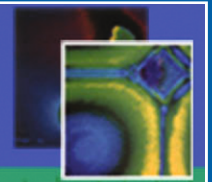
International Symposium

TOPICAL PROBLEMS OF NONLINEAR WAVE PHYSICS (NWP-2014)

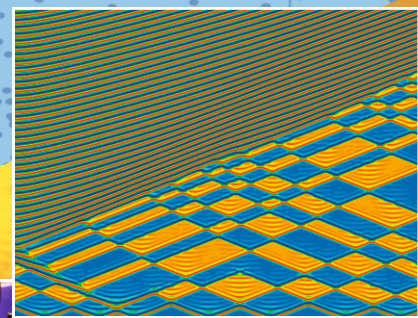


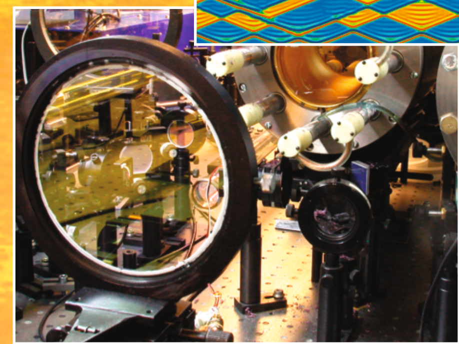
17-23 July, 2014
Nizhny Novgorod, Russia

2014 NWP

Nonlinear Dynamics on Complex Networks (NWP-1)

Lasers with High Peak and High Average Power (NWP-2)





Nonlinear Phenomena in Geophysics (NWP-3)

Workshop "Ultra-high Fields in Plasmas: New Models, High Performance Simulations and Experiments

Young Scientists School

PROGRAM and ABSTRACTS

Russian Academy of Sciences
Institute of Applied Physics

International Symposium

TOPICAL PROBLEMS OF NONLINEAR WAVE PHYSICS

17 – 23 July, 2014

PROGRAM and ABSTRACTS

Nizhny Novgorod, 2014

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International Symposium

TOPICAL PROBLEMS OF NONLINEAR WAVE PHYSICS (NWP-2014)

Topical Conferences

Nonlinear Dynamics on Complex Networks

Lasers with High Peak and High Average Power

Nonlinear Phenomena in Geophysics

Workshop

Ultra-high Fields in Plasmas: New Models, High Performance Simulations and Experiments

School for Young Scientists

PROGRAM

	Nonlinear Dynamics on Complex Networks	Lasers with High Peak and High Average Power	Nonlinear Phenomena in Geophysics	Ultra-high Fields in Plasmas: New Models, High Performance Simulations and Experiments
Chairs	**Vladimir Nekorkin (Russia) Arkady Pikovsky (Germany-Russia)**	**Efim Khazanov (Russia) Ken-ichi Ueda (Japan-Russia)**	**Michael Ghil (France) Juergen Kurths (Germany-Russia) Evgeny Mareev (Russia) Vladimir Rakov (USA-Russia)**	**Igor Kostyukov (Russia) Alexander Pukhov (Germany-Russia)**
	NWP-1	**NWP-2**	**NWP-3**	**WORKSHOP**

Thursday, July 17, morning

7:00-9:00	**Registration**
7:30-9:00	**Breakfast**
9:00	**Departure from Nizhny Novgorod**
11:00-11:40	**Opening ceremony (HALL A)**
	HALL A
11:40-12:30	**V.A. Rakov** *(USA-Russia)*. Lightning: some new insights. **(Plenary)**
12:30-13:20	**Th. Kuehl** *(Germany)*. The Helmholtz beamline laser project at the facility for anti-proton and ion research (FAIR). **(Plenary)**
13:30-15:00	**Lunch**

	HALL A	HALL B	HALL C
	NWP-1	**NWP-2**	**WORKSHOP**
	Session: Dynamical networks	**Session: Laser materials**	**Session: "Ultra-high fields in plasmas: new models, high performance simulations and experiments"**
15:00-17:00	**15:00-15:30 V.I. Nekorkin** *(Russia).* Cluster transient dynamics in neural networks. (Invited)	**15:00-15:30 J. Shao, Y. Dai and Q. Xu** *(China).* An overview of the optical materials and components for SG laser facilities. (Invited)	**15:00-15:30 N. Kumar, K.Z. Hatsagortsyan, and C.H. Keitel** *(Germany).* Effect of the radiation reaction force on the electronic parametric instabilities of a strong laser pulse in a plasma. (Invited)
	15:30-16:00 S. Teller and J. Soriano *(Spain).* Dynamics in clustered neuronal cultures: a versatile experimental system for complex networks. (Invited)	**15:30-15:50 A. Starobor, O. Palashov** *(Russia).* Thermally induced distortions of radiation in Faraday isolators for magnetooptical elements and laser beams without axial symmetry.	**15:30-16:00 S. Meuren, F. Mackenroth, N. Neitz, C.H. Keitel, and A. Di Piazza** *(Germany).* Nonlinear QED-effects in strong laser fields. (Invited)
	16:00-16:30 I. Potapov, B. Zhurov, and E. Volkov *(Russia).* Nonlinear dynamics of coupled genetic oscillators. (Invited)	**15:50-16:10 A. Yakovlev, I. Snetkov, O. Palashov** *(Russia).* Measurements of optical anisotropy parameters of BaF_2 and SrF_2 crystals.	**16:00-16:20 A. Gonoskov, A. Bashinov, I. Gonoskov, E. Efimenko, C. Harvey, A. Ilderton, A. Kim, M. Marklund, A. Muraviev, and A. Sergeev** *(Russia, Sweden).* Anomalous radiative trapping in laser fields of extreme intensity.
	16:30-17:00 T. Yazawa *(Japan).* Quantification of stress by detrended fluctuation analysis of heartbeats, both in the lobsters and humans. (Invited)	**16:10-16:30 A. Vyatkin, E. Khazanov** *(Russia).* Influence of clastic anisotropy on thermally induced beam distortions in cubic single crystals.	**16:20-16:40 E. Efimenko, A. Bashinov, A. Gonoskov, I. Gonoskov, A. Ilderton, A. Kim, M. Marklund, A. Muraviev and A. Sergeev** *(Russia).* Generation of GeV photons in ART regime in the ultra-intense *e*-dipole laser fields.
		16:30-16:50 E. Mironov, A. Voitovich, O. Palashov *(Russia).* Permanent magnet systems for Faraday isolators for high average power laser radiation.	**16:40-17:00 V.B. Bashmakov, E.G. Gelfer, E.N. Nerush, I.Yu. Kostyukov, A.M. Fedotov and N.B. Narozhny** *(Russia).* Near-threshold QED cascade in the strong laser field.
17:00-17:20	**Coffee break**		

Thursday, July 17, evening

	NWP-1	**NWP-2**	**WORKSHOP**
	Session: Synchronization and Control	**Session: High peak power lasers I**	**Session: "Ultra-high fields in plasmas: new models, high performance simulations and experiments"**
17:20-19:20	**17:20-17:50 N.I. Semenova and V.S. Anishchenko** *(Russia).* Poincaré recurrences in the stroboscopic section of a nonautonomous van der Pol oscillator. (Invited)	**17:20-17:50 Z. Wei** *(China)*. Route and recent progresses on high contrast ultraintense femtosecond laser. (Invited)	**17:20-17:50 A. Savel'ev, K. Ivanov, S. Shulyapov, A. Lar'kin, I. Tsymbalov, D. Uruypina, R. Volkov, A. Brantov, P. Ksenofontov, V. Bychenkov, J. Breil, B. Chimier, and V.T. Tikhonchuk** *(Russia)*. Pre-pulse control of fast electrons production from solids at relativistic intensities. (Invited)
	17:50-18:20 N. Marwan, J. Donges, R. Donner, and J. Kurths *(Germany).* Recurrence plots and complex networks for time series analysis. (Invited)	**17:50-18:20 J. Kawanaka** *(Japan)*. Ultrabroadband parametric amplification by using a partially deuterated KDP pumped cryogenic laser. (Invited)	**17:50-18:20 G. Lehmann and K.H Spatschek** *(Germany)*. Non-filamented ultra-intense and ultra-short pulses in Raman seed amplification (Invited)
	18:20-18:50 S.P. Cornelius, W.L. Kath, and A.E. Motter *(USA).* A nonlinear dynamics-based approach to control complex networks. (Invited)	**18:20-18:40 S. Bagayev, V. Trunov, E. Pestryakov, S. Frolov, V. Leshchenko, and V. Vasiliev** *(Russia).* Problems and perspectives of creation of high intensity femtosecond laser systems with coherent beam combining.	**18:20-18:50 A.S. Pirozhkov, M. Kando, T.Zh. Esirkepov, T.A. Pikuz, A.Ya. Faenov, K. Ogura, Y. Hayashi, H. Kotaki, E.N. Ragozin, D. Neely, H. Kiriyama, J.K. Koga, Y. Fukuda, M. Nishikino, T. Imazono, N. Hasegawa, T. Kawachi, H. Daido, Y. Kato, P.R. Bolton, S.V. Bulanov, and K. Kondo** *(Japan)*. High-order harmonics from singularities of relativistic plasma. (Invited)
	18:50-19:10 V.V. Klinshov and V.I. Nekorkin *(Russia).* Neuron clustering controls persistent activity in cortex.	**18:40-19:00 K. Burdonov, A. Fokin, A. Shaykin, and A. Soloviev** *(Russia)*. Upgrade of Nd:glass pump laser for petawatt level PEARL facility.	**18:50-19:10 A.A. Balakin and G.M. Fraiman** *(Russia)*. Method for the phase correction of intense ultrashort laser pulses at Raman backscattering in a plasma
		19:00-19:20 V. Ginzburg, E. Khazanov, A. Kochetkov, and S. Mironov *(Russia).* Optimization of temporal parameters of petawatt femtosecond pulses by XPW and SPM techniques.	
19:30-20:30	**Dinner**		
21:30	**Welcome party / Music program**		

Friday, July 18

7:30-8:30	**Breakfast**		
8:00-12:00	KAZAN **Bus tour (8:30-11:30)**		
13:30-15:00	**Lunch**		
	HALL A		
15:00-15:50	**E. Schöll** *(Germany)*. Control of complex networks: interplay of structure and delay. **(Plenary)**		
15:50-16:40	**J. Kurths** *(Germany-Russia)*. Climate networks and extreme events. **(Plenary)**		
16:40-17:00	**Coffee break**		
	HALL A	**HALL B**	**HALL C**
	NWP-3	**NWP-2**	**WORKSHOP**
	Session: Climatic dynamic systems	**Session: High average power lasers**	**Session: "Ultra-high fields in plasmas: new models, high performance simulations and experiments"**
17:00-19:30	**17:00-17:30 A.M. Feigin, D.N. Mukhin, E.M. Loskutov, and A.S. Gavrilov** *(Russia)*. Global empirical reconstruction of complex systems: General approach & application to climate modeling. (Invited)	**17:00-17:30 X. Liu** *(China)*. Recent developments in high power diode lasers. (Invited)	**17:00-17:30 D.P. Higginson, J. Béard, S.N. Chen, E. d'Humières, H. Pépin, Ph. Korneev, S. Pikuz, B. Pollock, R. Riquier, and J. Fuchs** *(France)*. High-velocity magnetized plasma collisionless interactions using high-intensity lasers. (Invited)
	17:30-17:50 D. Mukhin, A.S. Gavrilov, E.M. Loskutov, A.M. Feigin *(Russia)*. Optimal prognostic models from spatially distributed time series.	**17:30-18:00 I. Mukhin, E.A. Perevezentsev, O.L. Vadimova, I.I. Kuznetsov, and O.V. Palashov** *(Russia)*. Cryogenic disk Yb:YAG laser: status quo and perspectives. (Invited)	**17:30-18:00 S. Ter-Avetisyan** *(Korea)*. Ion acceleration from relativistic laser plasma. (Invited)
	17:50-18:10 D. Kondrashov, M.D. Chekroun, and M. Ghil *(USA)*. Data-driven climate modeling and prediction.	**18:00-18:30 Y. Ochi, K. Nagashima, M. Maruyama, M. Tsubouchi, F. Yoshida, and A. Sugiyama** *(Japan)*. High average power laser from Yb:YAG thin-disk amplifiers and its applications. (Invited)	**18:00-18:20 A. Korzhimanov, M. Marklund** *(Russia, Sweden)*. Simulation of laser ion acceleration in targets with sub-wavelength surface.
	18:10-18:40 J. Tribbia *(USA)*. Is the atmospheric dynamic attractor composed of nonlinear waves or linear stochastic structures? (Invited)	**18:30-19:00 T. Gonçalvès-Novo, B. Vincent, and J.-C. Chanteloup** *(France)*. Lucia low temperature amplifier head performance. (Invited)	**18:20-18:40 E.N. Nerush and I.Yu. Kostyukov** *(Russia)*. Gamma-ray emission effect on laser-solid interaction in ultrahigh intensity regime.
	18:40-19:00 A. Gritsun *(Russia)*. Unstable periodic orbits in the models of large scale atmosphere dynamics.		
	19:00-19:30 V. Lucarini *(Germany)*. Climate response and climate prediction. (Invited)		
19:30-20:30	**Dinner**		
21:00	**Classical music concert**		

Saturday, July 19, morning

7:30-8:30	**Breakfast**		
8:00-10:00	**SHIRYAEVO** **Riverside outings**		
	HALL A	**HALL B**	**HALL C**
	NWP-3	**NWP-2**	
	Session: Lightning: physics and effects	**Session: High peak power lasers II**	
10:30-13:00	**10:30-11:00 C. Price** *(Israel).* Using natural and anthropogenic radio waves to monitor climate change. (Invited)	**10:30-11:00 A. Pirozhkov, H. Kiriyama, M. Mori, M. Nishiuchi, Y. Fukuda, H. Kotaki, K. Ogura, A. Sagisaka, H. Sakaki, Y. Hayashi, A. Kon, M. Kanasaki, T. Esirkepov, J. Koga, S. Bulanov, P. Bolton, T. Kawachi, M. Kando, and K. Kondo** *(Japan).* J-KAREN laser upgrade and perspectives. (Invited)	
	11:00-11:30 S. Smyshlyaev *(Russia).* A model study of the feedbacks between lightning activity and atmospheric composition for regional and global scale. (Invited)	**11:00-11:20 A. Shaykin** *(Russia).* Pulse splitting as a way to increase efficiency, to decrease shape distortion, and to prevent breakdown optical elements in the high energy solid state laser.	
	11:30-11:50 S.O. Dementyeva, N.V. Ilin, and E.A. Mareev *(Russia).* Prediction of lightning activity based on direct electric field calculations.	**11:20-11:40 V. Venediktov** *(Russia).* Adaptive optical and holographic correction in laser systems: comparison and possible combining.	
	11:50-12:20 A. Nag and V.A. Rakov *(USA).* Two lightning processes producing relatively short duration bipolar electromagnetic radiation signatures. (Invited)	**11:40-12:00 A. Andrianov, E. Anashkina, A. Kim, I. Meyerov, S. Lebedev, A. Sergeev and G. Mourou** *(Russia, France).* Multimillijoule chirped pulse tapered fiber amplifiers for coherently combined laser systems.	
	12:20-12:50 V.A. Rakov, M.D. Tran, S. Mallick, and V.B. Somu *(Russia, USA).* Recent research at the Lightning Observatory in Gainesville, Florida: A review and update. (Invited)	**12:00-12:20 E. Anashkina, A. Andrianov, M. Koptev, S. Muravyev, and A. Kim** *(Russia).* Generation and characterization with FROG technique of femtosecond optical pulses tunable in the range of 2 to 3 µm from silica-based all-fiber laser system.	
	12:50-13:20 W. Lu, L. Chen, Y. Ma, Ya. Zhang, and Yi. Zhang *(China).* New results of tall-object lightning observation in Guangzhou. (Invited)	**12:20-12:40 Julia Siv (Amplitude Technologies)** *(France).* Latest developments on high temporal contrast, ultra-short pulse duration, PW laser systems.	
13:30-15:00	**Dinner**		

Saturday, July 19, afternoon

	HALL A		
15:00-15:50	**G. Martínez-Mekler** *(Mexico)*. Complex network dynamics approach to marine external fertilization. **(Plenary)**		
	HALL A	**HALL B**	**HALL C**
	NWP-3	**NWP-2**	
	Session: Nonlinear phenomena in geophysical hydrodynamics	**Session: Laser diognostics**	
16:00-17:30	**16:00-16:30 M. Nosov** *(Russia).* Primary and secondary effects that lead to tsunami generation during an earthquake. (Invited)	**16:00-16:30 I. Kozhevatov** *(Russia).* Consideration of the optical scheme of IAP RAS large aperture interferometer for metrology of extremely high power laser facilities elements. (Invited)	
	16:30-16:50 V.P. Reutov and G.V. Rybushkina *(Russia.)* Evolution of the convective structures in a water layer with an internal drift flow and an insoluble surfactant on the free surface.	**16:30-17:00 P. Ryabochkina, A. Lyapin, E. Garibin, S. Ushakov, P. Fedorov** *(Russia).* The visualiser of 2 μm laser radiation based on CaF_2:Ho. (Invited)	
	16:50-17:10 S.V. Shagalov and G.V. Rybushkina *(Russia).* Nonlinear dynamics of barotropically unstable Rossby wave packets and formation of zonally modulated vortex streets in weakly supercritical zonal flows.		
	17:10-17:30 A. Kandaurov, Yu. Troitskaya, G. Caulliez, D. Sergeev, and M. Vdovin *(Russia).* Laboratory modeling of the wind-wave interaction by modified PIV technique.		
17:30-17:50	**Coffee break**		
19:30-20:30	**Dinner**		
21:00	**Musical program**		

Poster Session

18:00-19:30

NWP 1

Y. Boev, T. Vadivasova, and V. Anishchenko *(Russia).* Poincaré recurrences in the phase-frequency synchronization regime in the Rössler oscillator.

A.S. Dmitrichev and V.I. Nekorkin *(Russia).* Wave patterns in a ring of electrically coupled oscillatory neurons with extra chemical couplings.

S.Yu. Gordleeva, A.Yu. Simonov, A.N. Pisarchik, and V.B. Kazantsev *(Russia).* Phase locking with arbitrary phase shift of two synaptically coupled neurons.

N.I. Semenova, T.E. Vadivasova, and V.S. Anishchenko *(Russia).* Afraimovich-Pesin dimension of Poincare recurrences in circle map.

V.V. Semenov, A.V. Feoktistov, and T.E. Vadivasova *(Russia).* The effect of coherence resonance is studied in different time-delayed systems.

NWP 3

V. Chernov *(Russia).* The influence of air humidity on auto-oscillations on ground surface.

S.S. Davydenko, D.I. Iudin, V.Yu. Klimashov, A.Yu. Kostinskiy, and V.S. Syssoev *(Russia).* On the electrical structure of the artificial charged aerosol cloud.

N. Marinina, Yu. Troitskaya, D. Sergeev, V. Papko, G. Baidakov, M. Vdovin, A. Kandaurov, D. Zenkovich, and A. Kuznetsova *(Russia).* Field measurements of wind-wave interaction in the atmospheric boundary layer over a reservoir.

M.Yu. Kulikov and A.A. Nechaev *(Russia).* Retrieval of important gases concentrations from time series of ozone measurements at altitudes of 50 km to 75 km.

V.V. Perekatova and D.N. Mukhin *(Russia).* Optimization technique for retrieving vertical distributions of atmospheric ozone from radiometry data.

D. Sergeev *(Russia).* Modeling of wind waves on the lake-like basin of Gorky Reservoir with WAVEWATCH III.

I. Soustova, K. Gorshkov, and A. Ermoshkin *(Russia).* Investigation of the compound soliton of Gardner’s equation in the oceanic shelf.

I.I. Mokhov and A.V. Timazhev *(Russia).* Risk and predictability of Eurasian climate anomalies associated with climatic quasi-cycles like ENSO.

NWP-2

A. Fokin, A. Soloviev, K. Burdonov, A. Shaykin *(Russia).* Wide-aperture rod laser amplifier on neodymium glass.

D.S. Gavrilov, A.G. Kakshin, and E.A. Loboda *(Russia).* The pulse contrast of the multi-TW phosphate nd:glass laser facilty.

A. Kochetkov and V. Ginzburg *(Russia).* Study of XPW-filter for temporal contrast improvement of PEARL laser.

I. Kuznetsov, I. Mukhin and O. Palasov *(Russia).* Application of composite Yb:YAG/YAG active element for high average and peak power lasers development.

G. Rogozhnikov, V. Romanov, S. Bel’kov, M.Y Schelev, N. Vorobyev and P. Gornostaev *(Russia).* Registration of spatio-temporal properties of ultrashort laser pulses in high-power multichannel facilities.

V.Romanov, S. Belkov, and S. Garanin *(Russia).* Petawatt laser system for high-speed processes diagnostics in dense hot plasma.

A. Zuev and I. Yakovlev *(Russia).* Offner triplet telescope stretcher for PEARL system.

Workshop

A.A. Golovanov and I.Yu. Kostyukov *(Russia).* Analytical model for electron side injection into linear plasma waves.

P.A. Ksenofontov, A.V. Brantov, V.Yu. Bychenkov, A.B. Savel’ev, I.N. Tsymbalov, and A. Drobinin *(Russia).* Numerical simulation of electrons acceleration in long-scale-length underdense plasma.

A.S. Lar`kin, K.A. Ivanov, D.S. Uryupina, A.B. Savel'ev, C. Fourment, P.-M. Leguay, B. Chimier, V.T. Tikhonchuk, A.V. Brantov, and V.Yu. Bychenkov *(Russia).* Interaction of the relativistic laser pulse with the melted gallium surface.

I.D. Laryushin, N.V. Vvedenskii, V.A. Kostin, and A.A. Silaev *(Russia).* Theory and simulations of laser-plasma generation of frequency-tunable mid-infrared pulses.

A.A. Romanov, A.A. Silaev, and N.V. Vvedenskii *(Russia).* Quantum-mechanical description of gas ionization and residual-current excitation by two-color laser pulses.

D.A. Serebryakov, E.N. Nerush, and I.Yu. Kostyukov *(Russia).* Analytical model for gamma-ray generation in laser-irradiated plasma.

O. Vais, S.G. Bochkarev, V.Yu. Bychenkov, and A.B. Savel’ev *(Russia).* Nonlinear Thomson scattering of a tightly focused linearly polarized ultrashort laser pulse.

Sunday, July 20

8:00-9:00	**Breakfast**		
9:30-14:00	SARATOV **Bus tour (9:30-13:00)**		
13:30-15:00	**Lunch**		
	HALL A		
15:00-15:50	**O. Talagrand** *(France)*. State estimation and uncertainty quantification in the atmosphere and the ocean. **(Plenary)**		
15:50-16:40	**V. Bychenkov** *(Russia)*. Optimization study for laser-triggered ion acceleration from thin targets and societal nuclear applications. **(Plenary)**		
16:40-17:00	**Coffee break**		
	HALL A	**HALL B**	**HALL C**
	NWP-1	**SCHOOL FOR YOUNG SCIENTISTS**	
	Session: Applications in life sciences and engineering		
17:00-19:30	**17:00-17:30 G. Ansmann, R. Karnatak, K. Lehnertz, and U. Feudel** *(Germany)*. Extreme events in excitable systems. (Invited)	**17:00-18:00 F.A. Starikov** *(Russia)*. Adaptive optics and powerful lasers, part 1.	
	17:30-18:00 F. Polezhaev *(Russia)*. Segmented patterns and mechanisms of their formation. (Invited)	**18:00-19:00 F.A. Starikov** *(Russia)*. Adaptive optics and powerful lasers, part 2.	
	18:00-18:30 S.P. Kuznetsov *(Russia)*. Examples of mechanical systems manifesting chaotic hyperbolic attractors of Smale-Williams type. (Invited)		
	18:30-18:50 A.P. Kuznetsov, L.V. Turukina, and I.R. Sataev *(Russia)*. About Landau-Hopf scenario in ensembles of regular and chaotic oscillators.		
	18:50-19:10 D. Zakharov *(Russia)*. Simultaneous action of AMPA and NMDA synaptic currents on the model of dopaminergic neuron.		
	19:10-19:30 T. Yazawa and H. Kitajima *(Japan)*. Neurobiology of alternans arrhythmia: A simulation study of the heart of animal models.		
19:30-20:30	**Dinner**		
21:00	**Classical music concert**		

Monday, July 21, morning

8:00-9:00	**Breakfast**		
	HALL A	**HALL B**	**HALL C**
	NWP-1	**SCHOOL FOR YOUNG SCIENTISTS**	
	<u>Session</u>: Dynamical networks: Elements of general theory		
9:00-11:30	**9:00-9:30 M. Hasler** *(Switzerland).* On the dynamical behavior of large dynamical networks. (Invited)	**9:00-10:00 L. Xingsheng** *(China)*. Basic characteristics of high power diode lasers.	
	9:30-10:00 V. Rasvan *(Romania).* On hyperstable interconnections (from the legacy of V.M. Popov). (Invited)	**10:00-11:00 L. Xingsheng** *(China)*. Packaging of high power semiconductor lasers.	
	10:00-10:30 L.I. Manevitch *(Russia).* Energy exchange and localization in finite nonlinear oscillatory chains. (Invited)		
	10:30-10:50 <u>M.A. Kovaleva</u> and Yu. Starosvetsky *(Russia).* Energy localization to energy transport in the system of n weakly coupled granular chains.		
	10:50-11:10 D. Kasatkin *(Russia).* Synchronization phenomena in complex networks of dynamically coupled phase oscillators.		
	11:10-11:30 <u>E.V. Kurmyshev</u> and H.A. Juarez *(Mexico).* Efficiency of leader´s strategy to gain public opinion: modeling and computer simulation in a social network.		
11:30-15:00	**SAMARA** **Bus tour (11:30-14:00)**		
14:00-15:30	**Lunch**		

Monday, July 21, afternoon

	HALL A		
15:30-16:20	**A.S. Dmitriev** *(Russia)*. Simulation of interacting dynamical systems in wireless sensor networks. **(Plenary)**		
16:20-17:10	**M. Tamburini** *(Germany).* The classical limit of radiation reaction effects in ultraintense laser fields. **(Plenary)**		
17:10-17:30	**Coffee break**		
	HALL A	**HALL B**	**HALL C**
	NWP-1	**SCHOOL FOR YOUNG SCIENTISTS**	**NWP-3**
	Session: Dynamical networks: Elements of general theory		**Session: Nonlinear phenomena in geophysical dynamics**
17:30-19:30	**17:30-18:00 A. Pikovsky and M. Komarov** *(Germany).* Synchronization in multifrequency oscillator communities. (Invited)	**17:30-18:30 S.A. Belkov** *(Russia).* Concept of laser driver for ICF.	**17:30-18:00 E. Morozov** *(Russia).* Semidiurnal internal wave global field. (Invited)
	18:00-18:30 S. Acharyyal and R.E. Amritkar *(India).* Synchronization of coupled nearly identical dynamical systems. (Invited)	**18:30-19:30 Ken-Ichi Ueda** *(Japan, Russia).* Introduction to laser physics and engineering: Part 1. light amplification, gain, loss, saturation and efficiency.	**18:00-18:30 H. Matsumoto, Y. Kaneda, M.A. Nosov, and S.V. Kolesov** *(Russia)* Offshore observation of earthquakes and related tsunamis. (Invited)
	18:30-19:00 M. Porfiri *(USA).* Synchronization and control in networks of stochastically coupled oscillators (Invited).		
	19:00-19:20 A. Yeldesbay, A. Pikovsky, and M. Rosenblum *(Germany).* Chimeralike states in an ensemble of globally coupled oscillators.		
	19:20-19:40 A. Zakharova, M. Kapeller, and E. Schöll *(Germany)* Amplitude chimeras and chimera death in dynamical networks.		
19:30-20:30	**Dinner**		
21:00	**Music program**		

Tuesday, July 22, morning

<table>
<tr><td>8:00-9:00</td><td colspan="3">Breakfast</td></tr>
<tr><td></td><td colspan="3">HALL A</td></tr>
<tr><td>9:00-9:50</td><td colspan="3">Ken-ichi Ueda (Japan). Progress of ceramic lasers and thermal-lens free cooling. (Plenary)</td></tr>
<tr><td>9:50-10:40</td><td colspan="3">E. d'Humières (France). Ion acceleration in low density targets using ultra-high intensity lasers. (Plenary)</td></tr>
<tr><td>10:40-11:00</td><td colspan="3">Coffee break</td></tr>
<tr><td rowspan="3"></td><td>HALL A</td><td>HALL B</td><td>HALL C</td></tr>
<tr><td>NWP-3</td><td>SCHOOL FOR YOUNG SCIENTISTS</td><td></td></tr>
<tr><td><u>Session</u>: Climatic dynamic systems</td><td></td><td></td></tr>
<tr><td rowspan="5">11:00-13:30</td><td>11:00-11:30 <u>S.V. Kravtsov</u>, I. Rudeva, and S.K. Gulev (USA). Reconstructing spatiotemporal characteristics of sea-level pressure variability using a feature tracking approach. (Invited)</td><td>11:00-12:00 S.A. Belkov (Russia). Laser – tool for study of matter extreme states.</td><td></td></tr>
<tr><td>11:30-11:50 <u>E. Loskutov</u>, D.N. Mukhin, A.S. Gavrilov and A.M. Feigin (Russia) Decomposition of the complex systems: spatio-temporal expansion of data.</td><td>12:00-13:00 A. Pukhov (Germany, Russia). Electron acceleration in laser-plasma bubbles.</td><td></td></tr>
<tr><td>11:50-12:10 <u>A.S. Gavrilov</u>, D.N. Mukhin, E.M. Loskutov, and A.M. Feigin (Russia). Decomposition of the complex systems: nonlinear mode extraction.</td><td></td><td></td></tr>
<tr><td>12:10-12:40 <u>D.A. Smirnov</u> and I.I. Mokhov (Russia). Inferring directional couplings from time series: avoiding spurious detection, estimation of long-term effects, and application to climatic data. (Invited)</td><td></td><td></td></tr>
<tr><td>12:40-13:00 <u>A. Rheinwalt</u>, B. Goswami, N. Boers, J. Heitzig, N. Marwan, R. Krishnan, and J. Kurths (Germany). A network of networks approach to investigate the influence of sea surface temperature variability on monsoon systems.</td><td></td><td></td></tr>
<tr><td>13:30-15:00</td><td colspan="3">Lunch</td></tr>
</table>

Tuesday, July 22, afternoon

	HALL A	HALL B	HALL C
	NWP-3	**SCHOOL FOR YOUNG SCIENTISTS**	
	Session: Lightning: physics and effects		
15:00-17:00	**15:00-15:30 M. Chen and Ya-P. Du** *(China)* Lightning leader evolution. Observations and simulations. (Invited)	**15:00-16:00 Ken-Ichi Ueda** *(Japan, Russia).* Introduction to laser physics and engineering: Part 2. High-damage threshold, ultra-low-loss optics and measurement.	
	15:30-16:00 E.A. Mareev, A.Yu. Kostinskiy, V.S. Syssoev, N.A. Bogatov, and V.A. Rakov *(Russia).* Variety of electrical discharges in electrified clouds. (Invited)	**16:00-17:00 A. Pukhov** *(Germany, Russia).* Electron trapping in laser field due to radiation reaction.	
	16:00-16:20 D. Iudin *(Russia).* Cellular automaton modelling of intracloud lightning.		
	16:20-16:40 A.A. Evtushenko and F.A. Kuterin *(Russia).* The axially-symmetric plasma-chemical model of halo.		
17:00-17:20	**Coffee break**		
	HALL A	**HALL B**	**HALL C**
	NWP-3		
	Session: Lightning: physics and effects		
17:20-19:20	**17:20- 17:50 A. Nag, M.J. Murphy, W. Schulz, and K.L. Cummins** *(USA).* Lightning locating systems: overview of characteristics and validation techniques. (Invited)		
	17:50-18:10 S.S. Davydenko, S.A. Savikhin, A.S. Sergeev, and S.A. Zolotov *(Russia).* Electromagnetic response of the inhomogeneous anisotropic atmosphere to a single lightning discharge.		
	18:10-18:30 A.V. Kalinin, E.A. Mareev, N.N. Slyunyaev, and A.A. Zhidkov *(Russia).* Numerical analysis and analytical relations for stationary and non-stationary models of the global electric circuit.		
19:30-20:30	**Dinner**		
21:00-23:00	**CHEBOKSARY**	**Ethnic Chuvash program, local bear testing (21:15-22:00)**	
22:00	**Party, musical program**		

Wednesday, July 23

8:00-9:00	**Breakfast**		
9:00-11:00	**MAKARIEVO** **Excursion**		
	HALL A	**HALL B**	**HALL C**
	NWP-1		
	<u>Session</u>: Applications in life sciences and engineering		
11:30-13:30	**11:30-11:50 <u>V. Vlasov</u>, E.E.N. Macau, and A. Pikovsky** *(Germany).* Synchronization of oscillators in a Kuramoto-type model with generic coupling.		
	11:50-12:10 <u>O.V. Maslennikov</u> and V.I. Nekorkin *(Russia).* Collective dynamics of spiking neural networks with modular structure and delayed coupling.		
	12:10-12:30 <u>S.Yu. Kirillov</u> and V.I. Nekorkin *(Russia).* Delay of the spike oscillation suppression in the nonautonomous model of neuron firing.		
13:30-15:00	**Lunch**		
	HALL A		
15:00-15:40	**Round Table**		
15:40-16:30	**Closing ceremony**		
17:30	**Arrival in Nizhny Novgorod**		

OPTIMIZATION STUDY FOR LASER-TRIGGERED ION ACCELERATION FROM THIN TARGETS AND SOCIETAL NUCLEAR APPLICATIONS

V.Yu. Bychenkov

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Center for Fundamental and Applied Research, VNIIA, ROSATOM, Moscow, Russia

Here the results of 3D optimization study with PIC code "Mandor" for acceleration of ions from thin targets triggered by femtosecond laser pulses are presented. For a volumetric heating of the targets with optimum thicknesses, the dependence of maximum ion energies on laser intensity shows very universal scaling $\sim I^{0.7}$ for a wide intensity range and different pulse durations and spot sizes of practical interest. More sharp dependence of maximum ion energy as compared to popular scaling $\sim I^{0.5}$ is a result of absorption increase with increasing laser intensity. The proposed analytical model is consistent with numerical simulations. Several nuclear applications of societal trend are discussed for new generation lasers of high peak and averaged power.

SIMULATION OF INTERACTING DYNAMICAL SYSTEMS IN WIRELESS SENSOR NETWORKS

A.S. Dmitriev, M.Y. Gerasimov, R.Y. Emelyanov, and **V.V. Itskov**

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Moscow, Russia, chaos@cplire.ru

Generalized wireless sensor networks – wireless active networks (WAN) – are considered as distributed multiple-unit processor platform for modeling behavior of interacting dynamical systems. During the simulation, each sensor network node represents a dynamical system. The equations of this system are solved by a special computing unit, e.g., microcontroller (MCU) placed on each node. The interaction between the dynamical systems is understood as transmission of data on the system state between the nodes of active network via radio channel. Here, this approach is investigated on an example of an ensemble of coupled logistic maps. This ensemble is implemented as a wireless network composed of ultra wideband direct chaotic transceivers PPS-43 [3] with special actuator boards attached. These actuator boards contain an MCU to iterate the maps and a display to visualize information (color LED). The modeling technique, experimental results and analysis are described.

ION ACCELERATION IN LOW DENSITY TARGETS USING ULTRA-HIGH INTENSITY LASERS

E. d'Humières[1], M. Lobet[2], A. Debayle[2], L. Gremillet[2], and **V.T. Tikhonchuk[1]**

[1] Univ. Bordeaux – CNRS - CEA, Talence, France, dhumieres@celia.u-bordeaux1.fr
[2] CEA/DAM-DIF, Arpajon, France

Recent theoretical and experimental studies suggest the possibility of enhancing the efficiency and ease of laser acceleration of protons and ions using underdense or near critical plasmas through electrostatic shocks. Scaling shock acceleration in the low density regime to ultra high intensities is a challenge as radiation losses and electron positron pair production change the optimization of the shock process. Using large-scale Particle-In-Cell simulations, the transition to this regime in which intense beams of relativistic ions can be produced is investigated. The application of these beams to high energy laboratory astrophysics is discussed.

THE HELMHOLTZ BEAMLINE LASER PROJECT AT THE FACILITY FOR ANTI-PROTON AND ION RESEARCH (FAIR)

Thomas Kuehl

GSI-Helmhotzzentrum Darmstadt, Germany

The international accelerator Facility for Anti-Proton and Ion Research (FAIR) currently under construction at the GSI heavy ion accelerator laboratory in Darmstadt, Germany, will enable an unprecedented variety of experiments. Thereby physicists from all around the world will be able to gain new insights into the structure of matter and the evolution of the universe from the Big Bang to the present.

CLIMATE NETWORKS AND EXTREME EVENTS

Juergen Kurths

Potsdam Institute for Climate Impact Research & Humboldt University,
Berlin & King´s College, University of Aberdeen, UK

We analyse some climate dynamics from a complex network approach. This leads to an inverse problem: Is there a backbone-like structure underlying the climate system? For this we propose a method to reconstruct and analyze a complex network from data generated by a spatio-temporal dynamical system. This approach enables us to uncover relations to global circulation patterns in oceans and atmosphere. The global scale view on climate networks offers promising new perspectives for detecting dynamical structures based on nonlinear physical processes in the climate system. Moreover, we evaluate different regional climate models from this aspect.

COMPLEX NETWORK DYNAMICS APPROACH TO MARINE EXTERNAL FERTILIZATION

G. Martínez-Mekler[1], J. Espinal[2], and **A. Darszon[3]**

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mekler@fis.unam.mx
[2] Instituto Nacional de Medicina Genómica, Distrito Federal, México
[3] Instituto de Biotecnología, UNAM, Cuernavaca, México

In this work we study the fertilization of sea urchins by focusing on a biochemical signaling pathway of calcium concentration [Ca^{2+}], oscillations within the spermatozoa flagella, triggered by chemicals surrounding the egg, and known to control their swimming to the egg (chemotaxis). We study the discrete dynamics of a logical regulatory network model representing the pathway. With our model we predict behaviors that are corroborated by new experiments and that contribute to a better understanding of chemotaxis, membrane electrophysiology, drug operation and issues related to the development of a male contraceptive.

LIGHTNING: SOME NEW INSIGHTS

V.A. Rakov

Department of Electrical and Computer Engineering, University of Florida, USA
Institute of Applied Physics, Russian Academy of Science, Nizhny Novgorod, RF

An overview of recent progress in studying the physics of cloud-to-ground lightning is given, including its initiation, propagation, and attachment to ground. Lightning electromagnetic pulse interaction with the ionosphere and production of energetic radiation (x-rays and gamma radiation) by lightning are considered. Some topics are outlined below.

CONTROL OF COMPLEX NETWORKS: INTERPLAY OF STRUCTURE AND DELAY

E. Schöll

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Time delayed coupling or feedback can be used to control the dynamics of complex networks. We study synchronization in delay-coupled oscillator networks, using a master stability function approach, and show that for large coupling delays synchronizability relates in a simple way to the spectral properties of the network topology, allowing for a universal classification. As illustrative examples we consider synchronization and desynchronization transitions in neural networks, in particular small-world networks with excitatory and inhibitory couplings, chimera states, and group and cluster synchronization. We show that adaptive algorithms of time-delayed feedback control can be used to find appropriate value of the control parameters, and one can even self-adaptively adjust the network topology to realize a desired cluster state.

STATE ESTIMATION AND UNCERTAINTY QUANTIFICATION IN THE ATMOSPHERE AND THE OCEAN

O. Talagrand[1], **M. Jardak**[1], **G. Candille**[1], and **L. Descamps**[2]

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[2] Météo-France, Toulouse, France

Estimation of the state of the atmospheric or oceanic flow, as well as of the associated uncertainty, is crucial for many applications. We present and discuss the methods that are used at present for assimilation of observations, in which an appropriate description of the propagation of uncertainty in the dynamical evolution of the flow is absolutely necessary. Similar questions arise in the context of the prediction of the future state of the flow. Emphasis is put on the Bayesian character (or otherwise) of the methods, and on their possible limitations.

THE CLASSICAL LIMIT OF RADIATION REACTION EFFECTS IN ULTRAINTENSE LASER FIELDS

M. Tamburini, A. Di Piazza and **Ch.H. Keitel**

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Matteo.Tamburini@mpi-hd.mpg.de

The dynamics of an electron in a strong laser field can be significantly altered by radiation reaction (RR) effects. Here the features and the implications of RR effects in the classical limit are discussed. In particular, the influence of RR effects on laser-driven ion acceleration in the radiation pressure acceleration regime is examined. In addition, a novel route to the control of the electron dynamics via the nonlinear interplay between the Lorentz and RR forces is presented.

PROGRESS OF CERAMIC LASERS AND THERMAL-LENS FREE COOLING

Ken-ichi Ueda

Inst. for Laser Science, Univ. Electro-Communications, Tokyo, Japan
Inst. of Laser Engineering, Osaka Univ. Suita, Osaka
Hamamatsu Photonics, Hamamatsu, Hamamatsu, Japan
Toyota Physical and Chemical Institute, Nagakute, Aichi Japan
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Until today, the major scaling technique to generate high output is an aperture scaling because the output power is limited by the damage threshold. We need a large aperture amplifier for high power output. LLNL (Lawrence Livermore National Laboratory) developed 40x40 cm power glass amplifiers for NIF (National Ignition Facility) to achieve the ignition of laser fusion. The NIF laser is a largest laser system in the human history. A scalable glass laser system was only one possibility to generate MJ, EW power output. However, such type of scaling law is not so available any more because the new frontiers of science request high peak & high average power all together. We need a paradigm shifting technology in laser materials and power scaling technique. Ceramic laser and coherent beam combining are the keys to break the bottleneck.

ABSTRACTS OF NWP-1: NONLINEAR DYNAMICS ON COMPLEX NETWORKS

SYNCHRONIZATION OF COUPLED NEARLY IDENTICAL DYNAMICAL SYSTEMS

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We study the stability of generalized synchronization by obtaining an approximate master stability function (MSF) in a network of coupled nearly identical dynamical systems. We show that in the star network of coupled Rössler systems, the critical size beyond which synchronization is unstable can be increased by having a larger frequency for the central node. For the ring network, the critical size is not significantly affected. Next we use the MSF to construct optimized networks which show better synchronizability. Optimized network shows interesting structural properties, e.g. in the optimized network, nodes with higher frequencies, have higher degrees and are chosen as hubs.

POINCARÉ RECURRENCES IN THE STROBOSCOPIC SECTION OF A NONAUTONOMOUS VAN DER POL OSCILLATOR

N.I. Semenova and **V.S. Anishchenko**

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In the present work we analyze the statistics of a set which is obtained by calculating a stroboscopic section of phase trajectories in a harmonically driven van der Pol oscillator. It is shown that this set is similar to the linear shift on a circle with an irrational rotation number which is defined as the detuning between the external and natural frequencies. The dependence of minimal return times on the size ε of the return interval is studied numerically for the golden ratio. Furthermore, it is also found that in this case, the value of the Afraimovich-Pesin dimension is $\alpha_C=1$.

POINCARÉ RECURRENCES IN THE PHASE-FREQUENCY SYNCHRONIZATION REGIME IN THE RÖSSLER OSCILLATOR

Y. Boev, T. Vadivasova, and **V. Anishchenko**

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The effect of locking of the mean Poincaré return time is considered for the phase-frequency synchronization regime in the Rössler oscillator. The Poincaré recurrence statistics is studied in detail for both autonomous and nonautonomous cases. The relationship is established between the basic oscillation frequency and the probability distribution density of Poincaré recurrences. It is shown that the fractal dimension of the chaotic spiral Rössler attractor can be defined by using Poincaré recurrence times.

A NONLINEAR DYNAMICS-BASED APPROACH TO CONTROL COMPLEX NETWORKS

S.P. Cornelius[1,2]**, W.L. Kath**[2]**,** and **A.E. Motter**[2]

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[2]Northwestern University, Evanston, USA

The control of complex networks is of paramount importance in areas as diverse as ecosystem management, emergency response, and cell reprogramming. A fundamental property of networks is that perturbations to one node can affect other nodes, potentially causing the entire system to change behavior or fail. Here, I will show that it is possible to exploit this same principle to control network behavior. The approach is based on exploiting

the nonlinear dynamics inherent to real systems, and allows bringing the system to a desired target state even when this state is not directly accessible due to constraints that limit the allowed interventions. Applications show that this framework permits both reprogramming a network to a desired task as well as rescuing networks from the brink of failure—which I will illustrate through the mitigation of cascading failures in a power-grid network and the identification of potential drug targets in a signaling network of human cancer.

WAVE PATTERNS IN A RING OF ELECTRICALLY COUPLED OSCILLATORY NEURONS WITH EXTRA CHEMICAL COUPLINGS

A.S. Dmitrichev and **V.I. Nekorkin**

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We study spatial-temporal dynamics of a network of oscillatory cells, whose architecture has two components – regular and irregular ones. The regular component is represented by a ring of electrical couplings. As the irregular component we consider both a pair and a random set of mutual chemical couplings. The laws of evolution of wave activity in such a network are investigated depending on coupling strengths and statistical characteristics of the irregular component.

EXTREME EVENTS IN EXCITABLE SYSTEMS

G. Ansmann[1], R. Karnatak[2], K. Lehnertz[1], and **U. Feudel[2]**

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[2] Institute for Chemistry and Biology of the Marine Environment,
Carl von Ossietzky University Oldenburg, Oldenburg, Germany

We consider the dynamics of rare events at which an observable of a complex dynamical system is extreme in amplitude. Since our goal is to contribute to the understanding of the emergence and the termination of epileptic seizures and of harmful algal blooms, we focus on excitable systems, which are useful models to describe those two phenomena. Therefore, we study deterministic networks of excitable elements of FitzHugh–Nagumo type. We demonstrate that these networks are capable of self-generating such events at irregular times, i.e., without a change of control parameters or without an input to the system. To get a better understanding of this behavior, we study a reduced system consisting of two coupled FitzHugh–Nagumo oscillators, which mimics the extreme-event dynamics observed for the networks. We discuss the properties of the networks as well as of the reduced system that may be involved in the generation and termination of such extreme events.

PHASE LOCKING WITH ARBITRARY PHASE SHIFT OF TWO SYNAPTICALLY COUPLED NEURONS

S.Yu. Gordleeva[1,2], A.Yu. Simonov[2], A.N. Pisarchik[3], and **V.B. Kazantsev[2]**

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[2] Nizhny Novgorod State University, Nizhny Novgorod, Russia
[3] Centro de Tecnologia Biomedica, Universidad Politecnica de Madrid, Madrid, Spain

The phase dynamics of a pair of spiking neural oscillators coupled by a unidirectional nonlinear connection has been studied. The synchronization effect with the controlled relative phase of spikes has been obtained for various coupling strengths and depolarization parameters. It has been found that the phase value is determined by the difference between the depolarization levels of neurons and is independent of the synaptic coupling strength. The synchronization mechanism has been studied by means of the construction and analysis of one-dimensional phase maps. The phase locking effect for spikes has been interpreted in application to the synaptic plasticity in neurobiology.

ON THE DYNAMICAL BEHAVIOR OF LARGE DYNAMICAL NETWORKS

M. Hasler

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Networks of N interconnected dynamical systems are considered, where N is supposed to be large. Often, their collective dynamical behavior is studied by analyzing the infinite network as $N \to \infty$. It is then tacitly assumed that the qualitative behavior of the network for sufficiently large, but finite N is the same as for infinite N. We make the point that this has to be rigorously proved, by giving a counter-example. We also show for a network of identical phase oscillators, how to establish such a proof for multistable, synchronously rotating behavior. We believe that the method is widely applicable.

SYNCHRONIZATION PHENOMENA IN COMPLEX NETWORKS OF DYNAMICALLY COUPLED PHASE OSCILLATORS

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The processes of synchronization and phase cluster formation are investigated in complex networks of dynamically coupled phase oscillators. Coupling weights evolve dynamically depending on the relative phases between the oscillators. It is shown that a network exhibits several types of behavior: two-cluster mode, synchronized, partially synchronized and desynchronized modes. We find the occurrence of multi-stable states depending on initial distribution of coupling weights.

DELAY OF THE SPIKE OSCILLATION SUPPRESSION IN THE NONAUTONOMOUS MODEL OF NEURON FIRING

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The spike response to a slowly varying synaptic current has been investigated in the modified FitzHugh-Nagumo model of neuron firing. It was shown that the spike oscillations disappear when the synaptic current value greatly exceeds the value predicted by the classical bifurcation theory. It was found that the dynamic double limit cycle bifurcation and nonlocal oscillation properties underlie the delay phenomenon.

NEURON CLUSTERING CONTROLS PERSISTENT ACTIVITY IN CORTEX

V.V. Klinshov and **V.I. Nekorkin**

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vladimir.klinshov@gmail.com

We derive connectivity rules from experimental data observed in layer 5 of rat neocortex to generate a model of neural connectivity in cortical microcircuits. Our model predicts that microcircuits of about 100 μm contain groups of densely connected neurons which we call clusters. We show that such clusters contain comparatively large groups of excitatory neurons which are almost all-to-all connected with stronger than average synapses. We demonstrate that a small network of about a hundred of cortical neurons embedding such a cluster creates a bistable neural spiking with distinct high and low firing rates. Furthermore, interactions among hundreds of such minimal clusters and surrounding neurons are sufficient for generating both spontaneous network activity and persistent activity representing several simultaneously stored memories in a large-scale network.

ENERGY LOCALIZATION TO ENERGY TRANSPORT IN THE SYSTEM OF N WEAKLY COUPLED GRANULAR CHAINS

M.A. Kovaleva[1] and **Yu. Starosvetsky**[2]

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[2] Technion - Israel Institute of Technology, Haifa, Israel

Regimes of nonlinear, resonant energy transport in the system of three weakly coupled, non-linear oscillators and oscillatory chains are considered. A special analytical method based on the limiting phase trajectories and saw-tooth transformations has been developed to obtain the analytical criterion of formation of a highly non-stationary regime manifested by irregular energy transport from the first to the third oscillator. The results are extended for the case of larger numbers of oscillators(chains).

EFFICIENCY OF LEADER´S STRATEGY TO GAIN PUBLIC OPINION: MODELING AND COMPUTER SIMULATION IN A SOCIAL NETWORK

E.V. Kurmyshev and **H.A. Juarez**

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Public opinion is formed by means of self-organization of agents' opinion influenced by a leader, the latter uses a strategy to gain as many followers as possible. Efficiency of straightforward, zigzag and staircase strategies of a single leader in the opinion formation in a social network is studied in the frame of C/PA bounded confidence model. Results of simulation show complex bifurcation patterns of opinion dynamics; a decrease or even the total loss of control of the leader over the society is observed. Comparative analysis of the efficiency of the three strategies of a dictator and democratic leader is presented.

EXAMPLES OF MECHANICAL SYSTEMS MANIFESTING CHAOTIC HYPERBOLIC ATTRACTORS OF SMALE-WILLIAMS TYPE

S.P. Kuznetsov

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The talk is devoted to consideration and numerical study of several simple mechanical systems with chaotic dynamics associated with attractors of Smale -Williams type: (i) motion of a particle on a plane under periodic pulsed kicks, (ii) two interacting particles placed on alternately rotating disks, and (iii) parametric excitation of a string by modulated pump in a finite-dimensional approximation. The main evidence for the presence of attractors of Smale - Williams type is the topological nature of the iterative diagrams for angular variables of all three models corresponding to expanding circle maps. These examples are interesting as they attribute the hyperbolic theory of dynamical systems with clear physically meaningful content. The relative simplicity of the systems suggested and of their principle of operation allows one to hope for their possible implementation in experiments. Due to the structural stability of chaos associated with the uniformly hyperbolic attractors, feasibility of the models should not critically depend on details, like the precise definition of involved parameters and functions in the equations.

ENERGY EXCHANGE AND LOCALIZATION IN FINITE NONLINEAR OSCILLATORY CHAINS

L.I. Manevitch

Semenov Institute of Chemical Physics of the Russian Academy of Science, Moscow, Russia
manevitchleonid3@gmail.com

We discuss a recently developed concept of limiting phase trajectories (LPT) allowing a unified description of resonance non-stationary processes for a wide range of classical and quantum dynamical systems. This concept provides the far going extension of the linear beating phenomenon to a diverse variety of nonlinear systems. The non-stationary processes are characterized by intense energy exchange between different parts of the system or by strong energy localization. They include, e.g., targeted energy transfer, non-stationary vibrations of carbon nanotubes, quantum tunneling, auto-resonance and non-conventional synchronization. In such processes, LPTs play the key role, similar to that of normal modes in a stationary case.

RECURRENCE PLOTS AND COMPLEX NETWORKS FOR TIME SERIES ANALYSIS

N. Marwan, J. Donges, R. Donner, and **J. Kurths**

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Recurrence plots and derived techniques are powerful and modern time series analysis tools with a wide applicability. Recent developments have linked recurrence plots with complex networks analysis, thus, providing new and complementary measures of complexity for time series analysis. The complex network measures are related to geometrical and topological properties of the phase space representation of the dynamics. Recent applications have demonstrated the potential for data classification (e.g., for medical diagnosis), transition analysis (e.g., for detecting paleoclimatic regime transitions), or coupling analysis (e.g., for identifying coupling directions or indirect couplings).

COLLECTIVE DYNAMICS OF SPIKING NEURAL NETWORKS WITH MODULAR STRUCTURE AND DELAYED COUPLING

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We consider the impact of the delayed coupling on the collective dynamics of modular neural networks. Each module with complex topology contains excitatory and inhibitory neurons displaying irregular spiking sequences. Different modules are connected by relatively sparse excitatory delayed coupling. We found a dual role of the inter-module coupling delay in the collective network dynamics. First, with increasing time delay, in-phase and anti-phase regimes of the modular activity alternate. Second, the average frequency of the collective oscillations in each of these regimes decreases with increasing inter-module coupling delay.

SYNCHRONIZATION IN MULTIFREQUENCY OSCILLATOR COMMUNITIES

A. Pikovsky and **M. Komarov**

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Typically in considerations of globally coupled oscillator populations one considers narrow frequency distributions. In this talk results for heterogeneous populations consisting of subpopulations at different natural frequencies are discussed.

SEGMENTED PATTERNS AND MECHANISMS OF THEIR FORMATION

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Segmented patterns are formed in different systems: physical, chemical, biological. First we give examples of segmented patterns observed in living systems and discuss possible mechanisms of their formation. Then we suggest three possible mechanisms for formation of segmented waves and spirals observed in the Belousov-Zhabotinsky reaction dispersed in a water-in-oil microemulsion. The first mechanism is caused by interaction of two coupled subsystems, one of which is excitable, and the other one has Turing instability. For the second mechanism we suggest ”splitting” of the traveling wave in the vicinity of the bifurcation point of codimension-2, where the boundaries of the Turing and wave instabilities intersect. Finally we show that segmented waves can emerge in some simple two-component reaction-diffusion models with more than one steady state.

SYNCHRONIZATION AND CONTROL IN NETWORKS OF STOCHASTICALLY COUPLED OSCILLATORS

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The study of synchronization has attracted the interest of researchers from different fields of science and engineering for its pervasiveness across natural and technological settings. While most of the existing research has focused on static networks, in many instances, the coupling strength or the network topology may vary in time. In this presentation, we focus on stochastic networks, and we specifically address mean square synchronization of networks of chaotic maps. We demonstrate the possibility of formulating a master stability function for a class of stochastic networks and we offer a toolbox of close-form results to study blinking networks and stochastic pinning control.

ON HYPERSTABLE INTERCONNECTIONS (FROM THE LEGACY OF V.M. POPOV)

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The role of the interconnections in analysis of complex systems is emphasized in the context of hyperstability theory (hyperstable interconnections) and dissipativeness theory (neutral interconnections). It is conjectured that neutral/hyperstable interconnections are preserving individual properties in various structures of oscillators connected through a graph – as considered within the synchronization theory.

THE EFFECT OF COHERENCE RESONANCE IN DIFFERENT TIME-DELAYED SYSTEMS

V.V. Semenov, A.V. Feoktistov, and **T.E. Vadivasova**

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The effect of coherence resonance is studied in different time-delayed systems. The possibility to control the coherence resonance by changing time-delayed feedback parameters is shown in numerical and full-scale (physical) experiments. The observed effects are exemplified for the excitable FitzHugh-Nagumo oscillator and the van der Pol oscillator with subcritical Andronov-Hopf bifurcation, which is not an excitable system. The behavior of these systems is analyzed in terms of stochastic bifurcations. The numerical and experimental results are in a good correspondence, and this gives evidence of their reliability.

THE AFRAIMOVICH-PESIN DIMENSION OF POINCARE RECURRENCES IN A CIRCLE MAP

N.I. Semenova, T.E. Vadivasova, and **V.S. Anishchenko**

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It is first established that the dependence of the minimal return time on the vicinity size is universal for the golden and silver sections in a circle map and can be referred to as "Fibonacci's stairs". The theoretical result for the Afraimovich-Pesin dimension equality $\alpha_C=1$ is confirmed for irrational rotation numbers with the measure of irrationality μ=2. It is shown that some transcendental numbers ($\omega=e$, $ln2$, π) are Diophantine and have the measure μ=2. It is also confirmed that the calibration function $1/t$ cannot be applied for Liouvillian numbers. All the obtained features hold for both the linear and nonlinear circle map.

DYNAMICS IN CLUSTERED NEURONAL CULTURES: A VERSATILE EXPERIMENTAL SYSTEM FOR COMPLEX NETWORKS

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We study spontaneous activity in networks formed by interconnected aggregates of neurons (‘clustered neuronal cultures’). We monitor spontaneous activity using high-resolution fluorescence imaging. Network’s dynamics is characterized by collective episodes of activity in which groups of clusters fire sequentially in a short time window. The functional connectivity of the network is drawn from the observed dynamics, picturing a circuitry that is both directed and weighted. These functional networks have distinct topological properties, in particular the existence of assortativity traits and a ‘rich-club’ core. Our work illustrates the attractiveness of a relatively simple experimental system to explore complexity in neuronal networks.

ABOUT LANDAU-HOPF SCENARIO IN ENSEMBLES OF REGULAR AND CHAOTIC OSCILLATORS

A.P. Kuznetsov, L.V. Turukina, and **I.R. Sataev**

Kotel’nikov Institute of Radio-Engineering and Electronics of RAS, Saratov Branch

As is known, the Landau-Hopf scenario implies that the oscillatory modes with incommensurable frequencies emerge subsequently, which leads to increasingly more complicated oscillatory regimes. In this case, we can speak about a cascade of quasi-periodic Hopf bifurcations [3] responsible for the soft birth of the tori of increasingly higher dimension. The possibility of such a scenario remains largely debated for several decades. In this paper we discuss the conditions and situations, in which such a scenario can actually occur.

SYNCHRONIZATION OF OSCILLATORS IN A KURAMOTO-TYPE MODEL WITH GENERIC COUPLING

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We study synchronization properties of coupled oscillators on networks that allow description in terms of global mean field coupling. These models generalize the standard Kuramoto-Sakaguchi model, allowing for different contributions of oscillators to the mean field and to different forces from the mean field on oscillators. We present the explicit solutions of self-consistency equations for the amplitude and frequency of the mean field in a parametric form, valid for noise-free and noise-driven oscillators. As an example we consider spatially spread oscillators, for which the coupling properties are determined by finite velocity of signal propagation.

DETERMINISTIC AND STOCHASTIC DYNAMICS IN MULTISTABLE NON-ADIABATIC GENETIC REPRESSILATOR

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The dynamics of the simplest ring genetic oscillator – Repressilator – is investigated by extensive bifurcation analysis and stochastic simulations of intrinsic noise. A full deterministic model demonstrates the emergence of an unusual genetic switch between a stable steady state and a limit cycle, if realistic in vivo values of parameters are taken into account. Stochastic simulations for small copy numbers of Repressilators in one plasmid confirm the existence of the switch and point out how to control the effects of intrinsic noise.

NEUROBIOLOGY OF ALTERNANS ARRHYTHMIA: A SIMULATION STUDY OF THE HEART OF ANIMAL MODELS

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Alternans is an arrhythmia exhibiting alternating amplitude/interval from beat to beat on heartbeat recordings, such as the finger pulse. Alternans is well known since Traube's document in 1872 and is called harbinger of death, but the mechanisms for its generation is not fully defined and much work still remains. We studied this abnormal state of the heart, in animal models (electrophysiology) and with a numerical model (computer simulation). We focused our attention on a causal association between the pace-making cells and ventricular cells. We revealed that one of the main causalities in generating alternates was a potassium ionic abnormality.

QUANTIFICATION OF STRESS BY DETRENDED FLUCTUATION ANALYSIS OF HEARTBEATS, BOTH IN THE LOBSTERS AND HUMANS

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The aim of this study is to develop a method to quantify stress. Electrocardiograms of both animal models and humans were analyzed by the Detrended Fluctuation Analysis (DFA) that calculates the scaling exponent (SI) from the beat-interval time series. I found that SI numerically distinguishes between normal hearts and abnormal hearts. SI ranges across various heart conditions: healthy basal condition and stressful condition. This study suggests that DFA is a practical method to make a gadget for health management.

CHIMERA-LIKE STATES IN AN ENSEMBLE OF GLOBALLY COUPLED OSCILLATORS

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We demonstrate the emergence of a complex state in a homogeneous ensemble of globally coupled identical oscillators, reminiscent of chimera states in nonlocally coupled oscillator lattices. In this regime some part of the ensemble forms a regularly evolving cluster, while all other units irregularly oscillate and remain asynchronous. We argue that the chimera emerges because of effective bistability, which dynamically appears in the originally monostable system due to internal delayed feedback in individual units. Additionally, we present two examples of chimeras in bistable systems with frequency-dependent phase shift in the global coupling.

SIMULTANEOUS ACTION OF AMPA AND NMDA SYNAPTIC CURRENTS ON THE MODEL OF DOPAMINERGIC NEURON

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Dopaminergic neurons are unique neurons due to the response differentiation to the action of the typical excitatory stimuli. It means that only NMDA synaptic current can significantly increase generation frequency (more than 5-fold in comparison with tonic activity frequency), whereas AMPA current usually suppresses neuron activity. Here we consider the simultaneous action of these synaptic currents. It is shown that in the case of stimuli steps, either frequency growth or activity suppression is demonstrated, depending on the strength of AMPA and NMDA receptors. The highest frequency is obtained for the case of simultaneous action of these synaptic currents.

AMPLITUDE CHIMERAS AND CHIMERA DEATH IN DYNAMICAL NETWORKS

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We find chimera states with respect to amplitude dynamics in a network of Stuart-Landau oscillators. They appear due to the interplay of nonlocal network topology and symmetry-breaking coupling. As the coupling range is increased, the oscillations die out, amplitude chimeras disappear and the network enters a symmetry breaking stationary state. This particular regime is a novel pattern which we call *chimera death.* It is characterized by the coexistence of spatially coherent and incoherent inhomogeneous steady states and therefore combines the features of chimera state and oscillation death. Additionally, we show two different transition scenarios from amplitude chimera to chimera death.

ABSTRACTS OF NWP-2: LASERS WITH HIGH PEAK AND HIGH AVERAGE POWER

GENERATION AND CHARACTERIZATION WITH FROG TECHNIQUE OF FEMTOSECOND OPTICAL PULSES TUNABLE IN THE RANGE OF 2 TO 3 MM FROM SILICA-BASED ALL-FIBER LASER SYSTEM

E.A. Anashkina, A.V. Andrianov, M.Yu. Koptev, S.V. Muravyev, and **A.V. Kim**

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Coherent optical sources in the mid-IR range are attractive for a variety of applications. Typically, mid-IR light is generated by using optical parametric oscillators, solid-state lasers based on Cr^{2+} and Fe^{2+} doped II-VI crystals or quantum cascade lasers. However, an all-fiber, mid-IR light source using nonlinear optical conversion in a fiber with special composition can provide significant advantages over existing laser sources. Passive GeO_2-doped core fibers attract researchers' attention for operation in the "molecular fingerprint" mid-IR (2-3 μm) spectral range. Here we report a simple technique of routine generation of femtosecond optical pulses tunable in the range of 2-3 μm in an all-fiber scheme starting from an Er-doped laser setup based on telecom components. We demonstrate Raman-shifted solitons with durations of the order of one hundred fs in a passive silica-based GeO_2-doped core fiber.

MULTIMILLIJOULE CHIRPED PULSE TAPERED FIBER AMPLIFIERS FOR COHERENTLY COMBINED LASER SYSTEMS

A.V. Andrianov[1,2], E.A. Anashkina[1,2], A.V. Kim[1,2], I.B. Meyerov[2], S.A. Lebedev[2], A.M. Sergeev[1,2], and **G. Mourou[3]**

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We numerically investigated amplification of high energy chirped pulses in Large Mode Area tapered fiber amplifiers and their coherent combining. We developed a three-dimensional model of strongly chirped nanosecond pulse amplification and compression back to femtosecond duration fully taking into account transverse and longitudinal variations of refractive index profile and distribution of active ions in the fiber, wavelength dependence of emission and absorption cross sections, gain saturation and Kerr nonlinearity. About 3 mJ of output energy can be extracted in 1 ns pulse from the tapered amplifier with single-mode beam quality. We also numerically investigated possibilities of compression and coherent combining of up to 36 perturbed amplifying channels.

UPGRADE OF ND:GLASS PUMP LASER FOR PETAWATT LEVEL PEARL FACILITY

K.F. Burdonov, A.P. Fokin, A.A. Shaykin, and **A.A. Soloviev**

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This paper presents experimental study of an extremely-short spatial filter for multistage nanosecond pump laser of OPCPA-based petawatt-class PEARL laser facility. The degradation of pump radiation parameters associated with the filter induced spherical aberrations was investigated. The experiments showed that the spherical lenses based spatial filter does not lead to pump beam quality degradation paving the way to increase the energy of Nd:glass pump laser.

WIDE-APERTURE ROD LASER AMPLIFIER ON NEODYMIUM GLASS

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We present the test of the unique big-aperture rod laser amplifier with 150 mm diameter made of neodymium glass. The main results are the distribution of low-signal gain with mean value of 2.3, calculations of stored energy and pulse distortion.

OPTIMIZATION OF TEMPORAL PARAMETERS OF PETAWATT FEMTOSECOND PULSES BY XPW AND SPM TECHNIQUES

V.N. Ginzburg, E.A. Khazanov, A.A. Kochetkov and **S.Yu. Mironov**

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The investigation of linear and nonlinear optical properties of industrially produced thin plastic plates demonstrates good perspectives for implementation of this material for PW power pulse shortening by SPM and compression on chirped mirrors. The calculations show that the XPW technique can also be used for this purpose.

LUCIA LOW TEMPERATURE AMPLIFIER HEAD PERFORMANCE

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Within the framework of LULI's Lucia DPSSL program, a low temperature amplifier head was developed to ramp up the energy to 30 J. This amplifier takes advantage of the benefits of the laser properties of Yb^{3+}: YAG at low temperature (around 100-200K) for efficiency and thermal management. We will detail the prototype with particular emphasis on the laser gain medium cooling approach and present the latest performances achieved.

THE PULSE CONTRAST OF THE MULTI-TW PHOSPHATE ND:GLASS LASER FACILTY

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We report on the results of the phosphate Nd:glass laser facility pulse contrast investigation. All types of radiation before the main pulse arrival, having various geneses and the degree of influence on the target surface, are thoroughly studied. The measurements were carried out in all time intervals of interest with necessary resolution and dynamic range. A set of ultrashort prepulses in the chirp duration time interval (~ 1 ns), originating from the optical elements with parallel surfaces in the optical system, have been detected.

STUDY OF XPW-FILTER FOR TEMPORAL CONTRAST IMPROVEMENT OF PEARL LASER

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We investigated the effect of generation of a cross-polarized wave (XPW) in relation to terawatt femtosecond laser pulses. On the basis of the written software code which simulates the process of XPW, a theoretical study in the temporal and spatial dimensions was performed. The generation efficiency in the laser system PEARL was estimated. It was shown experimentally that the efficiency of the XPW-process based on the front end of the complex can achieve 20%. We studied the modulation of the signal spectrum, the dependence of efficiency on the crystal's angle of rotation, and made more accurate estimates of the loss of efficiency in case of the off-axis crystal clipping. Also, different variants of schemes of installing the XPW-filter in the laser complex PEARL were developed.

PROGRESS ON THL-100 MULTI-TERAWATT LASER SYSTEM OF THE VISIBLE RANGE

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Up-grading of the THL-100 multi-terawatt hybrid laser system operating in the visible range [1, 2] will be discussed in this presentation. To date, an energy of 1 J and a peak power of 14 TW in a 50 fs pulse at 475 nm wavelength were realized in the THL-100. The laser system consists of two basic parts: Ti:sapphire front-end

"Start-480M" (Avesta-Project Ltd) and photochemical XeF(C-A) booster amplifier with a clear aperture of 24 cm (Fig. 1). Performances of both of them are now improved aimed at reaching 50 TW peak power in the hybrid system. Particularly, the front-end was supplemented by another Ti:sapphire multipass amplifier to increase seed pulse energy in the booster amplifier four times up to 15-20 mJ. According to numerical simulations, this energy should provide 2.5 J at the XeF(C-A) amplifier output, which corresponds to the peak power of 50 TW in a 50 fs pulse. Results of the front-end and XeF(C-A) amplifier up-grading will be discussed in detail.

CRYOGENIC DISK YB:YAG LASER: STATUS QUO AND PERSPECTIVES

I.B. Mukhin, E.A. Perevezentsev, O.L. Vadimova, I.I. Kuznetsov, and **O.V Palashov**

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A ytterbium doped, disk shaped "active mirror" is a most perspective design for high average and peak power lasers and advantages of disk lasers may be improved by cooling active elements to cryogenic temperatures. A high power cryogenic disk laser is currently under development at IAP RAS. Composite Yb:YAG/YAG disks with undoped cup are used to suppress amplified spontaneous emission and thermal distortions. The developed laser system emits more than 100 mJ of output energy in a 7 ns laser pulse at a repetition rate up to 1 kHz with ~1kW of pump power. The next amplification stage with 3 kW of pump is planned to increase the output energy to 1 Joule.

HIGH AVERAGE POWER LASER FROM YB:YAG THIN-DISK AMPLIFIERS AND ITS APPLICATIONS

Yo. Ochi, K. Nagashima, M. Maruyama, M. Tsubouchi, F. Yoshida, and **A. Sugiyama**

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We developed a high average power picosecond laser based on the chirped pulse amplification technology using Yb:YAG thin-disk amplifiers. The Yb:YAG thin-disk regenerative amplifier at room temperature provided 10 mJ pulses at the repetition rate of 1 kHz. The spectrum after the regenerative amplifier has Gaussian shape with FWHM width of 1.2 nm. The pulses were recompressed to be 1.3 ps. By employing this picosecond pulse as a pump source, a THz pulse at the center frequency of 0.3 THz with micro joule class energy has been obtained by the optical rectification in Mg-$LiNbO_3$ crystal.

J-KAREN LASER UPGRADE AND PERSPECTIVES

A.S. Pirozhkov, H. Kiriyama, M. Mori, M. Nishiuchi, Y. Fukuda, H. Kotaki, K. Ogura, A. Sagisaka, H. Sakaki, Y. Hayashi, A. Kon, M. Kanasaki, T.Zh. Esirkepov, J.K. Koga, S.V. Bulanov, P.R. Bolton, T. Kawachi, M. Kando, and **K. Kondo**

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J-KAREN is a state-of-the-art high-power laser with hybrid OPCPA/Ti:Sapphire, double CPA architecture. Due to high temporal and spatial beam quality, the on-target intensity exceeds 10^{21} W/cm^2 with an f/2 focusing. The temporal contrast is high enough for shooting 1 μm foils without plasma mirrors. These allowed us to demonstrate proton acceleration up to energies exceeding 40 MeV and Al ion acceleration up to 320 MeV (12 MeV/nucleon). We present the current laser performance, recent experimental achievements, and the upgrade plan to achieve the on-target peak power of 1 PW and repetition rate of 0.1 Hz.

HIGH ENERGY/INTENSITY LASERS FOR HED SCIENCE AT EUROPEAN XFEL

G. Priebe[1,2], M. Nakatsutsumi[1], I. Thorpe[1], B. Mueller[3], A. Pelka[1,4], K. Appel[1], Th. Tschentscher[1], and **Max Lederer[1]**

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Free-electron laser facilities provide new applications in the field of high-pressure research including planetary materials. The European X-ray Free Electron Laser (XFEL) in Hamburg will start user operation in 2017 and will provide photon energies of up to 25 keV. With a photon flux of about 10^{12} photons/pulse, with a pulse duration of 2-100 fs and a repetition rate of up to 4.5 MHz during 600 μs long bursts with a repetition rate of 10 Hz, rendering up to 27000 pulses per second, this facility will provide unique opportunities to study material under extreme conditions. The high-energy density science instrument (HED) is one of the six baseline instruments at the European XFEL. It enables the study of dense material at strong excitation and high pressures, studying structural and electronic properties of excited states with hard x-rays. Besides the use of the x-ray FEL beam as a possible pump and/or probe, it will be equipped with a high contrast PW-class ultra-high power, a temporal shaped ultra-high energy, KJ-class and amJ-class MHz repetition rate, matching the X-ray burst structure, laser facility. Probing of the laser-generated excited states will be performed with the x-ray free electron laser.

REGISTRATION OF SPATIO-TEMPORAL PROPERTIES OF ULTRASHORT LASER PULSES IN HIGH-POWER MULTICHANNEL FACILITIES

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In order to efficiently apply laser radiation of multichannel laser facilities in experiments concerning fast processes diagnostics in dense hot plasma, accurate information about spatio-temporal properties of laser pulses is required. One of the most promising solutions is using high-speed streak cameras. This paper deals with methods of laser beams alignment on the target, experimental results on measuring ultrashort laser pulses properties are discussed.

PETAWATT LASER SYSTEM FOR HIGH-SPEED PROCESSES DIAGNOSTICS IN DENSE HOT PLASMA

V.V. Romanov, S.A. Belkov, and **S.G. Garanin**

RFNC–VNIIEF, Sarov, Russia

The paper deals with the project concerning the development of a petawatt multi-channel laser system for high intensity physics processes research using laser plasma electromagnetic fluxes created by intensive ultrashort laser pulses with high temporal resolution.

THE VISUALIZER OF 2 μm LASER RADIATION BASED ON CaF_2:Ho

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A method for visualization of IR radiation in the two-micron range using CaF_2:Ho crystals is proposed. The energy efficiency of conversion of two-micron laser radiation to radiation in the red spectral range 620 – 690 nm by a CaF_2:Ho crystal is estimated. A study of upconversion processes in CaF_2:Ho crystals is presented.

AN OVERVIEW OF THE OPTICAL MATERIALS AND COMPONENTS FOR SG LASER FACILITIES

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Owing to the prospect to achieve human being's dream for clean, carbon-free energy, researchers around the world have made tremendous efforts toward achieving inertial confinement fusion (ICF) using laser [1-3]. Scientists in China have also been devoted to the development of laser driver for ICF since the late 1960s. During the past decades, numerous works have been dedicated to optimize the materials and fabrication process to enhance the performance of the optical components to meet the requirements of increasingly larger and more powerful laser systems. Significant progresses on the essential raw materials, such as hafnium and potassium dihydrogen phosphate, as well as the main optical materials, including the Nd-doped phosphate glass, KDP/DKDP crystal, K9 glass and fused silica, have been achieved. In general, a complete supporting system of optical materials and components has been developed in China to meet the demands of the SG laser facilities.

PULSE SPLITTING AS A WAY TO INCREASE EFFICIENCY, TO DECREASE SHAPE DISTORTION, AND TO PREVENT OPTICAL ELEMENTS BREAKDOWN IN HIGH ENERGY SOLID STATE LASERS

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A method for decreasing flattop pulse distortion in a high energy solid state laser in a high saturation regime is proposed. It's basic idea is pulse splitting and consistent amplification of all replicas in the same active elements. This method allows increasing the amplifiers efficiency and output energy. Another advantage of this method is prevention of optical elements breakdown is.

ADVANCES IN TITANIUM SAPPHIRE MULTI-PETAWATT LASERS

C. Simon-Boisson, F. Lureau, G. Matras, S. Laux, O. Casagrande, C. Radier, O. Chalus, and **L. Boudjemaa**

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We review the recent results achieved on Titanium Sapphire PetaWatt lasers. Key enabling technologies are presented. Perspectives towards higher peak power of 10 PW are discussed.

THERMALLY INDUCED DISTORTIONS OF RADIATION IN FARADAY ISOLATORS FOR MAGNETOOPTICAL ELEMENTS AND LASER BEAMS WITHOUT AXIAL SYMMETRY

A.V. Starobor and **O.V. Palashov**

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A model for numerical calculation of depolarization in complex configurations of a magnetooptical element (MOE) and a complex beam profile is created. The model is supported by experiments. It is shown that in the disk geometry of the MOE there is a strong dependence of thermally induced depolarization on beam diameter. It is demonstrated that the degree of isolation in a "multichannel" Faraday isolator (FI) may be increased by a factor of 6-8 as compared to the traditional FI.

PROBLEMS AND PERSPECTIVES OF CREATION OF HIGH INTENSITY FEMTOSECOND LASER SYSTEMS WITH COHERENT BEAM COMBINING

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The basic design principles of high intensity laser systems based on coherent combining of radiation of multichannel laser complexes are considered. The influence of the instability of parameters of individual components of radiation on coherent combining efficiency is analyzed, and requirements to their values for realization of high efficiency coherent combining are determined. Experimental results showing the fundamental possibility of coherent combining of parametrically amplified femtosecond pulses with energy up to 100 mJ and 20 fs pulse duration are presented and analyzed. The peculiarities of the coherent summation of radiation in multichannel scheme are discussed.

ADAPTIVE OPTICAL AND HOLOGRAPHIC CORRECTION IN LASER SYSTEMS: COMPARISON AND POSSIBLE COMBINING

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The review paper considers "traditional" adaptive optics and dynamic holography as two competitive alternative tools for laser beam control and at the same time reveals some fields of technology, where these two techniques can be combined.

THE INFLUENCE OF ELASTIC ANISOTROPY ON THERMALLY INDUCED BEAM DISTORTIONS IN CUBIC SINGLE CRYSTALS

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Thermally induced distortions of laser beam polarization and phase on passing active elements made of single crystals with cubic symmetry were calculated for a particular temperature distribution taking into account anisotropy of the elastic properties of the materials. The isotropic expressions for the induced birefringence were extended for the case of a thin disk and modified for the long rod geometry. The depolarization degree and the focal length of the thermal lens were found.

ROUTE AND RECENT PROGRESS ON HIGH CONTRAST ULTRAINTENSE FEMTOSECOND LASER

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The progress of chirped-pulse amplification CPA technology provides great opportunities for studying laser-matter interactions with on-target intensity exceeding 10^{22}W/cm^2. To date, several laser systems with peak power up to PW have been realized with different schemes, and the effort to deliver 200 PW peak power with Ti: sapphire laser system has been pursued through the Extreme Light Infrastructure (ELI) project. For laser-matter interaction experiments at such intense level, the contrast is required as high as 10^{-10} to prevent pre-plasma dynamics. In order to suppress the noise, several pulse-cleaning techniques have been developed. For example, in 1998 Itatani et al. increased the ASE contrast by two orders from 10^{-5} to 10^{-7} with saturable absorbers. In particular, contrasts as high as 10^{-10} to 10^{-11} have been achieved by using the cross-polarized wave (XPW) generation, nonlinear polarization rotation (NPR), double-CPA and OPCPA. Although those techniques are improved continuously, up to now they are mainly achieved at a limited power level.

MEASUREMENTS OF OPTICAL ANISOTROPY PARAMETERS OF BAF_2 AND SRF_2CRYSTALS

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The thermally induced depolarization caused by thermally induced birefringence can be characterized by the optical anisotropy parameter ξ. The optical anisotropy parameters ξ of BaF_2 and SrF_2 were measured for three probing wavelengths of 531 nm, 633 nm and 1076 nm. With the experimental accuracy these materials have the same value of optical anisotropy parameter ξ equal to -0.34±0.03 and didn't show a significant dependence on the used wavelength of the probing radiation.

ABSTRACTS OF NWP-3: NONLINEAR PHENOMENA IN GEOPHYSICS

LIGHTNING LEADER EVOLUTION – OBSERVATIONS AND SIMULATIONS

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This talk summarizes the authors' work on lightning leader formations in last decades. It includes two parts: (1) highly time-resolved observations of leader developments, and (2) simulations of leader evolutions. Part (1) includes: i) optical images of downward stepped leaders in natural lightning and bidirectional leaders in triggered lightning observed with ALPS, ii) spatial evolutions of leaders in triggered lightning observed with broadband VHF interferometer, and iii) charge evolutions of leaders based on simultaneous optical and electrical observations of leaders. Part (2) includes a 2D model for bi-directional leaders and a 3D self-organized model for downward stepped leaders.

THE INFLUENCE OF AIR HUMIDITY ON AUTO-OSCILLATIONS ON GROUND SURFACE

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We report results of experimental study of the action of acoustic radiation on ground for a small loudspeaker height. Apart from the nonlinear effects observed in experiment [1], active impact of air humidity on the ground was revealed. Air humidity influences the amplitude and spectra of auto-oscillations in systems with positive feedback.

ELECTROMAGNETIC RESPONSE OF THE INHOMOGENEOUS ANISOTROPIC ATMOSPHERE TO A SINGLE LIGHTNING DISCHARGE

S.S. Davydenko[1], **S.A. Savikhin**[2], **A.S. Sergeev**[1], and **S.A. Zolotov**[2]

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3D numerical model of the electromagnetic environment of an isolated lightning discharge in the plane atmosphere is developed. Spatiotemporal distribution of the discharge current depends on the flash type and generally consists of different components, such as the return stroke and continuous current. Disturbance of the electric conductivity inside the thundercloud and anisotropy of the upper atmosphere conductivity are taken into account. The model describes both the quasistatic electric field burst caused by the Maxwell's relaxation of the charge disturbance and electromagnetic pulse generated mainly by the return stroke. An application of the model to both direct and inverse problems of the atmospheric electrodynamics is discussed.

ON THE ELECTRICAL STRUCTURE OF THE ARTIFICIAL CHARGED AEROSOL CLOUD

S.S. Davydenko[1], **D.I. Iudin**[1,2], **V.Yu. Klimashov**[2], **A.Yu. Kostinskiy**[1,3], and **V.S. Syssoev**[1,4]

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Based on the assumption that the charge density can be represented as a superposition of the regular and irregular parts, a model of the electrical structure of the artificial charged aerosol cloud is developed. The regular part of the charge density is calculated in the stationary current approximation taking into account the source current structure and disturbance of the electric conductivity in the vicinity of the cloud. The irregular part describes random spatiotemporal fluctuations of the charge density. It is shown that the charge density fluctuations can lead to a significant local enhancement of the electric field and serve as one of the important mechanism of the spark initiation.

THE AXIALLY-SYMMETRIC PLASMA-CHEMICAL MODEL OF HALO

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We developed the plasma-chemical self-consistent model to describe the influence of halo on the chemical balance of the mesosphere and lower thermosphere as well as the optical emissions in different bands. An isolated cloud-to-ground discharge is considered as a source of the electromagnetic field at the heights of mesosphere.

GLOBAL EMPIRICAL RECONSTRUCTION OF COMPLEX SYSTEMS: GENERAL APPROACH & APPLICATION TO CLIMATE MODELING

A.M. Feigin[1,2], D.N. Mukhin[1], E.M. Loskutov[1], and **A.S. Gavrilov[1,2]**

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The report surveys the current state of the new empirical approach to reconstructing an unknown evolution operator of complex (high-dimensional, spatially distributed, with a broad spectrum of temporal scales) systems.

DECOMPOSITION OF COMPLEX SYSTEMS: NONLINEAR MODE EXTRACTION

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The method for constructing nonlinear basic dynamic modes by multivariate time series is presented. We apply the Bayesian approach for finding both time series of latent modes and the parameters of nonlinear transformation from modes space to observation data space. The simplest evolution law for each mode is included as prior information about the decomposition. The Bayesian evidence criterion is proposed to optimize the transformation structure parameters characterizing the degree of the parameterization nonlinearity. The method is tested on an example of a strongly nonlinear two-dimensional model and is applied to spatially distributed sea surface temperature time series over the Globe. It is shown that nonlinearity improves the data variance capturing by the modes.

PREDICTION OF LIGHTNING ACTIVITY BASED ON DIRECT ELECTRIC FIELD CALCULATIONS

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In this paper a new lightning prediction algorithm based on direct electric field calculations is presented. The model shows results that correlate with experimental data better than available indexes used for thunderstorms prediction.

CELLULAR AUTOMATON MODELLING OF INTRACLOUD LIGHTNING

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There is a controversy in the lightning community regarding the origin and the role of the lower positive charge region in the cloud. Whatever the source of the lower positive charge, it is generally thought that it serves to enhance the electric field at the bottom of the main negative charge region and thereby facilitate the launching of a negatively-charged leader toward ground. On the other hand, the presence of an excessive lower positive charge region may prevent the occurrence of negative cloud-to-ground discharges by “blocking” the progression of the descending negative leader from reaching ground. Based on the graph theory and percolation theory, we develop a fractal simulation code to take into account the detailed space and temporal dynamics of the cloud discharge, and the fine structure of the electric field and charge in a cloud. The results will be compared with observations to address some problems of lightning initiation physics. We quantitatively and qualitatively examine the dependence of lightning type statistics on the magnitude and lateral structure of the lower positive charge region.

NUMERICAL ANALYSIS AND ANALYTICAL RELATIONS FOR STATIONARY AND NON-STATIONARY MODELS OF THE GLOBAL ELECTRIC CURCUIT

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Different problem formulations concerning modeling the global atmospheric electric circuit within steady-state and non-stationary approaches are discussed. The question of whether the problem is well-posed for several possible approaches to establishing the boundary conditions which are natural from the physical perspective is studied. The problem formulations in which the ionospheric potential, i.e., the potential difference between the Earth's surface and the upper boundary of the atmosphere is not explicitly specified but is uniquely determined from the solution, is discussed in particular. Well-posed problem formulations for the electric potential in the case where the conductivity is anisotropic due to the substantial influence of the magnetic field at altitudes exceeding 70 km are also found. The problem formulation in which the boundary condition at the outer boundary requires that the values of the potential at magnetically conjugate points be equal is analyzed.

For all the discussed problems equivalent formulations are found in the form of integral identities, which serve as the foundation for the development of projection numerical algorithms (employing, e.g., the Ritz method or the Galerkin method). Discrete relationships within the framework of the finite-element approach are obtained and justified.

A number of analytical relationships are discussed which make it possible to determine the ionospheric potential from the given spatial distributions of the conductivity and the external current density, the latter describing generators of the global electric circuit.

DATA-DRIVEN CLIMATE MODELING AND PREDICTION

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Comprehensive dynamical climate models aim to simulate past, present and future climate; more recently, they also attempt to predict climate on longer and longer time scales. These models, commonly known as general circulation models or global climate models (GCMs), represent a broad range of time and space scales and use a state vector that has many millions of degrees of freedom. Considerable work, both theoretical and data-based, has shown that much of the observed climate variability can be represented with a substantially smaller number of degrees of freedom. While detailed weather prediction out to a few days requires high numerical resolution, it is fairly clear that a major fraction of climate variance can be predicted in a much lower-dimensional phase space. Low-dimensional models (LDMs) can simulate and predict this fraction of variability, provided they are able to account for (i) linear and nonlinear interactions between the resolved high-variance climate components; and (ii) the interactions between the small number resolved components and the daunting number of unresolved ones. LDMs hold great promise to provide predictive understanding of natural hazards from the consequences of global warming and climate change.

RECONSTRUCTING SPATIOTEMPORAL CHARACTERISTICS OF SEA-LEVEL PRESSURE VARIABILITY USING A FEATURE TRACKING APPROACH

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This paper is aimed at quantifying the contribution of synoptic transients to the full spectrum of space–time variability of sea-level pressure (SLP) in middle latitudes. In the authors' previous work it was shown that tracking cyclones and anticyclones in an idealized atmospheric model allow reconstructing a surprisingly large fraction of the model's variability, including not only synoptic, but also its large-scale low-frequency component. Motivated by this result, the authors performed tracking of cyclones and anticyclones and estimated cyclone/anticyclone size and geometry characteristics in the observed SLP field using 1948–2008 NCEP/NCAR reanalysis data set. The reconstructed synoptic field was then produced via superimposing radially symmetrized eddies moving along their actual observed trajectories. It was found that, similarly to earlier results for an idealized model, the synoptic reconstruction so obtained accounts for a major fraction of the full observed SLP variability across a wide range of time scales, from synoptic to those associated with the low-frequency variability (LFV). The synoptic reconstruction technique developed in this study helped elucidate connections between the synoptic eddies and LFV defined via more traditional spatiotemporal filtering. In particular, we found that the zonal-index (ZI) variability is synonymous to random ultra-low-frequency redistributions of cyclone/anticyclone trajectories and, hence, is inseparable of that in the storm-track statistics.

NEW RESULTS OF TALL-OBJECT LIGHTNING OBSERVATION IN GUANGZHOU

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Some new results of analysis of tall-object lightning flashes obtained at the Tall-Object Lightning Observatory in Guangzhou during 2009-2012 are summarized. The three-dimensional and two-dimensional propagation characteristics of the downward leader, the upward connecting leader, and the unconnected upward leader are given. The non-"Tip-to-Tip" connection phenomenon in the attachment process is presented and the diversity of the connecting behavior of the downward and upward leaders during the attachment process is discussed.

CLIMATE RESPONSE AND CLIMATE PREDICTION

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The sensitivity of the climate system to increasing CO_2 concentration and the response at decadal time scales are still major factors of uncertainty for the assessment of the long and short term effects of anthropogenic climate change. Here we demonstrate that it is possible to use Ruelle's response theory to predict the impact of an arbitrary CO_2 forcing scenario on the global surface temperature of a general circulation model. Response theory puts the concept of climate sensitivity on firm theoretical grounds, and addresses rigorously the problem of predictability at different time scales. Conceptually, our results show that climate change assessment is a well-defined problem from a physical and mathematical point of view. Practically, our results show that considering one single CO_2 forcing scenario is enough to construct operators able to predict the response of climatic observables to any other CO_2 forcing scenario, without the need to perform additional numerical simulations, thus paving the way for redesigning climate change experiments from a radically new perspective.

VARIETY OF ELECTRICAL DISCHARGES IN ELECTRIFIED CLOUDS

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Physical processes leading to lightning initiation, including formation and propagation for a leader discharge, remain poorly understood in spite ofa long history of their studies [1, 2]. Recent experiments, using modern observation means such as high-speed video cameras, triggering lightning, Lightning-Mapping-Array technique, provided new information on the variety of cloud discharge forms and their dynamics under different physical and meteorological conditions (i.e., [3-5]). There is evident progress in the study of laboratory lightning analogues - long spark and artificial cloud discharges.

FIELD MEASUREMENTS OF WIND-WAVE INTERACTION IN THE ATMOSPHERIC BOUNDARY LAYER OVER A RESERVOIR

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Information about wave roughness for inland and coastal zone is important from a practical point of view (in terms of safety of navigation, especially on the riverside, as well as the problem of erosion of shores). Also, the waves significantly affect the parameters of wind and transfer processes in the atmospheric boundary layer, and hence the evaporation and temperature regime that are the main factors in the water balance of internal reservoirs, lakes and rivers. At the present the majority of the models for wind wave evolution describe ocean and sea conditions. At the same time, the wave roughness in small reservoirs has its own features (very steep, the influence of the banks and shallows, small fetches, etc.) that must be taken into account when developing models. For this, it is necessary to obtain experimental data on the wind-wave regime of the reservoir. We report results of field experiments on wind-wave coupling carried out at the Gorky Reservoir.

OFFSHORE OBSERVATION OF EARTHQUAKES AND RELATED TSUNAMIS

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Offshore observations make it possible to detect tsunamis in advance prior to their arrivals at the shoreline. For this purpose, ocean bottom pressure gauges are traditionally used. However, in near- and intermediate fields, ocean bottom pressure records usually exhibit a complicated interference of signals related not only to gravitational, but also to hydroacoustic and seismic waves. Network of offshore observatories recently developed and deployed in Japan provide high sampling records of ocean bottom pressure and seismic (acceleration and velocity) signals. In the present study, by taking advantage of simultaneous measurements of pressure and seismic signals that were recorded during some recent tsunamigenic earthquakes, we reveal particular features of these signals and develop a practical method for selecting a tsunami signal from ocean bottom pressure records.

SEMIDIURNAL INTERNAL WAVE GLOBAL FIELD

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Estimates were made for semidiurnal internal wave generation over submarine ridges based on the models of wave generation. The fluxes of internal wave energy from submarine ridges greatly exceed the fluxes from the continental slopes because the dominating part of the tidal flow is directed parallel to the coastline. They account for about one-fourth of the total energy loss from the barotropic tides. Submarine ridges if normal to the tidal flow form an obstacle that can cause generation of large internal waves. Energy fluxes from most submarine ridges were estimated. The decay of internal tide during propagation was estimated from the measurements on buoys in the ocean and from numerical models. Combined calculations and measurements result in a map of the global internal wave amplitude distribution. Extreme amplitudes were found near the Mascarene Ridge in the Indian Ocean, Mid-Atlantic Ridge in the Southern Atlantic, Great Meteor Bank, and Strait of Gibraltar.

LIGHTNING LOCATING SYSTEMS: OVERVIEW OF CHARACTERISTICS AND VALIDATION TECHNIQUES

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Lightning locating systems, often referred to as lightning detection networks, are the most common way to geolocate lightning. Such systems also report a variety of characteristics associated with lightning events (cloud-to-ground return strokes, M-components, ICC pulses, and cloud lightning pulses). We summarize the various methods to geolocate lightning, both ground-based and satellite-based, and discuss the characteristics of lightning data available from various sources. The performance characteristics of lightning locating systems are determined by their ability to accurately geolocate lightning events and report various features such as lightning type and intensity. Methods used to validate the performance characteristics of lightning locating systems are discussed.

TWO LIGHTNING PROCESSES PRODUCING RELATIVELY SHORT DURATION BIPOLAR ELECTROMAGNETIC RADIATION SIGNATURES

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The preliminary breakdown and the compact intracloud discharge are lightning processes that produce characteristic microsecond-scale bipolar radiation field signatures. Such characteristic electromagnetic signatures in conjunction with engineering-type models allow us to study these processes and make inferences about various parameters of these lightning discharges.

RETRIEVAL OF IMPORTANT GAS CONCENTRATIONS FROM TIME SERIES OF OZONE MEASUREMENTS AT ALTITUDES OF 50 KM TO 75 KM

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One of the main directions in the Earth's atmosphere physics is the study of spatial distribution and dynamics of minor gas constituents. One of the problems arising in this connection is how to obtain information about the parameters of a certain atmospheric system, which are difficult to measure directly. The aim of this work is to retrieve the value of the control parameter of mesospheric photochemical system (MPCS), the water vapor concentration, from time series of ozone concentration measurements at altitudes of 50 – 75 km.

PRIMARY AND SECONDARY EFFECTS THAT LEAD TO TSUNAMI GENERATION DURING AN EARTHQUAKE

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Strong ocean-bottom earthquakes are the most widespread cause of devastating tsunami waves. In this talk, we shall first discuss the main, and nowadays widely accepted, mechanism of tsunami generation that is associated with the instant displacement of water by co-seismic (residual) ocean-bottom deformation. Second, on the base of offshore registration of earthquakes and related tsunamis by ocean bottom stations (JAMSTEC) both in the tsunami source and at intermediate source distance (400-800 km), the role of water compressibility and non-linearity will be examined.

OPTIMIZATION TECHNIQUE FOR RETRIEVING VERTICAL DISTRIBUTIONS OF ATMOSPHERIC OZONE FROM RADIOMETRY DATA

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An optimization technique for retrieving vertical distributions (profiles) of atmospheric ozone from radiometry data is proposed. The technique is based on the statistical (Bayesian) approach to solution of inverse problems. It is assumed that initial data contains measurement noise, and *a priori* information about properties of the profile is used. It is proposed to approximate the sought profile by a linear combination of empirical orthogonal functions (EOF) calculated from statistics of the previous measurements. This approximation allows optimal inclusion of *a priori* information into retrieval procedure. Efficiency of the proposed technique is demonstrated on the modeled data.

RECENT RESEARCH AT THE LIGHTNING OBSERVATORY IN GAINESVILLE, FLORIDA: A REVIEW AND UPDATE

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A review of several recent studies conducted at the Lightning Observatory in Gainesville (LOG), Florida, is given, including (a) X-rays produced by first and subsequent strokes in natural lightning, (b) lightning interaction with the ionosphere, and (c) lightning properties inferred from high-speed video camera observations.

EVOLUTION OF THE CONVECTIVE STRUCTURES IN A WATER LAYER WITH AN INTERNAL DRIFT FLOW AND INSOLUBLE SURFACTANT ON THE FREE SURFACE

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The convective structures arising in a thin horizontal water layer cooled from above are studied numerically. The layer contains a shear flow produced by tangential stresses on the top and an insoluble absorption-type surfactant film on the free surface. Evolution of patterns of the surface temperature is studied with increasing film elasticity, Reynolds number, and layer depth. The consideration is aimed at modeling the small-scale subsurface convective structures arising in open water basins in the presence of wind.

A NETWORK OF NETWORKS APPROACH TO INVESTIGATE THE INFLUENCE OF SEA SURFACE TEMPERATURE VARIABILITY ON MONSOON SYSTEMS

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In this study we analyze large-scale inter-dependences between Sea Surface Temperature (SST) and rainfall variability using climate networks. On account of this analysis, we coarse-grain gridded SST and rainfall datasets by merging grid points that are dynamically similar to each other. We consider the SST and rainfall systems as two distinct climate networks and use established cross-network measures to understand their interrelations. As a first step, the spatial distributions of these cross-network measures illustrate regions which are of particular importance in the interaction between SST and rainfall. Secondly, we go into further detail by investigating the cross-network topology explicitly for these regions. Here, strong influences from regions in the SST system in relation to other regions in the rainfall system are detected. These influences structured in a spatially embedded directed network describe important mechanisms behind monsoon systems. For example, behind the Indian Summer Monsoon, which is known to be controlled by SST variability over the adjacent Indian Ocean.

LABORATORY MODELING OF THE WIND-WAVE INTERACTION BY MODIFIED PIV TECHNIQUE

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Wind-wave interaction processes (momentum, heat and moisture transfer) under severe conditions in the air-sea boundary layers are of special interest first of all in the case of studying the hurricane dynamics. Parameterization of these processes used in forecasts models are based on the experimental data, but at present there is not enough information (experimental data) about them. The problems of carrying out measurements in the real ocean could be eliminated to some extent in laboratory conditions. Recently non-contact methods of the airflow above surface waves based on modern visualisation, particularly PIV methods were developed. Some measurements of the wind velocity field above surface waves were carried out in. However, in those works only low wind speed conditions were investigated and the standard PIV method gives velocity fields with the time period that is insufficient to characterize a turbulent air flow.

NONLINEAR DYNAMICS OF BAROTROPICALLY UNSTABLE ROSSBY WAVE PACKETS AND FORMATION OF ZONALLY MODULATED VORTEX STREETS IN WEAKLY SUPERCRITICAL ZONAL FLOWS

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This study explores the supercritical dynamics of Rossby wave packets comprised of weakly unstable barotropic and baroclinic normal modes feeding on the common critical layer (CL) of a horizontally sheared barotropically unstable zonal flow in the presence of vertical stratification. Self-consistent equations governing the evolution of the wave packets envelopes and CL vorticity distribution are derived with the aid of an asymptotic procedure. Nonlinear generation mechanisms of slowly modulated wave-trains and CL potential vorticity patterns are examined for the regimes of weakly nonlinear and strongly nonlinear dissipative CL.

INFERRING DIRECTIONAL COUPLINGS FROM TIME SERIES: AVOIDING SPURIOUS DETECTION, ESTIMATION OF LONG-TERM EFFECTS, AND APPLICATION TO CLIMATIC DATA

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Detection and characterization of directional couplings between complex systems from time series are considered. Several factors leading to spurious detections are highlighted, including low temporal resolution and unobserved state variables. It prompts special tests for coupling bidirectionality based on empirical modelling. In addition to short-term Granger causality characteristics, it is suggested to assess long-term effects of couplings based on fitting an empirical model and considering its behavior under special parameter variations. With all those approaches, time-varying mutual effects of Atlantic Multidecadal Oscillation and El-Nino/Southern Oscillation over the last 150 years are revealed.

INVESTIGATION OF THE COMPOUND SOLITON OF GARDNER'S EQUATION IN THE OCEANIC SHELF

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Study of soliton propagation in media with variable parameters is an interesting problem in the general theory of nonlinear waves as well as in terms of practical applications. For example, internal waves in a shelf region of the oceans and seas are known to undergo nonlinear distortions and to generate nonlinear waves – solitons. Quasistationarity of the wave process permits reducing description of the transformation of the solitary wave field to a much simpler problem, namely, to description of the dynamics of a finite number of independent parameters of the soliton. However, when the soliton duration λ_s becomes comparable with or exceeds the scale of variation of medium parameters Λ, the scenarios of solitary wave evolution become more diverse. In this case, standard approximate methods do not work and individual approaches are required that would take into consideration both specific features of soliton structure and of the character of medium parameter variation.

RISK AND PREDICTABILITY OF EURASIAN CLIMATE ANOMALIES ASSOCIATED WITH CLIMATIC QUASI-CYCLES LIKE ENSO

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Probability of climate anomalies (including anomalies of surface air temperature, precipitation and drought conditions) in Eurasian regions are analyzed with an assessment of El Niño/La Niña effects.

ABSTRACTS OF THE WORKSHOP
"ULTRA-HIGH FIELDS IN PLASMAS: NEW MODELS, HIGH PERFORMANCE SIMULATIONS AND EXPERIMENTS"

METHOD FOR THE PHASE CORRECTION OF INTENSE ULTRASHORT LASER PULSES AT RAMAN BACKSCATTERING IN A PLASMA

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One of the most promising methods for obtaining ultraintense ultrashort laser pulses is currently based on the use of Raman backscattering in a plasma. It can provide an output power higher by a factor of 10^4–10^5 than that with the usual technique for amplifying frequency modulated pulses in the plasma [1]. The compression regime based on Raman backscattering in the plasma was experimentally implemented [2, 3]. In particular, the implementation of a nonlinear regime with depletion of the pump pulse was demonstrated. However, the nonlinear regime achieved in experiments was not transferred to the stage of a significant amplification of an output pulse. The reason was various parasitic effects responsible either for the enhancement of noise (thermal fluctuations of the plasma and the prepulse of the amplified pulse) or for the violation of the conditions of three- wave matching for Raman backscattering because of the inhomogeneity of the plasma density. Here, another method of the use of Raman backscattering in the plasma is proposed to obtain intense ultrashort laser pulses with a given phase front. In this case, requirements to the parameters of the plasma and to the duration of its existence in this regime are softer than those in the usual scheme of Raman compression. The method is based on the fact that phase perturbations of the pump pulse that are smooth in the longitudinal direction are concentrated in the weakest wave (plasma wave). As a result, the amplified pulse will have a weakly perturbed initial phase front and, correspondingly, good focusability.

NEAR-THRESHOLD QED CASCADE IN THE STRONG LASER FIELD

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We investigated the cascade development in laser field near its threshold for different field configurations. It was demonstrated that the threshold with respect to the total pulse power may be reduced using multiple pulse configurations. It was shown by numerical simulation that for eight pulses with a specific combination of polarizations the total power may be reduced to 8.9 PW, which is available with the modern technologies.

GENERATION OF GEV PHOTONS IN ART REGIME IN THE ULTRA-INTENSE E-DIPOLE LASER FIELDS

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In the present paper the results of theoretical investigation of the ART phenomenon in the presence of the electron-positron pair production process is discussed. Based on the PIC code simulations performed for the parameters of the upcoming large-scale facilities we propose a concept of an ultra-bright, well-collimated source of photons with energies up to several GeV.

ANALYTICAL MODEL FOR ELECTRON SIDE INJECTION INTO LINEAR PLASMA WAVES

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An analytical piecewise homogeneous model for electron side injection into linear plasma waves is developed. Betatron oscillation dynamics is studied. Longitudinal motion and electron trapping region are described. The results of the analytical model are verified by numerical calculations. The results predicted by piecewise homogeneous model are also compared to the results calculated using a more realistic inhomogeneous model.

ANOMALOUS RADIATIVE TRAPPING IN LASER FIELDS OF EXTREME INTENSITY

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We report the existence of a new regime of particle dynamics in ultra-intense light. We demonstrate that radiation losses of electrons moving in a strong enough electromagnetic standing wave, surprisingly, cause their localization in the vicinity of the electric field spatial maximum. This unusual behaviour, which we call "anomalous radiative trapping" (ART), can be achieved at the upcoming laser facilities via the many-sided focusing that reproduces reversed emission of a dipole antenna (*e*-dipole pulse). For this geometry, we demonstrate that ART can be used for particle control for studying fundamental physics, and for the generation of multi-GeV, directed, gamma rays and collimated, energetic particle beams.

HIGH-VELOCITY MAGNETIZED PLASMA COLLISIONLESS INTERACTIONS USING HIGH-INTENSITY LASERS

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The interaction of magnetized (20 T), counter-streaming high-velocity (~0.1c) hydrogen plasmas accelerated using high-intensity ($8x10^{19}$ W/cm^2) lasers is shown experimentally to create a strong increase in density at the interaction point. This feature is thought to be due to the pile-up of magnetic field leading to magnetic fields up to (500 T), causing the subsequent reflection of electron at the interaction region.

SIMULATION OF LASER ION ACCELERATION IN TARGETS WITH SUB-WAVELENGTH SURFACE GRATING

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A method to enhance the efficiency of rare side ion acceleration by laser heated electrons is investigated numerically. The method is based on the idea to improve laser-target coupling by placing sub-wavelength grating on the irradiated surface. The optimal parameters of the grating are found and theoretically justified. It is shown that the optimal parameters for maximal total energy deposited to ions differ from those for maximal energy of the most energetic ion and both are far from the optimum of the laser energy absorption.

GAMMA-RAY EMISSION EFFECT ON LASER-SOLID INTERACTION IN ULTRAHIGH INTENSITY REGIME

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The ion acceleration in laser-produced overdense plasmas is a key topic of many recent investigations thanks to its potential applications. Besides, at forthcoming laser intensities ($I > 10^{23}$ W·cm^{-2}) the interaction of laser pulses with plasmas can be accompanied by copious gamma-ray emission. Here we demonstrate the mutual influence of gamma-ray emission and ion acceleration during relativistic holeboring in overdense plasmas with ultraintense laser pulses. If gamma-rays emission is abundant, the hole-boring velocity is lower, the whereas gamma-ray radiation pattern is narrower than in the case of low emission. Conservation of energy and momentum allows one to elucidate the effects of gamma-ray emission.

NUMERICAL SIMULATION OF ELECTRONS ACCELERATION IN LONG-SCALE-LENGTH UNDERDENSE PLASMA

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In this work we report results of numerical simulations of relativistic laser interaction with long undercritical preplasma layer and discuss a complex mechanism of electron acceleration. Recently abnormally high energy electron bunches were observed when an additional controlled nanosecond prepulse created long preplasma from a solid target. Classical mechanisms such as ponderomotive acceleration, laser wake field acceleration (LWFA) and so on do not explain such results.

EFFECT OF THE RADIATION REACTION FORCE ON THE ELECTRONIC PARAMETRIC INSTABILITIES OF A STRONG LASER PULSE IN A PLASMA

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Influence of the radiation reaction force on the electronic parametric instabilities, in particular, stimulated Raman scattering of an ultra-intense laser pulse in plasmas is studied. Inclusion of the Landau-Lifshitz radiation reaction force in the plasma electron dynamics enhances the growth of the forward Raman scattering by causing a phase shift in nonlinear current densities that drive the two Raman sidebands (anti-Stokes and Stokes waves) and manifesting itself into the nonlinear mixing of two sidebands.

INTERACTION OF THE RELATIVISTIC LASER PULSE WITH THE MELTED GALLIUM SURFACE

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Femtosecond laser plasma is a well-known effective source of high-energy particles and ultrashort hard x-ray radiation in the wide energy range. Such x-ray and gamma sources could have a large number of applications, for example in x-ray spectroscopy with high temporal resolution or some medical and biological research. Thus the increase of hard x-ray radiation yield from laser plasma is very interesting and important experimental problem. In our experiments we use liquid targets, namely the melted gallium targets. The impact of laser pulse with a short weak pre-pulse which is ahead of the main pulse for a few nanoseconds onto the surface of the melted gallium target could significantly increase the hard x-rays yield from laser plasma. This effect is associated with formation of dense micro-jets of matter above the target surface after the action of the pre-pulse. We studied micro-jets formation at various energies of the pre-pulse and various times after its action using optical pump-probe shadowgraphy. We were able to bind the micro-jets formation with features of the energy fluence in the focal spot of laser beam and make some assumptions about optimal parameters of the pre-pulse for the experiments on hard x-rays generation. Then we perform some experiments on x-ray spectroscopy of laser plasma source. Twofold increase of gamma radiation was observed when the energy of the pre-pulse (0.2 mJ) and delay time (11 ns) of the main pulse were close to their optimal values and intensity of the main pulse was about 2*10^18 W/cm^2. The maximal energy of gamma photons in this case increased from 200 keV without pre-pulse to 1125 keV with pre-pulse.

THEORY AND SIMULATIONS OF LASER-PLASMA GENERATION OF FREQUENCY-TUNABLE MID-INFRARED PULSES

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We examine a new method for generation of coherent few-cycle mid-infrared pulses. The method utilizes gas ionization by ultrashort incommensurate two-color laser pulses. These incommensurate two-color pulses contain the fields at two different frequencies. One of the frequencies is detuned from the doubled value of the other one. Such incommensurate pulses can be obtained with the use of the nonlinear crystal (for example, BBO or KDP) or with the use of the optical parametric amplifier. In the latter case, the main (in the respect of intensity) field component has greater central frequency than the weaker field; and the frequency of the weaker field can be reasonably easily tuned around the halved value of central frequency of the main field which stays fixed.

NON-FILAMENTED ULTRA-INTENSE AND ULTRA-SHORT PULSES IN RAMAN SEED AMPLIFICATION

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Ultra-intense and ultra-short laser pulses may be generated up to the exawatt-zetawatt regime due to parametric processes in plasmas. The minimization of unwanted plasma processes leads to operational limits. We discuss these limits with respect to filamentation. It is shown that the limit for transverse filamentation, which originally was derived for plane waves, is actually less stringent for seed pulse propagation. Because of fast motion the leading pulse front can stay filamentation-free, whereas the rear parts show transverse modulations. Results from three-dimensional (3D) three-wave-interaction models are compared with one-dimensional PIC and Vlasov simulations. Although wave-breaking occurs, the kinetic simulations show that the leading pumped pulse develops a form similar to that obtained from the three-wave-interaction model.

NONLINEAR QED-EFFECTS IN STRONG LASER FIELDS

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We have investigated various quantum electrodynamical (QED) processes inside strong laser fields. Among them are nonlinear (double) Compton scattering, (quantum) radiation reaction, the influence of radiative corrections (Lamb shift analog for free electrons) and vacuum polarization effects (photon propagation inside a strong plane-wave background field). The talk will give an overview about the resent results of our group.

HIGH-ORDER HARMONICS FROM SINGULARITIES OF RELATIVISTIC PLASMA

A.S. Pirozhkov[1], M. Kando[1], T.Zh. Esirkepov[1], T.A. Pikuz[1,2], A.Ya. Faenov[1,2,3], K. Ogura[1], Y. Hayashi[1], H. Kotaki[1], E.N. Ragozin[4], D. Neely[5], H. Kiriyama[1], J.K. Koga[1], Y. Fukuda[1], M. Nishikino[1], T. Imazono[1], N. Hasegawa[1], T. Kawachi[1], H. Daido[6], Y. Kato[7], P.R. Bolton[1], S.V. Bulanov[1], and **K. Kondo[1]**

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We have discovered a new regime of high-order harmonic generation in gas jet targets driven by multi-TW femtosecond lasers [A.S. Pirozhkov et al., *Phys. Rev. Lett.*, 2012, **108**, 135004-5]. In this presentation, we discuss the results of recent experiments demonstrating bright off-axis (~13°) XUV harmonic emission. High-resolution harmonic source imaging reveals that the radiation is emitted by tiny sub-μm sources, in accordance with the model prediction.

QUANTUM-MECHANICAL DESCRIPTION OF GAS IONIZATION AND RESIDUAL-CURRENT EXCITATION BY TWO-COLOR LASER PULSES

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On the basis of analytical solution of the time-dependent Schrödinger equation the phenomenon of excitation of residual current density in plasma produced by the laser pulse is studied. It is assumed that the laser pulse contains along with a strong field at the fundamental frequency an additional field at the doubled frequency. We find analytical dependences of the residual current density on the laser pulse parameters in the ranges of parameters corresponding to the tunneling and multiphoton regimes of ionization.

PRE-PULSE CONTROL OF FAST ELECTRONS PRODUCTION FROM SOLIDS AT RELATIVISTIC INTENSITIES

A. Savel'ev[1], K. Ivanov[1], S. Shulyapov[1], A. Lar'kin[1], I. Tsymbalov[1], D. Uruypina[1], R. Volkov[1], A. Brantov[2], P. Ksenofontov[2], V. Bychenkov[2], J. Breil[3], B. Chimier[3], and **V.T. Tikhonchuk[3]**

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We present experimental and theoretical data on the interaction of relativistic femtosecond pulses with pre-pulse created dense plasma. We show that the energy of fast electrons as well as conversion to gamma rays can be controlled efficiently by the proper choice of pre-pulse parameters. Experiments were made using the ILC MSU TW laser (45 fs, 10 Hz, up to 10^{19} W/cm^2). The 3D PIC code Mandor and the hydrodynamic code CHIC were used for numerical simulations. The interaction with a melted gallium target is considered in the second part of the paper. Here we also achieved huge increase in the gamma yield and electron energy but applying short a very intense femtosecond pre-pulse (advancing the main pulse by ~10 ns and having intensity of ~10^{16} W/cm^2).

ANALYTICAL MODEL FOR GAMMA-RAY GENERATION IN LASER-IRRADIATED PLASMA

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Based on PIC-simulation results, we propose a model for gamma-ray emission from a plasma layer irradiated by an ultra-short high-intensity laser pulse. The radiation characteristics obtained from the model are in a good agreement with 3D PIC simulations for a range of parameters.

ION ACCELERATION FROM RELATIVISTIC LASRE PLASMA

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New perspectives have been opened up in the field of laser–matter interactions due to recent advances in laser technology, leading to laser systems of high contrast and extreme intensity values, where the frontier of maximum intensity is pushed now to about 10^{22} W/cm^2. Many striking phenomena such as laser-acceleration of electrons up to the GeV level, fast moving ions with kinetic energies of several 10s of MeV, as well as nuclear physics experiments have already actuated a broad variety of theoretical as well as experimental studies. Also highly relativistic effects like laser induced electron-positron pair production are under discussion. All these activities have considerably stimulated the progress in understanding the underlying physical processes and possible applications. This article reviews recent advances in the experimental techniques as well as the associated plasma dynamics studies at relativistic intensities.

NONLINEAR THOMSON SCATTERING OF A TIGHTLY FOCUSED LINEARLY POLARIZED ULTRASHORT LASER PULSE

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Current femtosecond pulse petawatt (PW) technologies enable reaching a very high concentration of laser energy in a tight focal spot with focal intensity up to 10^{22} W/cm^2. Laser-plasma interaction with ultra-short powerful laser pulses is a unique source of high energy electrons, ions and secondary radiation, including ultrashort X-ray and gamma pulses [1, 2]. In comparison with high-order harmonic generation in gas jets, where the flux and photon energy of X-rays are limited [3], a superintense laser pulse – plasma interaction is free of such limitation since a very strong EM field is applied to electrons in a plasma. Bright attosecond X-rays can be generated in relativistic laser-overdense plasma interactions [4], or through an inverse Compton backscattering source driven by ultrarelativistic electron beam and nonlinear Thomson scattering of laser pulse by free electrons from laser focus [5]. Such X-ray pulses have many applications in atomic and molecular physics, chemistry, and also in life science [1-3].

ELECTRON TRAPPING IN LASER FIELD DUE TO RADIATION REACTION

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A radiation trapping effect of electrons (RTE) [1] is revealed in the near-QED regime of laser-plasma interaction. Electrons quivering in laser pulse experience radiation reaction (RR) recoil force by radiating photons. When the laser field reaches the threshold, the RR force becomes significant enough to compensate for the expelling laser ponderomotive force. Then, electrons are trapped inside the laser pulse instead of being scattered off transversely and form a dense plasma bunch. The mechanism is demonstrated both by full three-dimensional (3D) particle-in-cell (PIC) simulations using QED photonic approach and numerical test-particle modeling based on the classical Landau-Lifshitz formula of RR force. Furthermore, the proposed analysis shows that the threshold of laser field amplitude for RTE is approximately the cubic root of laser wavelength over classical electron radius. Due to the pinching effect of the trapped electron bunch, the required laser intensity for RTE can be further reduced.

ELECTRON ACCELERATION IN LASER-PLASMA BUBBLES

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Electron acceleration in the laser-plasma bubble proved to be the most successful regime of laser wake field acceleration in the last decade. The laser technology became mature enough to generate short and relativistically intense pulses required to reach the bubble regime naturally delivering quasi-monoenergetic bunches of relativistic electrons. The upcoming laser technology projects are promising short pulses with many times more energy than the existing ones. The natural question is how the bubble regime will scale with the available laser energy. We present here a parametric study of laser-plasma acceleration in the bubble regime using full three dimensional particle-in-cell simulations and compare numerical results with the analytical scalings from the relativistic laser-plasma similarity theory.

ADAPTIVE OPTICS AND POWERFUL LASERS

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The lecture is devoted to the methods for correction of powerful laser beams by means of the adaptive optics. Adaptive optics is generally related to the controllable action of an optical system on the radiation field accommodating it to the required conditions.Adaptive optics, having famous employment in astronomy in the ground-based large-aperture space telescopes, during last time have resulted in considerable advances in ophthalmology and laser technologies.

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Leading Scientist – Juergen Kurths

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"Laboratory of the novel optical materials for advanced lasers"

Leading Scientist – Ken-ichi Ueda

Mega-grant No. 14.B25.31.0023

"Lightning and thunderstorms: physics and effects"

Leading Scientist – Vladimir Rakov

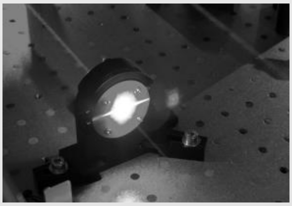
The ultimate laser systems

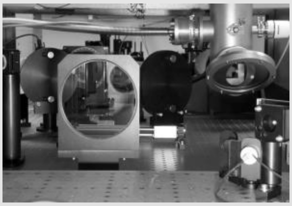
PULSAR for particle acceleration

- High peak power >1 PW
- High temporal contrast down to 10^{-12}
- Ultra-short pulse duration (sub-20 fs)
- Dedicated Man-Machine Interface
- Unique spatial and temporal real-time metrology and diagnostics

AURORA for ultrafast science

- High power CEP stabilized laser (> 20 W at 1-10 kHz)
- Ultra-short pulse duration down to 15 fs
- CEP single-shot measurement and control





nothing but ultrafast

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Corning Incorporated is the world leader in specialty glass and ceramics. We create and make keystone components that enable high-technology systems for consumer electronics, mobile emission control, telecommunications, and life sciences. We succeed through our sustained investment in R&D, more that 160 years of material science and process engineering knowledge, and a distinctive, collaborative culture. We work closely with our customers to solve complex problems that others can't, or won't solve. Time and again, our breakthrough, life-changing innovations have proven that, if it is possible, Corning will make it real.

From creating glass windows for space shuttles to developing optical components for high-tech industries, Corning develops solutions for virtually any glass-based challenge.

Corning is one of the very few manufacturers with deep capabilities in materials science, optical design, shaping, coating, finishing, and assembly. Our optical materials cover the entire spectrum, from extreme ultraviolet (EUV) to infrared, and from refractive to reflective. These capabilities position the company to meet the needs of a broad array of markets including display, semiconductor, aerospace/defense, astronomy, vision care, lithography, industrial/commercial, metrology and telecommunications.

Photonic Materials

Products such as Polarcor™ glass polarizers and specialty optical fibers (e.g. bend insensitive, polarizing or polarization maintaining) play an important role in optical modules and components from telecommunication to instruments, sensors or gyroscopes.

Technical glasses and glass ceramics

The rich portfolio of technical glasses and glass ceramics reflects Corning's innovations potential in glass technology. It ranges from Eagle XG™ Industrial Grade Substrate, used as an optical substrate for a variety of micro display components including small LCD displays, to Corning's new Gorilla™ Glass, a scratch resistant, durable, optical quality glass optimized for high-end portable devices and touch screens.

Zero Expansion Glass

Not only EUV optics or astronomical mirrors, but also reference scales or etalons are typical applications of ULE®. Its virtual zero expansion coefficient sets the standard and can be certified non-destructively to less than 10 ppb/K. Due to the specific properties of ULE®, it allows the manufacture of light weight structures with a weight reduction up to 95%.

Synthetic Fused Silica

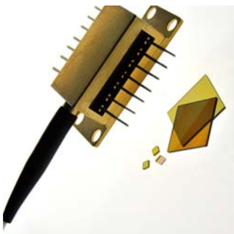
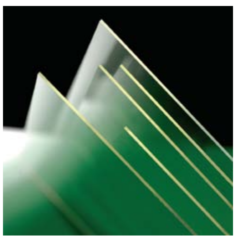
Corning HPFS® synthetic fused silica is of the highest purity. With excellent optical, thermal and mechanical properties, it is used for challenging applications from DUV microlithography to high-energy lasers and space shuttle windows.

Optical Crystals: CaF_2, MgF_2

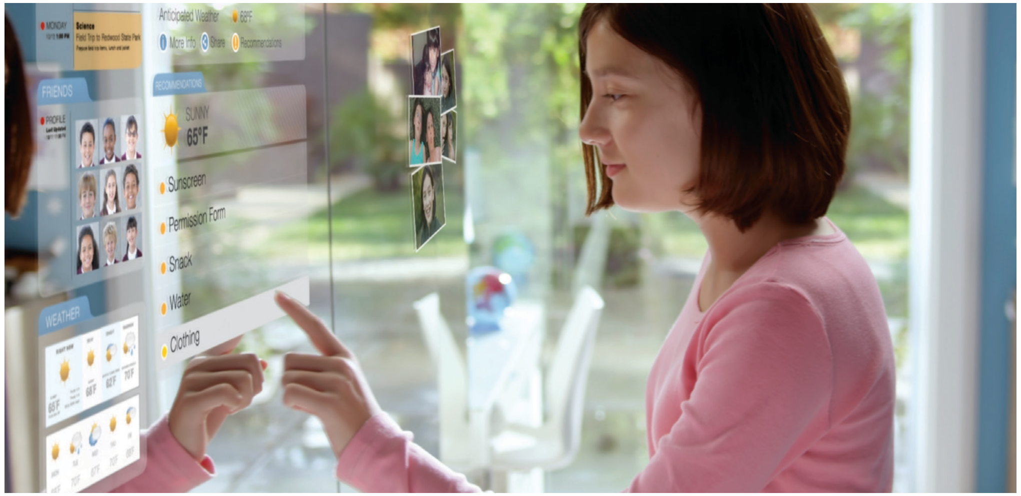
High transmission in the UV and excellent laser resistance are the reason why Corning's fluoride crystals are used for industrial and laser optics in industry, medicine and lithography.

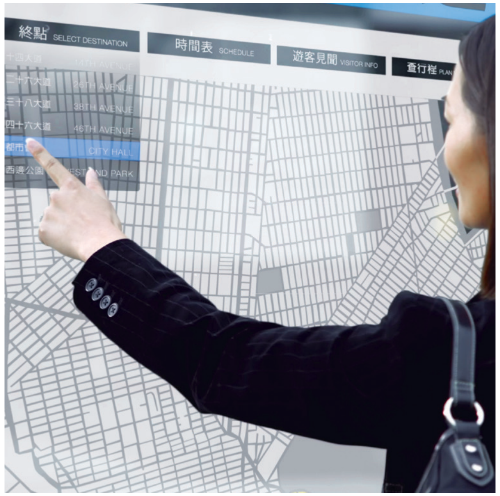
Corning Fairport Precision Optics

Corning Tropel is a leading company for development and manufacturing of customer specific optical subsystems (modules), mainly used in the DUV.

CORNING





At A Glance

About Corning

As the world leader in specialty glass and ceramics, Corning invents, makes, and sells keystone components that enable high-technology systems for consumer electronics, mobile emissions control, optical communications, and life sciences.

Corning succeeds through sustained investment in R&D, more than 160 years of materials science and process engineering knowledge, and a distinctive collaborative culture.

We work closely with customers to understand their toughest challenges. Corning's passion for science helps solve those problems with life-enhancing technologies.

Research & Development

Corning's commitment to research and development drives our ability to turn possibilities into breakthrough realities.

Our renowned laboratory and research facilities attract and enable the world's best scientific minds. Corning's state-of-the-art resources, multi-disciplined materials expertise, and dedicated technology leadership help foster our collaborative culture at every innovation phase.

Cross-functional teams and a broad portfolio of capabilities allow our researchers to leverage existing technologies across multiple product lines, enabling faster discovery of practical solutions.

Corning's sustained investment and unwavering commitment to R&D will ensure the next wave of technological advancements.

What's Next?

Beginning with a track record of more than 160 years, Corning's vision for the future is full of cutting-edge and life-enhancing technologies that deliver extraordinary benefits to everyday products.

Across our business segments and around the globe, Corning is constantly driving the next wave of innovations powered by specialty glass and ceramics.

Our Values

Quality. Integrity. Performance. Leadership. Innovation. Independence. The Individual.

Corning's visionary leadership remains steadfast to these enduring Values that guide us in everything we do. Our Values define our relationships with employees, customers, and the communities in which we operate in around the globe.

Equity Companies

Corning maintains successful alliances with other leading organizations in key markets, including the following equity companies: Cormetech, Inc.; Dow Corning Corporation; Eurokera, S.N.C.; and Samsung Corning Advanced Glass, LLC.

Want to learn more? Visit: Corning.com/AboutUs




Display Technologies

Corning's glass substrates enable the thin, high-resolution, multi-function displays consumers demand.

Our environmentally friendly glass compositions and technological innovations help advance the display industry, creating the foundation for a range of scalable and durable electronic devices used at work, home, and on the go.

As vivid organic light-emitting diode (OLED) displays and next-generation liquid crystal displays (LCDs) evolve, Corning will drive the advanced glass technologies required by display manufacturers.

Corning.com/DisplayTechnologies

Environmental Technologies

Our materials and process expertise in ceramic substrates have made Corning a key contributor in the campaign for cleaner air for 40 years.

We develop emissions-control products for the world's major manufacturers of gasoline- and diesel-powered engines and vehicles. Our advanced ceramic substrates and diesel particulate filters set the standard for catalytic converters and help control pollution around the world.

As the global concern for clean air intensifies, Corning's technologies continue to advance emissions-control solutions.

Corning.com/EnvironmentalTechnologies

Optical Communications

Corning keeps pace with the world's insatiable demand for bandwidth by providing optical communications solutions that put all the information you need right at your fingertips.

Our innovative optical connectivity solutions deliver high-quality broadband capabilities for the Enterprise, Carrier, and Wireless markets, as well as the expanding frontier of consumer electronic devices.

Corning's optical communications products and services are uniquely positioned to meet tomorrow's bandwidth demands for mobile devices, the increasing need for constant connectivity, and the growing volume of data being transmitted around the globe.

Corning.com/Products_Services/Telecommunications

Life Sciences

Corning helps scientists bring life-saving medicines to market through a comprehensive line of glass and plastic labware, as well as label-free technology, media, and reagents for cell culture, genomics, and bioprocessing applications.

By supplying high-quality tools and research technologies, we support life science advancements and help drive efficiencies for researchers and lab technicians seeking to compress costs and timelines during drug discovery.

Our industry-leading products help create the next wave of possibilities in healthcare.

Corning.com/LifeSciences

Specialty Materials

From cover glass for consumer electronics to advanced optics for high-technology industries, Corning develops customer-driven solutions for some of the toughest material-based challenges.

Our unmatched expertise in fundamental glass science and our hundreds of material formulations for glass, glass ceramics, and fluoride crystals makes this possible, along with our deep knowledge of thin films and our ability to process other materials.

Corning is changing the way the world thinks about glass while inspiring new possibilities and design applications for tomorrow.

Corning.com/SpecialtyMaterials

LASER COMPONENTS

For more than 8 years our company "Laser components" has supplied kinds of productions for lasers with different applications, also for optics, which manufacturers in China, Italy and USA.

Our company is the official distributor of such companies as: the manufacturer of optical glass "DGM Glass" (China), manufacturers of measuring instruments of laser radiation parameters "LaserPoint" (Italy) and "Duma Optronics" (Israel).

We also have cooperation with leading enterprises, as well as Shanghai Institute of Optics and Fine Mechanics (Chinese Academy of Sciences, CAS), Chinese Electronics Technology Group Corporation (CETC), and China North Industries Group Corporation (NORINCO GROUP). We can supply large size optics with high requirements of processing and coating. Our partners are large Russian industrial companies and academic institutes, working in different sectors of development and production.

Principles that our partners when choosing our company "Laser components" are transparent and professional approach to cooperation, high quality work and quick order.

The multi-national colleague in our company "Laser components" assure to contact the producers without language barriers, as well as to perform quality control at the factory.

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"GEORGIY ZHNUKOV"

"Георгий Жуков"

DECK MAP