film. Thus prepared metasurface exhibits anomalous optical response due to the excitation of metaldielectric resonances in visible and near IR spectral ranges. We investigate the effect of the "extraordinary" optical diffraction by tip-shaped metasurface. The multiple metal-dielectric resonances result in huge enhancement of the local electric field in-between metal particles placed on the surface of dielectric cones. SERS phenomenon is investigated by immobilization of DTNB (5,5'- dithio-bis-[2-nitrobenzoic acid]) molecules of on the metasurface.

- Coffee Break -

Location: Petrov-Vodkin 1 Room, 17:30 - 19:30

Photonics and nanobiotechnology VI

Session Chair: Andrey Sarychev,
Inst. for Theoretical and Applied Electrodynamics RAS, Russia

ThSMC-35 17:30-17:50

Connecting biochemistry and electronics with artificial allosteric protein biosensors *(Invited paper)*

Zh. Guo, J. Whitfield , S. Edwardraja, K. Alexandrov; Univ. of Queensland, Australia

The idea that biological systems can be built from standard components is the central tenet of Synthetic Biology. Although proteins control most of real time information and energy flow in a cell, our ability to create protein-based switches and thereon based circuits is woefully underdeveloped. We addressed this by developing a generally applicable strategy for converting constitutively active enzymes into allosterically controlled switches. This was achieved by constructing chimeric enzymes where the enzymatically active part is fused with a conformational switch. We demonstrated that such basic signaling units could be compiled into higher order biosensor systems capable of detecting potentially any analyte. Specifically using this approach we constructed electrochemical and optical biosensors specific to ions, small molecule drugs and proteins.

ThSMC-36 17:50-18:10

Prerequisites of human stress states diagnostics with the use of THz radiation *(Invited paper)*

E.E. Berlovskaya[1], A.S. Sinko[1], I.A. Ozheredov[1], T.V. Adamovich[1], E.S. Isaychev[1], S.A. Isaychev[1], O.P. Cherkasova[2], A.M. Makurenkov[1], A.M. Chernorizov[1], A.P. Shkurinov[1,3]; 1 - Lomonosov Moscow State Univ., 2 - Inst. of Laser Physics SB RAS, 3 - Crystallography and Photonics Federal Research Center RAS, Russia

Variations of psychophysiological characteristics, biochemical parameters and terahertz images of a human face were studied during the special test pass which modeled stress situations.

ThSMC-37 18:10-18:25

Laser correlation spectroscopy for immune testing

E.K. Nepomnyashchaya, E.N. Velichko, E.T. Aksenov, T.A. Bogomaz; Peter the Great St. Petersburg Polytechnic Univ., Russia

New results about the immune status of a human body estimation by dynamic light scattering (laser correlation spectroscopy) method are presented. A designed scheme of the laser correlation spectroscopy device allowed us to conduct measurements of blood proteins' sizes and dynamics under the influence of external factors. These results will be used for development of preliminary diagnosis of immune diseases.

ThSMC-38 18:25-18:40

New technology based on femtosecond optical lithography for fabrication of nanowire devices.

M.A.Tarkhov[1,2], N.V. Minaev[1], B.S.Shavkuta[1], A.M. Mumlyakov[2], A.V. Terentyev[2], Y.V. Anufriev[2], E.V. Zenova[2], and V. N. Bagratashvili[1]; 1 - Inst. of Photonic Technologies, FSRC, 'Crystallography and Photonics' RAS, 2 - Inst. of Nanotechnology and Microelectronics RAS, Russia

This report describes a new technology based on nonlinear femtosecond optical lithography for fabrication of nanowire devices. The nonlinear femtosecond optical lithography method allows the formation of planar structures with a spatial resolution of ~50 nm.

ThSMC-39 18:40-18:55

Designing a capacitive immunosensor for detection of hepatitis B surface antigen

E. Alipour[1], H. Ghourchian[1,2], S.L. Znoyko[3], P.I. Nikitin[3,4]; 1 - Univ. of Tehran, 2 - NBIC Research Center, Univ. of Tehran, Iran; 3 - Prokhorov General Physics Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia

A capacitive immunosensor for monitoring capacitance changes due to hepatitis B surface antigen (HBsAg) was designed. There are three factors affecting capacitive biosensors: surface area, distance between the capacitor electrodes and dielectric constant of the material between the electrodes. Our results indicate that the presence of HBsAg mostly affects the surface area of the capacitors and causes an increase in the capacitance. This method is simple, fast, low-cost, and the experiments were devoted to improvement of its accuracy and limit of detection. The results were achieved by developing a sandwich type immunoassay capacitor by using gold nanoparticles as amplifiers. The experiments were also conducted on accuracy enhancement by monitoring each step of the immunochemical reactions in real-time with new advanced optical methods and by using different designs of electrodes and magnetic nanoparticles.

ThSMC-40 18:55-19:10

Smart biolayers on solid phase: rational design and investigation by spectral-phase interferometry

A.V. Pushkarev[1,2], E.N. Mochalova[1,2], S.L. Znoyko[2], M.P. Nikitin[1], A.V. Orlov[1,2]; 1 - Moscow Inst. of Physics and Technology (State Univ.), 2 - Prokhorov General Physics Inst.RAS, Russia

Smart biomolecular layers, which enable/forbid binding of molecules depending on the presence in the microenvironment of certain analytes or ligands, have been self-assembled on solid phase. The spectral-phase interferometry was used for rational design of such layers, allowed estimation of kinetic parameters of reactions and determining the sensitivity of the smart layers to concentration of the ligands.

ThSMC-41 19:10-19:25

Novel wearable VCSEL-based blood perfusion sensor

E. Zherebtsov[1], S. Sokolovsky[1], V. Sidorov[2], I. Rafailov[4], A. Dunaev[3], E.U. Rafailov[1]; 1 - Aston Univ., UK; 2 - SPE "LAZMA" Ltd., Russia; 3 - Orel State Univ., Russia; 4 - Aston Medical Technology Ltd., UK

A wearable 850 nm VCSEL-based blood perfusion sensor operating on the principles of laser Doppler flowmetry (LDF) and Dynamic Light Scattering (DLS) has been developed and tested. The sensitivity of the sensor to changes in skin blood perfusion has been demonstrated.

SECTION D. PHOTODYNAMIC PROCESSES IN BIOLOGY AND MEDICINE

Location: Levinson Lounge, floor 2. 09:00 - 11:00

Photodynamic processes in biology and medicine I

Session Chair: Inna M. Belousova,
Vavilov State Optical Inst., Russia

ThSMD-01 09:00-09:20

Photochemical activity and luminescence of dissolved oxygen molecules upon direct laser excitation under ambient conditions. A review of currently available results *(Invited paper)*

A.A. Krasnovsky; Bach Inst. of Biochemistry RAS, Russia

The photochemical activities and luminescence of dissolved molecular oxygen upon direct laser excitation of the red, dark red and infrared oxygen spectral bands were studied using measurement of oxygenation rates of singlet oxygen traps and detection of IR (1270 nm) phosphorescence under ambient conditions. Summary of currently available results is presented. Biomedical importance of the data is discussed.

ThSMD-02 09:20-09:40

Targeted photodynamic therapy as potential treatment modality for cancer and cancer stem cells *(Invited paper)*

H. Abrahamse, N. Hodgkinson, C. Kruger; Univ. of Johannesburg, South Africa

Review focuses on photodynamic therapy treatments available for colorectal cancer and highlights proposed actively targeted photosynthetic drug uptake mechanisms specifically mediated towards colon cancer stem cells, as well as identify the gaps in research which need to be investigated in order to develop a combinative targeted photodynamic therapy regime that can effectively control colorectal cancer primary and metastatic tumour growth by eliminating colon cancer stem cells.

ThSMD-03 09:40-10:00

Therapeutic efficacy gains for rigorous treatment planning in Photodynamic Therapy *(Invited paper)*

L. Lilge; Univ. Health Network, Canada

Photodynamic Therapy, in contrast to standardized planning of ionizing radiation, is applied mostly on empirically derived protocols. Showed that compared to standard protocols the number of fibre sources can be reduced while achieving an equal or better coverage of a tumour. Additionally, the exposure of the host tissue is reduced by up to 50% and the light treatment time reduced by over 25%.

ThSMD-04 10:00-10:20

Experimental and clinical application of near-infrared fluorescence diagnostics and photodynamic therapy *(Invited paper)*

G.Papayan, A.Akopov, N.Petrishchev; Pavlov First State Medical Univ., Russia

We provide examples of fluorescence imaging techniques used during open and endoscopic surgery with Indocyanine Green as an NIR fluorescent dye, demonstrates applications of the technique for experimental and clinical purposes:for intraoperative imaging of bile ducts, blood and lymphatic vessels; for detection of tumours and sentinel lymph nodes; for assessment of tissue, organ, or anastomotic blood supply; its use in conjunction with photodynamic therapy (photodynamic theranostics).

ThSMD-05 10:20-10:40

Photodynamic therapy (PDT) in combined treatment of malignant tumours *(Invited paper)*

M.L. Gelfond, E.V. Levchenko, A.S. Barchuk, G.I. Gafton, V.V. Anisimov, I.A. Baldueva, O.YU. Mamontov, Yu.V. Semiletova, T.L. Nekhaeva, M.Yu. Myasnyankin; National Medical Research Center of Oncology, Russia

Based on clinical experience from 2000 to 2018, it should be concluded that photodynamic therapy is an effective component of combined treatment of some nosological forms of malignant neoplasms.

ThSMD-06 10:40-11:00

Cellular reactions of organic nanoparticles during PDT *(Invited paper)*

R.W. Steiner[1,4], C. Scalfi-Happ[1], Z. Zhu[1], A. Wiehe[2], A. Ryabova[3,4], V. Loschenov[3,4], R. Wittig[1]; 1 - Univ. Ulm, 2 - Biolitec Research GmbH, Germany; 3 - Natural Science Center of Prokhorov General Physics Inst. RAS, 4 - National Research Nuclear Univ. MEPhI, Russia

Organic crystalline nanoparticles (NPs) are not fluorescent due to the crystalline structure of the flat molecules organized in layers. For Aluminum Phthalocyanine (AlPc)-derived NPs, preferential uptake and dissolution by macrophages were demonstrated recently. Therefore, inflamed tissue or cancer tissue with accumulated macrophages (M1; M2 polarization state) may exhibit specific fluorescence in contrast to normal tissue, which does not fluoresce. The present study addresses the photo-biological effects of NP generated from the clinically utilized photosensitizer Temoporfin (mTHPC).

- Coffee Break -

Location: Levinson Lounge, floor 2. 11:30 - 13:30

Photodynamic processes in biology and medicine II

Session Chair: Alexandr A. Krasnovsky,
RAS - Federal Center for Biotechnology, Russia

ThSMD-07 11:30-11:50

A unique DDS for cancer chemotherapy with nanodiamond as drug carrier *(Invited paper)*

E. Osawa[1], D. Ho[2], E. Chou[3], A. Zarrinpar[4], H. Huang[5]; 1 - NanoCarbon Res. Inst., ,Japan; 2 - Dept. Bioeng. UCLA, USA; 3 - National Singapore Univ., Singapore; 4 - Dept. Surgery, UCLA, USA; 5 - Shanghai Inst. Eng., China

This is the first paper that introduces a new DDS using nanodiamond as drug carrier at the moment exclusively developed for cancer chemotherapy since 2007 by a small team of scientists in US, Singapore, China, and Japan. The development stage has just reached the first human clinical tests planned to start in early 2018.

ThSMD-08 11:50-12:10

Nanoparticle-based mTHPC delivery in the photodynamic therapy of cancer *(Invited paper)*

L. Bezdetnaya; Lorraine Univ., Inst. de Cancérologie de Lorraine, France

Application of meta-tetra(hydroxyphenyl)chorin (mTHPC) one of the most effective photosensitizer in photodynamic therapy of solid tumors encounters several complications resulting from its insolubility in aqueous medium. Various strategies of nanoparticles-based delivery of mTHPC were proposed to improve efficiency of mTHPC-PDT.

ThSMD-09 12:10-12:30

Biomedical image processing with thin films of bacteriorhodopsin for breast *(Invited paper)*

D.V.G.L.N. Rao; Univ. of Massachusetts Boston, USA

Real time medical image processing is demonstrated by recording and reconstructing transient photo isomerization grating formed in Bacteriorhodopsin films using transient Fourier Holography. Exploiting the fact that the diffraction efficiency of the grating is optimum when the intensity of the object and reference beams is matched, we are able to display micro calcifications in mammograms for possible early detection of breast cancer.

ThSMD-10 12:30-12:45

Effects of photodynamic treatment on mesenteric microvessels

T. G. Grishacheva[1,2], I. A. Mikhailova[1], A.I. Krivchenko[3], N. N. Petrishchev[1,2]; 1 - Pavlov First St. Petersburg State Medical Univ.; 2 - North-West Federal Medical Research Centre; 3 - Sechenov Inst. of Evolutionary Physiology and Biochemistry RAS, Russia

The photobiostimulation of rat microvessels caused by laser irradiation (λ = 532; 635 и 662 nm) and influence of photoactivated photosensitizers (Bengal Rose, Radachlorin, Coproporphyrin) on microvessel blood flow velocity are studied.

ThSMD-11 12:45-13:00

Luminescence properties of novel Phosphorus(V) porphyrin photosensitizers in solutions

I.V.Semenova[1], V.P.Belik[1], D.M.Beltukova[1], I.N. Meshkov[2], Yu.G. Gorbunova[2,3], O.S.Vasyutinskii[1]; 1 - Ioffe Inst. 2 - Frumkin Inst. of Physical Chemistry and Electrochemistry RAS; 3 - Kurnakov Inst. of General and Inorganic Chemistry RAS, Russia

Luminescence spectra of two novel P(V) porphyrin-based photosensitizers in aqueous and ethanol solutions were recorded in the visible and near IR spectral range. The singlet oxygen contribution into the luminescence signal was determined and singlet oxygen lifetimes were measured.

ThSMD-12 13:00-13:15

Studies of photophysical characteristics and in vitro photocytotoxicity of photosensitizer Dimegin

A.V. Dadeko[1], L. Lilge[2], P. Kaspler[3], I.M. Belousova[1], T.D. Murav'eva[1], A.M. Starodubtcev[1], V.M. Kiselev[1], I.V. Bagrov[1], G.V. Ponomarev[4]; 1 - Vavilov State Optical Inst., Russia; 2 - Princess Margaret Cancer Centre, Univ. Health Network and Department of Medical Biophysics Univ. of Toronto, 3 - Princess Margaret Cancer Centre, Univ. Health Network Toronto, Canada; 4 - Inst. of Biomedical Chemistry, Russia

In represented work was made a research of low-toxic photosensitizer Dimegin. Quantum yields of singlet oxygen generation, fluorescence and photobleaching of Dimegin were investigated. Photocytotoxicity was studied on four cell lines: U87, RG2, HT1372, AY27. Fluorescence microscopy images were used to detect the location and the luminescent intensity of Dimegin in cell cultures, used in photocytotoxicity study.

ThSMD-13 13:15-13:30

Photosensitized properties of tetraphenylporphyrins immobilized on calcium alginate aerogels in the photooxidation process

A.B.Solovieva[1], N.A.Aksenova[1], M.A.Savko[1], N.V.Menshutina[2], S.F.Timashev[1]; 1 - Semenov Inst. of Chemical Physics, 2 - Mendeleev Univ. of Chemical Technology, Russia

The photocatalytic systems based on tetraphenylporphyrins immobilized on calcium alginate solid gels in the conditions of thermal drying on air (xerogel), freeze drying in vacuum (cryogel) and supercritical drying in the supercritical carbon dioxide (aerogel) were prepared. As a test reaction to measure the prepared systems' efficiency, we studied the tryptophan photooxidation. It was shown the systems with aerogel exhibited the highest photocatalytic efficiency.

- Lunch Break -

Location: Levinson Lounge, floor 2. 15:00 - 17:00

Photodynamic processes in biology and medicine III

Session Chair: Lothar Lilge,
Princess Margaret Cancer Centre, Univ. of Toronto, Canada

ThSMD-14 15:00-15:20

Time-resolved spectroscopy and data mining techniques *(Invited paper)*

G. Ferrini; Univ. Cattolica del Sacro Cuore, Italy

The use of ultrafast optical techniques to study the dynamics of metallic nanostructures or aggregates of molecules of biological interest is briefly reviewed. The use of data mining analysis to discriminate samples with different properties, based solely on the experimental data and without previous knowledge of the sample properties is illustrated in selected examples. These analysis techniques are shown to have the potential to detect and characterize nanostructures in complex environments that are of interest in medicine and biology. Moreover, the use of surface sensitive optical techniques adds the possibility to enhance the detection of surface molecular complexes. Finally, the use of these optical techniques and the correlated analysis are discussed in the perspectives of real-world applications.

ThSMD-15 15:20-15:40

Multiphoton femtosecond laser spectroscopy of anisotropic molecular probes *(Invited paper)*

O.S. Vasyutinskii; Ioffe Inst., Russia

The talk reviews theoretical and experimental investigations of polarized fluorescence in anisotropic molecular probes excited via two-color two-photon transitions by femtosecond laser pulses. Investigation of polarized fluorescence from molecular probes imbedded into biological structures opens a new information channel on protein structure, folding, hydration, and the mechanisms of redox reactions in living organisms.

ThSMD-16 15:40-16:00

Structural pecularities of shungite nanocarbon hybrids in dispersions and films *(Invited paper)*

N.N. Rozhkova[1], A.S. Goryunov[2], A.G. Borisova[2], A.O. Kucherik[3], S.S. Rozhkov[1]; 1 - Inst. of Geology Karelian Research Center RAS, 2 - Inst. of Biology Karelian Research Center RAS, 2 - Vladimir State Univ., Russia

The stable dispersions of the hybrid shungite carbon (ShC)-Me(Ag, Au) nanoparticles were produced in water dispersions of ShC nanoparticles and corresponding metals affected by laser impulses of various durations. Films, occurring as periodic structures that contain graphene-like carbon without a hydration constituent, are formed upon condensation of such dispersions.

ThSMD-17 16:00-16:15

Comparitive accumulation study of chlorin group photosensitizers on monolayer and multicellular tumor spheroids of cell culture.

D.S. Farrakhova[1,2], I.V. Yakavets[3,4,5], V.B. Loschenov[1,2], L.N. Bolotine[4,5], V.P. Zorin[3,6]; 1 - National Research Nuclear Univ. «MEPHI», 2 - Prokhorov General Physics Inst. RAS, Russia; 3 - Belarusian State Univ., Belarus; 4 - Univ. de Lorraine, France; 5 - Inst. de Cancérologie de Lorraine, France; 6 - Belarusian State Univ., Belarus

The comparitive analisys of the new photosensitizer for photodynamic therapy were conducted for increasing of oncological diseases effecient treatment.

ThSMD-18 16:15-16:30

Thin photocatalytic and bactericidal coatings based on carbon or metal oxide nanoparticles

S.K. Evstropiev[1], A.V.Karavaeva[2], K.V. Dukelskii[1,3], K.S. Evstropyev[1], E.V. Kolobkova[1], I.M. Belousova[4], V.M. Kiselev[4], N.V. Nikonorov[1]; 1 - ITMO Univ., 2 - St. Petersburg State Chemical-Pharmacy Academy, 3 - Bonch-Bruevich State Univ. of Telecommunications, 4 - Vavilov State Optical Inst., Russia

The application of liquid polymer-salt method allows to form transparent oxide coatings on the glass surface. Prepared coatings are thin (200-250 nm) and uniform and fully cover the glass surface. Experimental data show that these coatings consist of small (10-20 nm) nanocrystals. Transparent nanocoatings demonstrate high bactericidal properties and the ability to generate singlet oxygen under UV irradiation.

ThSMD-19 16:30-16:45

Application of Ugleron® as a new means for laser and microwave hyperheat therapy

A.N. Ponomarev; Peter the Great St. Petersburg Polytechnic Univ., Russia

The virulicidal ability of Ugleron (one of sulfo-adducts of the car-bon clusters) against AIDS was first founded in 2010 [1]. It was discovered now that laser or microwaves irradiation of the Ugleron can be used as a hyper heat therapy against oncology diseases.

ThSMD-20 16:45-17:00

Laser structuring protein biostructures with carbon nano frame for bone & cartilage cells proloferation

A.Yu.Gerasimenko[1], O.E.Glukhova[2], M.M.Slipchenkov[2], V.M.Podgaetsky[1]; 1 - National Research Univ. of Electronic Technology, 2 - Saratov State Univ., Russia

The results of biostructures formation based on carbon nano frame in a protein matrix are presented. The binding mechanism of single-walled carbon nanotubes under the influence of laser radiation is described. The energy change during the formation of the nano frame covalent bonds reaches -7.36 eV/atom. Experiments on growing bone and cartilage tissue cells on samples were conducted.

- Coffee Break -

Location: Levinson Lounge, floor 2. 17:30 - 19:15

Photodynamic processes in biology and medicine IV

Session Chair: Natalia N. Rozhkova,
Inst. of Geology Karelian Research Center RAS

ThSMD-21 17:30-17:45

Investigations of layers of composite nanomaterials upon exposure laser radiation

L.P. Ickitidze[1], A.Yu.Gerasimenko[1], V.M. Podgaetsky[1], S.V. Selishchev[1], A.A. Dudin[2], A.A. Pavlov[2]; 1 - National Research Univ. of Electronic Technology, 2 - Inst. of Nanotechnology of Microelectronics RAS, Russia

The layers (thickness 0.3-100 μm) of composite nanomaterials in the matrix of collagen (CG) and filler of single-walled carbon nanotubes (SWCNT) are studied. The layers were prepared by applying an aqueous dispersion of CG/SWCNT (~1 wt.% CG, 0.1 wt.% SWCNT, remaining water) on the substrates by silk-screening and evaporation of the liquid part under normal conditions or under the action of laser radiation (LR). It is established that the density ρ and the specifice conductivity σ of the layers change under the action of LR. It is predicted that the obtained values of ρ≈1.4÷1.9 g/cm3 and σ ~10-1÷102 S/m are acceptable for the use of CG/SWCNT layers in medical applications.

ThSMD-22 17:45-18:00

Study of new infrared photosensitizers for photodynamic inactivation of pathogenic bacteria based on synthetic bacteriochlorin derivatives

E.V. Akhlyustina[2], G.A. Meerovich[1,2], I.G. Tiganova[3], E.A. Makarova[4], N.V. Alekseeva[3], N.I. Philipova[3], E.A. Lukyanets[4], Yu.M. Romanova[3], V.B. Loschenov[1,2]; 1 - Prokhorov General Physics Inst. RAS, 2 - National Research Nuclear Univ. «MEPHI», 3 - Gamaleya Research Inst. of Epidemiology and Microbiology, 4 - Organic Intermediates and Dyes Inst., Russia

Cationic bacteriochlorin derivatives which molecules differing by lipophilicity and positive charge degree have been investigated in vitro as photosensitizers for photodynamic inactivation of biofilm bacteria.

7 June, Thursday

ThSMD-23 18:00-18:15

Controlled chemical modification of biomolecules by femtosecond laser in polar liquids

V. Gruzdev[1], D. Korkin[2], B.P. Mooney[3,4,7], J.F. Havelund[5,6], I.M. Møller[5], J.J. Thelen[4,7]; 1 - Univ. of Missouri; 2 - Worcester Polytechnic Inst.;[3,] 4 - Univ. of Missouri, USA; 5 - Aarhus Univ., 6 - Univ. of Southern Denmark, Denmark; 7 - Univ. of Missouri, USA

Permanent chemical modifications of peptides and human insulin by ultrashort laser pulses in room-temperature polar liquids have highly nonlinear scaling with laser intensity. Mass spectroscopy analysis of the products obtained in several liquids, including isotope marked liquids, and in argon atmosphere suggest strong participation of dissolved air oxygen and interaction of the biomolecules with laser-modified molecules of the liquids.

ThSMD-24 18:15-18:30

Laser fiber optic equipment for embedding video photodynamic diagnostic and therapy control features into standard surgical instruments

M.V. Loshchenov[1], T.A. Savelieva[1], D.A. Golbin[2], K.G. Linkov[1], V.B. Loschenov[1]; 1 - Prokhorov General Physics Ins. RAS, 2 - Federal State Autonomous Inst. «Burdenko National Scientific and Practical Center for Neurosurgery» of the Ministry of Healthcare of the Russian Federation, Russia

Novel equipment for surgery navigation thru photodynamic diagnosis is presented with laser fluorescence excitation and dual channel video registration. This equipment could be incorporated in a standard surgery tool like aspirator canule. It is based on fiberoptic endoscope with special channels for laser illumination in red and blue spectral ranges and video head based on two spectrally-resolved cameras.

ThSMD-25 18:30-18:45

All optical detection for Photo-acoustic imaging

W.-I. Lin, M. Pollard, M. Lassen; Danish Fundamental Metrology, Denmark

Infrared microscopy is a method of choice for label free mapping of biomarkers leading to automated histopathology. However, infrared microscopy image acquisition speed is slow and offers limited spatial resolution. We address these limitations by using a photoacoustic method and present a novel and very sensitive method for measuring the acoustic and ultrasonic waves by using an all optically detection method using a probe laser and an interferometric readout.

ThSMD-26 18:45-19:00

Laser-assisted pore formation in tissues

O.I. Baum; Inst. Photonic Technologies of Federal Scientific Research Centre "Crystallography and Photonics" of RAS, Russia

Theoretical model predicting the optimal laser setting for modification of tissue shape and structure has been developed in application for three new laser methods: normalization of intraocular pressure in glaucomatous eyes; correction of eye cornea shape and refraction; laser reshaping of rib cartilage for larynx stenosis surgery.

ThSMD-27 19:00-19:15

Method of laser-induced fluorescent diagnostics of enamel microcracks using aluminum phthalocyanine nanoparticles

J.O. Zolotareva (Kuznetsova)[1], V.B. Loschenov[1,2]; 1 - National Research Nuclear Univ. MEPhI, 2 - Prokhorov General Physics Inst. RAS, Russia

In this paper the method of fluorescence diagnostics (FD) of tooth enamel using aluminum phthalocyanine nanoparticles and sur-factant for identify enamel microcracks of enamel and pathogenic microflora accumulation has been presented.

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AZIMUTH PHOTONICS specializes in the distribution and promotion of leading international manufacturers' optoelectronic components on the Russian market. Our company is actively involved in the development new projects with OEMs and research organizations. Our aim is introduction of state-of-the-art technologies and innovative solutions in the field of optoelectronics into production to encourage development and support projects of Russian OEM companies.

We supply optoelectronic components such as X-ray modules, photodiodes, photomultiplier tubes, detectors, CCD/CMOS, IR arrays, IR emitters, scintillation materials, laser diodes and laser modules, DPSS lasers.

We have strong long term relations with manufacturers of optoelectronic components as Cobolt, Omicron-Laserage, Frankfurt Laser Company, Pd-LD, Picoquant, Becker&Hickl, Laser Components GmbH, Thorlabs and many others.

LASER CENTER Ltd., RUSSIA

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LASER CENTRE is a manufacturer of modern laser machines and technologies. We offer a variety of cutting edge solutions for many purposes, such as engraving, cutting, marking and welding. Our products are successful among thousands of companies and are used all around the world every day by professionals working in various environments.

The current selection of our products was developed to fulfill numerous demands of our customers, from standard engraving and marking to more specific tasks which require utmost precision. The systems are perfectly suitable even for designing medical instruments, large machinery and the tiniest mechanical components.

MAIMAN ELECTRONICS LLC, RUSSIA

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Maiman Electronics LLC specializes in development and manufacturing Laser Diode Drivers. Our main product line:

SF6XXX – powerful OEM CW compact Laser Diode Driver;

SF8XXX – ultra-compact OEM driver for butterfly Laser Diode;

MBLXXXX – benchtop laser power supply for laboratory applications;

SF6XXX and SF8XXX ultra-compact and highly reliable solutions that can be easily integrated into the customers laser system. This makes Maiman Electronics LLC an important partner for companies across various industries – for example, material processing, medical equipment, laser measurement equipment applications and ect.

Benchtop solution MBLXXXX perfect fits scientific research and laser diode burn-In/life time tests. Benchtop MBLXXXX has modifications with TEC controllers and laser diode mounts.

OJSC "PLANT "OPTIC", BELARUS

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We are the largest optical cobmpany located in Lida, Republic of Belarus. Founded in 1970 the plant has established a reputation as a reliable manufacturer and supplier of high quality optical parts. The Quality Management System is functioned in the company in conformity with requirements of ISO 9001:2008.

The main kinds of products:

- optical parts: lenses, prisms, mirrors, plates, tubes, rods;
- fiber optics: faceplates and elements, tapers, lighting bundles;
- laser active elements from monocrystals of potassium gadolinium tungstate, activated by neodymium (Nd:KGW);
- medical devices: mineral spectacle lenses, three-mirror and four-mirror ophthalmological lenses, lenses for indirect ophthalmoscopy, sciascopy folders, mirror ophthalmoscopes;
- demonstration sets on physics for educational organizations.

We manufacture the products in accordance with technical requirements and specifications of the customer.

We will be glad to cooperate with you!

QD LASER, INC., JAPAN

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QD Laser, Inc. is a leading provider of high-performance semiconductor lasers and epitaxial wafers. The lasers are made on GaAs platform with the state-of-the-art epitaxial growth technologies of Quantum dot/well and design abilities of wafer, chip and package for industrial and data communication application. We are planning to display as follows:

532 - 594 nm laser for light source for biomedical equipment

640 nm-940 nm laser for various sensors

1064 nm laser for precision processing

1310 nm Quantum dot laser for Si photonics

High quality epitaxial wafers of Quantum dot/well

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Photonics Laboratories is a company that develops and produces lasers for wide range of applications. The company has started with flashlamp pumped medical lasers and achieved good results in the development of ultra-compact high-energy devices. Also top energies for long pulse Nd:YAG and Alexandrite lasers were obtained. As a next step a line of Nd:YAG Q-switched products were launched with pulse energy up to 2 Joules. At this moment the company has turned to diode-pumped solid state lasers for medical, industrial and special use. Picosecond laser technologies were also introduced into production.

OES SPECPOSTAVKA, RUSSIA

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OES Specpostavka is a specialized distributor of electronic components, microwave and HF components, measurement and optical equipment, photonics. Line-card of optics and photonics includes laboratory equipment, components for fiber lasers, communication, microwave photonics, plug and play laser systems, measurement and test equipment.

OES Specpostavka is an official representative of leaders of industry: Lightcomm, BWT Beijing, II-VI Laser Enterprise, Focuslight, Crytur, Castech, Oxxius, NKT Photonics, Menlo Systems, Apex Technologies.

Crytur (Czech Republic) is a booth co-exponent and one of the world's leading companies in synthetic crystal manufacturing and processing with a strong focus on niche applications and client specific projects built on high expertise and close cooperation in research and development

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TYDEX is a private company founded in 1994 in St. Petersburg by former scientists from the Ioffe Physical-Technical Institute of the Russian Academy of Sciences. The company specializes in custom manufacturing of optical components and instruments for research and the industry, including spectroscopy, pyrometry and thermography, THz photonics, sensors and detectors, metrology, lasers, and more.

Application wavelengths range from DUV to VIS, NIR, MIR, and MM waves (THz), depending on the materials used, component shapes, coatings, and instruments. Our R&D department develops THz components, devices and instruments which are then produced in-house. We also cooperate closely with state optics manufacturing enterprises and research institutes.

We ensure full spectrophotometer control from DUV to 3000 microns as well as interferometer control. Strict quality assurance is conducted with the use of autocollimators, MTF measuring equipment, environmental and other testing instruments.

VICON STANDA, RUSSIA

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For more than 25 years we have successfully presented opto-mechanical equipment of company Standa to research laboratories and industry in Russia.

You can find more than 3000 items in our catalogue, including optical tables, opto-mechanics, motorized positioners, lasers and other optical laboratory equipment.

We have successfully implemented over 1000 projects since we started representing Standa. We are currently in relationship with leading Russian universities and companies: Lomonosov Moscow State University, Moscow State Technical University n.a. N.E. Bauman, Ioffe Physical Technical Institute and many others.

LASERS AND OPTICAL SYSTEMS, RUSSIA

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LOS is an industrial company producing the solid state laser systems. We combine the science and the industrial experience to meet the consumer demand and to innovate the cutting-edge technologies into the commercial products. We produce the diode pumped solid state lasers, eye-safe lasers, environmental lidars and other laser systems. Over 20 years we are on the market and our brand is well known both in Russia and abroad.

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B.I. Stepanov Institute of Physics is well-known leader in the field of laser physics and techniques in Belarus with over 50-year history. Since 1997 much attention in the Institute is devoted to development, manufacturing and investigations of diode-pumped solid state lasers. As a result a group of highly qualified scientists, designers and engineers ready for practical realization of different customized diode pumped solid state laser systems was formed.

We produce eye-safe pulsed erbium glass lasers for wide temperature range, diode-pumped Nd:YAG and Nd:YVO4 lasers, optical parametric oscillators. Our own mechanical and optical departments enable manufacturing of lasers with required characteristics in the shortest time periods.

Author	Paper code
Aadhi, A.	WeR11-09
Abakshonok, A.V.	TuR9-18
Abdullina, S.R.	TuR1-14
Abdulrazak, S.H.	ThR3-p39
Abdulrazak, S.H.	ThR3-p43
Abrahamse, H.	ThSMD-02
Abushkin, I.A.	TuSMA-08
Abushkin, I.A.	WeSMA-22
Adamenkov, Yu.A.	ThR2-p13
Adamovich, T.V.	ThSMC-36
Adler, G.	ThR8-38
Afanasev, K.N.	ThSMC-23
Afanasev, K.N.	ThSMC-34
Afanasiev, A.V.	TuR5-p27
Afanasyev, K.N.	TuR9-p36
Afinogenov, B.I.	WeR3-15
Afonenko, A.A.	TuR3-08
Afonin, M.V.	WeSMC-p06
Agafonova, D.	TuR9-09
Agafonova, S.	WeR11-07
Agapov, D.	WeR11-p06
Agapov, D.	WeR8-p19
Agaptseva, O.V.	TuSMB-p12
Aglyamov, R.D.	ThR4-p10
Aglyamov, R.D.	ThR4-p21
Agrusov, P.M.	ThR8-41
Agruzov, P.M.	TuR9-p12
Agruzov, P.M.	WeR11-02
Aimukhanov, A.K.	TuR9-p07
Akentiev, A.S.	WePD-04
Akhlyustina, E.V.	ThSMD-22
Akhmadullin, R.M.	ThR2-p35
Akhmatkhanov, A.	WeR1-23
Akhmatkhanov, A.R.	ThR3-p39
Akhmedzhanov, T.	TuR5-05
Akhtyamov, O.R.	ThR1-40
Akimov, A.V.	TuR9-p29
Akimov, A.V.	TuR9-p41
Akimov, A.V.	WeR11-p02
Akimov, A.V.	WeR11-p07
Akimov, A.V.	WeR11-p08
Akimov, A.V.	WeR8-p53
Akkuzina, A.A.	TuR9-p06
Akkuzina, A.A.	TuR9-p28
Akmalov, A.E.	WeR7-03
Akopov, A.	ThSMD-04
Aksenov, E.T.	ThSMC-37
Aksenov, E.T.	TuSMB-p14
Aksenov, E.T.	WeR8-p40
Aksenov, E.T.	WeSMC-13
Aksenov, V.P.	ThR4-p02
Aksenova, K.	ThR4-27
Aksenova, N.A.	ThSMD-13
Aladov, A.V.	ThR3-p22
Alagashev, G.K.	TuR8-06
Albrecht, M.	ThR8-24
Aleinik, A.S.	ThR8-41
Aleksandrov, I.	ThR3-p18
Aleksandrova, P.V.	TuSMB-12
Alekseev, D.A.	WeR1-26
Alekseev, S.V.	WeR2-16
Alekseeva, N.V.	ThSMD-22
Alexandrov, K.	ThSMC-35
Aleynikov, M.S.	WeR8-p52
Ali, N.	TuSMB-10
Alibart, O.	WeR11-01
Aliev, I.N.	ThSMC-18
Aliev, Yu. M.	WeR5-13
Aliev, Yu.M.	TuR5-p13
Alimov, O.K.	WeR1-p41
Alimov, O.K.	WeR8-p11
Alimpiev, S.	WeSMA-23
Alipour, E.	ThSMC-39
Alipour, E.	WeSMC-p15
Alkhimova, M.A.	WeR5-12
Almuneau, G.	ThR3-p05
Alodjants, A.P.	WeR11-p01
Alodjants, A.P.	WeR8-p06
Aloian, G.A.	ThR2-p26
Aloian, G.A.	ThR2-p27
Aloian, G.A.	TuSMA-04
Aloian, G.A.	WeSMA-18
Alonso, E.T.	TuR9-20
Altshuler, G.	TuSMP-01
Altshuler, G.B.	TuSMA-04
Altshuler, G.B.	TuSMA-11
Altshuler, G.B.	WeSMA-18
Altshuler, G.B.	WeSMA-20
Altshuler, G.B.	WeSMA-24
Altshuler, G.B.	WeSMA-26
Alu, A.	TuR9-11
Alves, F.	WeSMC-04
Alvi, M.M.	WeR3-11
Alyabyeva, Zh. Yu.	TuSMB-p12
Alyshev, S.V.	ThR1-36
Ambartsumyan, D. M.	ThR4-p17
Amelin, K.S.	WeR7-12
Amouroux, M.	WeSMB-15
Ananich, T.S.	WeSMD-p10
Ananich, T.S.	WeSMD-p13
Anashkina, E.A.	ThR1-37
Anashkina, E.A.	ThR8-23
Anashkina, E.A.	WeR1-p25
Anchugova, A.E.	TuSMB-14
Anderson, M.	WeR11-06
Andersson-Engels, S.	TuSMB-03
Andersson-Engels, S.	WeSMA-17
Andreev, A.	TuR5-p10
Andreev, A.	TuR5-p18
Andreev, A.A.	TuR5-p01
Andreev, A.A.	TuR5-p08
Andreev, A.A.	TuR5-p15
Andreev, N.E.	WeR5-14
Andreev, Yu.M.	ThR7-p19
Andreev, Yu.M.	WeR8-p08
Andreev, Yu.M.	WeR8-p09
Andreev, Yu.M.	WeR8-p13
Andreeva, E.V.	ThR3-p01
Andreeva, V.	WeR8-12
Andreeva, V.A.	ThR8-46
Andreeva, V.A.	WeR5-16
Andrekson, P.A.	WeR11-08
Andrianov, A.V.	ThR8-23
Andrianov, A.V.	TuR8-03
Andrianov, A.V.	TuR8-10
Andronaki, S.A.	TuR9-p26
Angelis, C. De	ThR3-33
Angelov, I.	WeSMB-29
Anguluan, E.	TuSMB-p05
Anikeev, A.S.	ThR3-p01
Anisimov, V.V.	ThSMD-05
Ansari, M. A.	TuSMB-p07
Ansari, M.A.	TuSMB-p04
Ansari, M.A.	WeSMB-20
Antipov, A.	TuR9-10
Antipov, A.G.	WeR8-p04
Antipov, O.	WeR1-23
Antipov, O.A.	WeR4-10
Antipov, O.L.	TuR1-02
Antipov, O.L.	TuR1-04
Antipov, O.L.	WeR1-26
Antonov, E.N.	TuSMA-p03
Antonov, V.	TuR5-05
Antonov, V.A.	TuR5-p19
Antoshin, A.A.	TuSMA-p06
Antoshin, A.A.	TuSMA-p07
Antoshkin, L.V.	ThR4-p19
Antropov, A.A.	WeR1-32
Anufriev, Y.V.	ThSMC-38
Aperanza, G.	WeSMB-22
Aprelev, A.V.	ThR4-p15
Arakawa, Yasuhiko	MoPL-03
Arakelian, S.	TuR9-10
Arakelian, S.	TuR9-p35
Arakelian, S.M.	TuR9-p32
Arakelian, S.M.	WeR8-p06
Arakelian, S.M.	WeR8-p41
Arhipova, V.A.	WeSMA-26
Arkhipkin, V.G.	WeR8-21
Arkhipov, D.A.	WeR6-06
Arkhipov, M.V.	ThR8-26
Arkhipov, M.V.	ThR8-27
Arkhipov, M.V.	WeR8-p51
Arkhipov, R.M.	ThR8-26
Arkhipov, R.M.	ThR8-27
Arkhipov, R.M.	WeR8-p51
Arkhipova, V. A.	WeSMA-25
Arkhipova, V.A.	WeSMA-20
Armstrong, C.	TuR5-10
Arteev, D.S.	WeR3-21
Artemina, E.M.	TuSMB-p20
Artemov, S.A.	TuSMA-p08
Artyukov, I.A.	TuSMB-p13
Artyukov, I.A.	WeSMA-19
Aseev, V.	ThR4-p08
Aseev, V.A.	ThR2-p01
Aseev, V.A.	WeR1-p24
Aseev, V.A.	WeR1-p44
Aslanyan, A.E.	WeR8-p18
Asryan, L.V.	ThR3-p31
Asryan, L.V.	WePD-02
Astaf'ev, A.A.	TuSMA-02
Astapenko, V.A.	TuR5-p25
Astapenko, V.A.	WeR8-p02
Astapovich, M.S.	ThR8-25
Astapovich, M.S.	TuR8-06
Auslender, I.	TuR2-01
Auslender, I.	TuR2-02
Avakyan, L.A.	TuR9-p39
Avakyants, L.P.	WeR8-p18
Averkiev, N.S.	ThR3-p15
Avetisov, R.I.	TuR9-p06
Avetisov, R.I.	TuR9-p28
Avetissov, I.Ch.	TuR9-p03
Avetissov, I.Ch.	TuR9-p06
Avetissov, I.Ch.	TuR9-p27
Avetissov, I.Ch.	TuR9-p28
Avetissov, I.Ch.	TuR9-p38
Avramov, L.	WeSMB-16
Avramov, L.	WeSMB-19
Avrutin, E.A.	ThR3-34
Avtaeva, S.V.	WeR5-17
Aybush, A.V.	TuSMA-02
Ayt, A.O.	WeR8-p67
Azarova, V.V.	ThR4-p31
Azina, L.V.	TuR9-20
Azyazov, V.N.	ThR2-p07
Azyazov, V.N.	TuR2-06
Azyazov, V.N.	TuR2-11
Azyazov, V.N.	TuR2-12
Babenyshev, A.V.	ThSMC-25
Babenyshev, A.V.	WeSMC-p07
Babichev, A.V.	ThR3-p32
Babichev, A.V.	ThR3-p35
Babin, S.A.	ThR1-49
Babin, S.A.	ThR2-32
Babin, S.A.	TuR1-14
Babin, S.A.	WeR5-30
Babkin, K.D.	ThR2-p06
Babkin, K.D.	ThR2-p10
Babkin, K.D.	ThR4-p09
Babkina, A.	ThR4-p08
Babkina, A.	TuR9-09
Babkina, A.N.	WeR8-p73
Baburin, A.S.	TuR9-p36
Babushkin, I.	ThR8-26
Babushkin, I.	WeR8-12
Babushkin, I.	WeR8-p51
Badikov, D.V.	TuR2-09
Badikov, V.V.	TuR2-09
Bae, J.	WeSMB-33
Bagayev, S.	WeR2-22
Bagayev, S.N.	ThR8-39
Bagayev, S.N.	WeR1-24
Bagayev, S.N.	WeR1-p31
Bagayev, S.N.	WeR5-26
Bagratashvili, V. N.	ThSMC-38
Bagratashvili, V.N.	TuSMA-05
Bagratashvili, V.N.	TuSMA-p04
Bagratashvili, V.N.	TuSMA-p05
Bagratashvili, V.N.	WeSMA-14
Bagratashvili, V.N.	WeSMA-15
Bagrov, I. V.	ThR4-17
Bagrov, I.V.	ThSMD-12
Bahriz, M.	WeR3-23
Bai, Z.	WePD-05
Baidakova, M.V.	TuR10-15
Bakal, A.A.	WeSMC-09
Bakhvalov, K.V.	ThR3-p45
Bakoz, A.P.	ThR3-29
Bakulin, A.	WeR3-18
Balabanov, S.	ThR1-45
Balabanov, S.S.	ThR2-p24
Balabanov, S.S.	TuR1-04
Balakin, A.	WeSMB-26
Balakin, A.A.	TuR5-03
Balakin, A.A.	TuR8-02
Balakin, A.V.	WeR8-13
Balakin, M.I.	ThR3-p40
Balbekin, N.S.	WeSMC-p06
Balberg, M.	TuSMB-08
Baldueva, I.A.	ThSMD-05
Baldycheva, A.	ThR4-13
Baldycheva, A.	TuR9-20
Balle, S.	TuR3-03
Balmashnov, R.V.	WeR1-p20
Balmashnov, R.V.	WeR4-08
Balslev-Harder, D.	WeR7-06
Barachevsky, V.A.	WeR8-p67
Baranov, A. N.	WeR3-13
Baranov, A.I.	ThR2-33
Baranov, A.N.	WeR3-23
Baranov, K.	TuSMA-p10
Baranov, M.A.	TuSMB-p14
Baranov, M.A.	WeR8-p40
Baranov, V.E.	WeR5-14
Barantsev, K.A.	WeR8-p57
Baranyai, P.	ThSMC-22
Barchuk, A.S.	ThSMD-05
Bardakova, K.N.	TuSMA-p17
Barkanov, A.D.	TuR9-p38
Barke, V.V.	WeR7-08
Barmashenko, B.D.	TuR2-01
Barmashenko, B.D.	TuR2-02
Barmashenko, B.D.	TuR2-03
Barnea, I.	TuSMB-08
Bartulevičius, T.	WeR1-27
Bartulevičius, T.	WeR1-p33
Bartulevičius, T.	WeR2-25
Baryshev, A.V.	TuR9-p36
Baryshev, V.N.	WeR8-p52
Bashkatov, A. N.	WeSMB-37
Bashkatov, A.N.	TuSMB-p06
Bashkatov, A.N.	TuSMB-p11
Bashkatov, A.N.	TuSMB-p21
Battiato, S.	TuR9-06
Baty, D.	WeSMC-04
Baum, O.I.	ThSMD-26
Baum, O.I.	WeSMB-35
Baum, O.I.	WeSMB-39
Bazhenova, A.S.	WeSMC-p10
Beaudoin, G.	WeR3-19
Bekker, T. B.	WeR8-p13
Belashov, A.V.	ThSMC-31
Belashov, A.V.	WeSMC-p14
Belcov, S.A.	ThR2-29
Belcov, S.A.	ThR2-p03
Belenky, G.	WeR3-26
Belessa, J.	WeR3-17
Belik, V.P.	ThSMD-11
Belikov, A.V.	TuSMB-13
Belina, E.	WeSMC-05
Beloborodov, V.V.	ThR7-p06
Beloglazova, N.V.	TuR9-p08
Belousova, I.M.	ThSMD-12
Belousova, I.M.	ThSMD-18
Belousova, I.M.	WeSMD-p01
Beloysova, I. M.	ThR4-17
Beltukova, D.M.	ThSMD-11
Belyaev, A.N.	TuSMA-p08
Belyaev, A.N.	WeSMD-p08
Belyaev, V.V.	TuR9-p22
Belyaeva, T.N.	ThSMC-31
Belyaeva, T.N.	WeSMC-11
Belyaeva, T.N.	WeSMC-p10
Belyakov, V.A.	TuR9-01
Belyi, V.N.	ThR4-20
Benali, A.	ThSMC-28
Bendersky, G.P.	WeR4-07
Benditkis, A.S.	WeSMD-p02
Benisty, H.	TuR3-01
Berdnikov, Y.	TuR9-07
Berdnikov, Y.S.	TuR9-p22
Berlovskaya, E.E.	ThSMC-36
Beshplav, S.-I.T.	TuSMB-12
Beshplav, S.-I.T.	TuSMB-p08
Beshplav, S.T.	TuSMB-p09
Beshplav, Sh.-I.T.	WeSMB-25
Bespalov, V.G.	ThR7-14
Bespalov, V.G.	ThR7-p10
Bespalov, V.G.	TuR9-20
Bespalov, V.G.	WeR2-27
Bespalov, V.G.	WeR8-p50
Bespalov, V.G.	WeR8-p72
Bespalov, V.G.	WeSMC-p14
Bessonov, E.G.	WeSMA-19
Bezdetnaya, L.	ThSMD-08
Bezpaly, A.D.	WeR8-p24
Bibikova, O.	TuSMB-10
Bienaimé, T.	WeR8-p22

Bikbaev, R.G. WeR8-21
Bilenko, I. A. WeR11-p04
Bilenko, I.A. TuR8-07
Billet, C. TuR8-04
Bityurin, N.M. TuR5-p27
Blin, S. WeR3-19
Blinov, I.Y. WeR8-p52
Blokhin, S.A. TuR9-01
Blondel, W. WeSMB-15
Blondel, W. WeSMB-36
Bobkov, K.K. TuR1-19
Bobretsova, Yu.K. ThR3-p04
Bobrov, M.A. TuR9-01
Bobrovnikov, S.M ThR7-17
Bobrovnikov, S.M. WeR7-02
Bobtsov, A.A. ThR7-14
Bobylev, D.A. TuR5-p09
Bochkarev, S.G. WeR5-15
Bochkov, A.V. WeR1-p07
Bochkov, A.V. WeR1-p08
Bock, M. WeR2-15
Bodrov, S. WeR5-25
Bodrov, S.B. WeR8-p26
Bodrova, A.A. WeSMB-29
Bogachev, V.A. ThR4-p30
Bogdanov, A.A. TuR9-p30
Bogdanov, O.V. TuR10-04
Boginskaya, I.A. ThSMC-23
Boginskaya, I.A. ThSMC-34
Bogomaz, T.A. ThSMC-37
Boissier, G. WeR3-23
Bokov, P.Yu. WeR8-p18
Bolotine, L.N. ThSMD-17
Bolshedvorksii, S. WeR11-p08
Bolshedvorskii, S.V. TuR9-p29
Bolshedvorskii, S.V. TuR9-p41
Bolshedvorskii, S.V. WeR11-p07
Bondarenko, A.L. WeR8-p07
Bonn, M. TuR3-07
Bonora, S. WeR4-04
Boreysho, A. WeR7-05
Borisenko, G. G. TuSMA-p02
Borisenko, T.E. TuR1-09
Borisenko, T.E. TuSMA-p13
Borisenko, T.E. WeR2-24
Borisov, E.N. ThR4-27
Borisov, E.N. WeR8-p25
Borisova, A.G. ThSMD-16
Borisova, E. WeSMB-16
Borisova, E. WeSMB-19
Borisova, E. WeSMC-05
Borisova, E.G. WeSMB-29
Borodkin, A.V. TuSMB-p18
Borot, A. TuR5-01
Borovkova, M.A. TuSMB-p15
Boruleva, E.A. TuR9-p13
Borvinskaya, E. ThSMC-21
Borzilov, A.G. ThR4-p19
Bougrov, V.E. ThR3-p43
Bougrov, V.E. TuR9-01
Bouhelier, A. TuR9-p43
Boulley, L. WeR3-24
Boursier, C. WeR7-09
Bouscher, S. ThR8-38
Bousseksou, A. WeR3-24
Boyd, R.W. WeR8-p39
Boyko, A. WeR1-23
Boyko, A.A. ThR8-42
Bragina, V.A. ThSMC-20
Bragina, V.A. WeSMC-06
Bragina, V.A. WeSMC-p04
Bragina, V.A. WeSMC-p15
Bramati, A. WeR8-p22
Brantov, A. WeR5-18
Brantov, A.V. TuR5-p02
Brantov, A.V. TuR5-p13
Brantov, A.V. TuR5-p24
Brantov, A.V. WeR5-13
Bratashov, D.N. ThSMC-29
Bratashov, D.N. ThSMC-30
Bratashov, D.N. ThSMC-30
Brinkmann, R. TuSMA-27
Brodbeck, S. ThR8-38
Broslavets, Yu. Yu. ThR4-p17
Brunkov, P.N. TuR10-15
Brunner, Ch. WeR8-p67
Brusch, A. WeR7-06
Brynsev, A. TuSMA-p09
Brynsev, A. TuSMA-p10
Brynsev, A.V. TuSMA-p14
Brynsev, A.V. WeSMD-p07
Bubnov, M.M. TuR1-19
Buchenkov, V. WeR1-p15
Buchenkov, V. WeR1-p16
Buchenkov, V.A. WeR1-p13
Budrigă, M. TuR5-11
Budrigă, O. TuR5-11
Bufetov, I.A. ThR8-25
Bufetov, I.A. TuR8-06
Bugaev, L.A. TuR9-p39
Bugrov, A.E. ThR8-43
Bugrov, V.E. ThR3-p15
Bugrov, V.E. ThR3-p22
Bugrov, V.E. ThR3-p37
Bugrov, V.E. ThR3-p39
Bukharin, A.V. WeR7-10
Bukharin, A.V. WeR7-11
Bukharin, M.A. WeR5-29
Bukharina, A. WeSMA-23
Bukin, V.V. ThR7-p07
Bukin, V.V. WeR5-16
Bukin, V.V. WeR5-27
Bulanov, A.V. ThR7-p09
Bulatov, K.M. ThR4-p22
Bulgakova, N.N. WeSMB-18
Bunkin, A.F. WeR7-07
Bunkin, A.F. WeR8-13
Burdonov, K. WePD-03
Burdonov, K.F. WeR5-21
Burimov, N.I. ThR4-22
Burke, R. WeSMA-17
Burmistrova, N.A. TuR9-p23
Bushukina, O.S. WeSMD-p08
Butler, N.M.H. TuR5-10
Butnaru, D.V. TuSMA-p04
Butnaru, D.V. TuSMA-p06
Butov, O. V. TuR8-08
Butusov, L.A. TuR9-p13
Buzelis, R. ThR4-15
Buzelis, R. ThR4-p24
Bychenkov, V. WeR5-18
Bychenkov, V.Yu. TuR5-08
Bychenkov, V.Yu. TuR5-p02
Bychenkov, V.Yu. TuR5-p13
Bychenkov, V.Yu. TuR5-p21
Bychenkov, V.Yu. TuR5-p24
Bychenkov, V.Yu. WeR5-13
Bychenkov, V.Yu. WeR5-15
Bychkov, A. S. ThR8-28
Bychkov, I.N. ThR2-33
Bychkov, V.V. ThR7-16
Bykov, A. ThSMC-21
Bykov, A.A. ThR4-p22
Bykov, I.V. ThSMC-23
Bykov, I.V. ThSMC-34
Bykovskaia, E.A. ThR7-p12
Bykovsky, N.E. ThR1-38
Bzheumikhov, K.A. ThR3-p42
Camelin, P. TuR3-03
Cánovas, E. TuR3-07
Cao, H. WeR2-13
Cao, M. ThR8-40
Capdessus, R. TuR5-10
Carabaș, M. TuR5-11
Carletti, L. ThR3-33
Carneiro, I. WeSMB-37
Carvalho, S. WeSMB-37
Castellano-Hernández, E. ThR1-35
Castellano-Hernández, E. ThR1-39
Celebrano, M. ThR3-33
Cerutti, L. WeR3-23
Chames, P. WeSMC-04
Chamorovskiy, A.Yu. ThR3-p01
Chamorovskiy, Y.K. TuR8-08
Chandrasekar, R. WeR8-p74
Chang, T.-Y. TuR9-02
Chapman, H. N. TuR10-09
Chaves, P. WeR7-04
Chegnov, V.P. ThR3-p14
Chegnova, O.I. ThR3-p14
Chekalin, S.V. WeR8-p37
Chekhonin, V.P. WeSMC-12
Chekhov, A.L. TuR9-p36
Chekhova, M.V. TuR1-11
Chelushkin, D. M. TuSMP-05
Chen, H. WeSMB-36
Chen, S.N. WePD-03
Chen, Y. ThR8-46
Chen, Zh. WeR11-10
Cheng, C.L. TuSMB-10
Cheng, Ch.-L. WeSMB-22
Cheptsov, V.S. TuSMA-p05
Cheremisin, A.A. ThR7-16
Cheremkhin, P.A. ThR4-24
Cherenkov, A.V. ThR3-p03
Cherepenin, V.A. WeR8-p55
Cherepetskaya, E. B. ThR8-28
Cherkasov, V.R. ThSMC-19
Cherkasov, V.R. ThSMC-25
Cherkasov, V.R. WeSMC-p07
Cherkasov, V.R. WeSMC-p11
Cherkasova, O.P. ThSMC-26
Cherkasova, O.P. ThSMC-36
Cherkasova, O.P. TuSMB-p15
Cherkasova, O.P. WeSMB-27
Cherkassky, V.S. TuR10-12
Cherkesova, E.V. ThR3-p30
Chernishov, K.A. TuSMP-05
Chernomyrdin, N.V. ThR4-p01
Chernomyrdin, N.V. TuR3-09
Chernomyrdin, N.V. TuSMA-p16
Chernomyrdin, N.V. TuSMB-p08
Chernomyrdin, N.V. TuSMB-p09
Chernomyrdin, N.V. WeR8-p30
Chernomyrdin, N.V. WeSMB-25
Chernomyrdin, N.V. WeSMB-31
Chernorizov, A.M. ThSMC-36
Chernov, M.Yu. WeR3-25
Chernova, E.O. ThR8-43
Chernutsky, A.O. ThR7-18
Chernyakov, A.E. ThR3-p22
Chertoriyskiy, A.A. ThR4-23
Chervyakov, A.V. WeR8-p18
Cheshev, E. ThR2-35
Cheshev, E.A. ThR1-38
Chestnov, I.Yu. WeR11-p01
Chiappini, A. ThR1-43
Chichkov, B.N. ThR1-38
Chichkov, B.N. WeSMB-32
Chichkov, N.B. WePD-01
Chichkov, N.B. WeR3-20
Chichkov, N.B. WeR3-26
Chin, S.L. ThR8-46
Chipouline, A. ThR3-p40
Chipouline, A. WeR8-p68
Chistiakov, D.V. ThR3-p15
Chistyakov, A.A. TuR9-12
Chistyakov, A.A. WeR7-03
Chistyakov, D.V. ThR3-p37
Chistyakov, D.V. ThR3-p43
Chistyakov, V.V. ThR7-14
Chistyakov, V.V. WeR8-p72
Chizhevsky, V.N. ThR3-p08
Chizhevsky, V.N. ThR3-p12
Chizhov, P.A. ThR7-p07
Chizhov, P.A. WeR5-16
Chizhov, P.A. WeR5-27
Chizhov, S. ThR2-p14
Chizhov, S.A. WeR1-p45
Chkalov, R.V. ThR3-p36
Chkalov, R.V. WeR8-p16
Chkalov, R.V. WeR8-p41
Cho, D. WeSMB-33
Choi, D.-H. WeSMB-33
Choi, K.Y. WeSMB-24
Choi, S.Y. WeR1-p52
Chomet, B. WeR3-19
Choporova, Yu.Yu. TuR10-12
Chou, E. ThSMD-07
Choudhary, S. WeR8-p39
Chu, S.T. WeR11-09
Chuang, You-Lin WeR8-p06
Chubchenko, Y. ThR7-p14
Chubchenko, Y. WeSMC-p08
Chubchenko, Y.K. ThR7-p06
Chubykin, A.A. WeR6-04
Chubykin, A.A. WeR6-07
Chuchelov, D.S. ThSMC-17
Chudesnikov, N.M. WeSMA-26
Chudinova, G.K. TuR9-p13
Chudnovskii, V.M. TuSMA-05
Chukichev, M.V. ThR3-p14
Chulkov, R. WeR1-p01
Chunaev, D.S. WeR8-p44
Churbanov, S.N. TuSMA-p04
Churbanov, S.N. TuSMA-p06
Churbanov, S.N. TuSMA-p07
Churbanov, S.N. TuSMA-p17
Churbanova, E.S. TuSMA-p05
Churbanova, E.S. WeSMA-15
Churkin, D.S. TuR2-08
Chursinova, Y.V. TuSMB-p01
Chutko, E.A. TuSMA-p05
Chvykov, V. WeR2-13
Ciriolo, A. G. WeR4-04
Cirlin, G.E. TuR9-05
Coen, S. WeR11-06
Colombelli, R. WeR3-24
Conforti, M. TuR8-05
Cong, Z.H. TuR1-10
Copie, F. TuR8-05
Cousin, J. WeR7-08
Craciun, M.F. TuR9-20
Crowe, J.A WeSMB-32
Cui, Q. ThR2-p34
Czitrovszky, A. ThSMC-22
Czitrovszky, A. TuSMA-06
Czitrovszky, A. WeSMC-p09
Czitrovszky, A. WeSMD-p11
d'Humières, E. TuR5-11
Dadeko, A.V. ThSMD-12
Dadoenkova, Y. TuR9-p33
Dadoenkova, Y. WeR8-p48
Dai, J.F. WeR8-p09
Dalacu, D. WeR11-03
Dance, R. J. TuR5-10
Danilevicius, R. WeR1-p33
Daniliuk, H.A. ThR4-20
Danilov, O.B. WeR2-27
Danilov, V.V. ThR4-17
Danilov, V.V. ThR4-p05
Darvin, M.E. TuSMB-09
Dashkevich, V.I. ThR1-39
Dashkevich, V.I. WeR1-24
Datskevich, N.P. TuR9-p27
Datskevich, N.P. TuR9-p38
Daul, C. WeSMB-36
Davtian, A.S. WeR1-p20
Davtian, A.S. WeR6-08
Davydov, N.N. ThR4-p07
Davydov, N.N. ThR4-p07
Davydov, V.A. TuR9-p29
Davydov, V.A. WeR1-30
Davydov, V.V. ThR3-p06
Davydov, V.V. ThR3-p21
Davydov, V.V. ThR6-p02
Dawson, M.D. ThR3-27
Day, P.J.R. WeSMC-02
Dedova, V.V. ThR3-p40
Delconte, A. WeSMB-15
Delconte, A. WeSMB-36
Demesh, M.P. ThR1-39
Demidov, V.V. WeSMB-42
Demin, A. WeR11-p06
Demircan, A. WeR8-12
Demirchyan, S.S. WeR11-p01
Demkin, A.S. WeR2-19
Dempsey, E. TuSMB-03
Dems, M. ThR3-p05
Denis, A.G. WeSMA-22
Denisov, L.K. WeR1-30
Denisov, L.K. WeR1-31
Denker, B.I. WeR1-p22
Denker, B.I. WeR1-p38
Denker, B.I. WeR1-p46
Dergachenko, A.V. WeSMA-21
Derkach, I.N. ThR2-29
Derkach, I.N. ThR2-p03
Derkach, V.N. ThR2-29
Derkach, V.N. ThR2-p03
Dernovich, O.P. WeR1-p53
Deryagin, N.G. ThR3-p43
Devarapu, G. C.R. ThR3-29
Devetta, M. WeR4-04
Deyev, S.M. WeSMC-p13
Deyev, S.M. WeSMD-p15
Diagtereva, E.N. ThR4-17
Dianov, E.M. ThR1-36
Dianov, E.M. TuSMA-03
Dianov, E.M. WeR3-20
Dmitriev, A.K. ThR3-p27
Dmitriev, I.V. WeR1-p03

Dmitriev, P.S. ThR3-36
Dmitriev, S.P. ThSMC-17
Dmitrieva, N.I. WeR8-p31
Dobysh, I.I. WeSMD-p10
Docherty, K.E. WePD-01
Dolganova, I.N. TuSMA-p16
Dolganova, I.N. TuSMB-12
Dolganova, I.N. TuSMB-p09
Dolganova, I.N. WeSMB-31
Dolgopolov, Yu.V. ThR4-p02
Dolotova, E.P. TuR9-p27
Dolotova, E.P. TuR9-p38
Donchenko, E.K. WeR7-07
Dong, N. ThR4-14
Donodin, A.I. WeR1-29
Dormidonov, A.E. WeR1-p40
Dormidonov, A.E. WeR8-p37
Dorofeev, A.G. WeSMD-p07
Dorofeev, V.V. ThR1-37
Dorofeeva, E.V. TuSMB-p10
Doroganov, S.V. TuSMA-p12
Doroganov, S.V. WeR1-p51
Doroshenko, D.V. TuR5-p28
Doroshenko, M.E. TuR1-07
Doroshenko, M.E. WeR1-p23
Doroshenko, M.E. WeR1-p41
Doroshenko, M.E. WeR1-p46
Dostovalov, A.V. ThR1-49
Dostovalov, A.V. ThR2-32
Dostovalov, A.V. TuR1-14
Dostovalov, A.V. WeR5-30
Dover, N.P. WeR5-12
Dovzhenko, D.S. TuR9-12
Drachev, V. P. ThSMC-24
Drakin, A.E. TuR2-07
Dresvyansky, V.P. ThR8-43
Drobyshev, R.V. ThR1-50
Drong, M. WeR3-14
Drouhin, H. J. WeR3-14
Drozd, D.D. WeSMC-09
Drozdov, A.A. WeR8-p39
Drozdov, D.S. WeSMD-p07
Druginin, P. J. WeR8-p32
Druzhinin, P.J. WeR8-p10
Druzhinin, P.Ya. WeR1-p51
Dubiel, M. TuR9-p39
Dubin, S.A. WeSMA-21
Dubov, A.V. TuR5-p20
Dubov, A.V. WeR5-23
Dubov, V.V. TuR5-p09
Dubov, V.V. TuR5-p12
Dubov, V.V. TuR5-p14
Dubov, V.V. TuR5-p28
Dubrovskii, V. G. TuR10-11
Dubrovskii, V.G. TuR9-03
Dubrovskii, V.G. TuR9-04
Dubrovskii, V.G. TuR9-06
Dubrovskii, V.G. TuR9-07
Dubrovskii, V.G. TuR9-p19
Dubyanskaya, E.N. TuSMA-p16
Dudelev, V.V. ThR3-p37
Dudelev, V.V. ThR3-p38
Dudelev, V.V. ThR3-p39
Dudelev, V.V. ThR3-p43
Dudenkova, V.V. TuSMB-05
Dudin, A.A. ThSMD-21
Dudkin, V.I. ThR3-p21
Dudley, J.M. TuR8-04
Dukelskii, K.V. ThSMD-18
Dunaev, A. ThSMC-41
Dunaeva, E.E. WeR1-p46
Dunina, E.B. TuR9-p15
Dürr, H. TuR10-14
Dürr, H.A. TuR10-13
Durry, G. WeR7-08
Dvoretckaia, L.N. TuR9-p30
Dvoretskiy, D.A. WeR1-30
Dvoretskiy, D.A. WeR1-31
Dvornikova, M.A. TuSMA-p14
Dvoryanchikova, M.A. WeSMD-p08
Dyachkov, N.V. WeSMA-19
Dyachuk, L.I. TuSMB-p16
Dyankov, G. WeSMC-05
Dymov, A.M. TuSMA-13
Dymshits, O. ThR1-45
Dymshits, O. TuR9-p40
Dzhagarov, B.M. WeSMC-p02
Dzhagarov, B.M. WeSMD-p06
Dzhidzhoev, M.S. TuR5-p11
E, Yiwen WeR8-p50
Edwardraja, S. ThSMC-35
Efendiev, T.Sh. WeSMC-p17
Efimova, K.V. ThR4-16
Efimova, K.V. WeR1-p19
Efremov, V.P. TuR5-p06
Eggleton, B.J. WeR11-05
Egorov, A.Yu. ThR3-p32
Egorov, A.Yu. ThR3-p35
Egorov, N.A. TuR1-05
Egorov, V.I. ThR7-14
Egorova, O.N. ThR2-32
Egorova, O.N. TuR8-03
Egorova, O.N. WeR1-p38
Elandaloussi, H. ThR7-p02
Elandaloussi, H. WeR7-09
Elbakidse, A.V. ThR7-p18
El-Desouki, M. WeR1-p01
Eliava, Sh.Sh. TuSMP-05
Elistratova, A.A. ThR8-44
Elizarov, V. ThR7-p05
Elizarov, V. ThR7-p15
Elizarov, V. ThR7-p16
Elizarov, V. WeSMC-p08
Elizarov, V.V. ThR7-p10
Elizarov, V.V. WeR2-27
Elokhin, V.A. ThSMC-27
Elsaesser, Th. WeR2-15
Elshaari, A.W. WeR11-03
El-Tamer, A. WeSMB-32
Emons, M. TuR10-02
Endo, M. TuR2-04
Enikeev, D.V. TuSMA-10
Epikhin, V.M. ThR4-p15
Eranov, I.D. TuR1-02
Eranov, I.D. TuR1-04
Eravuchira, P. Ja. TuSMB-08
Ercolani, D. TuR9-06
Eremeev, A. WePD-03
Eremin, S.A. WeSMC-10
Eriksson, T.A. WeR11-08
Erkintalo, M. WeR11-06
Ermak, S.V. WeR8-p43
Ermakov, A.A. ThR7-p04
Ermolinskiy, P.B. TuSMB-p16
Esaulkov, M. WeR8-12
Esenaliev, R. TuSMA-01
Evlashin, S.A. TuR9-14
Evlashin, S.A. WeR8-21
Evlyukhin, A. ThR1-38
Evstropiev, S.K. ThSMD-18
Evstropyev, K.S. ThSMD-18
Evtichiev, N. TuSMP-01
Evtikhiev, V.P. ThR3-p23
Evtikhiev, V.P. ThR3-p28
Evtushenko, E.G. ThSMC-23
Ezhov, D.M. WeR8-p13
Fadeev, D.A. WeR8-17
Faenov, A.Y. TuR10-03
Faenov, A.Ya. WeR5-12
Fainberg, B.D. ThR8-30
Farrakhova, D.S. ThSMD-17
Farukhshin, I.I. WeR1-p18
Farukhsin, I.I. WeSMD-p12
Favero, I. ThR3-33
Fedorin, V.L. WeR8-p59
Fedorov, I.K. WeR1-p44
Fedorov, P.P. ThSMC-32
Fedorov, P.P. TuR9-22
Fedorov, P.P. TuR9-p21
Fedorov, S.V. ThR8-32
Fedorov, S.V. ThR8-33
Fedorov, S.V. WeR8-p23
Fedorov, Yu. ThR4-p08
Fedorova, K.A. ThR3-32
Fedorova, K.A. ThR3-p37
Fedorova, K.A. WePD-06
Fedorova, Yu.O. WeSMD-p04
Fedoseyev, V.N. WeR4-12
Fedyakov, M.D. TuSMA-p07
Fefelov, A.G. TuR9-01
Fefelova, E.L. TuR9-01
Feidenhans'l, Robert MoPL-02
Felgen, N. TuR9-15
Feng, Q. WeR8-p09
Feng, W. WeSMB-36
Fernandes, L. WeR7-04
Ferrari, M. ThR1-43
Ferrini, G. ThSMD-14
Feshchenko, R.M. ThR4-p20
Feshchenko, R.M. WeSMA-19
Feyter, S. De WeSMC-02
Filatova, S.A. WeR1-33
Filonenko, E.V. TuSMP-02
Finazzi, M. ThR3-33
Firsov, D.D. WeR3-25
Firsov, K.N. ThR2-p23
Firsov, K.N. ThR2-p24
Firsov, K.N. ThR2-p25
Firsov, K.N. WeR1-p40
Firsov, K.N. WeR2-21
Firstov, S.V. ThR1-36
Fisch, N.J. TuR5-03
Fisher, C. WeSMA-17
Flach, S. WeR11-10
Fofanov, Ya. TuR9-p11
Fognini, A. WeR11-03
Fomichev, A. A. ThR4-p17
Fomicheva, L.A. TuR9-p15
Fomicheva, Ya. Yu. WeR8-p67
Fomkina, Z.V. WeR8-p59
Fontaine, Q. WeR8-p22
Fördös, T. WeR3-14
Fotiadi, A.A. TuR8-08
Fraiman, G.M. TuR5-03
Francaviglia, L. TuR9-p19
Frank, M. WeR8-p14
Friedl, M. TuR9-p19
Frolov, M.P. ThR1-46
Frolov, M.P. ThR1-47
Frolov, M.P. TuR1-02
Frolov, S.A. ThR2-31
Frolov, S.A. WeR5-26
Frolov, Yu.N. TuR1-05
Frolov, Yu.N. TuR1-06
Frolovtsev, D. WeR8-p19
Frueh, J. WeSMC-03
Fuchs, J. TuR5-07
Fuchs, J. WePD-03
Fuchs, J. WeR5-22
Fujita, E. TuR1-01
Fukuda, Y. TuR10-03
Fukuda, Y. WeR5-12
Fülöp, A. WeR11-08
Fürjes, P. WeR8-p49
Gaafar, M. WeR3-11
Gabitov, I. WeR8-p68
Gacheva, E.I. TuR5-p29
Gafton, G.I. ThSMD-05
Gagarskiy, S.V. ThR2-p35
Gagarskiy, S.V. WeR1-p51
Gagarskiy, S.V. WeR8-p32
Gagarskiy, S.V. WeR8-p67
Gagarsky, S.V. WeR8-p10
Gai, M. WeSMC-03
Gaidash, A.A. ThR7-14
Gailevicius, D. WeR8-20
Gaimard, Q. TuR3-01
Galagan, B.I. WeR1-p22
Galagan, B.I. WeR1-p38
Galagan, B.I. WeR1-p46
Galaktionov, I. ThR4-p23
Galaktionov, I. WeR4-03
Galaktionov, I.V. ThR2-34
Galanzha, E.I. ThSMC-30
Galanzha, E.I. TuSMB-01
Galashov, E.N. WeR1-p39
Galiev, G.B. ThR3-p24
Galiev, R. ThR3-p13
Galiulin, M.Y. WeSMA-22
Gamaly, E.G. WeR5-24
Gamayunov, S. WeSMB-17
Gamov, N.A. ThR3-p20
Gao, Y. WeR6-01
Gao, Yu. TuR9-17
Gaponenko, M. TuR1-18
Gapontsev, V. TuSMP-01
Garasev, M.A. WeR5-20
Gareev, G.Z. WeSMC-p06
Gareev, K.G. WeSMC-p06
Garmatina, A.A. TuR5-p22
Garnache, A. WeR3-19
Garnov, S.V. ThR7-p07
Garyutkin, V.A. TuR1-05
Gavdush, A.A. TuSMB-p09
Gavrilova, O.A. WeSMA-22
Gavrina, P.S. ThR3-p25
Gavrina, P.S. ThR3-p29
Gavrina, P.S. ThR4-p16
Gavrishchuk, E. ThR1-45
Gavrishchuk, E.M. ThR2-p22
Gavrishchuk, E.M. ThR2-p23
Gavrishchuk, E.M. ThR2-p24
Gavrishchuk, E.M. ThR2-p25
Gavshina, A.V TuSMB-07
Gelfond, M.L. ThSMD-05
Gelikonov, G.V. WeSMB-39
Gelikonov, G.V. WeSMB-42
Genina, E. A. WeSMB-37
Genina, E.A. TuSMB-p06
Genina, E.A. TuSMB-p11
Genina, E.A. WeSMB-20
Genova, Ts. WeSMB-19
Genova-Hristova, Ts. WeSMB-16
Genty, G. TuR8-04
Georgieva, A.O. WeSMC-p06
Gerasimenko, A.S. TuR1-07
Gerasimenko, A.S. WeR1-p23
Gerasimenko, A.Yu. ThR4-p11
Gerasimenko, A.Yu. ThSMD-20
Gerasimenko, A.Yu. ThSMD-21
Gerasimenko, A.Yu. TuR9-p42
Gerasimenko, A.Yu. TuSMB-p22
Gerasimenko, A.Yu. WeSMC-p16
Gerasimenko, A.Yu. WeSMD-p04
Gerasimenko, A.Yu. WeSMD-p05
Gerasimenko, Ya. TuR10-14
Gerke, M.N. ThR3-p36
Gerken, M. WeR3-16
Ghanbari, S. WePD-06
Ghildina, A.R. ThR2-p05
Ghirardini, L. ThR3-33
Ghourchian, H. ThSMC-39
Ghourchian, H. WeSMC-p15
Ghysels-Dubois, M. WeR7-08
Gilevich, S.N. WeSMC-p02
Gili, V. ThR3-33
Gill, V.V. ThR7-p03
Ginzburg, V. WePD-03
Ginzburg, V.N. WeR5-21
Giudici, M. TuR3-03
Gladilin, A.A. ThR3-p14
Gladkiy, V.Y. ThR2-29
Gladkiy, V.Y. ThR2-p03
Gladkova, N.D. WeSMB-34
Gladskikh, I.A. TuR9-p16
Gladskikh, I.A. TuR9-p31
Gladskikh, P.V. TuR9-p31
Gladyshev, A.G. ThR3-p32
Gladyshev, A.G. ThR3-p35
Gladyshev, A.V. ThR8-25
Gladyshev, A.V. TuR8-06
Gladyshev, N.I. ThR3-p20
Gladysz, S. WeR4-01
Glagolev, N.N. WeSMC-p12
Gleim, A.V. ThR7-14
Gleim, A.V. WeR8-p72
Glorieux, Q. WeR8-p22
Glukhova, O.E. ThSMD-20
Gochelashvili, K.S. ThR8-29
Gochelashvili, K.S. WeR8-p58
Golbin, D.A. ThSMD-24
Golovan, O.A. TuSMB-p14
Golovin, N.N. ThR3-p27
Golovin, N.N. WeR8-p31
Golovin, P.A. ThR2-p06
Golovin, P.A. ThR2-p10
Golovin, V.S. ThR3-p25
Golovin, V.S. ThR3-p29
Golovin, V.S. ThR3-p45
Golubev, Yu.M. WeR8-p23
Golubeva, T.Yu. WeR8-p23
Golyaev, Yu.D. ThR6-p01
Golyeva, E.V. WeR7-13
Goncalves, M. ThSMC-15
Goncharov, P.A. ThR2-p30
Goncharov, P.A. ThR2-p31
Goncharov, P.A. ThR2-p32
Goncharov, S.E. WeSMD-p02
Goncharov, Yu.G. ThR3-p07
Gorbachenya, K.N. WeR1-25
Gorbatova, N. TuSMA-p09
Gorbatova, N. TuSMA-p10

Gorbatova, N.E. TuSMA-p14
Gorbatova, N.E. WeSMD-p07
Gorbunkov, M.V. WeSMA-19
Gorbunova, Yu.G. ThSMD-11
Gordeev, A.O. ThR1-51
Gordeev, N.Yu. ThR3-30
Gordeev, N.Yu. ThR3-31
Gordeev, N.Yu. WeR3-12
Gordienko, V.M. ThR1-46
Gordienko, V.M. TuR5-p11
Gorelik, V.S. WeR8-p15
Goriev, O.G. WeR1-p27
Gorieva, V.G. TuR9-22
Gorieva, V.G. WeR1-p02
Gorieva, V.G. WeR1-p05
Gorin, D.A. ThSMC-30
Gorkun, A.A. TuSMA-07
Gorkun, A.A. TuSMA-09
Gorlachuk, P.V. ThR3-p26
Gorlenko, M.V. TuSMA-p05
Gorlenko, M.V. WeSMA-15
Gorlov, E.V. ThR7-17
Gorlov, E.V. WeR7-02
Gorlova, D. WeR5-18
Gorlova, D.A. TuR5-p02
Gorlova, D.A. TuR5-p16
Gorodetsky, A. WeR3-18
Gorodetsky, A. WeR8-15
Gorodetsky, M. WeR11-07
Gorodetsky, M. L. WeR11-p04
Gorodetsky, M.L. ThR3-p03
Gorodetsky, M.L. ThR3-p11
Gorodetsky, M.L. ThR3-p13
Gorodetsky, M.L. ThR8-31
Gorodetsky, M.L. TuR8-07
Gorodetsky, M.L. WeR11-04
Gorodnichev, D.M. WeR8-p43
Gorodnitskii, A.S. WeR11-04
Gorodnitskiy, A. WeR11-07
Gorodnitskiy, A.S. ThR3-p11
Gorodnitskiy, A.S. WeR11-p04
Gorshkov, A.N. WeSMC-p06
Gorshkov, B.G. ThSMC-20
Gorshkov, B.G. WeSMC-06
Gorshkov, B.G. WeSMC-p04
Gorshkov, B.G. WeSMC-p11
Goryachev, I.S. WeSMB-28
Goryacheva, I. Y. TuR9-p10
Goryacheva, I.Y. TuR9-p08
Goryacheva, I.Y. TuR9-p23
Goryacheva, I.Yu. TuR9-p09
Goryacheva, I.Yu. WeSMC-09
Goryacheva, I.Yu. WeSMC-p03
Goryacheva, O.A. TuR9-p08
Goryacheva, O.A. WeSMC-09
Goryajnov, S.A. TuSMB-p18
Goryajnov, S.A. TuSMP-05
Goryaynov, S.A. TuSMB-p09
Goryaynov, S.A. WeSMB-25
Goryunov, A.S. ThSMD-16
Gospodinov, G. WeR5-18
Gostev, P. WeR11-p06
Gotlib, V.A. ThSMC-27
Goulain, P. WeR3-24
Gould, .J. WeSMC-03
Goulding, D. ThR3-36
Gouzien, E. WeR11-01
Gozhev, D. WeR5-18
Gozhev, D. A. TuR5-p24
Grabtchikov, A.S. WeR1-p24
Grachev, P.V. ThSMC-32
Grachev, P.V. ThSMC-33
Grachev, Ya.V. TuR9-20
Grachev, Ya.V. WeSMB-28
Grafenstein, L. von WeR2-15
Gray, R. J. TuR5-10
Grebenik, E.A. TuSMA-p04
Grebenikova, N.M. ThR6-p02
Grebenshchikova, E. A. WeR3-13
Grechin, S.G. WeR8-p07
Grechin, S.G. WeR8-p08
Grechin, S.G. WeR8-p09
Grechin, S.G. WeR8-p10
Grechin, S.G. WeR8-p32
Grechko, M. TuR3-07
Grechnikov, A. WeSMA-23
Grechukhin, I.A. WeR6-09
Green, J.S. TuR5-10
Greene, B. WeR6-01
Gric, T. WeR8-p01
Griebner, U. WeR2-15
Griffiths, A.D. ThR3-27
Grigireva, M.V. TuR9-p15
Grigorenko, A.N. WeSMC-02
Grigorenko, K. ThR1-45
Grigorenko, K. TuR9-p40
Grigoriev, A.M. ThR3-p30
Grigorievsky, V.I. ThR7-p18
Grimellet, L. WeR5-22
Grinchenko, V.D. TuSMA-p04
Grinevičiūtė, L. ThR4-15
Grinevičiūtė, L. ThR4-p24
Grishacheva, T. G. ThSMD-10
Grishin, E.A. WeR6-09
Grishin, M.Ya. ThR7-p07
Grishkanich, A. ThR7-p05
Grishkanich, A. ThR7-p14
Grishkanich, A. ThR7-p15
Grishkanich, A. WeR8-p21
Grishkanich, A. WeSMC-p08
Grishkanich, A.S. ThR7-p10
Grishkanich, A.S. WeR2-27
Gröbner, J. ThR7-p02
Gröbner, J. WeR7-09
Gromova, T.N. WeSMA-21
Gromovyih, T.I. TuSMA-p06
Gronin, S.V. ThR3-p20
Gruzdev, V. ThSMD-23
Grygoryev, K. WeSMA-17
Grzanka, S. WePD-01
Gubaidullin, A. R. WeR3-17
Gubaydullin, A.R. ThR3-35
Gubaydullin, A.R. WeR8-22
Gubin, K.V. WeR5-17
Gubin, M.A. ThR4-p32
Gugin, P.P. ThR2-p33
Guha, S. ThR8-42
Guina, M. WeR3-10
Gulyaev, P. Y. WeSMD-p09
Gumenyuk, R. WeR3-20
Güniat, L. TuR9-p19
Guo, Zh. ThSMC-35
Gureeva, I.A. WeR6-07
Guretsky, S.A. WeR1-p53
Gurfinkel, Y.I. TuSMB-09
Gurfinkel, Yu.I. TuSMB-p16
Gurkov, A. ThSMC-21
Guryanov, A.N. ThR1-36
Guryanov, A.N. TuR1-19
Gusakova, N.V. WeR1-24
Gusakova, N.V. WeR1-p52
Guseva, Y. WeR3-15
Gushchina, E.V. TuR9-p17
Guteneva, N.V. ThSMC-20
Guteneva, N.V. WeSMC-p04
Guyader, L. Le TuR10-14
Gwak, J. WeSMB-24
Gyulkhandanyan, A.G. WeSMD-p06
Gyulkhandanyan, G.V. WeSMD-p06
Ham, J. WeSMB-33
Han, K.Ch. TuR5-05
Hanna, M. WeR1-28
Havelund, J.F. ThSMD-23
Hawkes, S. J. TuR5-10
Hayat, A. ThR8-38
Heaven, M.C. ThR2-p05
Heaven, M.C. TuR2-06
Hegarty, S. ThR3-29
Hegay, A.M. ThR7-p04
Heigl, M. ThR8-24
Heinz, M. TuR9-p39
Helm, M. TuR10-06
Henrique, R. WeSMB-37
Heo, D. ThR2-p14
Herrmann, I. WeSMD-p14
Herrnsdorf, J. ThR3-27
Heuer, A. M. ThR1-35
Higginson, A. TuR5-10
Hill, E.J. WeSMB-32
Himics, L. ThSMC-22
Himics, L. TuR9-15
Hirsch, S WeR8-p21
Ho, D. ThSMD-07
Hodgkinson, N. ThSMD-02
Hoefling, S. ThR8-38
Hogg, R. TuR3-06
Homola, Jiri WeSMC-01
Hopper, T. WeR3-18
Hovhannesyan, K.L. TuR1-16
Hu, L.-X. TuR5-p03
Huang, H. ThSMD-07
Huang, J. ThR4-14
Huang, J.J. WeR8-p09
Huang, K. ThR8-40
Huang, L. ThR8-34
Huffaker, D.L. TuR9-02
Hunger, J. TuR3-07
Iadanza, S. ThR3-29
Iamatina, S.V. WeSMA-21
Ibrayev, N. TuR9-p20
Ibrayev, N.Kh. TuR9-p07
Ichkitidze, L.P. WeSMD-p05
Ickitidze, L.P. ThSMD-21
Iglev, H. WeR5-28
Iglev, H. WeR8-p67
Ignatenkov, B. TuR9-p11
Ihleman, J. TuR9-p39
Ikonnikov, V.B. ThR2-p23
Ikonnikov, V.B. ThR2-p24
Ikonnikov, V.B. ThR2-p25
Ilchenko, S.N. ThR3-p01
Ilday, F.Ö. ThR1-48
Ilichev, I.V. WeR11-02
Il'ichev, I.V. ThR8-41
Ilin, V.A. TuR9-p32
Ilina, I.V. TuSMA-07
Ilina, I.V. TuSMA-09
Inubushi, Y. TuR10-03
Ionel, L.E. TuR5-11
Ionin, A.A. ThR2-p11
Ionin, A.A. ThR7-p19
Ionin, A.A. TuR2-07
Ionin, A.A. TuR2-09
Ionin, A.A. TuR2-10
Ionin, A.A. TuR5-p26
Ionin, A.A. WeR5-31
Ionin, A.A. WeR8-p45
Isaev, A.A. TuSMA-12
Isaev, V.A. TuR8-08
Isaeva, A.A. ThR7-p08
Isaeva, A.A. TuSMB-p20
Isaeva, E.A. ThR4-p06
Isaeva, E.A. TuSMB-p20
Isakova, A.A. ThR3-p27
Isaychev, E.S. ThSMC-36
Isaychev, S.A. ThSMC-36
Ishino, M. TuR10-03
Ishkhanov, B.S. WeSMA-19
Ishmametiev, N.N. ThR2-p28
Ismagilova, R.I. WeR8-p27
Istranov, L.P. TuSMA-p17
Istranova, E.V. TuSMA-p17
Iun, N.G. ThR2-p10
Ivakin, S. WeR7-05
Ivanchenko, E.V. WeR8-p52
Ivanda, M. ThR1-43
Ivanda, M. WeR8-p38
Ivanenko, A.V. WeR1-p35
Ivanenko, A.V. WeR1-p42
Ivanov, A.V. ThR3-p26
Ivanov, A.V. ThR8-37
Ivanov, A.V. ThSMC-23
Ivanov, A.V. ThSMC-34
Ivanov, K. WeR5-18
Ivanov, K.A. ThR3-35
Ivanov, K.A. TuR5-p02
Ivanov, K.A. WeR3-17
Ivanov, K.A. WeR5-15
Ivanov, K.A. WeR8-22
Ivanov, M.V. WeR2-16
Ivanov, N.G. WeR2-16
Ivanov, O. TuR9-p33
Ivanov, O. WeR8-p48
Ivanov, O.V. ThR4-23
Ivanov, O.V. WeR8-p47
Ivanov, O.V. WeR8-p70
Ivanov, S.A. WeR1-p14
Ivanov, S.A. WeR1-p48
Ivanov, S.V. ThR3-p20
Ivanov, S.V. WeR3-25
Ivanov, S.Yu. ThR2-p09
Ivanov, V.K. TuR5-p12
Ivanov, V.K. TuR9-22
Ivanova, E.P. TuR5-06
Ivanova, E.P. TuR5-p05
Ivasenko, O. WeSMC-02
Ivlev, O.A. WeR6-09
Ivleva, L.I. WeR1-p46
Ivleva, L.I. WeR8-p14
Jacquemart, D. WeR7-09
Jaffrès, H. WeR3-14
Jana, S. WeR8-p66
Janssen, C. ThR7-p01
Janssen, C. ThR7-p02
Janssen, C. WeR7-09
Jasinskas, A. ThR4-p24
Javaloyes, J. TuR3-03
Jean, T. TuR9-03
Jelínek, M. WeR8-p14
Jelinkova, H. WeR1-p46
Jelínková, H. TuR1-07
Jelínková, H. WeR1-p23
Jeon, M.Yo. WeR1-p29
Jeong, B. ThR2-p14
Jeong, S. WeSMB-33
Jeseck, P. WeR7-09
Jezynski, T. TuR10-02
Ji, X. TuR9-17
Jia, Q. TuR5-03
Jiang, Yu. ThR8-34
Jin, Yu. ThR8-34
Joly, L. WeR7-08
Jöns, K.D. WeR11-03
Jr, A.A. Krasnovsky WeSMD-p02
Jr, A.A. Krasnovsky WeSMD-p03
Kabanau, D. ThR3-p17
Kablukov, S.I. ThR1-50
Kablukov, S.I. WeR1-34
Kadochkin, A. TuR9-p33
Kadochkin, A. WeR8-p48
Kaiser, F. WeR11-01
Kalashnikov, M.P. WeR2-13
Kalenkov, G. WeSMB-41
Kalenkov, G.S. WeSMB-40
Kalenkov, S. WeSMB-41
Kalenkov, S.G. WeSMB-40
Kaler, R.S. ThR7-15
Kalinichev, A.A. ThR8-44
Kalinichev, A.A. WeR7-13
Kalinichev, A.A. WeR8-p25
Kalinin, N.A. TuR8-03
Kalintseva, N.A. TuSMA-p12
Kalinushkin, V.P. ThR3-p14
Kaliteevski, M. A. WeR3-17
Kaliteevski, M.A. ThR3-35
Kaliteevski, M.A. WeR8-22
Kaliteevsky, I.N. WeR7-12
Kal'yanov, D. WeR1-23
Kalyanov, D.O. TuR1-02
Kalyuzhnyy, N.A. ThR3-30
Kalyuzhnyy, N.A. WeR3-12
Kamalieva, A.N. TuR9-p25
Kameshkov, O.E. TuR10-12
Kamynin, V.A. ThR2-p02
Kamynin, V.A. ThR2-p29
Kamynin, V.A. ThR7-p04
Kamynin, V.A. WeR1-33
Kamynin, V.A. WeR1-p32
Kamynin, V.A. WeR1-p38
Kanaev, A. ThR2-35
Kancer, A. ThR7-p15
Kancer, A. ThR7-p16
Kanda, N. WeR5-16
Kanda, N. WeR5-27
Kandidov, V.P. WeR8-p37
Kane, D. TuR10-02
Kanev, F.Yu. ThR4-p02
Kanev, F.Yu. WeR4-10
Kang, E.K. WeR1-p29
Kaplun, A.B. WeR1-p51
Kaprin, A.D. TuSMP-02
Kar, S. TuR5-10
Karabut, M.M. WeSMA-18
Karabutov, A. A. ThR8-28
Karabutov, A.A. ThR4-26
Karabytov, A. TuR5-p07
Karachinsky, L.Ya. ThR3-p32
Karachinsky, L.Ya. ThR3-p35
Karakus, M. TuR3-07
Karasik, A.Ya. WeR8-p44
Karasik, A.Ya. WeR8-p75
Karasik, V.E. ThR1-44

Karasik, V.E. TuSMB-p08
Karasik, V.E. TuSMB-p09
Karasik, V.E. WeR1-29
Karasik, V.E. WeR1-30
Karasik, V.E. WeR1-31
Karasik, V.E. WeR1-p49
Karavaeva, A.V. ThSMD-18
Karev, P.V. WeR4-11
Kargapoltsev, E.S. TuR2-08
Karimov, D.N. ThR1-41
Karmenyan, A. WeSMB-22
Karmenyan, A.V. TuSMB-10
Karp, V.N. TuSMA-p01
Karpeev, S.V. ThR4-26
Karpilova, M.A. WeSMB-40
Karpov, M. ThR8-31
Karpova, O.V. WeR7-07
Karsch, S. TuR5-04
Kartashov, D. WeR5-25
Kartashov, Ya.V. TuR8-11
Kascheev, S.V. ThR7-p10
Kascheev, S.V. WeR2-27
Kasianenko, E. M. WeSMD-p09
Kaspler, P. ThSMD-12
Katagiri, K. TuR10-03
Katarkevich, V.M. WeSMC-p17
Katarkevich, V.M. WeSMD-p13
Katenin, V.A. WeR6-07
Katsev, Y.V. WeR1-p20
Katyba, G.M. TuSMA-p16
Katyba, G.M. WeR8-p30
Katyba, G.M. WeSMB-31
Kawachi, T. TuR10-03
Kazak, N.S. ThR4-p03
Kazakov, B.N. WeR1-p27
Kazakov, V.A. WeR7-08
Kazantsev, S.Yu. ThR2-p23
Kazantsev, S.Yu. ThR2-p24
Kazantsev, S.Yu. ThR2-p25
Kazinski, P.O. TuR10-04
Kazyuchits, O.A. WeSMD-p10
Kekin, P.A. TuR9-p04
Kel', A.V. WeR11-p05
Kelleher, B. ThR3-36
Kellert, M. TuR10-02
Kelly, A. E. WePD-01
Kerekes, A. WeSMC-p09
Keropyan, V.V. WeSMD-p13
Kessel, A. TuR5-04
Kfir, O. ThR8-24
Khabibullin, R.A. ThR3-p07
Khabibullin, R.A. TuR3-08
Khadiev, A.R. WeR1-p27
Khairallah, G. WeSMB-15
Khairallah, G. WeSMB-36
Khairulin, I.R. TuR5-p19
Khakhalin, I.S. ThR4-21
Khakhalin, I.S. WeR1-p14
Khakhulin, D. TuR10-15
Khandokhin, P.A. WeR1-p43
Kharakhordin, A.V. ThR1-36
Kharasov, D.R. ThR7-19
Kharchenko, M.V. WeSMC-11
Khazanov, E. WePD-03
Khazanov, E.A. ThR2-p04
Khazanov, E.A. TuR5-p29
Khilov, A. WeSMB-17
Khilov, A.V. WeSMA-16
Khlebnikov, V.A. WeR8-p53
Khlebtsov, B. N. ThSMC-30
Khlebtsov, B. N. WeSMC-07
Khlebtsov, B.N. ThSMC-29
Khlebtsov, N.G. ThSMC-29
Khmelnintsky, E.N. WeR4-07
Khmelnitsky, D.V. WeR1-p08
Khodakovskiy, N. WeR2-13
Khodasevich, I.A. ThR7-p07
Khodasevich, I.A. WeR1-p24
Khodasevich, M.A. ThR2-p01
Khodasevich, M.A. WeR1-p24
Khodzitsky, M.K. TuSMB-p15
Kholin, I.V. TuR2-07
Khomich, A.A. TuR9-p21
Khomyakov, A.V. TuR9-p05
Khomyakov, A.V. TuR9-p06
Khomyakov, A.V. TuR9-p27
Khomyakov, A.V. TuR9-p28
Khomyakov, A.V. TuR9-p38
Khonina, S.N. ThR4-26
Khonina, S.N. TuR5-p04
Khopin, V.F. ThR1-36
Khorkov, K.S. ThR3-p36
Khorkov, K.S. TuR9-p32
Khorkov, K.S. WeR8-p16
Khorkov, K.S. WeR8-p41
Khorovodov, A.P. WeSMB-29
Khosrovian, G. WeR1-p47
Khramov, I.O. ThR2-p28
Khramova, Yu. V. TuSMA-07
Khrushchalina, S.A. TuSMA-p08
Khrushchalina, S.A. WeSMD-p08
Khudaiberganov, T.A. WeR11-p01
Khudyakov, D.V. WeR5-29
Khudyakov, M.M. ThR8-25
Khudyakov, M.M. TuR1-19
Khurgin, J.B. TuR9-p43
Khusnutdinova, R. Sh. TuR9-p37
Khvatov, N.A. TuR2-12
Kienberger, R. WeR5-28
Kim, A.V. ThR1-37
Kim, A.V. ThR8-23
Kim, A.V. TuR8-03
Kim, A.V. TuR8-10
Kim, A.V. WeR1-p25
Kim, B.C. WeSMB-24
Kim, Ch. ThR2-p14
Kim, E. TuSMB-p05
Kim, G.H. WeR1-p45
Kim, G.-H. ThR2-p14
Kim, H. TuR3-07
Kim, H. TuR9-02
Kim, J.G. TuSMB-p05
Kim, J.G. WeSMB-24
Kim, J.G. WeSMB-33
Kim, J.W. ThR2-p14
Kim, M. WeSMB-24
Kim, M.D. WeR1-p29
Kim, S. WeSMB-33
Kim, W. TuR9-p19
King, M. TuR5-10
Kinnunen, M. TuSMB-10
Kinyaevskiy, I.O. ThR2-p11
Kinyaevskiy, I.O. ThR7-p19
Kinyaevskiy, I.O. TuR2-09
Kippenberg, T. WeR11-07
Kippenberg, T.J. ThR8-31
Kipshidze, G. WeR3-26
Kirillin, M. TuSMB-02
Kirillin, M. WeSMB-17
Kirillin, M.Yu. TuSMB-05
Kirillin, M.Yu. WeSMA-16
Kirpichnikov, A.V. ThR2-p16
Kirpichnikov, A.V. ThR2-p17
Kirpichnikov, A.V. ThR2-p38
Kirpichnikov, A.V. WeR2-20
Kisel, V.E. ThR1-39
Kisel, V.E. TuR1-16
Kisel, V.E. WeR1-24
Kisel, V.E. WeR1-25
Kisel, V.E. WeR1-p52
Kisel, V.E. WeR1-p53
Kiselev, A. ThR2-35
Kiselev, A.M. WeR8-p69
Kiselev, V.M. ThR4-17
Kiselev, V.M. ThSMD-12
Kiselev, V.M. ThSMD-18
Kiselev, V.V. ThR2-p30
Kiselev, V.V. ThR2-p31
Kiselev, V.V. ThR2-p32
Kiseleva, E.B. WeSMB-34
Kislin, D.A. WeR8-p39
Kislov, V. I. ThR4-p13
Kislov, V.I. ThR4-p14
Kislyakov, I. ThR4-18
Kislyakov, I.M. ThR4-17
Kisov, H. WeSMC-05
Kita, T. TuR3-06
Kitaeva, G.Kh. ThR3-p24
Kitaeva, G.Kh. WeR8-14
Kitsyuk, E.P. TuR9-p42
Kiverin, A.D. TuR5-p06
Kiyko, V.V. WeR8-p67
Kleymenov, A.N. WeR4-06
Kleymenov, A.N. WeR4-07
Klimachev, Yu.M. ThR2-p11
Klimachev, Yu.M. ThR7-p19
Klimachev, Yu.M. TuR2-09
Klimchitskaya, G.L. TuR9-16
Klimchuk, A.Yu. WeR7-08
Klimov, A.A. ThR3-p04
Klimov, A.I. WeSMD-p14
Klimov, E.A. ThR3-p24
Klimov, E.I. ThR7-p13
Klimova-Korsmik, O.G. ThR2-p08
Klimova-Korsmik, O.G. ThR2-p15
Klochkov, A.N. ThR3-p24
Klotchenko, S.A. ThSMC-27
Kluge, T. ThR7-p01
Kluge, T. WeR7-09
Klyuchareva, S.V. TuSMA-12
Kniazev, M.A. WeR8-p39
Knyazev, B.A. TuR10-12
Knyukshto, V.N. WeSMD-p13
Kobtsev, S.K. WeR1-p42
Kobtsev, S.M. WeR1-32
Kobtsev, S.M. WeR1-p35
Koch, M. WeR3-11
Kocharovskaya, O. TuR5-05
Kocharovskaya, O.A. TuR5-p19
Kocharovsky, V.V. WeR5-20
Kochetkov, A.A. WeR5-21
Kochetov, I.V. TuR2-10
Kochiev, D.G. TuSMA-p02
Kochiev, D.G. WeR8-p07
Kochkurov, L.A. ThR3-p40
Kochubey, V.I. WeSMC-p01
Kochuev, D.A. ThR3-p36
Kochuev, D.A. TuR9-p32
Kochuev, D.A. WeR8-p16
Kochuev, D.A. WeR8-p41
Kojima, O. TuR3-06
Kokh, K. A. WeR8-p13
Kokhanovskiy, A.Yu. WeR1-p35
Kokhanovsky, A.Y. WeR1-p42
Kokorina, A. A. TuR9-p10
Kokorina, A.A. WeSMC-09
Kolesnikov, I.E. WeR7-13
Kolesova, I.M. WeR1-p53
Koliada, N.A. WeR1-32
Koliadenko, V. WeR8-20
Kolker, D. WeR1-23
Kolker, D.B. ThR8-42
Kolker, D.B. WeR1-32
Kolmakov, E. ThR7-p05
Kolmakov, E. ThR7-p15
Kolmakov, E. ThR7-p16
Kolmakov, E. WeSMC-p08
Kolmychek, I.A. WeR8-p20
Kolobkova, E.V. ThSMD-18
Kolodeznyi, E.S. ThR3-p32
Kolomeets, V.B. TuR1-06
Kolontaeva, G.S. TuR3-09
Kolontaeva, G.S. TuSMB-p08
Kolos, S.S. WeR1-p28
Kolosovskiy, A. O. TuR8-08
Kolubin, S.A. ThR7-14
Kolyadin, A.N. ThR8-25
Kolyadin, A.N. TuR8-06
Komandin, G.A. ThR3-p07
Komandin, G.A. TuR3-09
Komandin, G.A. TuSMB-p08
Komandin, G.A. TuSMB-p09
Komelyagin, D.Yu. WeSMA-21
Komkov, O.S. WeR3-25
Komolibus, K. WeSMA-17
Kompanets, V.O. WeR8-p37
Kondakof, D.F. TuR9-p04
Kondo, Ko. WeR5-12
Kondratiev, N. M. WeR11-p04
Kondratiev, N.M. ThR3-p03
Kondratiev, N.M. ThR3-p11
Kondratiev, N.M. ThR3-p13
König-Otto, J. C. TuR10-06
Konishi, K. WeR5-16
Konishi, K. WeR5-27
Kononov, I.G. ThR2-p23
Kononov, I.G. ThR2-p24
Kononov, I.G. ThR2-p25
Kononova, N.A. WeR8-p59
Konopel'ko, L.A. ThR7-p10
Konopelko, L. ThR7-p14
Konopelko, L. WeSMC-p08
Konopelko, L.A. ThR7-p06
Konotop, V.V. TuR8-11
Konovalov, A.N. TuSMA-p03
Konovalov, A.N. TuSMP-05
Kontorov, S.M. WeR8-p55
Konyashchenko, A.V. ThR8-43
Konyashkin, A.V. ThR2-p26
Konyashkin, A.V. ThR2-p27
Konyukhov, A.I. ThR3-p33
Konyukhov, A.I. ThR8-29
Konyukhov, A.I. WeR8-p58
Konyushkin, V.A. ThR1-38
Konyushkin, V.A. WeR1-p02
Konyushkin, V.A. WeR1-p12
Konyushkin, V.A. WeR1-p41
Koós, M. TuR9-15
Kopalkin, A.A. WeR8-p14
Kopalkin, A.V. ThR4-p02
Kopalkin, A.V. WeR1-p36
Koptev, M.Y. ThR1-37
Koptev, M.Y. ThR8-23
Koptev, M.Yu. TuR8-03
Koptyaev, S. WeR11-04
Kopylov, D.A. TuR1-11
Kopylov, D.A. WeR8-p74
Kopylov, E.A. WeR4-02
Kopylov, J. ThR2-35
Kopylov, Yu.L. ThR1-38
Kopylov, Yu.L. WeR1-p26
Korableva, S.L. TuR9-p34
Korableva, S.L. WeR1-p05
Korableva, S.L. WeR1-p18
Korableva, S.L. WeR1-p27
Korkin, D. ThSMD-23
Kornev, A. F. WeR1-p04
Kornev, A.F. TuR1-17
Kornev, A.F. TuR1-20
Kornev, A.F. WeR1-p20
Kornev, A.F. WeR1-p30
Kornev, A.F. WeR4-08
Kornev, A.F. WeR6-08
Kornienko, A.A. TuR9-p15
Kornienko, A.A. WeR1-p24
Kornienko, V.S. WeR8-p63
Kornienko, V.V. WeR8-14
Kornilova, E. S. WeSMC-11
Kornilova, E.S. ThSMC-31
Kornilova, E.S. WeSMC-p10
Korobko, D.A. ThR2-p02
Korobko, D.A. TuR5-p17
Korobko, D.A. TuR8-08
Korolev, D.V. WeSMC-p06
Koroleva, A.V. WeSMB-32
Korolkov, V.P. WeR5-30
Koromyslov, A.L. ThR1-38
Korostelin, Yu.V. ThR1-47
Korostelin, Yu.V. TuR1-02
Korovaitseva, E.V. WeR6-04
Korsakov, A. S. TuR9-p02
Korsakov, A. S. TuSMB-p23
Korsakov, A.C. TuR9-p01
Korsakov, A.S. TuR9-08
Korsakov, A.S. TuSMA-p15
Korsakov, A.S. WeR8-p28
Korsakov, A.S. WeR8-p29
Korsakov, A.S. WeR8-p64
Korsakov, M. S. TuR9-p02
Korsakov, M.S. TuR9-08
Korsakov, M.S. TuR9-p01
Korsakov, M.S. TuSMB-p23
Korsakov, V.S. TuR9-08
Korsakov, V.S. WeR8-p28
Korsakov, V.S. WeR8-p29
Korsakova, E.A. TuSMB-p23
Korsakova, E.A. WeR8-p64
Korsakova, S.A. ThSMC-18
Korshok, I.K. WeR8-p03
Korshok, I.K. WeR8-p25
Korshok, I.V. WeR8-p04
Koryakin, A.A. TuR9-06
Koryakovseva, D.A. TuR9-p37
Koryakovtseva, D. TuR9-p34
Korytin, A.I. WeR5-20
Korytin, A.I. WeR5-21
Korytin, A.I. WeR8-p26
Korytin, A.I. WeR8-p69
Korzhimanov, A. WePD-03
Korzhimanov, A.V. WeR5-22
Kosareva, O. TuR5-p07
Kosareva, O. WeR8-12

Kosareva, O.G. ThR4-26
Kosareva, O.G. ThR8-46
Kosareva, O.G. ThR8-47
Kosareva, O.G. TuR5-p26
Kosareva, O.G. WeR5-27
Kosareva, O.G. WeR8-p45
Kosareva, O.G. WeR8-p76
Koshelev, K.I. ThR1-44
Koshelev, K.I. ThR4-p32
Kosheleva, N.V. TuSMA-07
Kosheleva, N.V. TuSMA-09
Kosheverova, V.V. WeSMC-11
Kosolapov, A.F. ThR8-25
Kosolapov, A.F. TuR8-06
Kostamovaara, J.T. ThR3-34
Kostin, S.V. TuSMA-p08
Kostyukova, N.Y. ThR8-42
Kotelnikov, I.A. WeR8-13
Kotelnikova, P.A. WeSMD-p15
Kotereva, T.V. ThR2-p23
Kotereva, T.V. ThR2-p24
Kotereva, T.V. ThR2-p25
Kotkov, A.A. ThR2-p11
Kotkov, A.A. TuR2-09
Kotkovskii, G.E. WeR7-03
Kotlyar, K.P. TuR9-05
Kotlyar, V. V. ThR4-25
Kotov, O. TuR9-11
Kotova, S.P. ThR4-16
Kotova, S.P. WeR1-p19
Kotyushev, M.Yu. ThR2-32
Koval, V.V. WeR6-08
Kovalenko, A. A. WeSMA-25
Kovalenko, A.A. TuSMA-11
Kovalenko, A.A. WeSMA-20
Kovalenko, A.A. WeSMA-24
Kovalenko, N.O. TuR1-07
Kovalenko, N.O. WeR1-p23
Kovalenko, N.V. ThR2-p26
Kovalenko, N.V. ThR2-p27
Kovalenko, S.A. ThR3-p08
Kovalev, A. WeR1-p15
Kovalev, A. WeR1-p16
Kovalev, A.V. ThR3-36
Kovalev, A.V. WeR11-09
Kovalev, M.S. WeR4-09
Kovalska, E. TuR9-20
Kovyarov, A.S. TuR1-17
Kovyarov, A.S. TuR1-20
Kozhenkova, T.Y. WeR1-p36
Kozina, O.N. WeR8-16
Kozlov, A.A. TuR2-07
Kozlov, A.S. WeSMD-p02
Kozlov, A.S. WeSMD-p03
Kozlov, A.Yu. ThR2-p11
Kozlov, A.Yu. TuR2-09
Kozlov, A.Yu. TuR2-10
Kozlov, B.A. ThR2-p18
Kozlov, B.A. ThR2-p19
Kozlov, B.A. ThR2-p20
Kozlov, B.A. ThR2-p21
Kozlov, P.G. WeR6-03
Kozlov, S.A. ThR7-14
Kozlov, S.A. WeR8-p39
Kozlov, S.A. WeR8-p50
Kozlova, N.N. TuR9-p28
Kozlovsky, V.I. ThR1-47
Kozlovsky, V.I. TuR1-02
Kozlyakov, M.S. WeR7-01
Kozubov, A.V. ThR7-14
Kränkel, C. ThR1-35
Kränkel, C. ThR1-39
Krankel, Ch. TuR1-01
Krasin, G.K. WeR4-09
Krasnok, A. TuR9-11
Krasnok, A. WeR8-15
Krasnovsky, A.A. ThSMD-01
Krausz, F. TuR5-04
Kravets, L.Ya. WeSMB-34
Kravets, V.G. WeSMC-02
Kravtsenyuk, O.V. TuSMB-p17
Kravtsov, A.V. WeR1-p53
Krents, A.A WeR8-p35
Krents, A.A. ThR3-p09
Krents, A.A. ThR3-p34
Kress, S. WeR3-11
Krestin, S.V. ThR3-p34
Krisko, T.K. WeSMD-p01
Kriso, Ch. WeR3-11
Kriukova, E.V. WeSMD-p01
Krivchenko, A.I. ThSMD-10
Krivokharchenko, A.S. TuSMA-02
Krokh, G.V. ThR4-p03
Krotov, A.S. ThR7-18
Krueger, M. TuR5-04
Kruger, C. ThSMD-02
Kruse, K. TuR10-02
Krylov, A. WeR1-p15
Krylov, A. WeR1-p16
Krylov, A.A. WeR1-29
Krylov, A.A. WeR1-p13
Krylov, A.A. WeR1-p49
Krysa, A.B. WePD-06
Kryzhanovskaya, N.V. WeR3-12
Kryzhanovskaya, N.V. WeR3-15
Kubarev, V.V. TuR10-07
Kubeček, V. WeR8-p14
Kucherik, A. TuR9-10
Kucherik, A. TuR9-p14
Kucherik, A. TuR9-p18
Kucherik, A. TuR9-p35
Kucherik, A.O. ThSMD-16
Kucheryavenko, A.S. TuR3-09
Kucheryavenko, A.S. TuSMB-p08
Kuchinskii, V.I. ThR3-p38
Kuchma, I.G. WeR1-p20
Kuchma, I.G. WeR4-08
Kudelin, I.S. WeR1-30
Kudelin, I.S. WeR1-31
Kudlinski, A. TuR8-05
Kudryashov, A. ThR4-p23
Kudryashov, A. WeR4-03
Kudryashov, A.V. ThR2-34
Kudryashov, A.V. ThR4-p28
Kudryashov, M.A. WeR8-p69
Kudryavtseva, A.D. WeR7-07
Kues, M. WeR11-09
Kugler, Sz. ThSMC-22
Kugler, Sz. WeSMC-p09
Kuksin, A.V. WeSMC-p16
Kukushkin, S.A. TuR9-05
Kulachenkov, N.K. ThSMC-17
Kulagin, V.V. WeR8-p55
Kulagina, A.S. ThR4-p05
Kulagina, M.M. ThR3-30
Kulagina, M.M. ThR3-31
Kulagina, M.M. TuR9-01
Kulagina, M.M. WeR3-12
Kulagina, M.M. WeR3-15
Kulak, G.V. ThR4-20
Kulak, G.V. ThR4-p03
Kuleshov, N.V. ThR1-39
Kuleshov, N.V. TuR1-16
Kuleshov, N.V. WeR1-24
Kuleshov, N.V. WeR1-25
Kuleshov, N.V. WeR1-p52
Kuleshov, N.V. WeR1-p53
Kulikov, D.A. TuSMB-p01
Kulikovsky, A.N. TuSMA-08
Kulipanov, G.N. TuR10-12
Kulya, M.S. WeSMB-28
Kunitsyna, E. ThR3-p17
Kuodys, E. TuR1-12
Küppers, F. WeR8-p68
Kuptsov, G.V. ThR2-p16
Kuptsov, G.V. ThR2-p17
Kuptsov, G.V. ThR2-p38
Kuptsov, G.V. WeR2-20
Kurakin, A.I. ThR4-p09
Kuraptsev, A.S. WeR8-p46
Kurashkin, S.V. ThR2-p22
Kuratov, A.C. WeR5-13
Kuratov, A.S. TuR5-p13
Kurbatova, E.A. ThR4-24
Kurganov, N.S. ThR7-p11
Kurilchik, S.V. WeR1-24
Kurilchik, S.V. WeR1-p53
Kurilova, U.E. TuSMB-p22
Kurlov, V. N. WeSMB-31
Kurlov, V.N. TuSMA-p16
Kurlov, V.N. WeR8-p30
Kurlov, V.N. WeSMB-25
Kurnosov, K.V. ThR3-p26
Kurnosov, V.D. ThR3-p26
Kurochkin, A.S. ThR3-p32
Kurochkin, A.V. ThR7-p11
Kurochkin, I.N. ThSMC-23
Kurochkin, I.N. ThSMC-34
Kurochkin, M. WeSMC-03
Kurochkin, M.A. WeR7-13
Kurselis, K. ThR1-38
Kurths, J. WeSMB-29
Kustikova, M. ThR7-p15
Kustikova, M. ThR7-p16
Kustikova, M.A. ThR7-p12
Kutrovskaya, S. TuR9-10
Kutrovskaya, S. TuR9-p14
Kutrovskaya, S. TuR9-p18
Kutrovskaya, S. TuR9-p35
Kutrovskaya, S.V. WeR11-p05
Kutuza, I.B. ThR4-p22
Kuwata-Gonokami, M. WeR5-16
Kuwata-Gonokami, M. WeR5-27
Kuyanov, P. TuR9-04
Kuzechkin, N.A. WeR8-13
Kuzmenkov, A.G. TuR9-01
Kuzmin, A. WePD-03
Kuzmin, A.A. WeR5-21
Kuzmin, G.P. TuSMA-p14
Kuzmin, G.P. WeSMD-p07
Kuzmin, I.V. TuR5-p29
Kuzmin, V. TuSMB-04
Kuznetsov, A.A. TuSMA-p16
Kuznetsov, I. ThR2-p14
Kuznetsov, I. I. WeR2-17
Kuznetsov, I.I. WeR1-p45
Kuznetsov, K.A. ThR3-p24
Kuznetsov, K.A. WeR8-14
Kuznetsov, M.S. WeR1-26
Kuznetsov, M.V. ThR4-p09
Kuznetsov, S.A. ThSMC-26
Kuznetsov, S.A. WeR1-p31
Kuznetsov, S.S. TuSMB-05
Kuznetsov, S.S. WeSMB-34
Kuznetsov, S.V. ThSMC-32
Kuznetsov, S.V. TuR5-p23
Kuznetsov, S.V. TuR9-22
Kuznetsov, S.V. TuR9-p21
Kuznetsov, S.V. WeR1-p02
Kuznetsova, O.A. TuSMA-p08
Kuznetsova, O.A. WeSMD-p08
Kuzutkina, Yu.S. TuR5-p27
Kvasnov, B.A. WeSMC-p16
Kynev, S.M. ThR7-14
Kynev, S.M. WeR8-p72
Labaye, F. TuR1-18
Labonté, L. WeR11-01
Lademann, J. TuSMB-09
Ladenkov, I.V. TuR9-01
Ladugin, M.A. ThR3-p26
Ladugin, M.A. ThR3-p41
Lafaille, P. WeR3-24
Lagarkov, A.N. ThSMC-23
Lagarkov, A.N. ThSMC-34
Lalanne, P. WeR3-19
Lan, Ch. TuR5-p15
Landau, N. ThR8-38
Lanskii, G.V. WeR8-p08
Lanskii, G.V. WeR8-p09
Lanskii, G.V. WeR8-p13
LaPierre, R.R. TuR9-04
Lapin, V.O. WeSMA-22
Lapitan, D.G. TuSMB-p02
Lappa, A.V. TuSMA-08
Lappa, A.V. TuSMB-14
Lappa, A.V. WeSMA-22
Laptev, A.S. ThR4-p32
Laptev, A.V. ThR2-p16
Laptev, A.V. ThR2-p17
Laptev, A.V. ThR2-p38
Laptev, A.V. WeR2-20
Lar'kin, A.S. ThR4-26
Larin, K.V. WePD-07
Larin, K.V. WePD-08
Larin, K.V. WeSMB-38
Larin, N.R. TuR5-p14
Larin, S . TuSMP-01
Larin, S. WeR1-23
Larina, I.V. WeSMB-23
Lar'kin, A. WeR5-18
Larkin, A.S. TuR5-p04
Lashova, A.A. WeR8-p28
Lashova, A.A. WeR8-p29
Lashova, A.A. WeR8-p64
Lassen, M. ThSMD-25
Lassen, M. WeR7-06
Laszcz, A. ThR3-p10
Latypov, I.Z. ThR7-14
Latyshev, A.V. ThSMC-26
Laurat, J. ThR8-40
Lavrinenko, A.V. WeR8-p60
Lavrinov, V.V. ThR4-p18
Lavrinov, V.V. ThR4-p19
Lavrinov, V.V. WeR4-02
Lavrinova, L.N. ThR4-p19
Lavrov, E.A. ThR4-p15
Lavrukhin, D.V. ThR3-p07
Lavrushin, B.M. ThR1-47
Lazarenko, G.Yu. TuR10-04
Lazarenko, V.I. TuR1-05
Lazarenko, V.I. TuR1-06
Lazarev, V.A. WeR1-29
Lazareva, E.N. TuSMB-p06
L'dov, A.Yu. TuR2-07
Leaird, D.E. WeR11-08
Lebed', A.A. WeR5-23
Lebedev, V.F. WeR1-p48
Lebedev, V.F. WeR7-01
Lebedev, V.F. WeR8-p73
Lebedev, Yu.V. WeR7-08
Lebel, O. ThR4-19
Lebiadok, Ya. ThR3-p17
Lebiadok, Ya. ThR3-p18
Lécz, Zs. TuR5-p10
Lederer, M. J. TuR10-02
Lednev, V.N. ThR7-p07
Lee, B. ThR2-p14
Lee, B. WeR1-p45
Lee, H.W. WeR2-14
Lee, J.S. WeSMB-24
Lee, K. TuSMB-11
Lee, K.H. WeSMB-24
Lee, Ray-Kuang WeR8-p06
Lee, S.K. WeR2-14
Lee, W.-J. TuR9-02
Legratiet, L. WeR3-19
Lejennikova, K.A. WeR8-p43
Lekarev, V.YU. TuSMA-13
Lelekova, A.F. WeR11-p05
Lengert, E.V. TuSMB-p11
Leo, F. WeR11-06
Leo, G. ThR3-33
Leonov, S.O. WeR1-p49
Leontiev, A.P. WeR8-p20
Leontieva, E.A. WeSMC-11
Leontieva, E.A. WeSMC-p10
Leontyev, A.A. ThR3-p24
Leonyuk, N.I. WeR1-25
Lepeshkevich, S.V. WeSMC-p02
Lepeshkevich, S.V. WeSMD-p06
Lepeshov, S. TuR9-11
Lepeshov, S. WeR8-15
Leran, J.-B. TuR9-p19
Leshchenko, E.D. TuR9-04
Leshchenko, V.E. TuR5-04
Leshko, A.Yu. ThR3-p04
Leszczyński, M. WePD-01
Leuchs, G. TuR1-11
Leusenka, I.A. WeSMD-p10
Leusenka, I.A. WeSMD-p13
Levchenko, A.E. TuR1-19
Levchenko, E.V. ThSMD-05
Levi, M. TuSMB-08
Levitskii, I.V. ThR3-p23
Levitskii, I.V. ThR3-p28
Li, D. WeR11-10
Li, H.-Z. WeR5-19
Li, R. WeR1-22
Li, W. WeR1-22
Li, Ya. ThR3-p19
Li, Yo. TuR9-17
Liang, Sh. ThR2-p34
Liang, X. WeR1-22
Lihachev, G. ThR8-31
Lihachev, G.V. WeR11-04
Likhachev, I.G. WeR8-p62
Likhachev, M.E. ThR8-25
Likhachev, M.E. TuR1-19
Lilge, L. ThSMD-03
Lilge, L. ThSMD-12
Lin, B. ThR2-p34
Lin, W.-I. ThSMD-25

Lin, Y.C. TuSMB-10
Lin, Yu-Ch. WeSMB-22
Lin, Zh.-R. WeSMB-22
Linkov, K.G. ThSMD-24
Linkov, K.G. TuSMB-p18
Lipatov, D.S. TuR1-19
Lipovskii, A.A. WeR3-15
Lis, D.A. WeR1-p09
Lis, D.A. WeR1-p10
Lis, D.A. WeR8-p11
Little, B.E. WeR11-09
Litvak, A.G. TuR8-02
Litvak, A.G. TuR8-03
Litvinov, A.N. WeR8-p57
Litvinov, I.K. WeSMC-p10
Liu, Ch.-H. WePD-07
Liu, Hu. WeR3-22
Liu, R. WeR1-22
Liu, X. WeR11-10
Liu, Z.J. TuR1-10
Livshits, D.A. ThR3-p38
Lobach, I.A. ThR1-50
Lobach, I.A. TuR1-14
Lobach, I.A. WeR1-34
Lobanov, P.Yu. TuSMB-p10
Lobanov, V.E. ThR3-p03
Lobanov, V.E. ThR3-p13
Lobanov, V.E. TuR8-07
Lobintsov, A.V. ThR3-p26
Lobok, M.G. TuR5-p24
Lobok, M.G. WeR5-13
Locatelli, A. ThR3-33
Locquet, A. ThR3-36
Loghmari, Z. WeR3-23
Loginova, D. TuSMB-02
Loginova, D. WeSMB-17
Loginova, D.A. WeSMA-16
Logunov, S.E. ThR3-p06
Loiko, P. ThR1-45
Loiko, P. TuR9-p40
Loiko, P.A. WeR1-24
Loiko, P.A. WeR1-p28
Loktionov, D.E. ThR3-p20
Lorences-Riesgo, A. WeR11-08
Loschenov, V. ThSMD-06
Loschenov, V.B. ThSMC-32
Loschenov, V.B. ThSMD-17
Loschenov, V.B. ThSMD-22
Loschenov, V.B. ThSMD-24
Loschenov, V.B. ThSMD-27
Loschenov, V.B. TuSMB-p18
Loschenov, V.B. TuSMP-05
Loschenov, V.B. WeSMB-21
Loschenov, V.B. WeSMC-12
Loschenov, V.B. WeSMD-p14
Losev, S.N. ThR3-p43
Losev, V. F. WeR8-p13
Losev, V.F. ThR2-p12
Losev, V.F. WeR2-16
Losevsky, N.N. WeR1-p19
Loshchenov, M.V. ThSMD-24
Lotkov, E.S. TuR9-p36
Lou, Sh. ThR2-p34
Lovchev, A.V. ThR4-p10
Lovchev, A.V. ThR4-p21
Loza-Alvarez, P. TuR3-04
Lubenko, D. M. WeR8-p13
Lucas, E. ThR8-31
Luchinin, G.A. ThR4-p12
Luchinin, V.V. WeSMC-p06
Lugovtsov, A. TuSMB-11
Lugovtsov, A. WeSMB-41
Lugovtsov, A.E. TuSMB-p16
Lukanin, V.I. WeR8-p75
Lukashchuk, A. WeR8-p68
Lukashev, N.A. ThR6-p02
Lukin, A.B. WeR6-04
Lukin, V.P. WeR4-02
Lukin, V.P. WeR4-10
Lukinova, E.V. TuR9-p34
Lukinova, E.V. TuR9-p37
Lukinova, E.V. WeR1-p18
Lukinova, E.V. WeSMD-p12
Lukshin, V.A. TuSMP-05
Lukyanets, E.A. ThSMD-22
Luk'yanets, E.A. WeSMD-p14
Luk'yashin, K.E. WeR1-p26
Lundin, W.V. WeR3-21
Lunin, A.V. ThSMC-19
Lunin, A.V. WeSMC-p11
Lüning, J. TuR10-10
Luo, D. WeSMC-03
Lupu, A. TuR3-01
Lvov, A. E. TuR9-p02
Lvov, A.E. TuR9-08
Lvov, A.E. TuR9-p01
Lyapin, A.A. TuSMA-p08
Lyapin, S.G. WeR1-30
Lyash, A.N. WeR7-10
Lyash, A.N. WeR7-11
Lyashenko, A.I. WeR1-p03
Lysenko, S. ThR2-35
Lysov, O. TuR5-04
Lyspak, I.V. WeSMA-18
Machikhin, A.S. ThR4-p22
Machikhin, A.S. WeR1-p03
Mackonis, P. TuR1-13
Madeikis, K. WeR1-27
Madeikis, K. WeR1-p33
Madeikis, K. WeR2-25
Madirov, E.I. TuR9-p34
Madirov, E.I. WeSMD-p12
Magnitskiy, S. WeR11-p06
Magnitskiy, S. WeR8-p19
Mahmoodkalayeh, S. TuSMB-p07
Maiurova, A.S. ThR7-p12
Maiurova, A.S. ThR7-p13
Major, A. WePD-06
Major, Zs. TuR5-04
Mak, A.A. WeR1-p13
Makaev, S.V. TuR9-p04
Makarov, D. A. ThSMC-27
Makarov, E.A. ThR7-p10
Makarov, E.A. WeR2-27
Makarov, S.S. TuR10-03
Makarov, S.V. ThR8-36
Makarov, V. WeR8-12
Makarov, V. A. ThR8-28
Makarov, V.A. WeR8-13
Makarov, V.I. WeSMD-p14
Makarov, V.S. WeR7-10
Makarov, V.S. WeR7-11
Makarova, E.A. ThSMD-22
Maklygina, Yu.S. WeSMB-21
Maklygina, Yu.S. WeSMC-12
Maksimchuk, A. TuR5-p13
Maksimchuk, A. WeR5-13
Maksimov, R.N. WeR1-p26
Makurenkov, A.M. ThSMC-36
Mal'kov, Yu.A. WeR5-20
Malakhov, K.M. TuSMB-p08
Malakhov, K.M. TuSMB-p09
Malakhov, K.M. WeSMB-25
Malashko, Ya.I. WeR4-06
Malashko, Ya.I. WeR4-07
Maleev, N.A. TuR9-01
Maleev, S.N. TuR9-01
Malekizandi, M. WeR8-p68
Maltsev, P.P. ThR3-p24
Maltsev, V.V. WeR1-25
Malyarevich, A.M. WeR1-p28
Malyi, V.S. TuR9-16
Mamonov, E A. WeR8-p74
Mamonov, E. WeR11-p06
Mamontov, O.YU. ThSMD-05
Mamrashev, A. A. WeR8-p13
Manh, D.Q. ThR2-p18
Manh, D.Q. ThR2-p20
Mans, T. WeR1-21
Mantareva, V. WeSMB-29
Mantrova, Y.V. ThR4-p22
Mantsyzov, B.I. WeR8-19
Manuylovich, I.S. TuSMB-p10
Marchal, F. WeSMB-15
Marchal, F. WeSMB-36
Marchev, G.M. ThR8-42
Marconi, M. TuR3-03
Mareev, E.I. ThR8-28
Mareev, E.I. WeR8-p71
Margaryan, G.G. WeSMD-p13
Margushev, Z.Ch. ThR3-p42
Marichev, V.N. ThR7-16
Marino, G. ThR3-33
Marisov, M.A. TuR9-22
Marisov, M.A. WeR1-p18
Markevich, V. WeR1-p01
Marmalyuk, A.A. ThR3-p26
Marmalyuk, A.A. ThR3-p41
Maroutian, T. WeR3-24
Martin, P. TuR5-10
Martin, Ph. TuR5-01
Martynenko, A.S. WeR5-12
Martynov, I.L. TuR9-12
Martynov, I.L. WeR7-03
Martynov, S.A. WeR6-02
Martynov, S.A. WeR6-04
Martynov, V.O. WeR11-p03
Martynova, K.A. WeR1-p41
Martynova, O.V. ThR2-p22
Martynovich, E.F. ThR8-43
Masciovecchio, C. TuR10-05
Mashin, A.I. WeR8-p69
Mashkin, A. TuSMP-01
Maslennikova, A.V. TuSMB-05
Maslova, Y.Y. WeSMA-19
Maslyanitsina, A.I. TuSMB-p16
Masoumi, S. WeSMB-20
Mateos, X. ThR1-45
Matoba, M. WeR5-16
Matoba, M. WeR5-27
Matsuoka, T. TuR10-03
Matuhina, A. ThR1-45
Matuhina, A. WeR11-09
Matushevski, D.D. WeR1-p24
Matveev, A.L. WeSMB-39
Matveev, L.A. WeSMB-39
Matveev, L.A. WeSMB-42
Matveeva, I. A. WeSMC-p12
Matveeva, N.I. WeR8-p04
Matveyev, A.L. WeSMB-42
Maximov, M.V. ThR3-30
Maximov, M.V. ThR3-31
Maximov, M.V. WePD-02
Maximov, M.V. WeR3-12
Maximov, M.V. WeR3-15
Mayakova, M.N. TuR9-22
Mayakova, M.N. TuR9-p21
Mayorova, A.M. ThR4-16
Mayurova, A. ThR7-p15
Mayurova, A. ThR7-p16
Mazaheri, L. ThR4-19
Mazeas, F. WeR11-01
Mazhirina, Yu.A. WeR8-p56
Mazmanyan, P.A. WeSMD-p13
Mazur, M. WeR11-08
Mazur, M.M. ThR4-p29
Mazur, M.M. WeR1-p11
McKenna, P TuR5-02
Mckenna, P. TuR5-p03
McKenna, P. TuR5-10
McKenna, P. WeR5-19
Mebel, A.M. ThR2-p05
Mebel, A.M. TuR2-12
Medvedkov, O.I. ThR2-p02
Medyanik, I.A. WeSMB-34
Meerovich, G.A. ThSMD-22
Meglinski, I.V. TuSMB-p15
Mégret, P. TuR8-08
Melkumov, M.A. ThR1-36
Melkumov, M.A. ThR7-p04
Melkumov, M.A. WeR3-20
Meller, A.E. WeSMA-16
Melnik, M.V. WeR8-p50
Melnikov, L.A. ThR3-p40
Melnikov, L.A. ThR8-29
Melnikov, L.A. WeR8-16
Melnikov, L.A. WeR8-p42
Melnikov, L.A. WeR8-p56
Melnikov, L.A. WeR8-p58
Melnikov, P.A. TuSMA-p04
Melninkaitis, A. ThR4-15
Melninkaitis, A. ThR4-p24
Mendagaliyev, R.V. ThR2-p08
Menshutina, N.V. ThSMD-13
Merklein, M. WeR11-05
Merolla, J.M. TuR8-04
Merzliakov, M.A. ThR2-p39
Merzlikin, A.M. ThSMC-23
Mesaritakis, C. TuR3-02
Meshkov, I.N. ThSMD-11
Mesyats, G.A. WeR2-16
Michailovas, A. TuR1-12
Michailovas, A. WeR1-27
Michailovas, A. WeR1-p33
Michailovas, A. WeR2-25
Mics, Z. TuR3-07
Migal, E.A. TuR1-03
Mihailović, D. TuR10-14
Mikerin, S.L. WeR8-p12
Mikhailova, A.A. ThR7-p11
Mikhailova, I. A. ThSMD-10
Mikhailovskii, V. WeR8-15
Mikheev, G.M. WeR1-p21
Mikheev, L.D. WeR2-16
Mikheev, V.V. ThSMC-23
Mikheyev, P.A. TuR2-06
Mikheyev, P.A. TuR2-11
Mikheyev, P.A. TuR2-12
Mikulich, A.V. WeSMD-p10
Mikulich, A.V. WeSMD-p13
Mildren, R.P. ThR1-42
Mildren, R.P. WePD-05
Milekhin, A.G. ThSMC-26
Milekhin, I.A. ThSMC-26
Milian, C. TuR8-11
Milovsky, N.D. WeR1-p43
Minaev, N.V. ThSMC-38
Minaev, N.V. TuR9-14
Minaev, N.V. TuSMA-p03
Minaev, N.V. TuSMA-p04
Minaev, N.V. TuSMA-p05
Minaev, N.V. TuSMA-p06
Minaev, N.V. TuSMA-p07
Minaev, N.V. TuSMA-p17
Minaev, N.V. WeSMA-14
Minaev, N.V. WeSMA-15
Minaev, N.V. WeSMC-p12
Minaev, V. TuSMP-01
Minaev, V.P. TuSMA-13
Minaev, V.P. TuSMA-p01
Minaev, V.P. WeSMA-21
Minaeva, S.A. TuSMA-p03
Minaeva, V.A. ThSMC-26
Mineev, A.P. ThR2-p30
Mineev, A.P. ThR2-p31
Mineev, A.P. ThR2-p32
Mineev, A.P. ThR7-p04
Minissale, M. WeR7-09
Mintairov, S.A. ThR3-30
Mintairov, S.A. WeR3-12
Miranda, R.C. WePD-07
Mirfayzi, S.R. TuR5-10
Mirkasymov, A.B. WeSMC-p13
Mironov, E.A. ThR1-41
Mironov, S.Yu. TuR5-p29
Mironov, V.A. WeR11-p03
Mironov, V.A. WeR8-17
Mironova, T.V. WeR7-07
Mirsky, S.K. TuSMB-08
Mirzaeva, A.A. WeR1-p51
Mischenko, M. WeSMB-26
Mishchenko, G.M. TuR1-05
Mishra, S.K. TuR5-p18
Mitetelo, N.V. WeR8-p74
Mitina, E. TuR5-p07
Mitina, E.V. ThR4-26
Mitrofanov, M.I. ThR3-p23
Mitrofanov, M.I. ThR3-p28
Mitrokhin, V.P. WeR1-p40
Mittendorff, M. TuR10-06
Miyanaga, N. WeR1-p47
Miyanishi, K. TuR10-03
Mizerov, M.N. ThR3-p23
Mocci, J. WeR4-04
Mochalova, E.N. ThSMC-40
Mochalova, E.N. WeSMC-p05
Modsching, N. TuR1-18
Mohajerani, E. WeSMB-20
Moiseev, A.A. WeSMB-34
Moiseev, A.A. WeSMB-42
Moiseev, E.I. WeR3-12
Moiseev, E.I. WeR3-15
Moiseev, S. TuR9-p33
Moiseev, S. WeR8-p48
Mojzes, P. TuR9-18
Mokrousova, D.V. TuR5-p26
Mokrousova, D.V. WeR5-31
Mokrousova, D.V. WeR8-p45
Molevich, N.E. ThR3-p09
Molevich, N.E. ThR3-p34
Molevich, N.E. WeR8-p35
Molkov, A.A. TuR1-09

Author Index

Molkov, A.A. TuSMA-p13
Molkov, A.A. WeR2-24
Möller, Ch. WeR3-11
Møller, I.M. ThSMD-23
Molodtsov, S.L. TuR10-01
Molodtsov, S.L. TuR10-15
Momburg, F. ThSMC-15
Monakhov, A. M. WeR3-13
Monkman, A. WeR3-17
Mooney, B.P. ThSMD-23
Morandotti, R. WeR11-09
Mordvincev, I. WeR5-18
Morgner, U. WeR8-12
Moroz, N.N. WeR8-p02
Morozov, K.M. WeR3-17
Morozov, K.M. WeR8-22
Morozov, M.Yu. ThR3-p02
Morozov, O.A. ThR4-p10
Morozov, O.A. ThR4-p21
Morozov, O.A. TuR9-22
Morozov, O.A. TuR9-p37
Morozov, O.A. WeR1-p02
Morozov, O.A. WeR1-p18
Morozov, S. TuR3-05
Morozov, V.B. WeR2-26
Morozov, Yu.A. ThR3-p02
Morozov, Yu.A. ThR3-p33
Morral, A. Fontcuberta i TuR9-p19
Mosalskaya, D.V. TuSMB-p01
Moss, D.J. WeR11-09
Mostepanenko, V.M. TuR9-16
Motorin, S.E. ThR1-37
Mozharov, A.M. TuR9-p30
Mozhevitina, E.N. TuR9-p28
Muenzer, A. TuR5-04
Mukhin, I. ThR2-p14
Mukhin, I.B. WeR1-p45
Mukhin, I.S. TuR9-p30
Mukhin, I.S. TuR9-p43
Mukhin, N. WeR8-p21
Mukhina, E.E. TuSMA-p16
Mumlyakov, A.M. ThSMC-38
Munshi, T. WeR3-11
Muradore, R. WeR4-04
Murashko, D.T. WeSMD-p04
Murav'eva, T.D. ThSMD-12
Muraviova, T.D. WeSMD-p01
Muravyov, S.V. ThR1-37
Murdoch, S.G. WeR11-06
Muretova, M.E. WePD-02
Murzanev, A. WeR5-25
Murzanev, A.A. WeR5-20
Murzanev, A.A. WeR5-21
Murzanev, A.A. WeR8-p69
Murzina, T.V. TuR1-11
Murzina, T.V. TuR9-p36
Murzina, T.V. WeR8-19
Murzina, T.V. WeR8-p20
Murzina, T.V. WeR8-p74
Mussot, A. TuR8-05
Myara, M. WeR3-19
Myasnikov, D. TuSMP-01
Myasnikov, D.V. WeR2-19
Myasnyankin, M.Yu. ThSMD-05
Myazin, N. S. ThR3-p21
Mylnikov, V.Yu. ThR3-p38
Mylnikov, V.Yu. ThR3-p43
Mylnikov, V.Yu. ThR3-p44
Myslivets, S.A. WeR8-21
N, L. ThR4-p18
Nabiev, I. WeSMC-04
Nabiullina, R.D. TuR9-p16
Nadezhin, A.S. TuR1-06
Nadtochiy, A. M. WeR3-12
Nagai, T. TuR2-04
Nagaoka, H. TuR2-04
Nagaoka, R. TuR2-04
Nagel, D. WeSMB-32
Nagorny, I.G. ThR7-p09
Nagy, A. ThSMC-22
Nagy, A. WeSMC-p09
Nagy, A. WeSMD-p11
Nagymihaly, R.S WeR2-13
Najda, S. WePD-01
Nakatsutsumi, M. WeR5-22
Nakladov, A.N. WeR1-p41
Nalimov, A. G. ThR4-25
Nam, Ch.H. WeR2-14
Naniy, O.E. ThR7-19
Naniy, O.E. WeR8-p36
Napolskii, K.S. WeR8-p20
Narcy, G. WeR3-23
Närhi, M. TuR8-04
Narivonchik, A.S. TuSMA-p12
Naryshkin, S.A. TuSMA-p02
Nasibulin, A.G. WeR3-15
Naumov, A.K. ThR4-p10
Naumov, A.K. ThR4-p21
Naveau, C. TuR8-05
Navitskaya, R.I. WeR1-p34
Navolokin, N. WeSMB-29
Navolokin, N.A. TuSMB-p21
Nazac, A. ThSMC-28
Nazarov, M.M. ThR3-p42
Nazarov, M.M. WeSMB-27
Nebel, Ch.E. WeSMB-22
Nechaev, A.A. WeR5-20
Nedorezov, V. WeR5-18
Nedosekin, D.A. ThSMC-30
Neely, D. TuR5-02
Nefedov, I.S. WeR8-16
Nefedov, S.M. ThR2-p30
Nefedov, S.M. ThR2-p31
Nefedov, S.M. ThR2-p32
Negro, M. WeR4-04
Negrov, D.V. ThSMC-23
Nekhaeva, T.L. ThSMD-05
Němec, M. TuR1-07
Nemoto, N. WeR5-16
Nemoto, N. WeR5-27
Nepomnyashchaya, E.K. ThSMC-37
Nepomnyashchaya, E.K. TuR9-p12
Nepomnyashchaya, E.K. WeSMC-13
Neshev, D.N. ThR3-33
Neskorniuk, V.A. WeR8-p68
Nesterov, N.O. TuR8-07
Nevedomskiy, V.N. TuR10-15
Nezhdanov, A.V. WeR8-p69
Nguyen, J. WePD-07
Nguyen, M.Th. ThR2-p20
Nguyen, T. WeSMB-24
Nguyen-Van, H. WeR3-23
Nikiforov, S. TuSMA-p09
Nikiforov, S. TuSMA-p10
Nikiforov, S. WeSMA-23
Nikitin, A. ThR4-p23
Nikitin, M.P. ThSMC-15
Nikitin, M.P. ThSMC-40
Nikitin, M.P. WeSMC-08
Nikitin, M.P. WeSMC-p05
Nikitin, M.P. WeSMC-p13
Nikitin, M.P. WeSMD-p15
Nikitin, P.I. ThSMC-15
Nikitin, P.I. ThSMC-39
Nikitin, P.I. TuSMP-03
Nikitin, P.I. WeSMC-p05
Nikitin, P.I. WeSMC-p13
Nikitin, P.I. WeSMC-p15
Nikitin, P.I. WeSMD-p15
Nikitin, S. TuSMB-11
Nikitin, S. WeSMB-41
Nikitin, S.P. ThR7-19
Nikitin, S.Yu. WeSMB-30
Nikitina, E.V. TuR9-05
Nikitina, I.L. ThSMC-25
Nikitina, I.L. WeSMC-p07
Nikolaenko, T.V. ThR4-20
Nikolaev, A.E. WeR3-21
Nikolaev, D.N. ThR3-p23
Nikolaev, D.N. ThR3-p28
Nikolaev, D.N. ThR3-p45
Nikolaev, N. A. WeR8-p13
Nikolaev, N.I. TuR1-06
Nikolaev, P.P. WeR8-p07
Nikolaev, P.P. WeR8-p10
Nikolaeva, A.N. WeSMC-09
Nikolaevich, E.S. WeSMD-p10
Nikolashkin, N.S. ThR7-16
Nikonorov, N.V. ThSMD-18
Nikonorov, N.V. WeR1-p14
Nikonorov, N.V. WeR1-p44
Nikonorov, N.V. WeR1-p48
Nikonorov, N.V. WeR7-01
Nishikino, M. TuR10-03
Nishiuchi, M. WeR5-12
Nizametdinov, A.M. ThR4-23
Nizamutdinov, A.S. TuR9-22
Nizamutdinov, A.S. TuR9-p34
Nizamutdinov, A.S. TuR9-p37
Nizamutdinov, A.S. WeR1-p18
Nizamutdinov, A.S. WeSMD-p12
Noda, S. ThR3-28
Nomakonov, G.N. TuR1-05
Nomakonov, G.N. TuR1-06
Norman, E.A. ThR2-p15
Nosov, P.A. ThR4-p01
Nosyrev, N.A. ThR2-36
Novak, O. TuR1-08
Novikov, I.I. ThR3-p32
Novikov, I.I. ThR3-p35
Novikov, P.V. ThR7-16
Novikov, V.B. WeR8-19
Novikov, V.B. WeR8-p20
Novikova, A.S. WeSMC-09
Novikova, A.S. WeSMC-p03
Novikova, O. TuR9-p14
Novikova, T. ThSMC-28
Novitsky, A.V. WeR8-p60
Novitsky, D.V. WeR8-p60
Novitsky, D.V. WeR8-p61
Novogran, A.I. WeR8-p73
Novopashin, V.V. WeR1-p17
Novoselova, M.V. ThSMC-30
Nozdrina, A.I. ThR2-p17
Nunzi, J.M. ThR4-19
Nunzi, J.-M. ThR4-18
Nuryev, R. TuR9-09
Nyga, P. ThSMC-24
Nyushkov, B.N. WeR1-32
O'Faolain, L. ThR3-29
Oberhofer, K. WeR8-p67
Oborotov, D.O. WeR1-p20
Obraztsova, E.D. WeR1-33
Obronov, I.V. WeR2-19
Odinokov, S.B. WeR4-09
Odlyanitskiy, E.L. TuSMB-p17
Odlyanitskiy, E.L. WeSMB-28
Odnoblyudov, M. TuR8-08
Ofitserov, E. N. ThR4-p13
Ofitserov, E.N. ThR4-p14
Ogura, K. WeR5-12
Okhlopkov, V.A. TuSMP-05
Oladyshkin, I.V. WeR8-17
Olarte, O. E. TuR3-04
Olenin, A.N. WeR2-26
Oliveira, L. WeSMB-37
Omelchenko, A. I. WeSMD-p09
Omelyanenko, N.P. TuSMB-09
Orekhov, I.O. WeR1-30
Orekhov, I.O. WeR1-31
Orlinskaya, N.Yu. WeSMA-16
Orlov, A.P. WeSMD-p05
Orlov, A.V. ThSMC-20
Orlov, A.V. ThSMC-40
Orlov, A.V. WeSMC-06
Orlov, A.V. WeSMC-p04
Orlova, A. TuSMB-02
Orlova, A.O. WeSMC-p10
Orlova, E.E. WeSMD-p12
Orlovich, V. WeR1-p01
Orlovich, V.A. ThR1-39
Orlovich, V.A. WeR1-24
Orlovich, V.A. WeR8-p15
Orlovskaya, E.O. ThSMC-33
Orlovskii, Yu.V. ThSMC-33
Oropeza, J. C. Buitrago ThR4-p17
Osawa, E. ThSMD-07
Osiko, V.V. TuR1-07
Osiko, V.V. WeR1-p41
Osintseva, N.D. TuR10-12
Osipenko, G.V. WeR8-p52
Osipov, A. TuR9-10
Osipov, A. TuR9-p14
Osipov, A. TuR9-p18
Osipov, A. TuR9-p35
Osipov, A.V. TuR9-05
Osipov, E.V. TuR9-12
Osipov, E.V. WeR7-03
Osipov, V.V. WeR1-p26
Osmanov, R. WePD-03
Ossadtchi, A.E. ThSMC-17
Ossikovski, R. ThSMC-28
Osvay, K. WeR2-13
Osychenko, A.A. TuSMA-02
Ozaki, N. TuR10-03
Ozheredov, I. WeSMB-26
Ozheredov, I.A. ThR3-p42
Ozheredov, I.A. ThSMC-36
Pacheco, A.L. TuSMB-03
Padalitsa, A.A. ThR3-p26
Padusenko, E.A. WeR5-23
Paklinov, N. ThR7-p15
Paklinov, N. ThR7-p16
Palashov, O. ThR2-p14
Palashov, O.V. ThR1-41
Palashov, O.V. WeR1-p45
Pallas, F. TuR10-02
Palmer, G. TuR10-02
Pan, Ji. ThR3-p19
Panarin, A.Yu. TuR9-18
Panchenko, Yu.N. ThR2-p12
Panchenko, Yu.N. WeR2-16
Panchenko, Yu.N. WeR7-02
Panettieri, D. ThR3-29
Pankin, D.V. ThR7-p11
Pankin, P.S. WeR8-21
Pankov, M. ThR2-35
Panna, D. ThR8-38
Panov, N. WeR8-12
Panov, N.A. ThR4-26
Panov, N.A. ThR8-46
Panov, N.A. ThR8-47
Panov, N.A. TuR5-p26
Panov, N.A. WeR5-16
Panov, N.A. WeR5-27
Panov, N.A. WeR8-p45
Panov, N.A. WeR8-p76
Panyutin, V.L. ThR8-42
Papashvili, A.G. WeR1-p41
Papayan, G. ThSMD-04
Paquet, R. WeR3-19
Paradis, C. TuR1-18
Parekh, S. H. TuR3-07
Parfenov, M.V. WeR11-02
Park, J.E. WeSMB-24
Park, S.W. ThR2-p14
Parkhats, M.V. WeSMC-p02
Parkhats, M.V. WeSMD-p06
Parmar, G.S. WeR8-p66
Parri, R. WeSMB-32
Pashinin, P.P. ThR2-p30
Pashinin, P.P. ThR2-p31
Pashinin, P.P. ThR2-p32
Pashkin, A. TuR10-06
Patriarche, G. WeR3-23
Patsaev, D.V. WeR7-10
Pavelyev, V.S. TuR10-12
Pavlikov, A.I. ThR4-p12
Pavlikova, E.P. TuSMB-p16
Pavlov, A.A. ThSMD-21
Pavlov, A.A. TuR9-p42
Pavlov, A.A. WeSMD-p05
Pavlov, A.Yu. ThR3-p07
Pavlov, I.N. ThR4-p04
Pavlov, K.V. WeR8-p73
Pavlov, M.V. TuSMB-05
Pavlov, N.G. ThR3-p03
Pavlov, N.G. ThR3-p13
Pavlov, N.G. ThR8-31
Pavlov, N.G. WeR11-04
Pavlov, S.I. TuR9-p17
Pavlov, V.I. ThR3-p11
Pavlov, V.V. TuR9-22
Pavlova, A.L. ThR7-p03
Pavlovskiy, V.V. TuR3-08
Pavlyuk, A.A. WeR1-24
Payusov, A.S. ThR3-30
Payusov, A.S. ThR3-31
Payusov, A.S. WeR3-12
Pazgalev, A.S. ThSMC-17
Peckus, M. WeR8-20
Pelevic, N. WeR7-06
Pellegrini, G. ThR3-33
Peng, Ch. WeR1-22
Penkov, N. WeSMB-16
Penkov, N. WeSMB-19
Pentin, I.V. WeR8-14
Pento, A. TuSMA-p09
Pento, A. TuSMA-p10
Pento, A. WeSMA-23
Perego, A.M. TuR8-09
Perekatova, V. TuSMB-02

Perekatova, V.V. WeSMA-16
Perevedentseva, E. WeSMB-22
Perevedentseva, E.V. TuSMB-10
Pergament, M. TuR10-02
Perin, A.S. WeR8-p05
Perin, A.S. WeR8-p24
Perin, A.S. WeR8-p54
Perlin, P. WePD-01
Permyakov, M.A. WeR7-12
Perrière, V. Brac de la TuR3-01
Pershin, A.A. ThR2-p05
Pershin, A.A. ThR2-p07
Pershin, D.A. WeR8-p53
Pershin, S.M. ThR7-p07
Pershin, S.M. WeR1-p21
Pershin, S.M. WeR7-07
Pershin, S.M. WeR7-10
Pershin, S.M. WeR7-11
Pershukevich, P.P. WeR1-p24
Persijn, S. WeR7-06
Pestryakov, E.V. ThR2-p16
Pestryakov, E.V. ThR2-p17
Pestryakov, E.V. ThR2-p38
Pestryakov, E.V. ThR2-p39
Pestryakov, E.V. WeR1-p39
Pestryakov, E.V. WeR2-20
Pestryakov, E.V. WeR5-26
Petersen, J. C. WeR7-06
Petrarca, M. WeR5-25
Petrenko, M.V. ThSMC-17
Petrishchev, N. ThSMD-04
Petrishchev, N. N. ThSMD-10
Petrosyan, A.G. TuR1-16
Petrov, A.A. ThR6-p02
Petrov, A.A. TuSMA-p11
Petrov, V. ThR8-42
Petrov, V.A. ThR2-p16
Petrov, V.A. ThR2-p17
Petrov, V.A. ThR2-p38
Petrov, V.A. WeR2-20
Petrov, V.M. ThR4-21
Petrov, V.M. ThR4-22
Petrov, V.M. TuR9-16
Petrov, V.V. ThR2-p16
Petrov, V.V. ThR2-p17
Petrov, V.V. ThR2-p38
Petrov, V.V. ThR2-p39
Petrov, V.V. WeR2-20
Petrova, O.B. TuR9-p03
Petrova, O.B. TuR9-p05
Petrova, O.B. TuR9-p06
Petrulenas, A. TuR1-13
Petukhov, A.V. WeSMA-21
Pfeiffer, M. WeR11-07
Philipova, N.I. ThSMD-22
Pichugin, I.S. WeR1-p14
Pichugin, I.S. WeR1-p48
Pidenko, P.S. TuR9-p23
Pidenko, S.A. TuR9-p23
Pierangelo, A. ThSMC-28
Pikhtin, N.A. ThR3-p04
Pikhtin, N.A. ThR3-p25
Pikhtin, N.A. ThR3-p29
Pikhtin, N.A. ThR3-p31
Pikhtin, N.A. ThR3-p45
Pikhtin, N.A. ThR4-p16
Pikuz, S. WePD-03
Pikuz, S.A. TuR10-03
Pikuz, S.A. WeR5-12
Pikuz, T.A. TuR10-03
Pikuz, T.A. WeR5-12
Pinto, I.V. WeR7-04
Piper, M. TuSMB-06
Pirozhkov, A. S. WeR5-12
Pištora, J. WeR3-14
Pivtsov, V.S. WeR1-32
Pivtsov, V.S. WeR1-p31
Platonov, K.Yu TuR5-p08
Platonov, K.Yu. TuR5-p01
Plavskaya, L.G. WeSMD-p10
Plavskaya, L.G. WeSMD-p13
Plavskii, V.Yu. WeSMD-p10
Plavskii, V.Yu. WeSMD-p13
Plekhanov, A.I. WeR8-p12
Pleshakov, I.V. TuR9-p12
Plotnichenko, V.G. WeR8-p44
Plotnikov, M.Yu. ThR8-41
Pnev, A.B. ThR1-44
Pnev, A.B. ThR7-18
Pnev, A.B. WeR1-30
Pnev, A.B. WeR1-31
Pniov, A.B. ThR4-p32
Pochitalkina, I.A. TuR9-p04
Podgaetsky, V.M. ThSMD-20
Podgaetsky, V.M. ThSMD-21
Podgaetsky, V.M. TuSMB-p22
Podgaetsky, V.M. WeSMC-p16
Podmar'kov, Yu.P. ThR1-47
Podoskin, A.A. ThR3-p25
Podoskin, A.A. ThR3-p29
Podoskin, A.A. ThR3-p45
Pogoda, A.P. ThR4-21
Pokrovskiy, V.P. TuR1-17
Pokrovskiy, V.P. TuR1-20
Pokrovskyi, V.P. WeR1-p30
Pokryshkin, N.S. ThR3-p36
Polezhaev, E.A. TuR1-05
Polischuk, V.A. TuR9-13
Polishchuk, A. TuR9-p40
Polishchuk, A. WeR1-p15
Polishchuk, A. WeR1-p16
Pollard, M. ThSMD-25
Polokhin, A.A. WeSMD-p04
Polokhin, A.A. WeSMD-p05
Polschikova, O.V. WeR1-p03
Polukeev, E. A. ThR4-p17
Polunina, A.V. WeSMA-19
Polyak, B. ThSMC-16
Polyakov, V. WeR1-p15
Polyakov, V.M. ThR7-p03
Polyakov, V.M. WeR7-12
Pominova, D.V. ThSMC-32
Pominova, D.V. WeSMD-p14
Pomozov, A.R. TuR9-p36
Pomozov, A.R. WeR8-p20
Ponomarev, A.N. ThSMD-19
Ponomarev, D.S. ThR3-p07
Ponomarev, D.S. TuR3-08
Ponomarev, G.V. ThSMD-12
Ponomarev, I.V. TuSMA-12
Ponomareva, E.A. WeR8-p50
Ponosova, A.A. WeR1-p38
Ponurovsky, Ya.Ya. ThR7-p04
Poole, P. J. WeR11-03
Popov, A. ThSMC-21
Popov, A.P. TuSMB-p15
Popov, A.V. ThSMC-33
Popov, C. TuR9-15
Popov, E.N. WeR8-p57
Popov, N.L. TuSMB-p13
Popov, N.L. WeSMA-19
Popov, S.M. TuR8-08
Popov, V.K. TuSMA-p03
Popova, E. WeR11-p06
Porfirev, A.P. TuR5-p04
Postava, K. WeR3-14
Potapov, A.A. TuSMB-12
Potapov, A.A. TuSMB-p09
Potapov, A.A. TuSMB-p18
Potapov, A.A. TuSMP-05
Potapov, A.A. WeSMB-25
Potemkin, A.K. TuR5-p29
Potemkin, F.V. ThR1-46
Potemkin, F.V. ThR8-28
Potemkin, F.V. TuR1-03
Potemkin, F.V. WeR8-p71
Potts, H. TuR9-p19
Povalyaev, N.M. TuSMB-p16
Povolotckaia, A. TuR9-10
Povolotckaia, A.V. ThR7-p11
Povolotckii, A. TuR9-10
Povolotskiy, A.V. ThR8-44
Pozar, V.E. ThR4-p29
Pozdnjakova, T.I. WeSMB-18
Pozina, G. WeR3-17
Pozina, G.P. WeR8-22
Pravdin, A.B. TuSMB-p19
Priebe, G. TuR10-02
Priezzhev, A. TuSMB-11
Priezzhev, A. WeSMB-41
Priezzhev, A.V. TuSMB-09
Priezzhev, A.V. TuSMB-p16
Pritotsky, E. ThR2-35
Privalov, V.A. TuSMA-08
Privalov, V.A. WeSMA-22
Privalova, P.Yu. WeSMD-p05
Prochazka, I. WeR7-10
Prokhorov, D.A. WeR8-p55
Prokhorov, I. ThR7-p01
Prokhorov, I. WeR7-09
Prokofiev, A.V. TuR9-p12
Prokopchuk, M. WeSMB-26
Prokopova, D.V. WeR1-p19
Prokoshev, V.G. ThR3-p36
Prokoshev, V.G. TuR9-p32
Prokoshev, V.G. WeR8-p16
Prokoshev, V.G. WeR8-p41
Prokudin, V. WeR5-18
Pronin, I.I. TuR10-15
Pronkin, A.A. TuSMA-07
Proshkina, G.M. WeSMD-p15
Protsenko, I.E. TuR9-p43
Proydakova, V.Yu. ThSMC-32
Proydakova, V.Yu. TuR9-22
Proydakova, V.Yu. TuR9-p21
Prusakov, K.Y. TuR1-09
Prusakov, K.Y. TuSMA-p13
Prusakov, K.Y. WeR2-24
Pruszynska-Karbownik, E. ThR3-p10
Pryamikov, A.D. ThR8-25
Pryamikov, A.D. TuR8-06
Pshonkin, D.V. ThR4-p28
Puchikin, A.V. ThR2-p12
Pudovkin, M.S. TuR9-p34
Pudovkin, M.S. TuR9-p37
Pulkin, N.S. WeR8-p25
Pulkin, S.A. ThR4-27
Pulkin, S.A. WeR8-p03
Pulkin, S.A. WeR8-p04
Pulkin, S.A. WeR8-p25
Purlys, V. WeR8-20
Pushkarev, A.V. ThSMC-40
Pushkarev, A.V. WeSMC-p05
Pushkarev, D. TuR5-p07
Pushkarev, D.V. ThR4-26
Pushkarev, S.S. ThR3-p24
Pushkareva, A.E. TuSMA-12
Pustovoy, V.I. WeR8-p62
Pustozerov, A.V. WeR8-p54
Putilin, S.E. WeR8-p50
Qi, H. ThR2-30
Qi, M. WeR11-08
Qin, W. TuR9-17
Qin, Ya. ThR8-34
Quéré, F. TuR5-01
Quintavalla, M. WeR4-04
Rabchinskii, M.K. TuR10-15
Rabchinskii, M.K. WeR7-01
Rafailov, E. WePD-01
Rafailov, E.U. ThR3-p37
Rafailov, E.U. ThR3-p44
Rafailov, E.U. ThSMC-41
Rafailov, E.U. WePD-06
Rafailov, E.U. WeR3-20
Rafailov, E.U. WeR3-26
Rafailov, E.U. WeSMB-29
Rafailov, E.U. WeSMB-32
Rafailov, I. ThSMC-41
Raghunathan, R. WePD-07
Raghunathan, R. WePD-08
Rahimi-Iman, A. WeR3-11
Raja, A.S. ThR8-31
Rakhimov, N.F. ThR1-40
Rakhimov, N.F. WeR1-p18
Rakotomanga, P. WeSMB-36
Rakovich, A. ThSMC-14
Ralchenko, V.G. TuR9-p21
Ramachandran, A. WeR11-10
Ramalis, L. ThR4-15
Ramazanova, A.G. WeR1-p03
Ramdane, A. TuR3-01
Ramos-Gomes, F. WeSMC-04
Ranishenka, B.V. TuR9-18
Rao, D.V.G.L.N. ThSMD-09
Rapoport, L.M. TuSMA-10
Raskovskaya, I.L. ThR4-p04
Rastegaeva, M.G. ThR3-p45
Ratakhin, N.A. WeR2-16
Ravnik, J. TuR10-14
Razhev, A.M. TuR2-08
Raznitsyna, I.A. TuSMB-p01
Raznitsyna, I.A. TuSMB-p03
Razukov, V.A. WeR8-p42
Razumova, Y.A. TuR9-13
Redka, D. ThR7-p15
Redka, D. ThR7-p16
Redka, D. WeR8-p21
Rehbinder, J. ThSMC-28
Reimer, Ch. WeR11-09
Reimer, M. E. WeR11-03
Resan, B. TuR3-04
Reshetov, I.V. TuR3-09
Reshetov, I.V. TuSMA-p16
Reshetov, I.V. TuSMB-12
Reshetov, I.V. TuSMB-p09
Reshetov, I.V. WeSMB-25
Reshetov, I.V. WeSMB-31
Revet, G. WePD-03
Revez, M.J. WeR7-04
Reznik, R.R. TuR9-05
Rezunkov, Yu.A. WeR6-06
Rezvanov, R.R. ThR3-p14
Richter, V. TuSMB-06
Rigo, I. TuR9-15
Rigó, I. ThSMC-22
Rigó, I. WeR8-p49
Říha, A. TuR1-07
Říha, A. WeR1-p23
Rinkevichyus, B.S. ThR4-p04
Rippy, J. WePD-08
Ristić, D. ThR1-43
Ristić, D. WeR8-p38
Riumkin, K.E. ThR1-36
Rizaev, G.E. TuR5-p26
Rocco, D. ThR3-33
Rochas, S.S. ThR3-p32
Rochev, Yu.A. TuSMA-p04
Rode, A.V. WeR5-24
Rodin, A.M. TuR1-12
Rodin, A.M. TuR1-13
Rodin, A.V. WeR7-08
Rodin, S.A. ThR2-p22
Rodionov, A.A. TuR9-p37
Rodionov, I.A. TuR9-p36
Rodriguez, J.B. WeR3-23
Rodyakina, E.E. ThSMC-26
Rogatkin, D.A. TuSMB-p01
Rogatkin, D.A. TuSMB-p02
Rogatkin, D.A. TuSMB-p03
Rogova, D.A. ThSMC-31
Rogozhnikov, G.S. ThR4-p25
Rohrbacher, A. TuR3-04
Romanishkin, I.D. ThSMC-32
Romanishkin, I.D. WeSMC-12
Romanishkin, I.D. WeSMD-p14
Romanov, P.N. ThR2-34
Romanov, V.A. WeSMC-p14
Romanova, E. WeR8-p38
Romanova, E.A. TuR5-p27
Romanova, O.A. WeSMA-22
Romanova, Yu.M. ThSMD-22
Romanovich, D.N. ThR3-p25
Romanovich, D.N. ThR3-p29
Romanovich, D.N. ThR3-p45
Romashkin, A.V. WeR5-21
Romashkin, A.V. WeR8-p69
Ropers, C. ThR8-24
Ropot, P.I. ThR4-p03
Rosanov, N.N. ThR8-26
Rosanov, N.N. ThR8-27
Rosanov, N.N. ThR8-32
Rosanov, N.N. ThR8-33
Rosanov, N.N. WeR8-p23
Rosanov, N.N. WeR8-p51
Rosenwaks, S. TuR2-01
Rosenwaks, S. TuR2-02
Rosenwaks, S. TuR2-03
Roshchupkin, S. P. TuR5-p09
Roshchupkin, S. P. TuR5-p12
Roshchupkin, S. P. TuR5-p14
Roshchupkin, S. P. TuR5-p28
Roshchupkin, S.P. TuR5-p20
Roshchupkin, S.P. WeR5-23
Rossi, F. TuR9-06
Roste, O.Z. WeR7-08
Rotermund, F. WeR1-p52
Royz, M. A. WeR3-13
Rozhdestvensky, Y.V. ThR8-37
Rozhkov, S.S. ThSMD-16
Rozhkova, N.N. ThSMD-16
Roztocki, P. WeR11-09
Rubinas, O. WeR11-p08

Rubinas, O.R. WeR11-p02
Rubinas, O.R. WeR11-p07
Rudenkov, A.S. TuR1-16
Rudenkov, A.S. WeR1-25
Rue, R.M. De La WeR3-16
Rulev, O.A. TuR2-10
Rumiantsev, B.V. ThR8-28
Runina, K.I. TuR9-p06
Rusanov, S.Ya. WeR1-p12
Rusov, V.A. WeR1-p51
Russo, S. TuR9-20
Rusteika, N. WeR1-27
Rusteika, N. WeR1-p33
Rusteika, N. WeR2-25
Ruzankina, J. ThR7-p15
Ruzankina, J. ThR7-p16
Ruzankina, Yu.S. ThR7-p10
Ryabkin, D.I. WeSMC-p16
Ryabochkina, P.A. TuSMA-p08
Ryabochkina, P.A. WeR1-p05
Ryabochkina, P.A. WeSMD-p08
Ryaboshtan, Yu.L. ThR3-p26
Ryabova, A. ThSMD-06
Ryabova, A.V. ThSMC-32
Ryabova, A.V. ThSMC-33
Ryabova, A.V. WeSMB-21
Ryabova, A.V. WeSMC-12
Ryabova, A.V. WeSMD-p14
Ryabova, V.M. WeSMA-18
Ryabushkin, O.A. ThR2-p26
Ryabushkin, O.A. ThR2-p27
Ryabushkin, O.A. ThR2-p28
Ryabushkin, O.A. WeR8-p27
Ryazanov, R.M. TuR9-p42
Rybak, A.A. WeR1-p39
Rybak, L. ThR8-38
Ryczkowski, P. TuR8-04
Ryvkin, B.S. ThR3-34
Ryzhikov, I.A. ThSMC-23
Ryzhikov, I.A. ThSMC-34
Ryzhova, V ThR7-p16
Saburina, I.N. TuSMA-09
Sadot, O. TuR2-03
Sadovnikov, M.A. WeR6-02
Sadovnikov, M.A. WeR6-09
Sadovnikov, V.P. ThR7-p18
Sadovoy, A. ThSMC-21
Saeger, S. De TuR9-p08
Safronova, E.S. WeR1-p40
Sagaydachnaya, E.A. WeSMC-p01
Sagisaka, A. WeR5-12
Sagitova, A.M. ThR2-p11
Sagitova, A.M. TuR2-09
Sagnes, I. WeR3-19
Saifutyarov, R.R. TuR9-p28
Sakaki, H. WeR5-12
Sakharov, A.V. WeR3-21
Saletsky, A.M. ThR8-47
Saletsky, A.M. WeR8-p76
Salimgareev, D. D. TuR9-p01
Salimgareev, D. D. TuR9-p02
Salimgareev, D.D. TuR9-08
Sall, E. ThR2-p14
Sall, E.G. WeR1-p45
Salova, A.V. ThSMC-31
Salova, A.V. WeSMC-11
Samagin, S.A. ThR4-16
Samagin, S.A. WeR1-p19
Samarkin, V.V. ThR2-34
Samarkin, V.V. ThR4-p28
Samsonova, Z. WeR5-25
Sanina, V.V. WeR1-p09
Sanina, V.V. WeR1-p10
Saphonova, T. WeSMB-26
Sapunov, D.A. WeSMA-16
Sarang, S. WePD-05
Sarimollaoglu, M. ThSMC-30
Sarychev, A.K. ThSMC-23
Sarychev, A.K. ThSMC-34
Savchenko, E.A. WeSMC-13
Savchenko, G.M. ThR3-p15
Savel'ev, A.B. ThR8-46
Savel'ev, A.B. TuR5-p04
Savel'ev, A.B. WeR5-15
Savel'ev, A. TuR5-p07
Savel'ev, A. WeR5-18
Savel'ev, A. WeR8-12
Savelev, A.B. WeR8-13
Savel'ev, A.B. TuR5-p02
Savel'ev, A.B. TuR5-p16
Saveleva, S.V. WeR8-p04
Savelieva, T.A. ThSMD-24
Savelieva, T.A. TuSMB-p18
Savelieva, T.A. TuSMP-05
Savelyev, M.S. ThR4-p11
Savelyev, M.S. TuR9-p42
Savelyev, M.S. TuSMB-p22
Savelyev, M.S. WeSMD-p04
Savikin, A.P. ThR2-p22
Savin, A. WeR7-05
Savin, D.V. ThR2-p22
Savin, D.V. ThR2-p23
Savin, D.V. ThR2-p24
Savin, D.V. ThR2-p25
Savinov, K.N. ThR3-p27
Savitsky, A.P. TuSMB-07
Savko, M.A. ThSMD-13
Savvin, A.D. WeR1-p40
Sayfutyarov, R.R. TuR9-p27
Sayfutyarov, R.R. TuR9-p38
Sazanovich, I.V. WeSMC-p02
Sazonkin, S.G. WeR1-30
Sazonkin, S.G. WeR1-31
Sazonkin, S.G. WeR1-p49
Scalfi-Happ, C. ThSMD-06
Scarcelli, G. WePD-08
Schadko, A.O. ThR4-p01
Schadko, A.O. TuSMB-p08
Schelkanova, I.J. WeSMB-28
Schirrmacher, A. ThR8-42
Schneckenburger, H. TuSMB-06
Schneider, C. ThR8-38
Schneider, H. TuR10-06
Schpichka, A.I. TuSMA-p04
Schulz, S.A. ThR3-29
Schunemann, P.G. ThR8-42
Schwartz-Albiez, R. ThSMC-15
Scott, G.G. TuR5-02
Sedov, M.V. TuR5-p08
Sedov, V.S. TuR9-p21
Sedova, I.V. ThR3-p20
Sedova, M.V. ThSMC-23
Sedova, M.V. ThSMC-34
Segel, M. WeR4-01
Segev, Mordechai (Moti) MoPL-04
Seghilani, M. WeR3-19
Seisyan, R.P. WeR2-27
Seleznev, L.V. TuR5-p26
Seleznev, L.V. WeR5-31
Seleznev, L.V. WeR8-p45
Selin, A.A. WeR4-02
Selishchev, S.V. ThSMD-21
Seliverstova, E. TuR9-p20
Sellahi, M. WeR3-19
Semashko, V.V. ThR1-40
Semashko, V.V. TuR9-22
Semashko, V.V. TuR9-p34
Semashko, V.V. TuR9-p37
Semashko, V.V. WeR1-p02
Semashko, V.V. WeR1-p05
Semashko, V.V. WeR1-p18
Semashko, V.V. WeR1-p27
Semashko, V.V. WeSMD-p12
Semenko, A.V. WeR1-p31
Semenov, A. TuSMB-11
Semenov, A. WeSMB-41
Semenov, A.L. WeSMC-p14
Semenov, A.N. TuSMB-p16
Semenov, V.M. WeR7-08
Semenov, V.V. WeR8-p43
Semenova, E.S. WePD-02
Semenova, I.V. ThSMC-31
Semenova, I.V. ThSMD-11
Semenova, I.V. WeSMC-p14
Semenova, V.A. WeR8-p72
Semiletova, Yu.V. ThSMD-05
Semjonov, S.L. WeR1-p38
Semkin, A.O. ThR4-p26
Semkin, A.O. ThR4-p27
Semyachkina-Glushkovskaya, O.V. WeSMB-29
Semyonov, S.L. ThR2-32
Semyonov, V.Yu. ThR7-18
Sen'kevich, A. M. TuR5-p02
Senatsky, Yu.V. ThR1-38
Senkevich, A. WeR5-18
Serbezov, V. WeSMC-05
Serebryakov, V.A. TuSMA-p12
Serebryakov, V.A. WeR1-p51
Sergeev, A. WeR7-05
Sergeev, A. N. WeR8-p67
Sergeev, A.A. WeR1-p14
Sergeev, A.N. ThR2-p35
Sergeev, A.N. TuSMB-13
Sergeev, A.N. WeR8-p32
Sergeev, Yu.A. WeR8-p26
Sergeeva, E.A. TuSMB-05
Sergeeva, E.A. WeSMA-16
Serin, A.A. ThR3-30
Serin, A.A. ThR3-31
Serres, J. M. ThR1-45
Shabanov, D.V. WeSMB-39
Shabrov, D. ThR3-p17
Shagurina, A.Yu. WeR11-p05
Shaidullin, R.I. ThR2-p28
Shaidullin, R.I. WeR8-p27
Shaimanov, A.N. TuR9-p36
Shakaeva, D.Iu. TuSMB-14
Shaked, N.T. TuSMB-08
Shakhov, A.M. TuSMA-02
Shakhov, A.V. WeSMA-16
Shakhova, M.A. WeSMA-16
Shakhova, N.M. TuSMB-05
Shakin, O.V. ThR4-20
Shakin, O.V. ThR4-p03
Shakirov, A.A. WeR1-p18
Shalayeva, A. ThR3-p18
Shalin, A.S. WeR8-p60
Shalnova, S.A. ThR2-p08
Shalova, A.V. TuR5-p26
Shamahov, V.V. ThR3-p04
Shaman, Yu.P. TuR9-p42
Shamray, A.V. ThR8-41
Shamray, A.V. WeR11-02
Shamray, L.V. ThR8-41
Shamray, L.V. WeR11-02
Shandarov, S.M. ThR4-22
Shandarov, V.M. WeR8-p05
Shandarov, V.M. WeR8-p24
Shandarov, V.M. WeR8-p54
Shang, W. WeR6-05
Shao, F.-Q. TuR5-p03
Shao, F.-Q. WeR5-19
Shao, Ji. ThR2-30
Sharangovich, S.N. ThR4-p26
Sharangovich, S.N. ThR4-p27
Shargorodskiy, V.D. WeR6-02
Shargorodskiy, V.D. WeR6-04
Shargorodskiy, V.D. WeR6-09
Sharikov, A.N. WeR8-p07
Sharma, S. ThR7-15
Sharova, A.S. WeSMB-21
Shashkin, I.S. ThR3-p45
Shashkin, I.S. ThR4-p16
Shashkova, V.T. WeSMC-p12
Shatilova, K.V. TuSMA-04
Shatilova, K.V. TuSMA-p11
Shatilova, K.V. WeSMA-18
Shavelev, A.A. ThR1-40
Shavelev, A.A. WeR1-p18
Shavkuta, B.S. ThSMC-38
Shaykin, A. WePD-03
Shaykin, A.A. WeR5-21
Shaykin, I. WePD-03
Shaykin, I.A. WeR5-21
Shchavruk, N.V. TuR3-08
Shchedrina, M.A. TuR3-09
Shchedrina, M.A. TuSMA-p16
Shcherbakov, I.A. WeR8-p07
Shcherbakov, I.A. WeR8-p11
Shcherbakov, V.V. WeR8-p33
Shcherbakov, V.V. WeR8-p34
Shebarshina, I.V. ThR2-p26
Shebarshina, I.V. ThR2-p27
Shehtman, O.D. TuSMP-05
Sheldakova, J.V. ThR4-p28
Sheldakova, Ju. ThR4-p23
Sheldakova, Ju. WeR4-03
Shelestov, D.A. ThR1-44
Shelestov, D.A. ThR4-p32
Shelkovnikov, A.S. ThR4-p32
Shemchuk, D. TuR9-p40
Shen, Z. WeR6-05
Sheng, X. ThR2-p34
Sheng, Z.-M. WeR5-19
Sheremet, A.S. ThR8-40
Shernyakov, Yu.M. ThR3-30
Shernyakov, Yu.M. ThR3-31
Shernyakov, Yu.M. WeR3-12
Shestakov, A.V. WeR1-p17
Shevchenko, K.G. ThSMC-25
Shevchenko, K.G. WeSMC-p07
Shevchenko, M.A. WeR7-07
Shevchenko, O.A. TuR10-12
Shi, H. ThR8-34
Shikhaliev, I.I. WeR8-p36
Shikunova, I.A. TuSMA-p16
Shikunova, I.A. WeR8-p30
Shikunova, I.A. WeSMB-31
Shilov, A.V. ThR3-p42
Shilova, G.V. ThR1-52
Shilova, G.V. TuR1-10
Shilova, G.V. WeR1-p37
Shilova, O.N. WeSMD-p15
Shimko, A.A. ThR7-p11
Shin, T.J. WeSMB-33
Shipilo, D. WeR8-12
Shipilo, D.E. ThR4-26
Shipilo, D.E. ThR8-46
Shipilo, D.E. ThR8-47
Shipilo, D.E. TuR5-p26
Shipilo, D.E. WeR5-16
Shipilo, D.E. WeR5-27
Shipilo, D.E. WeR8-p45
Shipilo, D.E. WeR8-p76
Shipunova, V.O. WeSMC-p13
Shipunova, V.O. WeSMD-p15
Shirokov, A. WeSMB-29
Shirshin, E.A. TuSMB-09
Shiryaev, V. WeR8-p38
Shiryaev, V.S. TuR5-p27
Shitikov, A. WeR11-07
Shitikov, A.E. TuR8-07
Shkol'nik, A.S. ThR3-p38
Shkurinov, A. WeR8-12
Shkurinov, A. WeSMB-26
Shkurinov, A.P. ThR3-p42
Shkurinov, A.P. ThSMC-36
Shkurinov, A.P. WeR8-13
Shkurinov, A.P. WeSMB-27
Shlyagin, M. TuR9-p12
Shmakov, S.S. ThR4-22
Shmelyova, V.A. TuR9-p06
Shmygalev, A.S. TuSMA-p15
Shmygalev, A.S. TuSMB-p23
Shoev, V.I. ThR4-27
Shpichka, A.I. TuSMA-p07
Shpuntova, D.V. WeSMC-09
Shramenko, M.V. ThR3-p01
Shramova, E.I. WeSMD-p15
Shrif, E. WeSMB-29
Shtanko, A. WeSMB-41
Shtanko, A.E. WeSMB-40
Shterengas, L. WeR3-26
Shtumpf, S.A. WeR8-p50
Shtyreva, V.V. TuR9-p37
Shuklin, F.A. TuR9-p43
Shukshin, V.E. WeR8-p14
Shulunov, A.N. WeR8-p55
Shulyapov, S. WeR5-18
Shulyapov, S.A. TuR5-p02
Shur, V. WeR1-23
Shur, V.Ya. ThR3-p39
Shushunova, N.A. WeSMB-29
Shutov, A.V. ThR8-45
Shutov, A.V. WeR5-31
Shvachkina, M.E. TuSMB-p19
Shvedunov, V.I. WeSMA-19
Shvidchenko, A.V. WeR7-01
Sibirev, N.V. ThR4-p05
Sibirev, N.V. TuR9-p22
Sidorov, V. ThSMC-41
Sidoryuk, O.E. TuSMB-p10
Sikach, E. WeSMB-26
Silchonok, S.S. ThR2-p15
Sildos, I. ThSMC-33
Silva, V. C. de ThSMC-24
Simakani, G.Y. TuSMB-p04
Simakov, V.A. ThR3-p26
Simanchuk, A.E. WeR8-p12
Simanovsky, Ya. TuSMA-p09
Simanovsky, Ya. TuSMA-p10

Simanovsky, Ya. WeSMA-23
Simonov, V. TuR9-p14
Sin'kov, S.N. TuR1-06
Sindeeva, O. WeSMC-03
Singaravelu, P. ThR3-29
Singh, J.P. WeSMC-02
Singh, M. WePD-07
Singh, S. ThR7-15
Singh, S. ThR8-23
Sinitsyn, D.V. ThR2-p11
Sinitsyn, D.V. TuR2-07
Sinitsyn, D.V. TuR2-09
Sinitsyn, D.V. TuR2-10
Sinko, A.S. ThSMC-36
Sirotkin, A.A. ThR1-52
Sirotkin, A.A. TuR1-10
Sirotkin, A.A. TuSMA-p14
Sirotkin, A.A. WeR1-p11
Sirotkin, A.A. WeR1-p12
Sirotkin, A.A. WeR1-p37
Sirotkin, A.A. WeR1-p40
Sirotkin, A.A. WeSMD-p07
Sitnikov, D.S. TuSMA-07
Sitnikov, D.S. TuSMA-09
Sivis, M. ThR8-24
Skasyrsky, Ya.K. ThR1-47
Skasyrsky, Ya.K. TuR1-02
Skibina, Y.S. TuR9-p23
Skidanenko, A.V. TuR9-p39
Sklyar, M.O. ThR2-p06
Sklyar, M.O. ThR2-p08
Skobelev, I.Yu. WeR5-12
Skobelev, S.A. TuR8-02
Skovorodkin, I. TuSMB-10
Skryabin, I. TuR9-p18
Skryabin, I. TuR9-p35
Skryabin, N.N. WeR5-29
Skvortsov, A.A. ThR4-p28
Skvortsov, D.V. TuSMA-p12
Skvortsov, M.I. ThR1-49
Skvortsov, M.I. TuR1-14
Slabko, V.V. WeR8-p63
Sladkov, A. WePD-03
Slight, T.J. WePD-01
Slipchenko, S.O. ThR3-p04
Slipchenko, S.O. ThR3-p25
Slipchenko, S.O. ThR3-p29
Slipchenko, S.O. ThR3-p45
Slipchenko, S.O. ThR4-p16
Slipchenkov, M.M. ThSMD-20
Slobozhanin, A.N. WeR1-p07
Slobozhanin, A.N. WeR1-p08
Slobozhanina, M.G. WeR1-p08
Smashniy, V.V. WeR6-03
Smetanin, I.V. ThR8-45
Smetanin, I.V. TuR9-p43
Smetanin, I.V. WeR5-31
Smetanin, S.N. WeR8-p14
Smirnov, I.V. WeR1-p37
Smirnov, K.V. WeR8-14
Smirnov, L. ThR7-p16
Smirnov, S.N. TuSMB-13
Smirnov, S.V. WeR1-p35
Smirnov, S.V. WeR1-p42
Smirnov, S.V. WeR8-p50
Smirnov, S.V. WeR8-p72
Smirnov, V.A. WeR8-p11
Smith, C. WeR6-01
Smolina, E. TuSMB-02
Smolina, E.V. WeR1-24
Smolyaninov, A.N. TuR9-p29
Smolyaninov, A.N. WeR11-p07
Smolyaninov, A.N. WeR11-p08
Smolyanskaya, O.A. TuSMB-p17
Smolyanskaya, O.A. WeSMB-28
Smolyanskaya, O.A. WeSMC-p06
Smyslov, V.A. WeR7-12
Snetkov, I.L. ThR2-28
Sobchuk, A.N. WeSMD-p13
Sobol, E.N. WeSMB-35
Sobol, E.N. WeSMB-39
Sobolev, A.M. TuR9-p09
Sobolev, A.M. WeSMC-09
Sobolev, D. ThR4-p08
Sobolev, S.S. WeR1-p04
Sobolev, S.S. WeR1-p30
Soboleva, K.K. ThR3-p15
Soboleva, K.K. ThR3-p37
Soboleva, K.K. ThR3-p38
Soboleva, K.K. ThR3-p39
Soboleva, O.S. ThR3-p25
Soboleva, O.S. ThR3-p29
Soboleva, O.S. ThR4-p16
Soboloeva, K.K. ThR3-p44
Soifer, V.A. TuR10-12
Sokolov, A.L. WePD-04
Sokolov, I.A. ThR8-44
Sokolov, I.L. ThSMC-19
Sokolov, I.L. WeSMC-p11
Sokolov, I.M. WeR8-p46
Sokolova, Z.N. ThR3-p04
Sokolova, Z.N. ThR3-p31
Sokolovski, S.G. WeSMB-32
Sokolovskii, A.S. TuR9-p19
Sokolovskii, G.S. ThR3-p15
Sokolovskii, G.S. ThR3-p35
Sokolovskii, G.S. ThR3-p37
Sokolovskii, G.S. ThR3-p38
Sokolovskii, G.S. ThR3-p39
Sokolovskii, G.S. ThR3-p43
Sokolovskii, G.S. ThR3-p44
Sokolovsky, S. ThSMC-41
Sokolovsky, S.G. WeSMB-29
Soldevila, F. WeR4-05
Solodkov, A.F. WeR8-p33
Solodkov, A.F. WeR8-p34
Sologub, A.S. TuR9-p05
Solomashenko, A.B. WeR4-09
Solomonov, V.I. WeR1-p26
Solov'ev, V.A. WeR3-25
Soloviev, A. WePD-03
Soloviev, A.A. WeR5-21
Solovieva, A.B WeSMC-p12
Solovieva, A.B. ThSMD-13
Solovyev, I.D. TuSMB-07
Solyankin, P. WeR8-12
Solyankin, P. WeSMB-26
Solyankin, P.M. WeR8-13
Song, D. WeR11-10
Sorba, L. TuR9-06
Sorokin, N.I. TuSMA-13
Sorokin, S.V. ThR3-p20
Sorokin, V.N. TuR9-p29
Sorokin, V.N. TuR9-p41
Sorokin, V.N. WeR11-p02
Sorokin, V.N. WeR11-p07
Sorokin, V.N. WeR11-p08
Soshenko, V.V. TuR9-p29
Soshenko, V.V. TuR9-p41
Soshenko, V.V. WeR11-p02
Soshenko, V.V. WeR11-p07
Soshenko, V.V. WeR11-p08
Soshnikov, I.P. TuR9-05
Sosnov, E.N. ThR4-p05
Sotsky, A.B. ThR3-p42
Soussen, C. WeSMB-36
Sovetsky, A.A. WeSMB-39
Sovetsky, A.A. WeSMB-42
Spasibko, K.Yu. TuR1-11
Spector, I.E. TuSMB-p08
Spector, I.E. TuSMB-p09
Spektor, I.E. ThR3-p07
Spektor, I.E. TuR3-09
Spence, D.J. WePD-05
Spiridonov, V.V. WeR7-08
Stafeev, S.S. ThR4-25
Stagira, S. WeR4-04
Staliunas, K. TuR8-09
Staliunas, K. WeR8-20
Stanczyk, S. WePD-01
Stankevich, S. L. ThR2-p09
Starikov, F.A. ThR2-p37
Starikov, F.A. ThR4-p02
Starikov, F.A. ThR4-p30
Starikov, F.A. WeR1-p36
Starodubtcev, A.M. ThSMD-12
Starodubtsev, M. WePD-03
Starodubtsev, M.V. WeR5-21
Staroverova, E.N. WeSMA-21
Starovoytov, A.A. TuR9-p16
Starshova, N. TuSMA-p10
Starykh, D.D. WeR8-p36
Stashkevich, I.V. WeR1-p34
Stavrovsky, D.B. ThR7-p04
Stein, K. WeR4-01
Steiner, R. WeSMD-p14
Steiner, R.W. ThSMD-06
Stelmakh, O.M. ThR7-p04
Stepanov, A.N. WeR5-20
Stepanov, A.N. WeR5-21
Stepanov, A.N. WeR8-p26
Stepanov, A.N. WeR8-p69
Stepanov, A.P. ThR2-p19
Stepanov, A.P. TuR9-01
Stepanov, D.N. WeR7-01
Stepanov, K.V. ThR1-44
Stepanov, K.V. ThR7-18
Stepanova, I.V. TuR9-p03
Steshenkova, N.A. ThR2-36
Stifutkin, A. WeR11-p06
Stiller, B. WeR11-05
Stoliarov, D.A. TuR5-p17
Stolz, W. WeR3-11
Strain, M.J. ThR3-27
Striga, E.V. WeSMA-21
Strokov, M.A. WeR7-07
Studionov, V.B. ThR3-p20
Stupnikov, A. ThR7-p15
Stupnikov, A. ThR7-p16
Stupnikov, A.V. ThR7-p13
Subbotin, K.A. WeR1-p09
Subbotin, K.A. WeR1-p10
Subbotin, K.A. WeR8-p11
Subochev, P. TuSMB-02
Suchkova, D.S. TuSMA-p15
Südmeyer, Th. TuR1-18
Sukhanov, M.V. TuR5-p27
Sukhanov, S.V. WeR8-p56
Sukhanova, A. WeSMC-04
Sukhorukov, A.A. WeR8-18
Sukhorukov, G. B. TuR9-p10
Sukhorukov, G.B. WeSMC-03
Sulc, J. WeR1-p46
Šulc, J. WeR1-p23
Sunchugasheva, E.S. TuR5-p26
Sunchugasheva, E.S. WeR8-p45
Sung, Ja.H. WeR2-14
Surin, A.A. TuR1-09
Surin, A.A. TuSMA-p13
Surin, A.A. WeR2-24
Suzuki, A. TuR1-01
Švejkar, R. TuR1-07
Švejkar, R. WeR1-p23
Svelto, C. ThR1-44
Svenskaya, Yu.I. TuSMB-p11
Sverchkov, S.E. WeR1-p22
Sverchkov, S.E. WeR1-p38
Sverchkov, S.E. WeR1-p46
Svetikov, V.V. WeR8-p62
Svetlichnyi, V.A. WeR8-p13
Svyakhovskiy, S.E. TuR9-14
Svyakhovskiy, S.E. WeR8-21
Svyakhovskiy, S.E. WeR8-p17
Svyakhovskiy, S.E. WeR8-p18
Symonds, C. WeR3-17
Syrchina, M.S. TuSMA-02
Syrin, V. TuSMP-01
Sysoliatin, A.A . TuR5-p17
Sysoliatin, A.A. ThR8-29
Sysoliatin, A.A. WeR8-p58
Syvridis, D. TuR3-02
Szriftgiser, P. TuR8-05
Taichenachev, A.V. ThR8-39
Taidakov, I.V. TuR9-p06
Tang, D. TuR9-17
Tang, L. WeR11-10
Tang, X. ThR3-p16
Taniguchi, S. WeR1-p47
Tanzilli, S. WeR11-01
Tarabrin, M.K. WeR1-29
Taranenko, V. WeR8-20
Tarasenko, S.V. WeSMA-18
Tarasov, A.P. TuSMB-p03
Taratkin, M.S. TuSMA-10
Tarkhov, M.A. ThSMC-38
Tavalinskaya, A.D. TuSMB-13
Taydakov, I.V. TuR9-p27
Taydakov, I.V. TuR9-p38
Tcherniega, N.V. WeR7-07
Tcypkin, A.N. TuR9-20
Tcypkin, A.N. WeR8-p50
Tcypkin, A.N. WeSMB-28
Té, Y. WeR7-09
team, S. Düsterer for the FLASH TuR10-08
Teissier, R. WeR3-23
Telegina, T. A. WeSMD-p12
Teodorovich, O.V. TuSMA-p02
Ter-Avetisyan, S. TuR5-09
Terekhov, S.N. TuR9-18
Terekhov, S.S. WeR1-p04
Terekhov, S.S. WeR1-p30
Terentiev, R.V. TuR8-07
Terentyev, A.V. ThSMC-38
Terentyev, V.S. WeR5-30
Tereschenko, S.A. ThR4-p11
Ternovski, V.V. WeR8-p17
Terskov, A.V. WeSMB-29
Terukov, E. WeR8-p21
Terziev, I. WeSMB-16
Tesadov, Y.A. ThR7-p18
Thelen, J.J. ThSMD-23
Thomas, P.A. WeSMC-02
Tiganova, I.G. ThSMD-22
Tikhonevich, O.V. TuSMA-p14
Tikhonevich, O.V. WeSMD-p07
Timaev, D.S. WeR1-p06
Timashev, P.S. TuSMA-p04
Timashev, P.S. TuSMA-p06
Timashev, P.S. TuSMA-p07
Timashev, P.S. TuSMA-p17
Timashev, P.S. WeSMA-14
Timashev, S.F. ThSMD-13
Timashov, P.S. WeSMC-p12
Timofeev, I.V. WeR8-21
Timofeev, M. ThSMC-21
Timofeeva, N.A. ThR2-p23
Timofeeva, N.A. ThR2-p24
Timofeeva, N.A. ThR2-p25
Timoshina, P. A. WeSMB-37
Tishkov, V ThR7-p05
Tishkov, V WeSMC-p08
Tishkov, V. ThR7-p14
Tishkov, V. ThR7-p15
Titov, A.I. WeR8-p11
Titov, E.V. WeR6-03
Tkachenko, A.Yu. WeR1-34
Tkachenko, V.A. WeR8-p63
Togashi, T. TuR10-03
Tokurakawa, M. TuR1-01
Tolbin, A.Yu. ThR4-p11
Tolenis, T. ThR4-15
Tolenis, T. ThR4-p24
Tolkachev, A.V. ThR4-p04
Tolmachev, V.A. TuR9-19
Tolmachev, V.A. TuR9-p17
Tolstov, G.I. TuR2-12
Topalov, I.K. ThR2-p10
Toporovskiy, V.V. ThR2-34
Toporovskiy, V.V. ThR4-p28
Torbin, A.P. ThR2-p07
Torbin, A.P. TuR2-11
Torner, L. TuR8-11
Toropov, N.A. TuR9-13
Toropov, N.A. TuR9-p25
Toropova, Ya.G. WeSMB-28
Torres, V. WeR11-08
Tóth, S. ThSMC-22
Tóth, S. TuR9-15
Tournet, J. WeR3-23
Tournié, E. WeR3-23
Tregubov, A.A. ThSMC-25
Tregubov, A.A. WeSMC-p07
Treschikov, V.N. ThR7-19
Treschikov, V.N. WeR8-p36
Tretyakova, A.I. WeSMD-p10
Tretyakova, A.I. WeSMD-p13
Tribelsky, M.I. WeR8-p17
Trigub, M.V. ThR2-p33
Trikshev, A.I. ThR2-p02
Trikshev, A.I. WeR1-33
Trikshev, A.I. WeR1-p32
Trikshev, A.V. ThR7-p04
Trillo, St. TuR8-05
Trofimov, A. WeR8-p01
Tronev, A.V. WeR11-02
Troyanova, P. WeSMB-16
Trunov, I.A. TuR2-08
Trunov, V. WeR2-22
Trunov, V.I. ThR2-31
Trunov, V.I. WeR5-17
Trunov, V.I. WeR5-26

Trushin, S.A. TuR5-04
Tsarev, D.V. WeR8-p06
Tsatsulnikov, A.F. WeR3-21
Tsesses, S. ThR8-38
Tsipotan, A.S. WeR8-p63
Tsvetkov, V. WeR2-18
Tsvetkov, V.B. ThR2-29
Tsvetkov, V.B. ThR2-p02
Tsvetkov, V.B. ThR2-p03
Tsvetkov, V.B. ThR2-p29
Tsvetkov, V.B. WeR1-33
Tsvetkov, V.B. WeR1-p32
Tsvetkov, V.B. WeR1-p38
Tsyganok, V.V. WeR8-p53
Tsymbalov, I. WeR5-18
Tsymbalov, I.N. TuR5-p02
Tsymbalov, I.N. TuR5-p16
Tsymbalov, I.N. WeR5-15
Tsyupka, D.V. TuR9-p09
Tuchin, V. V. WeSMB-37
Tuchin, V.V. TuSMA-p16
Tuchin, V.V. TuSMB-01
Tuchin, V.V. TuSMB-p06
Tuchin, V.V. TuSMB-p08
Tuchin, V.V. TuSMB-p09
Tuchin, V.V. TuSMB-p11
Tuchin, V.V. TuSMB-p21
Tuchin, V.V. WeSMB-20
Tuchin, V.V. WeSMB-25
Tuchin, V.V. WeSMB-28
Tuchin, V.V. WeSMB-29
Tuchin, V.V. WeSMB-31
Tuchina, D. K. WeSMB-37
Tuchina, D.K. TuSMB-p21
Tuev, P.V. WeR5-17
Tukmakov, K.N. TuR10-12
Tunkin, V.G. WeR2-26
Turchin, I. TuSMB-02
Turchin, I. WeSMB-17
Turchin, I.V. WeSMA-16
Turchinovich, D. TuR3-07
Turichin, G. A. ThR2-p09
Turichin, G.A. ThR2-p08
Turichin, G.A. ThR2-p15
Turichin, G.A. ThR4-p09
Turin, A.V. WeR7-10
Turin, A.V. WeR7-11
Turitsyn, S.K. TuR8-09
Tütüncüoglu, G. TuR9-p19
Tuzova, I.V. WeR1-p44
Tykalewicz, B. ThR3-36
Tyrtyshniy, V. A. WeSMA-25
Tyrtyshnyy, V.A. WeR1-26
Tyurikov, D.A. ThR4-p32
Tyutin, S.V. WeR1-p36
Ulanova, M.V. WeSMB-29
Ulin, N.V. TuR10-15
Ulin, V.P. TuR10-15
Ulyanov, I.S. ThR2-33
Urgapov, D.A. ThR8-47
Urgapov, D.A. WeR8-p76
Uryupina, D. TuR5-p07
Uryupina, D.S. ThR4-26
Usachev, D.Yu. TuSMP-05
Ushakov, A.A. ThR4-26
Ushakov, A.A. WeR5-16
Ushakov, A.A. WeR5-27
Ushakov, D. V. TuR3-08
Ushakov, D.A. TuSMA-p01
Ushakova, E.V. TuSMB-p20
Uskov, A.V. TuR9-p30
Uskov, A.V. TuR9-p43
Usov, S.O. WeR3-21
Ustinov, V. TuSMB-11
Ustinov, V. WeSMB-41
Ustinov, V.M. ThR3-p22
Ustinov, V.M. ThR3-p35
Ustinov, V.M. TuR9-01
Ustinovskii, N.N. ThR8-45
Ustinovskii, N.N. TuR2-07
Ustinovskii, N.N. WeR5-31
Utkin, A.B. WeR7-04
Uvarova, S.V. WeR8-p03
Uvarova, S.V. WeR8-p04
Uvarova, S.V. WeR8-p25
Uvarova, T. WeR1-p50
Uvchenko, S.A. ThR7-p08
Váczi, T. ThSMC-22
Váczi, T. TuR9-15
Vadimova, O. ThR2-p14
Vadimova, O.L. WeR1-p45
Vagin, N.P. TuR2-10
Vainio, S. TuSMB-10
Vais, O.E. TuR5-p21
Vais, O.E. WeR5-15
Vakhtomin, Yu.B. WeR8-14
Valdaytseva, E. A. ThR2-p09
Validire, P. ThSMC-28
Valisheva, N.A. WeR8-p12
Valkov, A. TuSMB-04
Valov, A.P. ThR6-p02
Valshin, A.M. WeR1-p21
Valuev, V.V. WeR8-p55
Vanetsev, A.S. ThSMC-33
Varlamov, A.V. ThR8-41
Vartanyan, T.A. TuR9-13
Vartanyan, T.A. TuR9-p25
Vartanyan, T.A. TuR9-p26
Vasil'ev, A. P. TuR9-01
Vasilevsky, P.N. ThR4-p11
Vasilevsky, P.N. TuSMB-p22
Vasiliev, A.B. ThR7-14
Vasiliev, I.S. WeSMA-22
Vasilieva, O.O. WeSMC-p12
Vasilyeva, A.V. ThSMC-19
Vasilyeva, A.V. WeSMC-p11
Vasin, A.V. ThSMC-27
Vaskivskyi, I. TuR10-14
Vasyutinskii, O.S. ThSMC-31
Vasyutinskii, O.S. ThSMD-11
Vasyutinskii, O.S. ThSMD-15
Vasyutinskii, O.S. WeSMC-p14
Vatnik, S.M. WeR1-24
Vatnik, S.M. WeR1-p26
Vavilova, L.S. ThR3-p25
Vechtomova, Yu.L. WeSMD-p12
Vedin, I.A. WeR1-24
Vedin, I.A. WeR1-p26
Vedyashkina, A.V. ThR4-p04
Veiko, V.P. TuSMA-p11
Velichko, E.N. ThSMC-37
Velichko, E.N. TuR9-p12
Velichko, E.N. TuSMB-p14
Velichko, E.N. WeR8-p40
Velichko, E.N. WeSMC-13
Velikanov, S.D. TuR1-05
Velikanov, S.D. TuR1-06
Velikovskii, D.Yu. ThR4-p29
Velmiskin, V.V. TuR1-19
Velmiskin, V.V. WeR1-p22
Velmuzhov, A.P. TuR5-p27
Venanzi, T. TuR10-06
Venediktov, D.V. ThR4-27
Venediktov, V.Yu. ThR4-27
Venediktov, V.Yu. WeR4-09
Venediktova, A.V. ThR4-17
Venglyuk, V.I. WeR6-06
Venkatakrishnarao, D. WeR8-p74
Venkatesan, S. TuR10-02
Venkstern, A.A. WeR7-08
Veres, M. ThSMC-22
Veres, M. TuR9-15
Veres, M. WeR8-p49
Veres, M. WeSMD-p11
Veretekhin, I.D. ThR4-p02
Veretekhin, I.D. WeR4-10
Veretenov, N.A. ThR8-32
Veretenov, N.A. ThR8-33
Vergyris, P. WeR11-01
Vernaz-Gris, P. ThR8-40
Vershovskii, A.K. ThSMC-17
Veselis, L. WeR1-27
Veselis, L. WeR1-p33
Veselis, L. WeR2-25
Veselov, D.A. ThR3-p04
Veselov, D.A. ThR3-p29
Vesnin, V.L. ThR4-23
Vetrov, S.Ya. WeR8-21
Vetrov, V. TuR9-p11
Viktorov, E.A. ThR3-29
Viktorov, E.A. ThR3-36
Viktorov, E.A. ThR3-p38
Viktorov, E.A. WeR11-09
Vildanov, A.M. ThR2-p06
Vildanov, A.M. ThR2-p08
Vildanov, A.M. ThR4-p09
Vilejshikova, E.V. WeR1-p28
Vinarov, A.Z. TuSMA-13
Vinichenko, V. TuSMP-01
Vinnichenko, V. A. WeSMA-25
Vinnichenko, V.A. TuSMA-11
Vinnichenko, V.A. TuSMA-p11
Vinnichenko, V.A. WeSMA-20
Vinnichenko, V.A. WeSMA-24
Vinogradov, A.V. TuSMB-p13
Vinogradov, A.V. WeSMA-19
Vinogradov, I.I. WeR7-08
Vinokurov, N.A. TuR10-12
Vinokurov, N.A. WeR2-23
Vins, V.G. WeR11-p02
Viskontas, K. WeR1-p33
Visnevskaya, L.V. ThR4-17
Vitkin, A. WeSMB-42
Vitkin, V. ThR1-45
Vitkin, V. TuR9-p40
Vitkin, V. WeR1-p15
Vitkin, V. WeR1-p16
Vitkin, V.V. ThR7-14
Vizet, J. ThSMC-28
Vladimirov, B. WeSMB-16
Vladimirov, B. WeSMB-19
Vladimirov, F.I. WeSMA-21
Vladimirskaya, A.D. WeR1-34
Vlasov, A.A. ThR1-49
Vlasov, A.A. TuR1-14
Vodchits, A.I. WeR8-p15
Volchkov, S.S. TuR9-p24
Volchkov, S.S. WeR8-p65
Volikova, A.M. ThR2-p39
Volkov, M.V. ThR2-p37
Volkov, O.Yu. TuR3-08
Volkov, R. TuR5-p07
Volkov, R. WeR5-18
Volkov, R.V. ThR4-26
Volkov, R.V. TuR5-p02
Volkov, V.V. TuSMB-p18
Volkova, K.P. ThR7-14
Volodkin, B.O. TuR10-12
Vologdin, V.A. ThR3-p21
Volokitina, A. ThR1-45
Voloshin, A. WeR11-07
Voloshin, A. S. WeR11-p04
Voloshin, A.S. ThR3-p03
Voloshin, A.S. ThR3-p11
Voloshin, A.S. WeR11-04
Voloshin, G.V. WeR8-p57
Voloshin, V. V. TuR8-08
Vorob'ev, I. L. TuR8-08
Vorobyov, V.V. TuR9-p29
Vorobyov, V.V. TuR9-p41
Vorobyov, V.V. WeR11-p02
Vorobyov, V.V. WeR11-p07
Vorobyov, V.V. WeR11-p08
Voronets, A.I. WeR1-29
Voronich, I.N. ThR2-29
Voronich, I.N. ThR2-p03
Voronin, P.G. ThR2-p24
Voronkova, N.V. ThR3-p29
Voronov, V.V. ThSMC-32
Voronov, V.V. TuR9-22
Voronov, V.V. TuR9-p21
Voronov, V.V. WeR1-p09
Vorontsov, K.V. TuR1-05
Vorontsov, K.V. TuR1-06
Voropaev, V.S. WeR1-29
Voropaev, V.S. WeR1-p49
Vostrikova, A. M. TuR9-p10
Vostrikova, A.M. WeSMC-09
Vovk, T.A. ThR8-37
Vovnenko, S.V. TuSMA-p01
Voznesenskaya, A.A. WeR8-p16
Voznyuk, G.V. ThR3-p23
Voznyuk, G.V. ThR3-p28
Vozzi, C. WeR4-04
Vukajlovic-Plestina, J. TuR9-p19
Vul', A.Ya. WeR7-01
Vyatkin, A.G. ThR2-p04
Vyatkin, M. Yu. TuR8-08
Vyhlídal, D. WeR8-p14
Vyunishev, A.M. WeR8-21
Wabnitz, S. TuR1-14
Wabnitz, S. TuR8-01
Wagner, M. TuSMB-06
Waichman, K. TuR2-01
Waichman, K. TuR2-02
Waichman, K. TuR2-03
Wang, B. ThR2-30
Wang, H. ThR2-30
Wang, H. ThR3-p19
Wang, J. ThR4-14
Wang, J. TuR10-02
Wang, L. TuR9-17
Wang, M. WeR3-26
Wang, P.-H. WeR11-08
Wang, T. WeR11-09
Wang, X. ThR2-p34
Wang, Y. WeR11-06
Wang, Y. WeR6-01
Wang, Yi-F. TuR5-p15
Wang, Zh. WeR11-09
Wang., Ju. ThR4-18
Wani, F. TuR2-04
Watson, S. WePD-01
Wegner, U. TuR10-02
Wei, W.Q. TuR5-10
Weiner, A.M. WeR11-08
Whitfield, J. ThSMC-35
Więckowska, M. ThR3-p05
Wiehe, A. ThSMD-06
Williams, R.J. WePD-05
Williamson, S.D.R. TuR5-10
Wilson, B. C. WeSMA-17
Wilson, R. TuR5-02
Wilson, R. TuR5-10
Winnerl, S. TuR10-06
Wishon, M.J. ThR3-36
Wissmann, L. TuR10-02
Wittig, R. ThSMD-06
Wittwer, V. J. TuR1-18
Woerle, M. WeR5-28
Wolf, A.A. ThR1-49
Wolf, A.A. ThR2-32
Wolf, A.A. TuR1-14
Wu, Ch. WePD-07
Wu, F. WeSMC-02
Xia, R. ThR3-p16
Xia, Sh. WeR11-10
Xia, Sh. WeR11-10
Xiao, L. ThR8-34
Xie, X. ThR2-30
Xu, H. ThR3-p16
Xuan, Y. WeR11-08
Yablunovski, K.A. TuR9-p39
Yabuuchi, T. TuR10-03
Yachmenev, A.E. ThR3-p07
Yacoby, E. TuR2-01
Yacoby, E. TuR2-03
Yadav, A. WePD-01
Yadav, A. WeR3-20
Yadav, A. WeR3-26
Yagnyatinskiy, D.A. WeR4-12
Yakavets, I.V. ThSMD-17
Yakimansky, A.V. WeR8-p12
Yakimov, B.P. TuSMB-09
Yakovets, A.V. TuR5-p25
Yakovlev, D.A. TuSMB-p19
Yakovlev, D.D. TuSMB-p19
Yakovlev, D.V. WeR2-26
Yakovlev, E.V. ThSMC-18
Yakovlev, I. WePD-03
Yakovlev, I.V. WeR5-21
Yakovlev, V.A. ThR7-p17
Yakovlev, Yu. ThR3-p17
Yakovlev, Yu. P. WeR3-13
Yakovleva, V.I. WeR8-p04
Yakubovich, S.D. ThR3-p01
Yakushin, S.S. ThR2-32
Yalunina, T.R. ThR3-p06
Yampolskaya, S.A. ThR2-p12
Yang, H.M. WeR1-p29
Yanina, I.Yu. TuSMB-p06
Yapryntsev, A.D. TuR9-22
Yaremenko, A.V. ThSMC-19
Yaroslavsky, I. V. WeSMA-25
Yaroslavsky, I.V. TuSMA-04
Yaroslavsky, I.V. TuSMA-11
Yaroslavsky, I.V. TuSMA-p11
Yaroslavsky, I.V. WeSMA-18
Yaroslavsky, I.V. WeSMA-20
Yaroslavsky, I.V. WeSMA-24
Yaroslavsky, I.V. WeSMA-26
Yarunova, E.A. WeR8-p35

Yashin, K.S. WeSMB-34
Yashin, V.E. WeR1-p45
Yashkov, M.V. WeR3-20
Yastrebkov, A.B. ThR2-p21
Yastremsky, A.G. WeR2-16
Yasukevich, A.S. ThR1-39
Yasukevich, A.S. TuR1-16
Yasukevich, A.S. WeR1-24
Yasukevich, A.S. WeR1-p52
Yin, Y. WeR5-19
Yoon, Ji.W. WeR2-14
Yoshida, H. WeR1-p47
Yu, H. ThR3-p19
Yu, T.-P. TuR5-p03
Yu, T.-P. WeR5-19
Yuan, X.H. TuR5-10
Yudin, V.I. ThR8-39
Yuferev, V.S. ThR3-p25
Yumashev, K.V. WeR1-24
Yumashev, K.V. WeR1-p28
Yumoto, J. WeR5-16
Yumoto, J. WeR5-27
Yurchenko, S.O. ThR3-p07
Yurchenko, S.O. ThSMC-18
Yurchenko, S.O. TuSMB-p09
Yurlov, I.A. WeSMD-p08
Yuryshev, N.N. TuR2-10
Yushina, T.E. WeSMD-p07
Yusubalieva, G.M. WeSMC-12
Yusupov, V.I. TuSMA-05
Yusupov, V.I. TuSMA-p05
Yusupov, V.I. WeSMA-15
Yuvchenko, S.A. TuR9-p24
Yuvchenko, S.A. TuSMB-p20
Yuvchenko, S.A. WeR8-p65
Yuzhakov, A. WeSMB-39
Yuzhakov, A.V. WeSMB-35
Zaalishvili, N. WeSMB-41
Zabrodskiy, A.N. TuSMA-p01
Zackharenko, Yu.G. WeR8-p59
Zadeh, I. Esmaeil WeR11-03
Zadernovsky, A.A. WeR8-p33
Zadernovsky, A.A. WeR8-p34
Zadiranov, Y.M. ThR3-p43
Zadiranov, Yu.M. WeR3-15
Zagidullin, M.V. TuR2-12
Zagorulko, K.A. ThR1-51
Zaitsev, V.Y. WeSMB-39
Zaitsev, V.Y. WeSMB-42
Zakgeim, A.L. ThR3-p22
Zakharov, N.G. TuR1-05
Zakharov, N.G. TuR1-06
Zakoyan, A.A. WeSMD-p06
Zalesskiy, A.D. TuSMA-02
Zalevsky, Z. TuSMP-04
Zamyatin, O.A. WeR8-p44
Zannier, V. TuR9-06
Zanon-Willette, T. WeR7-09
Zarrinpar, A. ThSMD-07
Zayarnyi, D.A. TuR2-07
Zayko, S. ThR8-24
Zaytsev, K.I. ThR3-p07
Zaytsev, K.I. ThR4-p01
Zaytsev, K.I. ThSMC-18
Zaytsev, K.I. TuR3-09
Zaytsev, K.I. TuSMA-p16
Zaytsev, K.I. TuSMB-12
Zaytsev, K.I. TuSMB-p08
Zaytsev, K.I. TuSMB-p09
Zaytsev, K.I. WeR8-p30
Zaytsev, K.I. WeSMB-25
Zaytsev, K.I. WeSMB-31
Zaytsev, S.M. TuSMB-p11
Zeleneev, A.I. TuR9-p29
Zeleneev, A.I. TuR9-p41
Zelenikhin, P.V. TuR9-p37
Zelenkov, P.V. TuSMP-05
Zelepukin, I.V. WeSMC-p13
Zemlyakov, E.V. ThR4-p09
Zemskov, K.I. WeR7-07
Zenova, E.V. ThSMC-38
Zepp, A. WeR4-01
Zhang, H. ThR3-p16
Zhang, J. WePD-08
Zhang, J. WeR6-05
Zhang, S. ThR4-14
Zhang, X.-C. WeR8-p50
Zhang, X.L. WeR8-p09
Zhang, Yo. ThR2-p34
Zhang, Yo. WeR11-09
Zhang, Yu. ThR2-p34
Zhang., X. ThR4-18
Zhao, S. WeR6-05
Zharikov, E.V. WeR1-p09
Zharikov, E.V. WeR1-p10
Zharikov, E.V. WeR8-p11
Zharkov, V.I. ThR7-17
Zharkov, V.I. WeR7-02
Zharov, V.P. ThSMC-30
Zharov, V.P. TuSMB-01
Zharova, Yu.A. TuR9-19
Zharova, Yu.A. TuR9-p17
Zhdanova, E.V. ThR3-p20
Zhelyazkova, Al. WeSMB-19
Zheng, Y. WeR6-05
Zherebtsov, E. ThSMC-41
Zherebtsov, E. WeR3-20
Zherebtsov, E. WeR3-26
Zhevlakov, A. ThR7-p05
Zhevlakov, A. ThR7-p14
Zhevlakov, A. ThR7-p15
Zhevlakov, A. WeSMC-p08
Zhevlakov, A.P. ThR7-p10
Zhevlakov, A.P. WeR2-27
Zhigarkov, V.S. TuSMA-p05
Zhigarkov, V.S. WeSMA-15
Zhiguleva, D.O. WeR8-p51
Zhikhoreva, A.A. ThSMC-31
Zhikhoreva, A.A. WeSMC-p14
Zhilin, A. TuR9-p40
Zhilinskaya, N.T. WeSMC-p14
Zhilkin, B.P. TuSMA-p15
Zhilyakov, A.V. TuSMA-08
Zhilyakov, A.V. TuSMA-p15
Zhirnov, A.A. ThR1-44
Zhirnov, A.A. ThR7-18
Zhivotkov, D. ThR1-43
Zhivotkov, D. WeR8-p38
Zhluktova, I.V. ThR2-p29
Zhmurenkov, A.G. ThR2-36
Zhou, X. ThR3-p19
Zhu, D. WeSMB-36
Zhu, Z. ThSMD-06
Zhukov, A.E. ThR3-30
Zhukov, A.E. ThR3-31
Zhukov, A.E. WePD-02
Zhukov, A.E. WeR3-12
Zhukov, A.E. WeR3-15
Zhukova, L. V. TuR9-p02
Zhukova, L. V. TuSMB-p23
Zhukova, L.V. TuR9-08
Zhukova, L.V. TuR9-p01
Zhukova, L.V. WeR8-p28
Zhukova, L.V. WeR8-p29
Zhukova, L.V. WeR8-p64
Zhukova, M.O. TuR9-20
Zhumabay, N. TuR9-p20
Zhuravlev, K. ThR3-p18
Zhuravlev, S.G. ThR2-32
Zhurbina, N.N. ThR4-p11
Zhurbina, N.N. TuR9-p42
Zhurenkov, A.G. ThR7-p17
Zhvaniya, I.A. TuR5-p11
Zimnyakov, D.A. ThR4-p06
Zimnyakov, D.A. ThR7-p08
Zimnyakov, D.A. TuR9-p24
Zimnyakov, D.A. TuSMB-p20
Zimnyakov, D.A. WeR8-p65
Zinin, P.V. ThR4-p22
Zinoviev, A.P. ThR4-p12
Zlobin, A.O. ThR4-22
Znoyko, S.L. ThSMC-20
Znoyko, S.L. ThSMC-39
Znoyko, S.L. ThSMC-40
Znoyko, S.L. WeSMC-p04
Znoyko, S.L. WeSMC-p15
Zolotarev, V.V. ThR4-p16
Zolotareva (Kuznetsova), J.O. ThSMD-27
Zolotov, S. TuSMA-p09
Zolotov, S. TuSMA-p10
Zolotov, S.A. TuSMA-p14
Zolotov, S.A. WeSMD-p07
Zolotovskii, I. TuR9-p33
Zolotovskii, I. WeR8-p48
Zolotovskii, I.O. ThR2-p02
Zolotovskii, I.O. TuR5-p17
Zolotovskii, I.O. TuR8-08
Zorin, V.P. ThSMD-17
Zotov, O.G. ThR2-p15
Zubkov, L. TuSMB-04
Zubov, F.I. WePD-02
Zuev, A.S. WeR5-21
Zurina, I.M. TuSMA-07
Zurina, I.M. TuSMA-09
Zverev, M.M. ThR3-p20
Zverev, P.G. ThR1-52
Zverev, P.G. TuR1-10
Zverev, P.G. WeR1-p12
Zverev, P.G. WeR1-p37
Zverev, P.G. WeR8-p14
Zvorykin, V.D. ThR8-45
Zvorykin, V.D. WeR5-31
Zwiller, V. WeR11-03
Zykova, M.P. TuR9-p05
Zyryanova, K. TuR9-09
Zyryanova, K.S. WeR8-p73