P R O G R A M

MPLP-2018

The VIII International Symposium

“MODERN PROBLEMS OF LASER PHYSICS”

and International School on Laser Physics and Photonics

Novosibirsk, Russia, 25 August – 01 September, 2018

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INTERNATIONAL ADVISORY COMMITTEE

Registration

Registration will be held from **14^{00}** till **18^{00}** on Saturday, **August 25** and from **8^{30}** till **17^{00}** from **August 26** till **August 29** at the "**House of Scientists**".

For the report presentations on the Symposium we plan to use:

- multimedia projector;

- the presentation software "MS PowerPoint" and Acrobat Reader.

Accommodation

Accommodation is available in the hotel "**Golden Valley**" (rus. "**Zolotaya dolina**"). A walk from the hotel to the "House of Scientists" takes only 5 minutes.

Representatives of the MPLP–2018 Organizing Committee
In the "House of Scientists": room no. 200.
In the room no. 223 you are offered to use a personal computer with the Internet and a printer for your needs.
Wi-Fi will be available.

Meals

Breakfast, lunch and dinner will be served at the **House of Scientists restaurant**.
Breakfasts will be from 8^{00} to 9^{00}.
Lunches will be from 13^{00} to 14^{00}.
Dinners will be from 20^{00} to 21^{00}.
Welcome Party is scheduled on **August 26** at 19^{15}.
Symposium Dinner is scheduled on **August 28** at 20^{30}.

Cultural program

During the Symposium we plan various social events, including excursions in Akademgorodok and its museums, excursions in the city of Novosibirsk, etc. You will be offered to choose events to take part in.

International School on Laser Physics and Photonics

It starts on August 29 (Wednesday) at 14:00 and continues on August 30 and August 31 from 9:00. The school opening at the "House of Scientists" and the next days in Novosibirsk State University.

Symposium Program

Sunday, August 26

In the House of Scientists:

$8^{\underline{00}}$ - $9^{\underline{00}}$ Breakfast

$8^{\underline{30}}$ - $17^{\underline{00}}$ Registration

$09^{\underline{00}} – 09^{\underline{30}}$ ***Opening Speeches***

Session 1 *New trends*

$09^{\underline{30}} – 10^{\underline{00}}$ **E. Peik,** *Physikalisch-Technische Bundesanstalt, 38116, Braunschweig, Germany*

Trapped ion optical clocks and tests of the equivalence principle. Comparing two Yb+ ion clocks, a Sr lattice clock and Cs clocks at PTB we perform tests for variations of fundamental constants and violations of local Lorentz invariance. A nuclear clock based on the low-energy transition in Th-229 is investigated. Results from hyperfine spectroscopy of the Th-229 isomer provide first data on its nuclear moments.

$10^{\underline{00}} – 10^{\underline{30}}$ **S. Bagayev[1,2], A. Taichenachev[1,2], V. Yudin[1-3],** *[1]Institute of Laser Physics SB RAS, Novosibirsk, Russia; [2]Novosibirsk State University, Novosibirsk, Russia; [3]Novosibirsk State Technical University, Novosibirsk, Russia*

Recent advances in high-precision optical clocks based on ultracold atoms and ions. 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.

$10^{\underline{30}} – 11^{\underline{00}}$ **A. Landragin, X. Alauze, M. Altorio, A. Bonnin, R. Geiger, A. Imanaliev, R. Karcher, S. Merlet, F. Pereira Dos Santos, D. Savoie, L. Sodorenkov,** *LNE-SYRTE, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, 61 avenue de l'Observatoire, 75014, Paris, France*

Atom interferometry for high sensitivity in inertial measurements.

$11^{\underline{00}} – 11^{\underline{30}}$ Coffee Break

Session 2 *Quantum Optics*

$11^{\underline{30}} – 12^{\underline{00}}$ **B. Srivathsan[1], M. Fischer[1,2], V.A. Averchenko[1], L. Alber[1,2], D.V. Strekalov[1,2], Ch. Marquardt[1,2], M. Sondermann[1,2], G. Leuchs[1-4],** *[1]Max Planck Institute for the Science of Light, Erlangen, Germany; [2]Department of Physics, University Erlangen-Nürnberg, Germany; [3]Department of Physics, University of Ottawa, Canada; [4]Institute of Applied Physics, Russian Academy of Sciences, Nizhniy Novgorod, Russia*

Optimizing the interaction of light with a single atom in free space. We report on a single atom shifting the phase of a narrow band coherent light beam. This requires efficiently coupling the light to the atom, which might be referred to as impedance matching. In addition, the possibility of exciting a single atom with a single photon is discussed.

$12^{\underline{00}} – 12^{\underline{30}}$ **T.R. Akhmedzhanov[1], V.A. Antonov[2], X. Zhang[1], K.C. Han[1], E. Kuznetsova[1], I.R. Khairulin[2], Y.V. Radeonychev[2], O. Kocharovskaya[1],** *[1]Department of Physics and Astronomy, Texas A&M University, College Station, TX 77843, USA; [2]Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, 603950, Russia*

Dynamical control of the resonant interaction: Towards quantum x-ray optics and novel x-ray sources. We discuss the possibilities to control the spectral/temporal characteristics of an x-ray radiation via variation in time/space of the parameters of its resonant interaction with a medium driven by a sufficiently strong low-frequency laser field and consider several applications of such technique.

$12^{\underline{30}} – 13^{\underline{00}}$ **V.N. Zadkov[1,2], V.I. Balykin[1], P.N. Melentiev[1], Yu.V. Vladimirova[2], F. Song[3],** *[1]Institute of Spectroscopy, Russian Academy of Sciences, Troitsk, Moscow, 108840, Russia; [2]Faculty of Physics, Lomonosov Moscow State Univ., Moscow, 119991, Russia; [3]Photonics Center, Nankai University, Tianjin, 300071, P.R. China*

Single plasmonic nanostructure: A playground for nonlinear and quantum optics. In this talk, we will explore quantum and nonlinear optical effects due to interaction of a single quantum emitter with a plasmonic nanostructure in an external electromagnetic field.

$13^{\underline{00}} –14^{\underline{00}}$ Lunch

Session 3 *Optical Clocks*

$14^{\underline{00}} – 14^{\underline{30}}$ **M.D. Barrett[1,2], K.J. Arnold[1,2], R. Kaewuam[1,2], T.R. Tan[1,2],** *[1]Department of Physics, National University of Singapore, 119077; [2]Center for Quantum Technologies, Singapore, 117543*

An optical clock using $^{176}Lu^{+}$. Singly-ionized lutetium is a relatively new clock candidate with three available clock transitions. Each transition offers unique, and favorable atomic properties for clock applications. We will present our latest results and discuss prospects for the development of a multi-ion clock.

$14^{\underline{30}} – 15^{\underline{00}}$ **N. Kolachevsky[1,2], A. Golovisin[1,2], E. Kalganova[1,2], D. Tregubov[1], K. Khabarova[1,2], D. Sukachev[1], V. Sorokin[1],** *[1]P.N. Lebedev Physical Institute, Leninsky prospect 53, 119991, Moscow, Russia; [2]Russian Quantum Center, Novaya St. 100A, Skolkovo, 143025, Moscow, Russia*

Precision spectroscopy of Thulium in optical lattice. Recent results of spectroscopic studies of inner-shell magnetic-dipole transition in Tm are presented. The line width of the transition measured in the magic-wavelength optical lattice approaches 20 Hz. Low sensitivity to BBR shifts makes this transition an interesting candidate for optical clocks and paves a way to fundamental tests.

$15^{\underline{00}} – 15^{\underline{30}}$ **K. Gao, Y. Huang, H. Guan,** *Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan, 430071, China*

Progress towards a $^{40}Ca^{+}$ optical clock with a fractional uncertainty at the 10^{-18} level. We recently reported a 5×10^{-17} level frequency comparison of two $^{40}Ca^{+}$ optical clocks, one of which has fractional frequency uncertainty of 3.4×10^{-17}, limited by the BBR effect. Here we present progress towards a $^{40}Ca^{+}$ optical clock with uncertainty at the 10^{-18} level.

$15^{\underline{30}} – 16^{\underline{00}}$ **A.N. Goncharov[1-3], A.E. Bonert[1], V.I. Baraulya[1], M.A. Tropnikov[1], S.A. Kuznetsov[1], O.N. Prudnikov[1], A.V. Taichenachev[1,2], S.N. Bagayev[1,2],** *[1]Institute of Laser Physics SB RAS, Novosibirsk, Russia; [2]Novosibirsk State University, st. Pirogova 2, 630090, Novosibirsk, Russia; [3]Novosibirsk State Technical University, pr. Karla Marksa 20, 630073, Novosibirsk, Russia*

Toward an optical frequency standard based on ultra-cold magnesium atoms. We report on the results of theoretical and experimental studies aimed at development an optical frequency standard based on ultra-cold Mg atoms with relative uncertainty and long-term frequency instability at the level of 10^{-17} - 10^{-18}. When the frequency of "clock" laser system at a wavelength of 457 nm (transition $^1S_0 – {}^3P_1$) is stabilized to narrow Ramsey resonances of magnesium atoms cooled and localized in a magneto-optical trap, a long-term frequency stability at the level of 5×10^{-15} is obtained at an averaging time of 10^3 s. The measured frequency stability was determined by the stability of the measurement system based on the femtosecond optical frequency synthesizer stabilized to optical frequency of the Yb:YAG/I_2 standard. We also present the results of theoretical and experimental studies aimed at deep laser cooling of magnesium atoms to temperatures of the order of 10 μK, theirs localization in a dipole trap/optical lattice in order to significantly improve the metrological parameters of the developed optical frequency standard.

$16^{\underline{00}} – 16^{\underline{30}}$ Coffee Break

Session 4 *Quantum sensors*

$16^{30} – 17^{00}$ **E.M. Rasel for the QUANTUS/MAIUS cooperation,** *Institute of quantum optics and QUEST-LFS, Leibniz Universität Hannover QUEST, Institut für Quantenoptik-Leibniz Universität, Hannover, Germany*

BEC interferometry on ground and in space.

$17^{00} – 17^{30}$ **P. Haslinger[1], M. Jaffe[2], V. Xu[2], O. Schwartz[2,3], M. Sonnleitner[5], M. Ritsch-Marte[4], H. Ritsch[5], H. Müller[2,3],** *[1]Vienna Center for Quantum Science and Technology, Atominstitut, TU Wien, Stadionallee 2, 1020, Vienna, Austria; [2]Department of Physics, 366 Le Conte Hall MS 7300, University of California–Berkeley, Berkeley, CA 94720, USA; [3]Molecular Biophysics and Integrated Bioimaging, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA; [4]Division for Biomedical Physics, Medical University of Innsbruck, Muellerstrasse 44, A-6020, Innsbruck, Austria; [5]Institute for Theoretical Physics, University of Innsbruck, Innsbruck, Austria*

Gravity, blackbody radiation and chameleons – Towards lattice atom interferometry. Atom interferometry has proven its surprising versatility to sense with high precision tiniest forces. In this talk I will give an overview of our recent work using an optical cavity enhanced atom interferometer to sense with gravitational strength for 5th forces and for an on the first-place counter intuitive inertial force of blackbody radiation.

$17^{30} – 18^{00}$ **R. Folman and the Atom Chip group / Ben-Gurion University of the Negev.**

Matter wave interferometers interacting with the external world: decoherence, gravity, complementarity and time irreversibility. Matter-wave interferometry provides an excellent tool for probing the environment and studying its coupling to isolated atoms. We will present several interferometry experiments done with a BEC on an atom chip and in which different effects of the environment have been investigated.

$18^{00} – 18^{30}$ **L. Zhou[1,2], B. Tang[1,2], J.Q. Zhong[1,2], X. Chen[1,2], Z.W. Yao[1,2], R.B. Li[1,2], J. Wang[1,2], M.S. Zhan[1,2],** *[1]State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics, Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan, 430071, China; [2]Center for Cold Atom Physics, Chinese Academy of Sciences, Wuhan, 430071, China*

Atom interferometry and precision measurement. Based on cold atom interferometers, we performed precision measurement of gravitational acceleration and observed tidal phenomena, developed a high-precision 10-meter atom interferometer and carried out equivalence principle test. We also developed key technologies and relevant theoretical research work and achieved some good results.

$18^{30} – 19^{00}$ **C. Clivati[1], D. Calonico[1], A. Mura[1], A. Tampellini[1,2], F. Levi[1],** *[1]Physics Metrology Division, Istituto Nazionale di Ricerca Metrologica, 10135, Turin, Italy; [2]Politecnico di Torino, 10134, Turin, Italy*

Coherent time/frequency links over fiber for relativistic geodesy, radioastronomy and seismology. Optical fiber links are the most performing technique to compare remote atomic clocks. However, they also allow improved measurement capabilities in other physical sciences. We will describe our recent advances in the fields of synchronization of remote radiotelescopes for radioastronomy and geodesy, geophysical sensing, and relativistic geodesy.

$19^{15} – 21^{00}$ Welcome Party ***(for all registered participants)***

Monday, August 27

In the House of Scientists:

$8^{\underline{00}}$ - $9^{\underline{00}}$ Breakfast

$8^{\underline{30}}$ - $17^{\underline{00}}$ Registration

Session 5 *Microwave atomic clocks*

$09^{\underline{00}} – 09^{\underline{30}}$ **C. Affolderbach, N. Almat, M. Gharavipour, F. Gruet, W. Moreno, M. Pellaton, G. Mileti,** *Laboratoire Temps-Fréquence, Université de Neuchâtel, 2000, Neuchâtel, Switzerland*

Ramsey spectroscopy in vapour cells for compact high performance atomic clocks. We report on our development of high performance Rubidium atomic clocks. We have implemented two innovative technologies: 3D-printed microwave cavities and frequency-doubled telecom laser sources. We have improved the medium to long-term frequency stability at the 10^{-14} level.

$09^{\underline{30}} – 10^{\underline{00}}$ **S.I. Donchenko[1], A.N. Schipunov[1], I.Yu. Blinov[1], N.B. Koshelyaevsky[1], I.B. Noretz[1], Yu.F. Smirnov[1], V.G. Palchikov[1,2],** *[1]FGUP "VNIIFTRI", Mendeleevo, 141570, Moscow region, Russia; [2]National Research Nuclear University "MEPhI", Moscow, 115409, Russia*

Modified primary time and frequency standard of VNIIFTRI based on the use of cooled atoms technologies. A short description for the modified National time scale of the Russian Federation is presented.

$10^{\underline{00}} – 10^{\underline{30}}$ **S.M. Ignatovich[1], M.N. Skvortsov[1], V.I. Vishnyakov[1,3], N.L. Kvashnin[1], V.A. Vasiliev[1], A.V. Taichenachev[1,2], S.N. Bagayev[1],** *[1]Institute of Laser Physics SB RAS, Novosibirsk, Russia; [2]Novosibirsk State University, Novosibirsk, Russia; [3]Novosibirsk State Technical University, Novosibirsk, Russia*

Compact CPT atomic clock based on a buffer-gas-filled Cs vapor cell. Here we present the recent progress of development a version of CPT atomic clock, which involves a buffer-gas-filled glass-blown vapor cell. Physical block with supplied electronic units has a volume of 57.5 cm^3. It is worth saying that our CPT clock has an stability better than 6×10^{-13} at 1000 seconds integration time.

$10^{\underline{30}} – 11^{\underline{00}}$ **H. Lin[1], Y. Tian[2], J. Chen[2], S. Gu[1,2],** *[1]Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, PR China; [2]Key Laboratory of Atomic Frequency Standards, Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, PR China*

A scheme for chip scale atomic clock. We report a scheme for chip scale atomic clock (CSAC) which extracted the wanted signal by differentially detecting the magneto-optically rotated light from laser beam interacted with atoms, the scheme eliminates unwanted background signal, and depresses laser noise, thus improves CSAC performance.

$11^{\underline{00}} – 11^{\underline{30}}$ Coffee Break

Session 6 *Quantum Information*

$11^{\underline{30}} – 12^{\underline{00}}$ **I.I. Ryabtsev[1,2], I.I. Beterov[1,2], D.B. Tretyakov[1,2], E.A. Yakshina[1,2], V.M. Entin[1,2], P. Cheinet[3], P. Pillet[3],** *[1]Rzhanov Institute of Semiconductor Physics SB RAS, 630090, Novosibirsk, Russia; [2]Novosibirsk State University, 630090, Novosibirsk, Russia; [3]Laboratoire Aime Cotton, CNRS, Univ. Paris-Sud, ENS Paris-Saclay, 91405, Orsay, France*

Spectroscopy of many-body interactions between cold Rydberg atoms. We present the results of our experimental and theoretical studies of long-range interactions for a few cold Rb Rydberg atoms at Förster resonances controlled by the electric fields. The many-body effects appear as line-shape dependence of the Förster resonances on the number of atoms. These effects can be used in quantum information processing.

$12^{00} – 12^{30}$ **Y. Zeng[1-3], P. Xu[1,2], X. He[1,2], Y. Liu[1-3], M. Liu[1,2], J. Wang[1,2], D.J. Papoular[4], G.V. Shlyapnikov[5], M. Zhan[1,2,†],** *[1]State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics, Wuhan; Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan, 430071, China; [2]Center for Cold Atom Physics, Chinese Academy of Sciences, Wuhan, 430071, China; [3]School of Physical Sciences, University of Chinese Academy of Sciences, Beijing, 100049, China; [4]LPTM, UMR8089 of CNRS and Univ. Cergy–Pontoise, F–95302, Cergy–Pontoise, France; [5]LPTMS, UMR8626 of CNRS and Univ. Paris–Sud, F–91405, Orsay, France*

Entangling two individual atoms of different isotopes via Rydberg blockade. In this talk, I will present our experimental realization of the controlled-NOT (CNOT) quantum gate and entanglement for two individual atoms of different isotopes and demonstrate a negligible cross talk between two atom qubits. The raw fidelities of the CNOT gate and entanglement are 0.73 and 0.59, respectively.

$12^{30} – 13^{00}$ **I.N. Chuprina[1,2], N.S. Perminov[2,3], A.A. Kalachev[1,2],** *[1]Institute of Physics, Kazan Federal University, 420008, Kazan, Kremlevskaya str., 16; [2]Zavoisky Physical-Technical Institute, Kazan Scientific Center of RAS, 420029, Kazan, Sibirsky tract str., 10/7; [3]Kazan quantum center, Kazan National Research Technical University n.a. A.N.Tupolev, 420111, Kazan, K. Marx str., 10*

Heralded single-photon and two-photon sources based on nonlinear effects in ring microresonators. We present promising schemes of heralded sources of single photons and photon pairs based on spontaneous four-wave mixing and third-order spontaneous parametric down conversion, respectively, in ring microresonators.

$13^{00} – 14^{00}$ Lunch

Session 7 *Advanced cold-ion systems*

$14^{00} – 14^{30}$ **T.E. Mehlstäubler, D. Kalincev, J. Keller, J. Kiethe, A. Didier, A. Kulosa,** *Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116, Braunschweig, Germany*

Precision spectroscopy on ion Coulomb crystals. While lattice clocks have superior short-time stability, ion clocks can achieve lowest inaccuracies with controlled single atomic particles. We have developed a high-precision ion trap with the capability to control linear ion crystals to combine the best from both worlds. We present an estimated uncertainty budget for a multi-ion clock.

$14^{30} – 14^{45}$ **M. Okhapkin[1], J. Thielking[1], P. Glowacki[1], D.-M. Meier[1], E. Peik[1], L. v.d. Wense[2], B. Seiferle[2], P. Thirolf[2], C. Düllmann[3-5],** *[1]Physikalisch-Technische Bundesanstalt, 38116, Braunschweig, Germany; [2]Ludwig-Maximilians-Universität München, 85748, Garching, Germany; [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291, Darmstadt, Germany; [4]Helmholtz-Institut Mainz, 55099, Mainz, Germany; [5]Johannes Gutenberg Universität, 55099, Mainz, Germany*

Laser spectroscopic characterization of the nuclear-clock isomer ^{229m}Th. We present the laser spectroscopic investigation of the hyperfine structure of doubly charged ^{229}Th ions and the determination of the fundamental nuclear properties of the low-energy isomer ^{229m}Th, namely, its magnetic dipole and electric quadrupole moments, as well as its nuclear charge radius.

$14^{45} – 15^{00}$ **C. Lacroûte, M. Delehaye, L. Groult, B. Achi, M. Souidi, E. Bigler, J. Millo, P.-Y. Bourgeois, Y. Kersalé,** *FEMTO-ST Institute, Univ. Bourgogne Franche-Comté, CNRS, ENSMM, 25030, Besançon, France*

Design and development of a surface-electrode ion trap for optical frequency metrology. We report on the ongoing realization of a compact optical $^{171}Yb^{+}$ clock on a chip. The targeted fractional frequency stability is 10^{-14} at 1s for a total volume of less than 500 litre, including vacuum cell, optics and electronics. We will present the first characterization of our ion trap, including heating rate, lifetime and fluorescence measurements.

$15^{00} – 15^{30}$ **P.O. Schmidt[1,2],** *[1]Physikalisch-Technische Bundesanstalt, Bundesallee 100, Germany; [2]Leibniz Universität Hannover, Welfengarten 1, 30167, Hannover, Germany*

Quantum logic spectroscopy of trapped ions. I will present how high precision laser spectroscopy can be extended to molecular and highly charged ions through quantum logic spectroscopy. This will enable tests of fundamental physics using species with high sensitivity for e.g. changes in fundamental constants.

$15^{30} – 16^{00}$ **V.I. Yudin[1-3], A.V. Taichenachev[1,2], A. Derevianko[4], V.A. Dzuba[5],** *[1]Institute of Laser Physics, Novosibirsk, Russia; [2]Novosibirsk State University, Novosibirsk, Russia; [3]Novosibirsk State Technical University, Novosibirsk, Russia; [4]Department of Physics, University of Nevada, Reno, Nevada, USA; [5]University of New South Wales, Sydney, Australia*

Atomic clock based on magneto-dipole and two-photon transitions in highly charged ions. We evaluate the possibility of the use of magnetic dipole (M1) or two-photon optical transitions in highly charged ions, which have two *p*-shell electrons. It is shown that these ions can be considered as excellent candidates for the next generation of atomic clocks with an uncertainty at the fractional level of 10^{-19} and below.

$16^{00} – 16^{30}$ Coffee Break

Session 8 *Nonlinear Optics*

$16^{30} – 17^{00}$ **K. Ueda[1-4],** *[1]Inst. Laser Science, UEC-Tokyho, Tokyo, Japan; [2]Inst. Laser Engineering, Osaka Univ., Osaka, Japan; [3]JST PRESTO, Tokyo, Japan; [4]Hamamatsu Photonics K.K., Hamamatsu, Japan*

Toward the themal-lens-free solid state lasers Heat Capacitive Active Mirror (HCAM) concept. A new concept of thermal-lens-free solid state lasers, Heat Capacitive Active Mirror (HCAM), is proposed. HCAM concept is able to generate full aperture thermal lens free plane wave amplification for the partially pumped active mirror lasers. It keeps high efficiency heat flow under the thermal equilibrium condition. This is the heat capacity solid state laser available for the CW operation. The scaling law of HCAM concept has been investigated systematically. HCAM concept is extended to the top-capped active mirror. We found the phase transition negative to positive thermal lens as a function of top cap thickness for thin disk laser regime.

$17^{00} – 17^{30}$ **D.B. Kolker[2-4], N.Yu. Kostyukova[1,2], A.A. Boyko[1,2], V.V. Badikov[5], D.V. Badikov[5], A.G. Shadrintseva[1], N.N. Tretyakova[1], K.G. Zenov[1], A.A. Karapuzikov[1], J.-J. Zondy[6],** *[1]Special technologies, Ltd., 1/3 Zeljonaja gorka str., 630060, Novosibirsk, Russia; [2]Research Laboratory of Quantum Optics Technology; Novosibirsk State University, 2 Pirogova Str., 630090, Novosibirsk, Russia; [3]Institute of Laser Physics SB RAS, 630090, Lavrentyev av. 13/3, Novosibirsk, Russia; [4]Novosibirsk State Technical University, 630073, K. Marx av. 20, Novosibirsk, Russia; [5]High Technologies Laboratory, Kuban State University, 149 Stavropolskaya Str., 350040, Krasnodar, Russia; [6]School of Science and Technology, Nazarbayev University, 53 Kabanbay Batyr Ave., 010000, Astana, Kazakhstan*

MID-IR $BaGa_4Se_7$ optical parametric oscillator pumped by a Q-switched Nd:$YLiF_4$ laser. Mid-infrared (MIR) idler wave tuning from 2.6 μm to 10.4 μm is demonstrated with an angle-tuned type-I (*o-ee*) *y*-cut sample, highlighting the superior performance of this novel large bandgap chalcogenide nonlinear crystal to generate tunable coherent radiation over its full MIR transparency range (0.47 – 18 μm). Damage threshold measurements yielded values as high as 2.04 J/cm^2 at 100 Hz pulse repetition rate at 1053 nm and 3.5 J/cm2 at 100 pulse repetition rate for 2070 nm one of the largest among existing MIR $\chi^{(2)}$nonlinear materials. A maximum idler energy up to 45 μJ at 3.3 μm and 14 μJ at 8.1 μm has been achieved.

$17^{30} – 18^{00}$ **A.V. Mitrofanov[1,3,5,6], A.A. Voronin[1-4], D.A. Sidorov-Biryukov[1,3-5], A.B. Fedotov[1,3-5], A. Pugžlys[7], M.V. Rozhko[1,3], S.V. Ryabchuk, V. Shumakova[7], S. Ališauskas[7], A. Baltuška[7], A.M. Zheltikov[1-5],** *[1]Physics Department, International Laser Center, M.V. Lomonosov Moscow State University, Moscow, 119992, Russia; [2]Department of Physics and Astronomy, Texas A&M University, College Station, TX 77843, USA; [3]Russian Quantum Center, ul. Novaya 100, Skolkovo, Moscow region, 143025, Russia; [4]Kazan Quantum Center, A.N. Tupolev Kazan National Research Technical University, Chetaev 18a, 420126, Kazan, Russia; [5]Kurchatov Institute National Research Center, Moscow, 123182, Russia; [6]Institute of Laser and Information Technologies, Russian Academy of Sciences, Shatura, Moscow region, 140700, Russia; [7]Photonics Institute, Vienna University of Technology, Gusshausstrasse 27-387, 1040, Vienna, Austria*

Optical solitons in air. Within the range from 3.5 to 4.2 μm, anomalous dispersion acting jointly with optical nonlinearity of atmospheric air is shown to give rise to a unique three-dimensional field dynamics, enabling a highly efficient whole-beam self-compression of high-peak-power mid-infrared pulses to few-cycle pulse widths.

$18^{\underline{00}} – 18^{\underline{30}}$ **W. Barbosa, E. Rosero, J. Tredicce, A.Z. Khoury, J.R. Rios Leite,** *Departamento de Fisica, Universidade Federal Pernambuco, Recife, Brazil*

Dynamics in diode lasers: Effects of feedback and couplings. Semiconductor lasers when subject to optical feedback show an enormous variety of dynamical behaviors including periodic, quasi-periodic and chaotic intensity pulsations. We shall describe features of this dynamics when two feedback signals are applied to one such laser.

$18^{\underline{30}} – 18^{\underline{45}}$ **D. Kolker[3,5], O. Antipov[1,2], R. Kositsyin[1], D. Kal'yanov[2], S. Larin[4],** *[1]Institute of Applied Physics of Russian Academy of Science, Nizhniy Novgorod, Russia; [2]Nizhniy Novgorod State University, Nizhniy Novgorod, Russia; [3]Novosibirsk State University, Novosibirsk, Russia; [4]NTO «IRE-Polus», Fryazino, Moscow region, Russia; [5]Institute of Laser Physics SB RAS, Novosibirsk, Russia*

Competition of high efficiency SHG and MID-IR OPO process in multigrating and fan-out PPMgO:LN pumped by pulsed Tm^{3+}:Lu_2O_3-ceramics laser. Mid-infrared optical parametric oscillators based on multigrating and fan-out periodically-poled MgO-doped $LiNbO_3$ (PPMgO:LN) crystals pumped with repetitively-pulsed Tm^{3+}:Lu_2O_3-ceramics laser at 1966 nm were experimentally studied. The 983 nm wavelength second harmonic generation of the pumping beam was found to be competing with the parametric oscillations in PPMgO:LNcrystals. Double-resonant optical parametric oscillations near degeneracy point at 3.93 μm were observed in multigrating PPMgO:LN crystal, but were not detected in the fan-out PPMgO:LN structure due to pump-power depletion by second harmonic generation. The efficient second harmonic generation with the average power up to 4.66 W at 983 nm was achieved in the fan-out PPMgO:LN crystal.

$19^{\underline{00}} –20^{\underline{00}}$ POSTER SESSION A

$20^{\underline{00}} –21^{\underline{00}}$ Dinner

$21^{\underline{00}}$ CONCERT

Tuesday, August 28

In the House of Scientists:
8^{00} - 9^{00} Breakfast
8^{30} - 17^{00} Registration

Session 9 *THz sources and Applications*

$09^{00} – 09^{30}$ **K.H. Park, E.S. Lee, K. Moon, I.-M. Lee, H.-S. Kim, D.W. Park, J.-W. Park, J.H. Shin, D.-H. Choi,** *THz Creative Basic Research Section, ETRI, Daejeon, 34129, South Korea*

Terahertz non-destructive testing technologies for industrial applications. Terahertz (THz) technologies have attracted great interest in their possibilities over a wide range of industrial applications such as wireless communications, spectroscopy, and imaging. Recently, as the manufacturing processes of the industry have been diversified, much attention has been focused on the quality inspection technologies of product.

$09^{30} – 10^{00}$ **A. Balakin, V. Makarov, N. Kuzechkin, I. Kotelnikov, P. Solyankin, A. Shkurinov,** *Lomonosov Moscow State University, Moscow, Russia*

Broadband terahertz wave generation from "Liquid-like" media. We present results of the research on generation of THz radiation in liquid like media under irradiating them with high-intensity femtosecond optical pulses: gas clusters and 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.

$10^{00} – 10^{30}$ **A. Pitanti,** *NEST Lab., CNR – Istituto Nanoscienze and Scuola Normale Superiore, piazza San Silvestro 12, 56127, Pisa (PI), Italy*

THz QCL in a hybrid microdisk-dipole antenna resonator: a playground between optics and electronics. Exploiting this fact, we realize a quantum cascade laser in a subwavelength cavity made of whispering gallery resonators and a dipole antenna. The formers grant for high performances (CW, 250mW peak power, 6mA threshold), while the latter gives a low divergence, vertical emission.

$10^{30} – 11^{00}$ **O.P. Cherkasova,** *Institute of Laser Physics SB RAS, Novosibirsk, Russia*

The mechanisms of the interaction of terahertz radiation with neurons.

$11^{00} – 11^{30}$ Coffee Break

Session 10 *Nanophotonics*

$11^{30} – 12^{00}$ **M. Ducloy,** *Laboratoire de Physique des Lasers, Université Paris 13, France*

Recent progress in the interaction of atomic vapors with material surfaces.

$12^{00} – 12^{30}$ **V. Kavokin[1], S.M. Arakelian[2], A.O. Kucherik[2], S.V. Kutrovskaya[2], A.V Osipov[2], A.V. Istratov[2],** *[1]School of Physics and Astronomy, University of Southampton, SO17 1NJ, Southampton, England, United Kingdom; [2]Department of Physics and Applied Mathematics, Vladimir State University, Gorky Str. 87, 600000, Vladimir, Russia*

Laser-controlled cluster nanophysics: stability, dynamic quantum states, superconductivity opportunities… We studied in both theory and experiment the laser-induced nanocluster structures of different types (in topology and element composition) with correlations in nanoparticle ensemble by quantum states. The problem of high temperature superconductivity due to topological surface structures with localized/delocalized couplied states is considered.

$12^{30} – 12^{45}$ **N.A. Maleev, S.A. Blokhin, M.A. Bobrov, A.G. Kuzmenkov, A.M. Ospennikov, V.M. Ustinov**

Intracavity-contacted VCSELs with rhomboidal oxide current aperture for compact atomic clock. Intracavity-contacted vertical-cavity surface-emitting lasers (VCSELs) with rhomboidal current aperture provide fixed direction of output polarization without using special surface relief. Developed VCSELs have output power over 1 mW and modulation bandwidth about 9 GHz at operation temperature up to 70°C and suitable for Cs compact atomic clock.

$12^{45} – 13^{00}$ **A.V. Dostovalov[1,2], A.A. Wolf[1,2], E.A. Zlobina[1], M.I. Skvortsov[1,2], S.I. Kablukov[1], S.A Babin[1,2],** *[1]Institute of Automation and Electrometry of the SB RAS, Novosibirsk, Russia; [2]Novosibirsk State University, Novosibirsk, Russia*

Advanced features of femtosecond pulse inscribed fiber Bragg gratings for fiber lasers. In this work femtosecond laser inscription technology is applied for the creation of FBGs employed in different schemes of fiber lasers, including distributed feedback (DFB), multimode and multicore Raman fiber lasers. It is shown how the specifics of femtosecond pulse inscription can be used to improve the output characteristics of such lasers.

$13^{00} –14^{00}$ Lunch / Meeting of the International Advisory Committee

Session 11 *BioMed Applications of Lasers*

$14^{00} – 14^{30}$ **A.M. Razhev[1], S.N. Bagayev[1], D.S. Churkin[1,2],** *[1]Institute of laser physics SB RAS, Prosp. Ac. Lavrentyeva, 15B, Novosibirsk, Russian Federation; [2]Novosibirsk state technical university, Prosp. K. Marksa, 20, Novosibirsk, Russian Federation; [3]Novosibirsk state university, Pirogova st., 1, Novosibirsk, Russian Federation*

Pulsed inductive discharge as a new method of pumping lasers. The paper reports the creation of a number of UV, visible and IR ranges of pulsed gas-discharge lasers with the excitation of a new pump method-a pulse induction discharge. The results of experimental investigations of the energy, spectral, and parameters of laser radiation from a UV nitrogen laser, FI laser (703-731 nm), H_2 laser (0.89-1.12 μm), Xe laser (0.9-2.02 μm), HF laser (2.7 - 3.2 μm), CO_2 laser (10.6 μm).

$14^{30} – 15^{00}$ **N.V. Surovtsev, K.A. Okotrub,** *Institute of Automation and Electrometry, Russian Academy of Sciences, Novosibirsk, 630090, Russia*

Application of Raman spectroscopy for lipid research in biophysics. Activity and life cycle of biological cells are tightly interrelated with lipid structures. Present report reflects the experience of our group on the application of Raman spectroscopy for the characterization of synthetic phospholipid membranes and lipid granules of living cells.

$15^{00} – 15^{30}$ **A. Weis, S. Colombo, V. Dolgovskiy, Z.D. Grujić, S. Pengue, V. Lebedev,** *University of Fribourg, Physics Department, Chemin du Musée 3, 1700, Fribourg, Switzerland*

1D and 2D imaging of magnetic nanoparticles by atomic magnetometry. I will report on the use of different atomic magnetometry methods for imaging magnetic nanoparticle (MNP) distributions, both for blocked MNPs (relaxation times > seconds) and for MNPs in fluids (relaxation times < milliseconds).

$15^{30} – 16^{00}$ **K.S. Maiti[1], M. Lewton[1], E. Fill[2], A. Apolonskiy[1-3],** *[1]Max-Planck-Institut fuer Quantenoptik, D-85748, Garching, Germany; [2]Department für Physik, Ludwig-Maximilians-Universität München, D-85748, Garching, Germany; [3]Novosibirsk State University, 630090, Novosibirsk, Russia*

Breath study via mid-infrared spectroscopy: an individual`s island of stability (IOS). By using mid-infrared spectroscopy of human breath, we demonstrate progress in detection of volatile organic compounds absorbing in spectral ranges dominated by water vapor. In a small pilot study, we show the existence of individual's island of stability and effects affecting it. We propose and illustrate a way of representing a healthy cohort.

$16^{00} –16^{30}$ Coffee Break

Session 12 *Laser gyro- and spectroscopy*

$16^{30} – 17^{00}$ **N. Beverini,** *Dipartimento di Fisica, Università di Pisa and INFN, sezione di Pisa, I56127, Pisa, Italy*

Ring laser gyroscopes in the underground Gran Sasso Laboratories. GINGER (Gyroscopes IN GEneral Relativity) is a proposed experiment with the aim of measuring in a ground laboratory the gravito-electric (known also as Lense-Thirrings effect) and gravito-magnetic effects (or De Sitter effect), foreseen by General Relativity through an array of ring laser gyroscopes.

$17^{00} – 17^{30}$ **C.C. Kwong[1,2], S.A. Adjunid[3], E.A. Chan[1,3], R. Shakhmuratov[4], D. Wilkowski[1-3,5],** *[1]School of Physical and Mathematical Sciences, Nanyang Technological University, 637371, Singapore, Singapore; [2]MajuLab, CNRS-UCA-SU-NUS-NTU International Joint Research Unit, Singapore; [3]Centre for Disruptive Photonic Technologies, Nanyang Technological University, 637371, Singapore; [4]Kazan Physical-Technical Institute, Russian Academy of Sciences, Kazan, 420029, Russia; [5]Centre for Quantum Technologies, National University of Singapore, 117543, Singapore, Singapore*

High-index frequency-modulation spectroscopy. Conventional FM-spectroscopy operates at low modulation index, and gives an optimum sensitivity at low optical depth. The signal decreases at higher OD as resonant absorption deplete the carrier component, which makes FM spectroscopy unusable. Here, we present a new sensitive FM spectroscopy technique applicable at arbitrary large OD.

$17^{30} – 18^{00}$ **C. Ohae[1,2], J. Zheng[3], K. Minoshima[1-3], M. Katsuragawa[1-3],** *[1]Institute for Advanced Science, University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo, 182-8585, Japan; [2]JST, ERATO MINOSHIMA Intelligent Optical Synthesizer Project, 1-5-1 Chofugaoka, Chofu, Tokyo, 182-8585, Japan; [3]Department of Engineering Science, University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo, 182-8585, Japan*

Tailored optics with a highly-discrete optical frequency comb; toward high resolution nonlinear spectroscopy in the vacuum ultraviolet wavelength region. This paper describes an attractive optical property of a highly-discrete optical frequency comb. We experimentally demonstrate how nonlinear optical processes are tailored on the basis of this optical property. We also show a near future prospect to explore nonlinear high-resolution spectroscopy in the vacuum ultraviolet wavelength region.

$18^{00} – 18^{30}$ **T. Zanon-Willette,** *Sorbonne Universite, Observatoire de Paris, PSL Research University, CNRS, Laboratoire d'Etudes du Rayonnement et de la Matiere en Astrophysique et Atmospheres, LERMA, F-75005, Paris, France*

Composite laser-pulses in Ramsey interferometry. Probing an atomic resonance without disturbing effects is an ubiquitous issue in laser spectroscopy. I will review recent progress in generalized hyper-Ramsey quantum interferometry with composite laser-pulses in order to generate nonlinear compensation of probe-induced frequency shifts for the next generation of atomic clocks.

$19^{00} – 20^{00}$ POSTER SESSION B

20^{30} SYMPOSIUM DINNER

Wednesday, August 29

In the House of Scientists:
$8^{\underline{00}}$ - $9^{\underline{00}}$ Breakfast
$9^{\underline{00}}$ - $17^{\underline{00}}$ Registration

Session 13 *Fiber Optics*

$09^{\underline{00}} – 09^{\underline{30}}$ **P. Roztocki[1], C. Reimer[1,2], S. Sciara[1,3], L. Romero Cortés[1], Y. Zhang[1], B. Wetzel[1,4], M. Islam[1], A. Cino[3], S.T. Chu[5], B.E. Little[6], D.J. Moss[7], L. Caspani[8], J. Azaña[1], M. Kues[1,9], R. Morandotti[1,10,11],** *[1]INRS-EMT, 1650, Boulevard Lionel-Boulet, Varennes, Québec, J3X 1S2, Canada; [2]John A. Paulson School of Engineering and Applied Sciences, Harvard University, Cambridge, 02138, USA; [3]Department of Energy, Information Engineering and Mathematical Models, University of Palermo, Palermo, Italy; [4]School of Mathematical and Physical Sciences, University of Sussex, Falmer, Brighton, BN1 9RH, UK; [5]Department of Physics and Material Science, City University of Hong Kong, Tat Chee Avenue, Hong Kong, China; [6]State Key Laboratory of Transient Optics and Photonics, Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Science, Xi'an, China; [7]Centre for Micro Photonics, Swinburne University of Technology, Hawthorn, Victoria, 3122, Australia; [8]Institute of Photonics, Department of Physics, University of Strathclyde, Glasgow, G1 1RD, UK; [9]School of Engineering, University of Glasgow, Rankine Building, Oakfield Avenue, Glasgow, G12 8LT, UK; [10]Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China, Chengdu, 610054, China; [11]ITMO University, St Petersburg, Russia*

Complex quantum state generation and coherent control based on on-chip frequency combs. Integrated frequency combs introduce a scalable framework for the generation and manipulation of complex quantum states (including multi-photon and/or high-dimensional states), using only standard silicon chip and fiber telecommunications components. Here, I review recent work in the platform.

$09^{\underline{30}} – 10^{\underline{00}}$ **S.A. Babin[1,2],** *[1]Institute of Automation and Electrometry, SB RAS, Novosibirsk, 630090, Russia; [2]Novosibirsk State University, Novosibirsk, 630090, Russia*

Diode-pumped Raman fiber lasers.

$10^{\underline{00}} – 10^{\underline{30}}$ **L. Zhang, N. Chen, H. Zhao, K. Zhang, Y. Li, C. Zhu, D. Zhang, P. Gao, H. Zhang, Y. Liu, S. Zhou**

kW narrow linewidth all fiber laser. Through three stage fiber amplified, the central wavelength of 1064 nm, linewidth of 8 GHz and power of 1.02 kW are achieved respectively by tow stage sinusoidal phase modulation technology. The optical-optical efficiency is 80%. And the beam quality is M_x^2=1.36 and M_y^2=1.3.

$10^{\underline{30}} – 11^{\underline{00}}$ **S. Wabnitz[1-3], 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]Dipartimento di Ingegneria dell'Informazione, Università di Brescia, Via Branze 38, 25123, Brescia, Italy; [2]Istituto Nazionale di Ottica del Consiglio Nazionale delle Ricerche (INO-CNR), Via Branze 45, 25123, Brescia, Italy; [3]Novosibirsk State University, 1 Pirogova str., Novosibirsk, 630090, Russia; [4]Université de Bourgogne Franche-Comté, ICB, UMR CNRS, 6303, Dijon, France; [5]Institute of Automation and Electrometry, SB RAS, 1 ac. Koptyug ave., Novosibirsk, 630090, Russia; [6]Université de Limoges, XLIM, UMR CNRS, 7252, Limoges, France*

Nonlinear multimode fibers for high power fiber lasers. Nonlinear multimode optical fibers have recently emerged as easily accessible platform to control complex spatiotemporal beam reshaping phenomena. Light intensity oscillations associated to the self-imaging effect in graded-index (GRIN) MMFs lead, via the Kerr effect, to a dynamic long-period index grating which may phase-match the generation of ultra-broadband sideband series. For relatively short, virtually lossless GRIN fibers, beam self-cleaning activated by the Kerr effect is observed, at lower power thresholds than the Raman beam cleanup. The output highly multimode speckled beam evolves, at high powers, into a high brightness bell-shaped beam sitting on a low-power background of high-order modes. This Kerr beam self-cleaning is shown to be even reinforced in the presence of strong loss or gain, e.g., in a passive or active ytterbium doped MMF, which leads to its possible exploitation in high power multimode fiber laser sources. We shall overview recent experiments, which demonstrate the spatiotemporal pulse break-up and significant temporal compression that accompany the self-cleaning process.

$11^{\underline{00}} – 11^{\underline{30}}$ Coffee Break

Session 14 *Applications IV (High-Power Lasers)*

$11^{30} – 12^{00}$ **F. Song, H. Wang, S. Man, H. Liu, L. Liu,** *Nankai University, Tianjin, China*

Laser cleaning and its applications. Laser cleaning is a promising technique to remove the unnecessary contaminants or coatings from the substances, for instances, the rust, oil, dust, and paint from various substrates. It is green and environment-friendly. We introduce the theory mechanics and the applications such as in the rust-removal, paint-cleaning.

$12^{00} – 12^{30}$ **M. Starodubtsev, A. Soloviev, K. Burdonov, S.N. Chen, G. Revet, S. Pikuz, S. Ryazantsev, A. Stepanov, A. Murzanev, A. Korytin, A. Sladkov, A. Korzhimanov, V. Ginzburg, E. Khazanov, A. Kochetkov, A. Kuzmin, I. Shaykin, A. Shaykin, I. Yakovlev, J. Fuchs**, *Institute of Applied Physics RAS, Nizhny Novgorod, Russia*

Plasma physics and particle acceleration studies with high-intensity lasers. A review of recent experimental activities on the PEARL laser system (IAP RAS, Nizhny Novgorod, Russia) in the field of laboratory astrophysics, high energy density physics and particle acceleration is presented.

$12^{30} – 13^{00}$ **S.Yu. Mironov[1], I.V. Yakovlev[1], V.N. Ginzburg[1], A.A. Shaykin[1], E.A. Khazanov[1], G. Mourou[2],** *[1]Federal Research Center Institute of Applied Physics of the Russian Academy of Sciences, Russia; [2]IZEST, France*

Temporal recompression of powerful laser pulses. Temporal recompression of PW level laser pulses based on implementation of self-phase modulation effect for spectral broadening and chirped mirrors for spectral phase correction is a promising way for peak power increasing. Experimental results on pulse shortening from 57 fs to 22 fs obtained at sub PW laser system PEARL will be presented.

$13^{00} –14^{00}$ Lunch

International School on Laser Physics and Photonics

$14^{00} – 16^{00}$ **Opening in the House of Scientists**

Gerhard Leuchs
Max Planck Institute for the Science of Light, Erlangen-Nuremberg, Germany

"Calculating correlation functions from phase space distributions"

Martial Ducloy
Laboratoire de Physique des Lasers, Université Paris 13, France

"Doppler-free monitoring of dipole-forbidden transitions in atomic vapours"

$16^{00} – 16^{30}$ Coffee Break

Session 15 *Ultra High Fields and Attoscience*

$16^{30} – 17^{00}$ **X. Liu,** *Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan, China*

Ultrafast imaging of atoms and molecules with ultrafast intense laser pulses. Intense femtosecond laser provides a promising tool to explore the ultrafast electronic dynamics with unprecedented attosecond temporal and angstrom spatial resolution. We will report our recent progresses in ultrafast imaging of the structure and daynamics of atoms or molecules with intense femtosecond laser field.

$17^{\underline{00}} – 17^{\underline{30}}$ **J. Fuchs[1-3],** *[1]LULI–CNRS, CEA, École Polytechnique, Univ. Paris-Saclay, Sorbonne Univ., UPMC Univ. Paris 06, F-91128, Palaiseau cedex, France; [2]Institute of Applied Physics, 46 Ulyanov Street, 603950, Nizhny Novgorod, Russia; [3]ELI-NP, Magurele, Romania*

A glimpse on what high-power lasers can bring to astrophysics. High-power lasers are a new tool allowing gaining insight of a variety of astrophysical phenomena. We will show examples pertaining to the jets emanating from young stars as well as matter accretion towards the star. We will also discuss perspectives offered by the upcoming multi-PW lasers that could lead to advance in the field of nucleosynthesis.

$17^{\underline{30}} – 18^{\underline{00}}$ **V.I. Trunov, S.N. Bagayev, S.A. Frolov, E.V. Pestryakov,** *Institute of Laser Physics SB RAS (ILP SB RAS), Novosibirsk, Russia*

Scalable femtosecond coherent beam combining. We review recent progress in coherent beam combining of laser and parametrically amplified femtosecond pulses with active relative jitter stabilization for achievement ultrarelativistic intensities. New methods and approaches for scaling regime of high efficiency coherent addition of pulses with peak power up to multipetawatt level are discussed.

Session 16 *Cold atoms*

$18^{\underline{00}} – 18^{\underline{30}}$ **R. Dubessy, M. de Goër de Herve, A. Kumar, Y. Guo, T. Badr, A. Perrin, L. Longchambon, H. Perrin,** *Laboratoire de physique des lasers, CNRS UMR 7538 and Paris 13 University, Sorbonne Paris Cité 99 av. J.-B. Clément, 93430, Villetaneuse, France*

Superfluid dynamics in Bose gases. In this talk I will present recent results on the superfluid dynamics in a trapped Bose quantum gas. I will concentrate on two situations: (i) a quantum gas in an anharmonic oblate trap set into rapid rotation, and (ii) an annular quantum gas showing persistent superfluid currents.

$18^{\underline{30}} – 19^{\underline{00}}$ **M. Pierens[1], L. Lecordier[1], D.B.A. Tran[1], M. Manceau[1], A. Cournol[1], R. Santagata[1,4], B. Argence[1,5], A. Shelkovnikov[1,6], A. Goncharov[1,7], O. Lopez[1], C. Daussy[1], C. Chardonnet[1], M. Abgrall[2], Y. Le Coq[2], R. Le Targat[2], H. Álvarez Martinez[2,8], W.K. Lee[2], D. Xu[2], P-E Pottie[2], R.J. Hendricks[3,9], T.E. Wall[3], J. Bieniewska[3], B.E. Sauer[3], M.R. Tarbutt[3], A. Amy-Klein[1], S.K. Tokunaga[1], B. Darquié[1],** *[1]Laboratoire de Physique des Lasers, CNRS, Université Paris 13, Sorbonne Paris Cité, 93430, Villetaneuse, France; [2]LNE-SYRTE, Observatoire de Paris, PSL Research University, CNRS, Sorbonne Universités, UPMC Univ. Paris 06, 75014, Paris, France; [3]Centre for Cold Matter, Blackett Laboratory, Imperial College London, London, SW7 2AZ, United Kingdom; [4]present address: ONERA, The French Aerospace Lab., Centre de la Hunière, BP 80100, Palaiseau, 91123, France; [5]present address: Laboratoire Kastler Brossel, UPMC-Sorbonne Universités, CNRS, ENS-PSL Research University, Collège de France, F-75005, Paris, France; [6]permanent address: P.N. Lebedev Physics Institute, Russian Academy of Sciences, 119991, Moscow, Russia; [7]permanent address: Institute of Laser Physics of SB RAS, Pr. Lavrentyeva 13/3, Novosibirsk, 630090, Russia; [8]present address: Real Instituto y Observatorio de la Armada in San Fernando, Spain; [9]present address: National Physical Laboratory, NPL, Teddington, TW11 0LW, United Kingdom*

Testing the parity symmetry in cold chiral molecules using vibrational spectroscopy. We present our work toward measuring parity violation in chiral species via mid-IR Ramsey interferometry. It includes developing buffer-gas sources of complex species and frequency stabilized quantum cascade lasers calibrated on primary standards. We report investigations on test species of which promising chiral derivatives have been synthesized.

$19^{\underline{00}} – 19^{\underline{15}}$ **O.N. Prudnikov[1,2], R.Ya. Ilenkov[1,2], A.V. Taichenachev[1,2], V.I. Yudin[1-3],** *[1]Institute of Laser Physics SB RAS, 15B Lavrentiev ave., 630090, Novosibirsk, Russia; [2]Novosibirsk State University, 2 Pirogova str., 630090, Novosibirsk, Russia; [3]Novosibirsk State Technical University, 630073, Novosibirsk, Russia*

Laser cooling on narrow-line optical transitions. We study laser cooling of atoms on narrow-line optical transitions in monochromatic light field. We demonstrate the equivalence of momentum distribution time evolution function for various atoms at certain parametrization light field intensity, detuning and time.

$19^{\underline{15}} – 19^{\underline{30}}$ **V.D. Ovsiannikov[1], S.I. Marmo[1], S.N. Mokhnenko[1], V.G. Palchikov[2,3],** *[1]Voronezh State University, Voronezh, 394006, Russia; [2]FGUP "VNIIFTRI", Mendeleevo, 141570, Moscow region, Russia; [3]National Research Nuclear University "MEPhI", Moscow, 115409, Russia*

Non-linear spectroscopy of Mg and Ca atoms in optical frequency standards. Possibilities for operational tuning of optical lattice parameters are discussed aiming at minimizing uncertainties induced by nonlinear, nondipole and anharmonic effects on interaction of Magnesium and Calcium atoms with the field of magic-wavelength optical lattices.

$19^{\underline{30}} – 19^{\underline{45}}$ **<u>A.E. Afanasiev</u>[1], A.Yu. Kalatskiy[1], A.A. Meysterson[1,2], P.N. Melentiev[1], V.I. Balykin[1],** *[1]Institute of Spectroscopy Russian Academy of Sciences, Fizicheskaya Str., 5, Moscow, Troitsk, 108840, Russia; [2]Moscow Institute of Physics and Technology, 9 Institutskiy per., Dolgoprudny, Moscow region, 141700, Russia*

Atom femto trap. Atomic dipole trap using femtosecond laser radiation (pulse duration about 100 fs) has been realized for the first time. It has been shown that the main role in the process of localization plays momentum diffusion caused by high peak intensity of laser pulse. The implementation of the dipole trap using pulse laser radiation of femtosecond duration is possible only for low laser intensities when nonlinearity of momentum diffusion is small.

$19^{\underline{45}} – 20^{\underline{00}}$ **<u>S.V. Chepurov</u>[1], A.A. Lugovoy[1], O.N. Prudnikov[1,2], A.V. Taichenachev[1,2], V.I. Yudin[1,2], S.N. Bagayev[1],** *[1]Institute of Laser Physics SB RAS, Novosibirsk, Russia; [2]Novosibirsk State University, Novosibirsk, Russia*

Spectroscopy of the electric quadrupole transition of the trapped ytterbium-171 ion. We report on the spectroscopic research of the electric quadrupole transition of the single trapped ion of ytterbium-171 in the course of development of a highly accurate optical frequency standard.

$20^{\underline{00}} – 21^{\underline{00}}$ Dinner

Thursday, August 30

International School on Laser Physics and Photonics

In the Novosibirsk State University

$09^{00} – 09^{50}$	**Prof. Ekkehard Peik** *PTB, Braunschweig, Germany* "Exciting nuclei with lasers"
$09^{50} – 10^{40}$	**Prof. Sergei Arakelian** *Vladimir State University, Russia* "New dimensional cluster physics for the laser-induced topological nanostructure thin films on solid surface: basic principles and possible applications"
$10^{40} – 11^{00}$	Coffee break
$11^{00} – 11^{50}$	**Prof. Hélène Perrin** *Université Paris 13, Villetaneuse, France* "Adiabatic potentials for rf-dressed ultracold atoms"
$11^{50} – 12^{40}$	**Young Scientists Session 1** **(4x15 min talks)**
$13^{00} – 14^{00}$	Lunch
$14^{00} – 17^{00}$	**Excursions to Institutes and Novosibirsk State University**

Friday, August 31

International School on Laser Physics and Photonics

In the Novosibirsk State University

$09^{00} – 09^{50}$	**Prof. Sergei Kulik** *Lomonosov Moscow State University, Russia* "Quantum Interference: Spectroscopy Applications."
$09^{50} – 10^{40}$	**Prof. Nicolò Beverini** *Dipartimento di Fisica, Universita' di Pisa, Italy* "Optical gyroscopes: application to Geodesy, Earth Science, and Fundamental Physics"

$10^{\underline{40}} – 11^{\underline{00}}$	Coffee Break
$11^{\underline{00}} – 11^{\underline{50}}$	**Prof. Igor Ryabtsev** *Rzhanov Institute of Semiconductor Physics SB RAS, Russia* "Quantum information with single atoms and photons"
$11^{\underline{50}} – 12^{\underline{40}}$	**Young Scientists Session 2** **(4x15 min talks)**
$13^{\underline{00}} – 14^{\underline{00}}$	Lunch
$14^{\underline{00}} – 17^{\underline{00}}$	**Young Scientists Session 3** **(12x15 min talks)**

Poster Sessions A

(All Topics)

A 1 **V.M. Klementyev, E.A. Titov, V.F. Zakharyash**

Investigation of mode-locking in diode laser with feedback on intermode frequency. The results of experimental investigation of mode-locking in three-mirror diode laser obtained by current modulation at intermode frequency are reported. Stable mode-locking regime is achieved.

A 2 **V.I. Yudin, A.V. Taichenachev**

Mass-defect effects in atomic clocks. We consider some implications of the mass defect on the frequency of atomic transitions. We have found that some well-known frequency shifts (such as gravitational and quadratic Doppler shifts) can be interpreted as consequences of the mass defect, i.e., without the need for the concept of time dilation used in special and general relativity theories. Moreover, we show that the inclusion of the mass defect leads to previously unknown shifts for clocks based on trapped ions.

A 3 **V.I. Yudin, A.V. Taichenachev**

Possibility of cosmological gravimetry using high-precision atomic clocks. We discuss and substantiate a hypothesis of the possibility of cosmological gravimetry with the use of high-precision atomic clocks. This method is based on comparison of chronometric measurements in the case of spatially non-uniform gravitational potential. If our hypothesis will be experimentally confirmed, then it will allow us to extract an information on the cosmological gravitational action of the Universe on our planetary system.

A 4 **M. Tropnikov, A. Bonert, A. Goncharov, S. Kuznetsov, V. Baraulya, D. Brazhnikov, O. Prudnikov**

Precision spectroscopy of cold magnesium atoms for an optical frequency standard. In this paper, the results of experimental research aimed at creation of the optical frequency standard based on cooled and localized in a magneto-optical trap Mg atoms are presented. The frequency of the clock laser system is stabilized to optical Ramsey resonances on the $^1S_0$–$^3P_1$ transition. Long-term frequency stability of $5*10^{-15}$ is obtained.

A 5 **S. Kuznetsov, A. Taichenachev, V. Yudin, N. Huntemann, Chr. Sanner, Chr. Tamm, E. Peik**

Hyper-Ramsey spectroscopy of clock transitions in the presence of heating of single ion in a trap: the efficiency of suppression of probe-induced frequency shift. In this paper we analyze the influence of ion heating on the efficiency of several generalized Ramsey schemes of suppression of probe-induced shifts in ion-based optical clocks. We show that the finite heating rate limits the efficiency of all proposed generalized Ramsey schemes due to the reduction of effective Rabi frequency and decoherence.

A 6 **D. Sutyrin, G. Belotelov, O. Berdasov, S. Slyusarev**

Towards the development of transportable and portable ytterbium optical lattice clocks. We report on the design concept of transportable and portable ytterbium optical lattice clocks. In particular we present the compact distribution breadboard layout for the first and second cooling stages. Likewise we discuss compact mirror designs for a single beam magneto-optical trap for the use in portable version.

A 7 **O. Berdasov, D. Sutyrin, A. Gribov, S. Strelkin, G. Belotelov, A. Kostin, R. Balaev, D. Fedorova, A. Malimon, S. Slyusarev**

The strontium optical clock in the Russian National Time Scale. We report on an accurate frequency comparison system between strontium optical lattice clock, group of hydrogen masers, rubidium frequency standards and cesium fountain. It is developed to enhance the National Time Scale and support redefinition of the SI second.

A 8 **A. Semenko, S.A. Kuznetsov, V.S. Pivtsov, S.N. Bagayev**

Femtosecond tapered diode-pumped Yb:KYW laser. A powerful single-mode diode laser (DBR TDL) is developed. The output characteristics of the DBR TDL laser are investigated. With the DBR TDL laser as a pumping source, a free running mode of a Yb:KYW laser is obtained and investigated. It is shown that a compact precision femtosecond frequency synthesizer based on a Yb:KYW laser can be created.

A9 **A. Lugovoy, N. Kvashnin, S. Chepurov, S. Bagayev**

Narrow linewidth laser for the spectroscopy of the quadrupole transition of single Yb ion. We investigate the frequency stability of the ECDL laser at 871 nm locked to the thermally stabilized Fabry-Perot cavity. The laser frequency deviation was estimated from the signal in the lock loop and the beat against Yb:YAG/I_2 laser frequency standard at 1030 nm. The frequency gap between lasers was filled with the help of the femtosecond comb.

A10 **D.S. Kryuchkov, N.O. Zhadnov, K.S. Kudeyarov, I.A. Semerikov, K.Yu. Khabarova, N.N. Kolachevskiy**

Ultra-stable laser systems based on Fabry-Perot cavities. Locking laser frequency to the mode of ultrastable high-finesse Fabry-Perot cavity is a basic technology to obtain ultranarrow linewidth. Frequency stability turns limited by cavity length instability. In present work we consider cryogenic single-crystall Si and and large-base ULE cavities with predicted frequency instability at 10^{-16} on 1 second.

A11 **E. Baklanov, S. Kobtsev, A. Taichenachev**

About measuring the forbidden 1S-2S transition frequency of a hydrogen atom by stimulated Raman scattering. We demonstrate the possibility of measuring the forbidden 1S-2S transition frequency (121 nm) of hydrogen atom by the method of stimulated Raman scattering (SRS) when atom from 1S level moves to 2S level through intermediate 3P level. The frequency of the pumping field (103 nm) is close to the frequency of transition 3P-1S, and the frequency of the stimulated scattering (656 nm) - to the frequency of transition 3P-2S.

A12 **P.V. Pokasov, E.V. Baklanov, A.V. Taichenachev**

About measuring the forbidden $2^1S_0 - 2^3S_1$ transition frequency of helium by the method of stimulated Raman scattering. We demonstrate the possibility of measuring the forbidden $2^1S_0 - 2^3S_1$ transition frequency (1557 nm) of a helium atom by the method of stimulated Raman scattering through the intermediate 2^3P_1 level. The transition is important for the spectroscopy of the helium atom because it relates the singlet and triplet parts of the spectrum.

A13 **V.I. Yudin, A.V. Taichenachev, M.Yu. Basalaev, T. Zanon-Willette, J.W. Pollock, M. Shuker, E.A. Donley, J. Kitching**

Generalized autobalanced Ramsey spectroscopy. For eliminating probe-induced perturbations, a method of generalized autobalanced Ramsey spectroscopy is presented and rigorously substantiated. The usual local-oscillator frequency control loop is augmented with a second control loop derived from secondary Ramsey sequences interspersed with the primary sequences and with a different Ramsey period.

A14 **N.N. Golovin, N.I. Dmitrieva, K.M. Sabakar, A.K. Dmitriev**

Periodic sequence of femtosecond pulses with preselected carrier envelope offset phase. The method is proposed for creating femtosecond radiation without an offset of the frequency comb in the absence of a local oscillator laser with selecting a pulse train with a given carrier envelope offset phase using an intensity modulator and a phase shifter.

A15 **R. Ilenkov, O.N. Prudnikov, A.V. Taichenachev, V.I. Yudin**

Optimization of deep laser cooling of atoms on narrow-line optical transitions in standing wave. Using the previously developed quantum calculation method, laser cooling of atoms on narrow optical transitions was investigated. The equivalence of cooling of various atoms (Mg, Sr, Ca) was shown with the correct choice of the normalization. The universal optimal cooling parameters are found.

A16 **B. He, X. Cheng, H. Zhang, H. Chen, Q. Zhang, Z. Ren, S. Ding, J. Bai**

Particle trapping and manipulation using hollow beam with tunable size generated by thermal nonlinear optical effect. We generate the hollow beam of tunable size using thermal nonlinear optical effect, achieving particle manipulation by modulating the beam size rather than the power, which effectively prevents particle damage for intense laser is avoided.

A17 **S.L. Mikerin, A.E. Simanchuk, A.V. Yakimansky, N.A. Valisheva**
Electro-optic waveguide modulators based on poled chromophore-doped polymers. Electro-optic modulation properties of elaborated waveguide modulators made of original chromophore-doped polymer systems have been demonstrated.

A18 **E.A. Stepanov, A.A. Lanin, A.B. Fedotov, A.M. Zheltikov**
Electron band structure analysis by intraband high-harmonic generation. In his work we study HHG in ZnSe polycrystalline film using mid-IR driver pulses within the wavelength range of 5.0 to 6.7 μm. We demonstrate that these harmonics directly relate to the nonlinearities of electron bands, providing a tool for electron band structure analysis in bulk solids.

A19 **N. Kostyukova, A. Boyko, E. Erushin, D. Malakhov, D. Kolker**
Frequency down-conversion of solid-state laser sources in barium chalcogenide nonlinear crystals. The work is devoted to comparison of two barium chalcogenide crystals: BGSe and BGGSe. New crystal BGGSe has a very wide transparency range of 0.58–18 μm at 0-level like a BGSe but has a few time large nonlinearity coefficient.

A20 **A. Budagovsky, A.A. Kuznetsov, S.A. Shvetsov, M.P. Smayev, A.S. Zolot'ko, P.A. Statsenko, S.I. Trashkeev, A.Yu. Bobrovsky, N.I. Boiko, V.P. Shibaev**
Features of orientational optical transition in dye doped nematic liquid crystalline polymers. The light beam action on nematic liquid crystalline polymers (NLCP) is investigated. The nonlinear optical response is caused by NLCP director reorientation at light excitation of a dye dopant. This study shows the effect of spatial limitation of light beam on the director deformation in NLCP.

A21 **Q. Zhang, X. Cheng, J. Bai, B. He**
Demonstration of Bessel-like beam with variable parameters generated using crossphase modulation. We propose a new method to generate Bessel-like beam using cross-phase modulation. It is demonstrated that the Bessel-like beam exhibits self-healing after encountering an obstruction on the beam path. The parameters of the Bessel-like beam are found to be easily adjusted by the pump beam power and sample temperature.

A22 **V.A. Tomilin, T.S. Yakovleva, A.M. Rostom, L.V. Il'ichov**
Geometric phase in non-standard settings. An expansion of the concept of geometric phase to mixed states of open quantum systems and two-state vector formalism is presented. An expression for the geometric phase as a function of a record of measurement outcomes is derived and illustrated on the case of a qubit system and environment interacting via a controlled two-qubit operation.

A23 **A. Duplinskiy, E. Kiktenko, N. Pozhar, M. Anufriev, R. Ermakov, A. Kotov, R. Yunusov, V. Kurochkin, K. Fedorov, Y. Kurochkin**
Industrial quantum key distribution. We present the result of the field test of the quantum key distribution setup. We connected two bank offices with the setup generating qubits with the 300 MHz rate. The quantum key was used by the standard equipment to establish secure VPN tunnel.

A24 **S. Kutrovskaya, A. Kucherik, A. Povolotckii, V. Samyshkin, S. Arakelian, A. Kavokin**
Metal-carbyne materials: New possibility of laser synthesis and applications. In this work we presented two stage setup for forming of macroscopically long linear carbyne chains stabilized by metallic nanoparticles synthesized by a laser ablation method in colloidal solution. We have studied the limit of sensitivity and amplification of SERS device based on an organometallic film by a proper choice of silver to gold ratio.

A25 **A. Kuraptsev, I. Sokolov**

Cooperative effects in an ensemble of impurity atoms located in a charged Fabry-Perot cavity or near a single charged conductive plate. On the basis of quantum microscopic approach we study the excitation dynamics of an ensemble of motionless point atoms located in a Fabry-Perot cavity with perfectly conducting charged mirrors as well as near a single charged mirror.

A26 **D. Kamynina, V. Kazakevich, P. Kazakevich, P. Yaresko**

Laser structuring of submillimeter metal targets in an ethanol-aqueous solution of various concentrations. The metal targets structuring by an infrared subnanosecond pulsed-periodic laser in an ethanol-aqueous solution of various concentrations is considered. The targets were NiTi sample with processing surface comparable to the laser focusing spot area and a two-component sample consisting of a glass substrate and a titanium film several microns thick.

A27 **F. Bo, Z. Hao, L. Zhang, J. Wang, F. Gao, G. Zhang, J. Xu**

Lithium niobate microdisk resonators on a chip. Monocrystalline, polycrystalline, and periodically poled lithium niobate whispering gallery mode resonators on a chip were mass fabricated using microfabrication techniques. Active modulation and nonlinear optical effects were realized in these fabricated lithium niobate microresonators.

A28 **L.S. Basalaeva, Yu.V. Nastaushev, F.N. Dultsev, N.V. Kryzhanovskaya**

Silicon-based structural coloring. Silicon-based structural color generation has aroused considerable interest with its promising applications in various fields .We investigate the tunable color generation from silicon nanopillars. Electron-beam lithography and reactive ion etching are used for the formation of nanopillars arrays on the Si (100) wafer coated thermal oxide.

A29 **N.D. Goldina**

Reflection of light on a metal – dielectric boundary in FTIR. The angular dependence of the amplitude reflection coefficients in scheme with frustrated total internal reflection (FTIR) is analyzed by the admittance method. The changes introduced by a thin metal film placed between dielectric media are considered in order to obtain a sharp reflection band.

A30 **L. Zhang, N. Chen, H. Zhao, K. Zhang, Y. Li, C. Zhu, D. Zhang, P. Gao, H. Zhang, Y. Liu, S. Zhou**

kW narrow linewidth all fiber laser. Through three stage fiber amplified, the central wavelength of 1064 nm, linewidth of 8 GHz and power of 1.02 kW are achieved respectively by tow stage sinusoidal phase modulation technology. The optical-optical efficiency is 80%. And the beam quality is M_x^2=1.36 and M_y^2=1.3.

A31 **S. Trashkeev, B. Nyushkov, S. Shvetsov**

Optical vortex induced by light–matter interaction in fiber-coupled liquid crystal. Optical vortex generation is obtained in a nematic liquid crystal (NLC) film placed onto the end-face of an optical fiber. Transformation of the optical fiber fundamental mode to the optical vortex is caused by the light propagation via the self-induced orientational defect in the NLC. The vortex profile can be modified by external electric field.

A32 **E. Saprykin, A. Chernenko**

On the mechanism of formation of the electromagnetically induced absorption resonances at closed transitions in spectroscopy of unidirectional waves. Physical processes forming the features of the saturated absorption resonance on transition with moments Jn = 1 - Jm = 2 in the field of two unidirectional waves are numerically studied. It is shown that the cause of the EIA resonance appearance at closed transition is the specific relaxation of the level population beats in bichromatic wave field.

A33 **E. Popov, V. Bobrikova, K. Barantsev, A. Litvinov**

Polarized states of alkali with null effective gyromagnetic ratio. In the work we consider optical pumping of alkali atoms in a gas cell. The main task is to suggest a method of preparing states of alkali atoms ensemble, in which spin polarization is non-zero and magnetization is absent. The idea of possibility such states is based on the difference between the signs of the g-factors of lower hyperfine levels.

A34 **G. Osipenko, V. Baryshev, M. Aleynikov, I. Blinov**

Pulsed optical pumping technique in application to rubidium compact atomic clocks. The results of the pulsed optical pumping experiments in a ^{87}Rb vapor cell with Ar-Ne buffer gases are presented. We report the achievement of CPT-Ramsey resonances in lin||lin configuration of bichromatic laser radiation in the same cell. The experimental results of optimization of POP and pulsed CPT atomic clocks are presented.

A35 **A. Novokreshchenov, D. Brazhnikov**

Theory of the high-quality magneto-optical resonances observed in a buffer-gas-filled vapour cell. This work represents a theory of the electromagnetically-induced absorption (EIA) resonances that quantitatively predicts the experimental data in the configuration of two counter-propagating light waves in the presence of buffer gas. It reveals new features of the scheme like shifting of the resonance caused by a stray magnetic field.

A36 **G.V. Voloshin, K.A. Barantsev, E.N. Popov, A.N. Litvinov**

Compensation of the light shifts of the resonance of the coherent population trapping under the Ramsey response scheme in an optically dense medium. A study is made of the Ramsey method for detecting the CPT resonance taking into account the collective effects associated with the finite optical thickness of the ensemble. A shift of the CPT is observed, which increases with increasing density of the medium. A method for full compensation of this shift is proposed.

A37 **A. Isakova, K. Savinov, N. Golovin, A. Dmitriev**

Diode laser with HF modulation of pump current for lasing of CPT resonances. The regimes of diode laser generation in the case of HF modulation of the pump current were investigated. It has been experimentally demonstrated that under certain conditions an equal intensity of the optical frequencies can be achieved, which can be used to pump the CPT resonances, that will eliminate their field shifts.

A38 **N.A. Maleev, S.A. Blokhin, M.A. Bobrov, A.G. Kuzmenkov, A.M. Ospennikov, V.M. Ustinov**

Intracavity-contacted VCSELs with rhomboidal oxide current aperture for compact atomic clock. Intracavity-contacted vertical-cavity surface-emitting lasers (VCSELs) with rhomboidal current aperture provide fixed direction of output polarization without using special surface relief. Developed VCSELs have output power over 1 mW and modulation bandwidth about 9 GHz at operation temperature up to 70°C and suitable for Cs compact atomic clock.

A39 **M. Petersen, R. Boudot, G. Coget, N. Passilly, V. Maurice, C. Gorecki, D.V. Brazhnikov**

High-contrast saturated-absorption resonance observed in a MEMS vapor cell for development of a miniaturized optical-frequency-stabilized laser. We perform saturated-absorption spectroscopy under the counter-propagating beams. Previously it was showed that two-frequency regime of excitation can lead to increase of the nonlinear resonance amplitude in a 2-cm vapor cell. Here we check this effect in a MEMS cell. The results can be used for creation of a chip-scale frequency-stabilized laser.

A40 **N.L. Lazareva, V.P. Dresvyanskiy, A.L. Rakevich, E.F. Martynovich**

Features of defect formation in crystalline anisotropic media under the influence of coherent pairs of femtosecond laser pulses.

A41 **A.A. Tyutrin, A.L. Rakevich, D.S. Glazunov, E.F. Martynovich**

Formation of a luminescent layer in LiF crystals by the glow discharge radiation.

A42 **M.I. Vaskovskaya, D.A. Shiryaev, A.P. Bogatov, A.E. Drakin, S.A. Zibrov, V.V. Vassiliev, V.L. Velichansky**

The response of a diode laser with an external cavity to the microwave modulation of the pumping current. We have studied emission spectra of a laser with an extended selective cavity under microwave current modulation. We have found and explained the peculiarity in the response of the laser to current modulation: the longitudinal modes become splitted and the number of frequencies at which modulation efficiency reaches the maximum is doubled.

A43 **M.I. Vaskovskaya, D.S. Chuchelov, A.B. Egorov, S.A. Zibrov, V.V. Vassiliev, V.L. Velichansky**

Study and optimization of atomic cell characteristics for CPT-clocks. We studied and optimized characteristics of atomic cells (filled with ^{87}Rb and a mixture of Ar-N_2 gases) to be used in CPT atomic clocks. To minimize the temperature dependence of reference line the Ar-N_2 partial pressures was determined. To minimize the CPT resonance width, the optimal total pressure of buffer gases was found.

A44 **E.A. Tsygankov, D.S. Chuchelov, V.V. Vasiliev, M.I. Vaskovskaja, V.L. Velichansky, S.A. Zibrov, S.V. Petropavlovsky, V.P. Yakovlev**

Modulation spectroscopy of CPT resonance displayed by polychromatic light. We present theory of frequency modulation spectroscopy of the CPT resonances for both adiabatic and non-adiabatic regime of modulation. Analytical formulae for spectroscopic signals are given in a model of three-level atom interacting with the FM modulated laser field. Results are compared with the experiment carried out with ^{87}Rb atoms.

A45 **D. Chuchelov, A. Taichenachev, E. Tsygankov, M. Vaskovskaya, V. Vassiliev, V. Velichansky, S. Zibrov, V. Yudin**

Ramsey fringes in coherent population trapping resonance formed by counter-propagating $\sigma^+ - \sigma^-$ polarized fields. We studied the CPT resonance in a ^{87}Rb/buffer gas cell using the scheme of counter-propagating $\sigma^+ - \sigma^-$ fields and Ramsey technique that allows to increase the contrast of resonance without its broadening and to suppress significantly the light shift. A new method for distinguishing central Ramsey fringe has been demonstrated in pulsed CPT.

A46 **C. Andreeva, T. Vartanyan, S. Gateva, A. Markovski, P. Todorov, S. Tsvetkov, S. Cartaleva**

Dynamics of velocity selective optical pumping on the D_2 line hyperfine transitions in spatially restricted Cs vapor. We study sub-Doppler-width resonances at the D_2 line of Cs atoms confined in two thin optical cells. Two lasers are used: with frequency fixed near the closed hyperfine transition, and with a scanned frequency. The absorption spectrum of the fixed-frequency laser vs the detuning of the scanned one is very sensitive to its frequency position.

Poster Session B

(All Topics)

B 1 **P. Zhao, Z. Dong, J. Zhang, X. Lin**

Passive coherent beam combination of three Nd:YAG lasers using cascaded Michelson-type compound cavities. Passive coherent combination of multiple lasers with improved beam quality is proposed and verified using cascaded Michelson-type cavities. Three 65 W Nd:YAG lasers with an M^2 factor of about 5.5 were coherently combined into a 124.4 W single lobed output while improving the M^2 factor to 1.36, corresponding to a total combined efficiency of 66.7%.

B 2 **I.A. Vedin, S.M. Vatnik, V.V. Osipov, K.E. Luk'yashin, R.N. Maksimov, V.I. Solomonov, Yu.L. Kopylov**

Oscillation performance of YAG ceramics with losses. 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.

B 3 **I.A. Vedin, S.N. Bagayev, V.A. Orlovich, S.M. Vatnik, N.V. Kuleshov, E.V. Smolina, A.A. Pavlyuk, N.V. Gusakova, S.V. Kurilchik, A.S. Yasukevich, V.E. Kisel, K.V. Yumashev, P.A. Loiko, V.I. Dashkevich**

Efficient Tm-laser operation based on 5%Tm:KLu(WO_4)$_2$ with N_m and AT orientation. We report on highly-efficient room-temperature lasing in 5at.%Tm:KLu(WO_4)$_2$ mini-slabs side-pumped by a 50 W 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.

B 4 **P.A. Statsenko, S.I. Trashkeev, Y.S. Fedotov**

Laser cavity optical scheme optimization of a compact mechanically stable laser with intracavity filtration of transverse modes. Numerical modeling and optimization of the Nd:YAG optical scheme of a laser with a stable resonator are carried out. A gradient mirror with a variable reflection coefficient was used to filter the transverse modes. The profile of the reflection coefficient was chosen in order to ensure the best quality of the output beam.

B 5 **V.V. Petrov, G.V. Kuptsov, V.A. Petrov, A.V. Laptev, A.V. Kirpichnikov, E.V. Pestryakov**

The development of all-solid state laser system with high average and high peak power radiation. The progress of development of all-solid state laser system with high average and high peak power radiation is reported. Small-signal gain coefficient of 1.5 per pass through active element is experimentally obtained in high power diode-pumped cryogenically cooled booster laser multidisc amplifier at pulse repetition rate of 1 kHz.

B 6 **A.A. Rybak, E.N. Galashov, V.V. Petrov, E.V. Pestryakov**

Yb-doped SrB_4O_7 -glass: A perspective laser material. We report on spectroscopic and laser properties of Yb-doped SrB_4O_7-glass (Yb:SBO) as new laser material. The absorption and luminescence spectra of Yb^{3+} in the SBO-glass at room and cryogenic temperatures were determined. On the basis of the experimental data the spectroscopic and laser parameters of Yb:SBO-glass have been calculated and discussed.

B 7 **G.V. Kuptsov, V.V. Petrov, A.I. Nozdrina, V.A. Petrov, A.V. Laptev, A.V. Kirpichnikov, E.V. Pestryakov**

Indirect measurements of the temperature inside active elements of high power laser amplifier. An indirect measuring method of the temperature inside the pumped volume of a cryogenically cooled active element of a high-power laser amplifier is proposed and experimentally implemented. Based on the results of the temperature measurements, the optimal spot size of pump and seed beams is calculated and experimentally verified.

B 8 **A.A. Kuzmin, A.A. Shaykin, I.A. Shaykin, E.A. Khazanov**

Extension of PEARL Nd:glass pump laser to subkilojoule level. The output energy of the existing Nd:glass laser which radiation is used for pumping PEARL OPSPA facility has been increased from 300 to 600 J by means of splitting the input nanosecond pulse into two orthogonally polarized sub-pulses.

B 9 **X. Lin, D. Li, P. Zhao, Z. Zhang**

High power solid state laser and its applications. High-power all-solid-state lasers and their applications are introduced. A series of key technologies of high efficient pumping, depolarization compensation, cascade amplification, high beam quality control, and fiber coupling were broken through. We successfully achieved 7.13 kW laser with electro-optical efficiency of 18.4% and beam quality of 50.

B 10 **Yu.P. Zakharov, A.G. Ponomarenko, V.A. Terekhin, I.F. Shaikhislamov, V.G. Posukh, E.L. Boyarintsev, A.A. Chibranov, A.G. Berezutsky, I.B. Miroshnichenko, M.A. Rumenskikh**

New type of large scale laser plasma experiments for laboratory astrophysics. A lot of Laser Plasma Experiments (LPE) with LP-energy $E_0 \sim 5$ J were done for simulation astrophysical phenomena in strong field >30 kG at mm-scale of Rb. A large scale chamber D1,2*5m of KI-1 facility ILP and new method of LP-generation with effective $E_0 \sim$ kJ allow us to perform LPE at scale ~m to simulate MHD-shocks and their impact onto terrella.

B 11 **Yu.P. Zakharov, A.G. Ponomarenko, V.A. Terekhin, I.F. Shaikhislamov, V.G. Posukh, E.L. Boyarintsev, A.V. Melekhov, K.V. Vchivkov, A.A. Chibranov, M.A. Rumenskikh, A.G. Berezutsky, I.B. Miroshnichenko**

Investigations of collisionless energy transfer to magnetised ionised background from super-Alfvenic laser plasma stream with ions of different masses. In Laser Plasma (LP) experiment and simulation we investigated interaction processes between interpenetrating plasmas at super-Alfvenic velocities and rather different masses (i.e. m/z) of LP ions. It was established that effective energy transfer from LP and even shock formation in Background could be described by Larmor Coupling model with <m/z>.

B 12 **I.B. Miroshnichenko, V.N. Tischenko, I.F. Shaikhislamov, A.G. Berezutsky, Yu.P. Zakharov, A.A. Chibranov, M.S. Rumenskikh, M.A. Efimov**

Whistlers produced by laser plasma in a rarefied magnetized background. Using calculations on a cluster, it is shown that when optimal conditions are satisfied, laser plasma generates intense whistlers, the spectrum of which contains high and lower frequency. This opens up the prospect of generating whistlers in a wide range of kilometers of wavelengths.

B 13 **I. Metelskii, V. Kovalev, V. Bychenkov**

Harmonic generation in an inhomogeneous plasma in the relativistic plasma field regime. A theory of the harmonic generation by the relativistic plasma resonance mechanism in an inhomogeneous laser plasma via the renormgroup symmetries method is presented. Power-law spectra of the radiation field are found and their characteristics depending on the laser radiation incidence angle and on the plasma inhomogeneity scale are discussed.

B 14 **A. Medvedev, P. Pinaev**

Plasma polarization in scientific, technical and technological applications. In addition to the well-studied high-frequency branch of the plasma polarization characteristic used in the acceleration of electrons in the wakefield of a laser pulse, low-frequency polarization is considered, which the existence for being any gas discharge is necessary.

B 15 **M. Khomyakov, P. Pinaev, P. Statsenko, G. Grachev**

Laser-plasma surface modification of steels and Fe-based alloys. The work is devoted to the investigation and new applications of the method of laser-plasma surface modification of steels and Fe-based alloys. The method is based on the use of an optical pulsed discharge plasma, which is ignited by repeating pulses of a CO_2-laser generator-amplifier system focused on the surface being treated.

B 16 **M.A. Efimov, M.S. Rumenskyh, A.A. Chibranov, A.G. Berezutsky, I.B. Miroshnichenko**

Plasma parameters derived from spectrally resolved optical measurements. In this paper, spectral lines in the CH_2 plasma flow were investigated. Measurements were completed using a CCD ruler and Doppler formula for calculated the transverse component of the velocity and the angle of propagation of the plasma plume. Analyzing the obtained data, we confirmed the correctness of the assumed propagation model.

B17 **A.A. Chibranov, A.G. Berezutsky, M.A. Rumenskikh, M.A. Efimov, I.B. Miroshnichenko**

Laser plasma dynamics in a magnetized background. In this paper, laboratory experiments on interaction laser plasma flow with magnetized background were considered. To study the characteristics of laser plasma we used probe and spectral diagnostics. One of the results of this paper is that, propagating in vacuum, laser plasma has a velocity.

B18 **A.G. Berezutsky, V.N. Tishchenko, Yu.P. Zakharov, I.B. Miroshnichenko, M.A. Efimov, M.S. Rumenskikh, A.A. Chibranov, I.F. Shaikhislamov**

Generation of Alfvén and magnetosonic waves produced by periodic laser plasma bunches in lower layers of the ionosphere. The generation of quasistationary Alfven and magnetosonic waves generated by plasma bunches in the ionosphere at low altitudes was studied. It is shown that waves are effectively formed and carry the longitudinal and azimuthal momentum if the ratio of the background plasma pressure to the magnetic field pressure is less than unity.

B19 **S.N. Chen**

Ion acceleration with ultra-intense laser pulses. We will show how ultra-intense laser pulses offer unique possibilities in accelerating high-energy, extreme current ion bunches in a very short time. We will present the perspectives offered by the upcoming multi-PW lasers, and review some applications like ion stopping power in plasmas which becomes with such beams uniquely possible.

B20 **V. Kochanov**

Polychromatic stimulated Raman scattering at low-frequency transitions. The theory of stimulated Raman scattering of light is developed with the generation of a large number of Stokes and anti-Stokes scattering components. Low-frequency rotational transitions of molecules on which scattering occurs are modeled by a quantum lambda-system. The influence of various factors on the efficiency of generation of a large number.

B21 **V. Kochanov, L. Sinitsa**

Retrieval of small- and large-angle scattering collision frequencies from H_2O line profiles near 0.8 μm. A new method of retrieving quantitative information on the hard, soft, and diffraction collision's frequencies from pressure broadened line profiles was proposed and tested. The essence of the method lies in the processing of recorded profiles using various profiles' models containing these frequencies treated as adjustable parameters in different.

B22 **I.A. Zyatikov, N.G. Ivanov, V.F. Losev, V.E. Prokop'ev**

Superradiance by nitrogen ions in atmospheric filament. Superradiance at N_2^+ transitions in the blue spectrum range was obtained in the filament, created by femtosecond radiation, and focused by the lens with a focal length of 13.7 cm. The spectrum line width and the pulse duration were measured taking into account

B23 **V.G. Oshlakov, Yu.V. Khokhlova, S.M. Prigarin**

Laser beam instrumental system (LBIS) landing aircraft. In LBIS planting the laser beam coincides in direction with the glide path and is 15 meters from runway. Two photodetector placed on the aircraft receive radiation. To study of multiple scattering we calculated body brightness (radiance angular distributions) of the optical field at glide path points by the Monte Carlo method.

B24 **A. Britvin, Yu.D. Kolomnikov, S.I. Konyaev, A.V. Povazhaev, B.V. Poller**

Characteristics of a multipath optical monitoring system. The evolution and characteristics of synchronous multi-beam optical systems for remote monitoring of environmental parameters are considered.

B25 **Z. Changming, Z. Zilong, Z. Haiyang, Y. Hongzi, Z. Xingyuan**

Building a bridge over lidar and radar. Compared with radar, the most essential characteristics of lidar is high spatial resolution, originated from its shorter wavelength. Lidar is also suffered from atmospheric turbulence in coherent detection. We introduce here research works on a novel architecture-coherent dual frequency lidar, which can be regarded as a bridge over lidar and radar.

B26 A. Karapuzikov, A. Markelov

Influence of rf channel power transmission on the laser pulses stability of waveguide CO_2 lasers. The influence of high frequency (HF) paths of waveguide CO_2 lasers on the stability of the radiation pulse parameters is studied. The created theoretical model of the HF tract is verified using a vector reflect meter. The energy stability of the laser radiation pulses for various waveguide materials and the laser housing is studied.

B27 A.M. Razhev, E.S. Kargapol'tsev, D.N. Kapusta, D.S. Churkin

New visible pulse gas-discharge pumped atomic Ne I-laser. The results of an experimental investigation of spectral, energy and temporal characteristics of pulsed gas-discharge high-pressure Ne I-laser are presented. Laser performance with HV excitation system in order to obtain a powerful generation of noble Ne gas electronic transition of gaseous active media without the buffer gas was designed. Laser action on the electronic Ne atoms transition 3p[1/2]1 – 3s[1/2]0 (λ=743.889 nm) with pulse duration (FWHM) 12 ns was obtained and reported for the first time. The laser spectrum is presented by one sharp laser line. Also, the output laser radiation divergence was estimated. The laser action was realized by transverse high-voltage excitation with UV preionization of a high-pressure high purity Ne gas without helium gas.

B28 A.M. Razhev, D.S. Churkin, E.S. Kargapoltsev, R.A. Tkachenko, I.A. Trunov

IR inductive Xe laser pumped by a pulsed longitudinal inductive discharge of the transformer type. The creation of an IR laser on neutral Xe atoms transitions pumped by a pulsed longitudinal inductive discharge of a transformer type is reported for the first time. The radiation spectrum consisted of three lines: 840.92 nm, 904.5 nm, 979.9 nm. The lines with wavelengths of 904.5 nm and 979.9 nm had the highest intensity.

B29 D. Shiyanov

Metal halides vapor lasers with inner reactor. Investigation of the energy characteristics of copper, manganese, lead halide vapor lasers with inner reactor was made. Under identical pump conditions, such systems are not inferior in their characteristics to standard metal halide vapor lasers. It is shown that the use of a zeolite halogen generator provides lifetime laser operation.

B30 A. Fedorov, D. Shiyanov

CuBr-laser with an efficiency of 2.7% in the double-pumping-pulse mode. Investigation of the energy characteristics of copper, manganese, lead halide vapor lasers with inner reactor was made. Under identical pump conditions, such systems are not inferior in their characteristics to standard metal halide vapor lasers. It is shown that the use of a zeolite halogen generator provides lifetime laser operation.

B31 T. Zhang, P. Demchenko, M. Khodzitsky, Yu. Kononova, A. Babenko, E. Grineva

The influence of blood components on the optical properties of whole blood in terahertz frequency range. The glucose level of blood can be obtained using refractive index in THz frequency range, but the impact of other components wasn't considered. 14 human blood samples were tested using THz TDS. The results show that with a certain concentration of glucose, the optical properties change along with the concentrations of bilirubin, creatinin and etc.

B32 I. Timofeev, V. Annenkov, S. Avtaeva, K. Gubin, V. Khudyakov, V. Trunov, E. Volchok

Project of the proof-of-principle experiment on THz generation in colliding laser wakefields. It is studied how efficiently a new idea for the generation of high-power narrow-band terahertz radiation by counterpropagating wake fields driven in a plasma by femtosecond laser pulses can be experimentally implemented using the 0.2 J, 830 nm laser system in ILP SB RAS. Optimal parameters for the proposed experiment are found.

B33 D. Serdyukov, O. Cherkasova, V. Popik, S. Peltek

Study of genetic effects of terahertz radiation with Escherichia coli based genosensors. In this work, the effect of THz radiation on the activity of some genes in Escherichia coli cells was studied using the assembled artificial genosensorsistems. Using the E. coli/pTdcR-yfpgenotensor, activation of the tdcR gene at the irradiation was demonstrated.

B34 E. Nemova, O. Cherkasova, G. Dultseva

Effect of terahertz radiation on the transport properties of albumin: in vitro investigation. It was shown that under the action of a terahertz laser on film preparations of a globular protein, the properties of the protein on the adsorption of oxygen is change. This affects the strength of the bond in the protein complex with nitric oxide.

B35 **N. Nikolaev, S. Kuznetsov, M. Beruete**

Angle-susceptible sensing metasurface in terahertz regime. We propose the idea of THz thin-film sensing using a metasurface with a narrowband plasmonic resonance sensitive to the angle of radiation incidence. The metasurface enables detection of submicron-thick analyte layers in the regime of single-wavelength operation when measuring the transmittance as a function of the incidence angle.

B36 **A. Mayorov, A. Goncharenko, D. Bordzilovskiy, I. Zhuravleva, E. Kuznetsova**

Laser making of elements of heart prosthetic from biological tissue. This paper describes the laser conditioning (removal of crispness, smoothing) is presented to a fibrous surface of elements cardiovascular bioprostheses at their cutting from a pericardial tissue. The description of results of experiments of the influence on a pericardial tissue by laser radiance with various wavelength.

B37 **A. Mayorov, S. Nikonov, S. Strutz, O. Kazakov, D. Bredikhin**

Photodynamic fractional laser photothermolysis by transcutaneous photosensitization. Development of transdermal medical products transport methods using fractional laser photothermolysis and photodynamic therapy (PFLF) for problem and aging skin. For the first time, the method of PFLF has been tested, which proved safety, low invasiveness, efficiency and availability for use in dermatocosmetology.

B38 **A. Mamrashev, N.A. Nikolaev, T.B. Bekker, K.A. Kokh, G.V. Lanskii, Yu.M. Andreev**

Nonlinear applications of beta-barium borate in the terahertz regime. Optical properties of beta-BBO crystals were studied by THz-TDS in the range of 0.2-2.0 THz at the temperatures of 293 K and 81 K. The measured o- and e-wave refractive indices were formulated in the form of Sellmeier equations. Phase-matching conditions for the IR-THz and THz-THz frequency conversion were calculated.

B39 **S. Gusev, V. Soboleva, M. Khodzitsky**

Glucose level sensor based on metasurface in THz frequency range. This work is devoted to theoretically and experimentally verification of possibility of development of glucose level sensor based on metasurface in THz frequency range.

B40 **D. Gomon, P. Demchenko, M. Khodzitsky**

Investigation of oxipane optical properties in THz frequency range. This work devoted to study “oxipane” optical properties (such conductivity, permittivity, refractive index and so on) in THz frequency range. Material “oxipane” may be effective absorber for using in biological destructive THz frequencies screening.

B41 **M.A. Surovtseva, A.P. Lykov, O.V. Kazakov, A.V. Kabakov, O.V. Poveshchenko, A.F. Poveshchenko, D.S. Serdyukov, S. Kuznetsov, O.P. Cherkasova, A.Yu. Letyagin**

The effect of 0.14 THz radiation on human skin fibroblasts. The prospect of widely using THz radiation in medical diagnosis and therapy raises the question of how electromagnetic radiation in the 0.1–10-THz range affects biological objects. The aim of our study was to evaluate the effect of 0,14 THz radiation on the proliferation, migration and nitric oxide production by the human skin fibroblasts.

B42 **N. Nikolaev, A. Mamrashev, D. Shpakov, E. Nemova, O. Cherkasova**

Study of dielectric properties of DNA solutions by terahertz time-domain spectroscopy. DNA molecules normally assume the B-conformation in water and the A-conformation in water-ethanol solutions. The aim of the work was to study dielectric properties (frequency dependence of absorption, complex refractive index and dielectric permittivity) of water and water-ethanol DNA solutions measured by THz time-domain spectroscopy (THz-TDS).are comparable with those obtained in convenient transverse discharge.

B43 **Z. Zhang, Y. Wang, X. Lin**

Study on removal of low thermal conductivity paint by high repetition rate pulsed laser. A high repetition rate pulsed laser was used to study the quantitative removal of low thermal conductivity resin based paint.This study provides theoretical and experimental support for the quantitative removal of lacquer by laser.

B44 **A. Pazgalev, A.E. Ossadtchi, S.P. Dmitriev, V.A. Kartoshkin, M.V. Petrenko, A.K. Vershovskii**

High sensitivity laser pumped Caesium magnetic sensor for magnetoencephalography. Compact room temperature optically pumped magnetic sensor for a numerous applications, medical especially, is designed and tested. Principal sensitivity is high enough to detect the neural activity of human brain, as supposed.

B45 F. Zhou, L.L. Yan, T.P. Xiong, K. Rehen, M. Feng

Exploring quantum thermodynamics on a single qubit. We report two of our recent experiments accomplished in an electro-magnetic trap, relevant to Jarzynski–related equalities in an non-equilibrium thermodynamic process and to the Landauer principle. Our experimental investigation substantiates an intimate link between information thermodynamics and quantum information candidate systems.