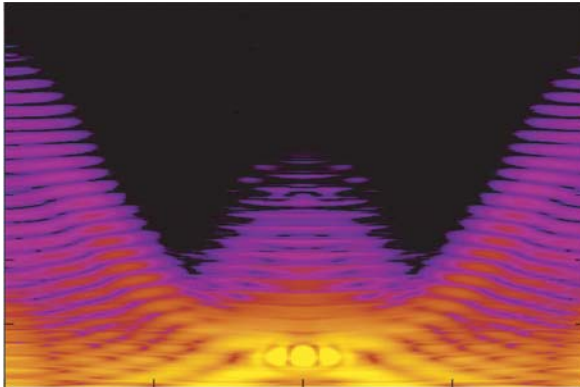




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## COVER PICTURE

Scattering of an electron on an ion in a strong laser field. The graph shows the angular energy distribution. Fig. 6 of the paper by S. Bauch and M. Bonitz.

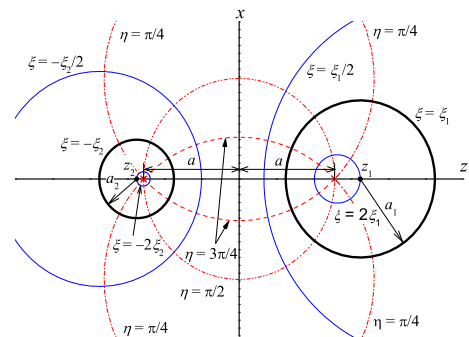
## ORIGINAL PAPERS

### I. DYNAMICS OF COMPLEX DUSTY PLASMA

Page **431–445** ——— A.V. Filippov

#### Electrostatic interaction of spherical microparticles in dusty plasmas

The interaction of two conducting spherical microparticles is considered in the bipolar or bispherical coordinate system for cases of constant charges and constant surface potentials of the microparticles. Approximated analytical expressions for the interaction potential, which are more accurate than the available in the literature, are obtained for both the constant charges and the constant surface potentials.



Page **446–450** ——— V.S. Filinov, L.V. Deputatova, V.N. Naumkin, V.I. Vladimirov, V.I. Meshakin, and V.A. Rykov

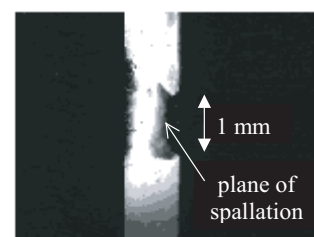
#### Influence of Potential and Non Potential Forces of Interparticle Interaction on Stability of Nuclear Excited Dusty Plasma

The highly ordered levitating structures of radioactive dusty particles in nuclear excited plasma of tube capacitor are studied using the Brownian dynamics. Models with potential and non potential forces acting on charged dusty particles have been investigated. Types and stability of obtained dust particle structures are analyzed at atmospheric pressure and normal conditions.

## II. CRITICAL STAGES OF MATTER UNDER THE ACTION OF POWERFUL ELECTROMAGNETIC RADIATION

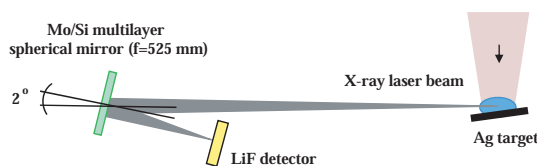
- Page **451–454** — A.A. Geraskin, K.V. Khishchenko, I.K. Krasnyuk, P.P. Pashinin, A.Yu. Semenov, and V.I. Vovchenko  
**Specific Features of Spallation Processes in Polymethyl Methacrylate Under High Strain Rate**

Direct laser interaction and laser-driven thin foils were used for investigation spallation phenomena in polymethylmetacrylate (PMMA) targets in case of high strain rate. The aluminium foils with thickness 8 and 15  $\mu\text{m}$  were used as impactors. Mass and velocity of the laser-driven foils after laser ablation and acceleration were determined by the method of foil deceleration in a gas atmosphere.



- Page **455–466** — N.A. Inogamov, A.Ya. Faenov, V.A. Khokhlov, V.V. Zhakhovskii, Yu.V. Petrov, I.Yu. Skobelev, K. Nishihara, Y. Kato, M. Tanaka, T.A. Pikuz, M. Kishimoto, M. Ishino, M. Nishikino, Y. Fukuda, S.V. Bulanov, T. Kawachi, S.I. Anisimov, and V.E. Fortov  
**Spallative Ablation of Metals and Dielectrics**

The results of theoretical and experimental studies of ablation of LiF crystal by X-ray beam having photons with 89.3 eV and very short duration of pulse  $\tau = 7$  ps are presented. It is found that the crater is formed for fluencies above the threshold  $F_{abl}$  10 mJ/cm<sup>2</sup>. Such a small threshold is one order of magnitude less than the one obtained for X-ray ablation by longer (nanoseconds) pulses.



## III. DYNAMICS OF MICRO-, NANO- AND CLUSTER PLASMAS

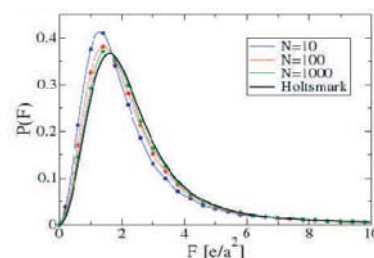
- Page **467–476** — A.Ya. Faenov, A.V. Lankin, I.V. Morozov, G.E. Norman, S.A. Pikuz Jr., and I.Yu. Skobelev  
**Strongly Coupled Nonequilibrium Nanoplasma Generated by a Fast Single Ion in Solids**

A plasma model for relaxation of a medium in heavy ion tracks in condensed matter is proposed. The model is based on three assumptions: the Maxwell distribution of plasma electrons, localization of plasma inside the track nanochannel, and constant values of the plasma electron density and temperature during the X-ray irradiation.

Page 477–487 ——— W. Ebeling and M. Yu. Romanovsky

### Microfields, Kinetic Equations and Fusion Rates in Exploding Ion Clusters

The fusion of light nuclei is the main source of valuable energy. Recent experiments with intense, ultrafast laser pulses acting on deuterium clusters have shown that these clusters can explode with sufficient kinetic energy to produce DD nuclear fusion. We study the influence of nonequilibrium effects in the velocity distribution due to the Coulomb explosion of the clusters.

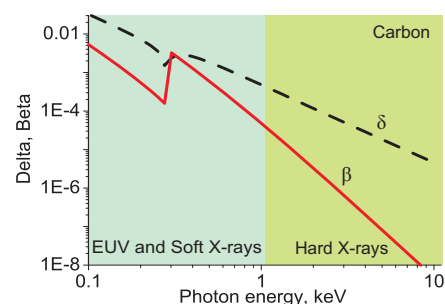


Page 488–495 ——— S. Gasilov, A. Faenov, T. Pikuz, I. Skobelev, A. Boldarev, V. Gasilov, A. Magunov, Y. Fukuda, M. Kando, H. Kotaki, K. Kawase, T. Kawachi, H. Daido, T. Tajima, Y. Kato and S. Bulanov

### Conventional and Propagation-based Phase Contrast Imaging of Nanostructures Using Femtosecond Laser Driven Cluster Plasma Source and LiF Crystal Soft X-ray Detectors

Bright source of soft X-ray emission was developed. Soft X-ray radiation was produced by femtosecond laser pulses irradiation of submicron size CO<sub>2</sub> clusters. These clusters were produced in custom designed supersonic nozzle from the mixture of the 10% CO<sub>2</sub> + 90% He expanding gases. Lithium fluorine based soft X-ray detectors was used for registration of absorption images of ultrathin

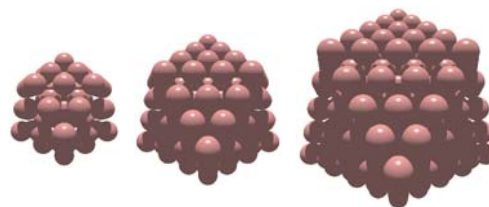
(nanoscale) foils and biological structures illuminated by the developed source.



Page 496–506 ——— T. Raitza, H. Reinholz, G. Röpke, I. Morozov, and E. Suraud

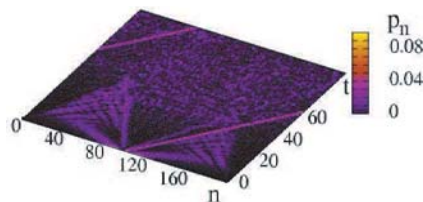
### Laser Excited Expanding Small Clusters: Single Time Distribution Functions

The time evolution of laser excited small clusters such as Na<sub>309</sub> is investigated using a classical MD simulation code. The question of local thermal equilibrium is addressed comparing the simulated profiles with predictions from equilibrium statistical physics. Once the local thermal equilibrium is established, the time evolution of collective modes of the excited electron system can be investigated.



- Page **507–516** ————— A.Ya. Faenov, T.A. Pikuz, S.A. Pikuz Jr., Y. Fukuda, M. Kando, H. Kotaki, T. Homma, K. Kawase, T. Kameshima, A. Pirozhkov, A. Yogo, M. Tampo, V. Kartashev, I.Yu. Skobelev, S.V. Gasilov, A.S. Boldarev, V.A. Gasilov, A. Magunov, S. Kar, M. Borghesi, A. Giulietti, C.A. Cecchetti, M. Mori, H. Sakaki, et al.  
**Ionography of Submicron Foils and Nanostructures Using Ion Flow Generated in FS-Laser Cluster Plasma**
- A novel type of submicron ion radiography designed to image low-contrast objects, including nanofolds, membranes and biological structures, is proposed. It is based on femtosecondlaser-driven-cluster-plasma source of multicharged ions and polymer dosimeter film CR-39. High contrast ion radiography images were obtained for 2000 dpi metal mesh, 1  $\mu\text{m}$  polypropylene and 100 nm Zr foils as well as for the different biological objects.

#### IV. COMPLEX QUANTUM PLASMAS

- Page **517–528** ————— M.Ya. Amusia  
**Big Consequences of Small Changes (Non-locality and non-linearity of Hartree-Fock equations)**
- It is demonstrated that non-locality and non-linearity of Hartree-Fock equations dramatically affect the properties of their solutions that essentially differ from solutions of Schrödinger equation with a local potential.
- Page **529–535** ————— A.P. Chetverikov, W. Ebeling, and M.G. Velarde  
**Electron Dynamics in Tight-Binding Approximation - the Influence of Thermal Anharmonic Lattice Excitations**
- We study here several basic problems of the quantum mechanics of electrons which are embedded into an onedimensional (1D) nonlinear, thermally excited lattice. Our approach uses the tight-binding model for the dynamics of the electrons. Through coupling terms in the Hamiltonian the electron quantum dynamics is connected with the classical dynamics of the lattice endowed with Morse interactions.
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- Page **536–543** ————— V.S. Filinov, M. Bonitz, Y.B. Ivanov, V.V. Skokov, P.R. Levashov, and V.E. Fortov  
**Equation of State of Strongly Coupled QuarkGluon Plasma Path Integral Monte Carlo Results**
- A strongly coupled plasma of quark and gluon quasiparticles at temperatures from  $1.1T_c$  to  $3T_c$  is studied by path integral Monte Carlo simulations. This method extends previous classical nonrelativistic simulations based on a color Coulomb interaction to the quantum regime. We present the equation of state and find good agreement with lattice results.

Page **544–549** ————— A.L. Galkin, V.A. Egorov, M.P. Kalashnikov, V.V. Korobkin, M.Yu. Romanovsky, O.B. Shiryaev, and V.A. Trofimov

### Energy Distribution of Electrons Expelled from Relativistically Intense Laser Beam

Motions of electrons driven by the fields of relativistically intense laser pulses are studied. The treatment is based on the numerical solution of the relativistic Newtons equation with the Lorentz force. It is demonstrated that an electron can be accelerated by a relativistically intense optical field up to a considerable part of the energy of its oscillation within the pulse.

Page **550–557** ————— V.V. Belyi and Yu.A. Kukhareenko

### Electric Field Fluctuations in the Systems of the Charged Particles with Exchange Interaction

The quantum plasma of Bose and Fermi particles is considered. A scheme of equation linearization for density matrix with the exchange interaction taken in account is proposed and the equation solution is found. An expression for Hartree- Fock dielectric permeability with the exchange interaction is obtained.

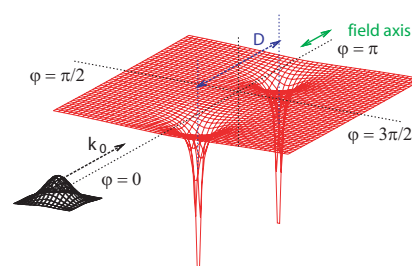
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## V. CLUSTER, MICROPELLET AND MICRODROPLET INTERACTIONS WITH SUPERSTRONG LASER RADIATION

Page **558–567** ————— S. Bauch and M. Bonitz

### Fast Electron Generation by Coulomb Scattering on Spatially Correlated Ions in a Strong Laser Field

Electrons colliding with spatially fixed ions in strong laser fields are investigated by solving the time-dependent Schrödinger equation. Considering first simple one-dimensional model systems, the mechanisms and energy spectra of fast electrons are analyzed, starting from collisions on a single ion.



Page **568–574** ————— V.V. Bolshakov, A.A. Vorobiev, R.V. Volkov, and A.B. Savelev

### Experimental Study of Hard X-Ray Production at Sub-Relativistic Intensities: Effect of Polarization and Nanosecond Pre-Pulse

Comparative investigation of hot electrons generation at intensities up to  $2 \times 10^{17}$  W/cm<sup>2</sup> using transparent target (quartz glass) and solid target (silicon) showed, that relativistic effects play noticeable role even at intensities one order less than the relativistic one. In particular, they lead to effective generation of hot electrons by s-polarized laser radiation, and mean energy of such electrons is almost equal to the similar value for the p-polarized radiation.

- Page **575–584** ————— S.A. Smolyansky, A.V. Tarakanov, and M. Bonitz  
**Vacuum Particle Creation: Analogy with the Bloch Theory in Solid State Physics**  
A nonperturbative kinetic description of interband tunneling under the action of a strong electric field (dynamical analogue of the Zener effect) is presented. The developed approach is based on the similarity to the Sauter-Schwinger effect and its dynamical analogue in QED.
- Page **585–592** ————— N.V. Bordyukh and V.P. Krainov  
**Resonant Penetration of Intense Femtosecond Laser Pulses Through Plasma of Ultra-Thin Foils**  
Simple analytic expression for the transmission coefficient as a function of foil thickness  $d$  describing penetration of intense femtosecond laser pulse through ultra-thin foils with the thickness of the order of 100 nm has been derived using the Maxwell-Vlasov-Boltzmann equation.
- Page **593–601** ————— A.L. Galkin, V.V. Korobkin, M.Yu. Romanovsky, and O.B. Shiryayev  
**Generation of Zeptosecond Electromagnetic Pulses by Electrons Under their Interaction with Femtosecond Laser Pulses**  
The electromagnetic radiation of an electron interacting with a laser pulse is also studied. It is shown that: laser fields accelerate electrons both in the transverse and longitudinal directions and the electron radiation comprises short pulses having zeptosecond (and even subzeptosecond) durations.
- Page **602–608** ————— D. B. Blaschke, S. V. Ilyine, A. D. Panferov, G. Röpke, and S. A. Smolyansky  
**Optical Properties of the  $e^-e^+$  Plasma Generated in the Focal Spot of a High-Intensity Laser**  
We discuss the high frequency conductivity and absorption coefficient of a quasi-particle electron-positron plasma (EPP) created from the vacuum in a strong non-stationary electric field (nonstationary Schwinger mechanism), e.g., in the focus spot of two counterpropagating laser beams.

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