CPP 10 POSTER Nonequilibrium Phenomena in Soft Condensed Matter

Time: Tuesday 17:00–19:00 Room: P3

CPP 10.1 Tue 17:00 P3

Free Cooling of the One-dimensional Wet Granular Gas — •Vasily Zaburdaev, Martin Brinkmann, and Stephan Herminghaus — MPI for Dynamics and Self-Organization, Bunsenstr.10, 37073 Göttingen, Germany

In the present work we consider a one-dimensional gas of hard balls covered with a thin liquid film. A liquid bridge, formed at each collision, is responsible for the hysteretic and dissipative interaction. Each rupture of a liquid bridge requires a fixed amount of energy, and thus determines a threshold of relative velocities below which the two colliding particles form a bounded state loosing their relative kinetic energy. We aim to study the cluster formation process in the free cooling system. Macroscopic laws of energy dissipation and cluster growth are studied in this model on the basis of numerical simulations supported by a scaling-like system of equations. We show that the sticky gas regime is an attracting asymptotic limit of the wet granular gas and does not dependent on the liquid bridges strength. The next neighbor velocities correlations play the key role in the establishing of this regime.

CPP 10.2 Tue 17:00 P3

Global homogeneity of non-cubic bicontinuous space partitions — •Gerd E Schroeder[1], Andrew Fogden[2], and Stephen T Hyde[1] — [1]Applied Maths, Research School of Physical Sciences, Australian National University, 0200 Canberra, Australia — [2]Institute for Surface Chemistry, P.O. Box 5607, SE-11486 Stockholm, Sweden

Infinite periodic minimal surfaces (IPMS) form the structural basis of cubic phases in copolymer, lipid or surfactant self-assemblies. Although few non-cubic equilibrium phases have been reported to date, there are compelling reasons to study non-cubic IPMS: first, they offer possible transition structures between bicontinuous cubic phases. Second, the reason why soft systems (that favour homogeneity but not explicitly symmetry) exhibit phases of cubic symmetry is still uncertain.

We use the concept of *medial surfaces* to quantify *packing homogeneity*, i.e. variations of the channel radius within the structure [1]. This analysis is carried out on IPMS families that are degradations of the cubic P, D and G surfaces (the rPD, rG, tG, tD tP, and H).

We show that the cubic G and D are locally maximally homogeneous, whereas the cubic P has at least one relative that is more homogeneous. We discuss the implications for molecular self-assembly (chain stretching), and compare this result to analyses of curvature fluctuations [2].

[1] A. Fogden, S.T. Hyde, Eur. Phys. J. B **7**, 91–104 (1999)
[2] G.E. Schröder, S.J. Ramsden, A.G. Christy, S.T. Hyde, Eur. Phys. J. B **35**, 551–564 (2003)

CPP 10.3 Tue 17:00 P3

Nonlinear dynamics of elastic nano-filaments — •Hirofumi Wada and Roland Netz — Physik Department, Technical University Munich, 85748 Garching, Germany

Dynamics of flexible filaments in viscous fluids, which is dominated by hydrodynamic dissipation and elasticity, is characterized by an intriguing interplay between geometry and physics. Examples are the motion of vortex lines in superconductors, the buckling and super-coiling of rubber tubes or long DNA molecules, and the swimming of bacteria flagella. We developed a dynamic simulation model of elastic filaments in low Reynolds number fluids, in which full couplings between stretch, bend and twist are properly taken into account and the hydrodynamic interaction is also incorporated within the Stokesian technique. We study non-linear dyanmics of filaments subjected to various external forces and boundary conditions. In particular, we describe the stretching instability of a flexible helical spring and the super-coiling behavior of an overtwisted straight filament, and provide some insights into the kinetics of those non-equilibrium phenomena.

CPP 10.4 Tue 17:00 P3

Hydrodynamic simulations of polymers at surfaces — •Christian Sendner and Roland Netz — Physik Department, TU Muenchen, James Franck Strasse, 85748 Garching

We investigate the dynamics of a semiflexible polymer at a surface in the low-Reynolds-number limit. We include full hydrodynamic interactions between polymer segments and the boundary. The response of the polymer to external electric fields as well as to shear flow at finite temperatures is considered, using simulations and scaling arguments. Hydrodynamic interactions influence the conformation of the polymer leading to orientation effects and an effective repulsion from the surface. This might be useful for controlled desorption of short DNA strands in DNA-chip applications.

CPP 10.5 Tue 17:00 P3

Mediated Forces in out of Equilibrium Systems — •Ali Najafi — Max-Planck Institut for Physics of Complex Systeme, Nothnitze str. 38, 01187 Dresden, Germany

We study the fluctuation-induced forces in systems with nonequilibrium nature. we show that in a system with nonuniform temperature profile a net force is exerted on a single flat plate that restricts the scale-free fluctuations of a scalar medium. This force resembles the thermophoresis or the Soret effect. Another class of non-equilibrium systems corresponds to the case where a topological defect moves in a phononic background. We show that inertial coupling between A single defect and ambient phonons leads to variety of interesting phenomena. Similar to the problem of dynamical Casimir effect the energy dissipation and mass renormalization of A moving defects are the results of this mediated interactions. Phonon-mediated coupling between many defects also investigated. We show that a regular lattice of such interacting defects will have anisotropic and anomalous mass and elastic constants.

CPP 10.6 Tue 17:00 P3

Structure formation in thin block-copolymer films — •Ludovic Marquant, Hendrik Hähl, Daniel Podzimek, Renate Fetzer, Martin Meier, and Karin Jacobs — FR 7.2 Experimentalphysik - Weiche Materie, Universität des Saarlandes, D-66123 Saarbrücken

We are investigating rearrangement phenomena within structured liquids. Our system consists of a thin block-copolymer film of polystyrene-block-polyethylen/propylen (PS/EP) deposited on a non-wetting substrate. Due to a preannealing procedure the microdomains of the polymer melt equilibrate and form an ordered layered structure. Upon shear stress which is induced by the dewetting of the film this stucture undergoes a rearrangement in the vicinity of the three-phase-contactline (air-substrate-film) and forms PS cylinders parallel to the edge of the film, embedded in a PEP-matrix. By tapping mode scanning probe microscopy we investigate this phenomenon at the solid/liquid interface. Here, the alignment of these cylinders gives evidence to a nonzero velocity at the interface, indicating slippage.

CPP 10.7 Tue 17:00 P3

Friction of macromolecules in solution: Effects of high–order correlations. — •Alexander Uvarov and Stephan Fritzsche — Universität Kassel, D–34132 Kassel, Germany

Apart from the rotational and translational motion of macromolecules, the concept of friction have been found helpful to understand their shape as well as the formation and deformation of such macromolecules. During the past decade, therefore, a large number of experiments and molecular dynamic (MD) simulations have been carried out to understand the friction properties of macromolecules. An alternative treatment of such molecules is based on statistical methods, if they are described in terms of their molecular subsystems, (*beads*), and if the influence of the solvent particles on the dynamics of the macromolecule is incorporated into the friction tensors of the macromolecule [1].

In this contribution we derived and explain the explicit expression for the friction tensors which can be applied in order to calculate the diffusion coefficient as function of the mass ratio of the molecules, relative to the mass of the solvent particles. In addition, we also discuss the effects of the transition between slip and stick boundary conditions by calculating the boundary condition coefficient of the macromolecule for different mass ratios as well as different bead–solvent potentials. The results from this semi–phenomenological theory are found to compare very well with MD simulations over a wide range of mass ratios [2].

[1] A. Uvarov and S. Fritzsche, Phys. Rev. E, accepted (2005);
[2] J. R. Schmidt, J. L. Skinner, J. Phys. Chem. B. **108**, 6767 2004.

CPP 10.8 Tue 17:00 P3

Monitoring Defect Dynamics by Local Minkowski Measures — •Sabine Scherdel[1], Christian Franke[1], Martin Kreis[2], and Robert Magerle[1] — [1]Chemische Physik, TU Chemnitz, D-09107 — [2]Physikalische Chemie II, Universität Bayreuth, D-95440

To structure large surface areas block copolymer films are often used as templates. However, the dynamic and structure formation in thin block copolymer films is still under research. In particular surfaces and interfaces or different experimental conditions have a strong effect on the obtained structures. We investigate these mechanisms experimentally with in-situ scanning probe microscopy. The resulting movies are large and complex data sets. We have used local Minkowski measures to characterize defects appearing in thin films. This allows us to examine systematically the structure of defects and their neigbourhood. Furthermore, we can describe the behaviour of individual defects with a few parameters and examine the influence of the geometry in the vicinity of defects.

CPP 10.9 Tue 17:00 P3

Defect Dynamics in Thin Films of Block Copolymers — •Marcus Böhme[1], Martin Kreis[2], Sabine Scherdel[1], Nicolaus Rehse[1], and Robert Magerle[1] — [1]Chemische Physik, TU Chemnitz, D-09107 Chemnitz — [2]Physikalische Chemie II, Universität Bayreuth, D-95440 Bayreuth

We investigate the dynamic processes in thin films of a cylinder forming polystyrene-*block*-polybutadiene block copolymer swollen in chloroform vapour. With tapping mode atomic force microscopy we study in situ the dynamics of defect structure during annealing of the liquid film. Our experiments show correlations between the dynamics of neighbouring defects, annealing of defects via formation of transient phases, shape fluctuations of cylinders and lamellae, as well as the dynamics of individual perforations in a hexagonally perforated lamellae.

CPP 10.10 Tue 17:00 P3

The General Physics Theory for 21 Century — •Tofig Gassym — Gehri Strasse 7, 6010 Kriens, Switzerland

By solving the coupled system of kinetic equations for interacting system of electrons positrons and photons at high external electric, arbitrary magneic and at the propagation of strong electromagnetic waves non-equilibrium and non-stationary distribution function (DF) of photons and charge carriers by taking into account of arbitrary heating and mutual drag of carriers and photons was found. Author was sure that received him DF function of photons must lay on the basis of Theoretical Physics of 21 Century, as the equilibrium Planck's DF of black-body radiation lied on the basis of Quantum Physics of 20 Century. Authors many years mental work confirmed the rightness of searched him way and leads to the conclusion that Kinetic Theory is more general and fundamental theory of nature, which unificated Non-stationary Dynamics (the left-hand side) with Non-stationary Statistical Mechanics (the right-hand side) of Kinetic Equation. Other sections of Theoretical Physics such as Newtonian, Hamiltonian and Relativistic Classical Mechanics, Quantum Physics may be received from Kinetic Theory under the special conditions and are the special parts of this theory. The problems irreversibility and instability, the paradox of time, quantum paradox and others are solved. This new General Theory explaines all the problems and trubles of foundations and interpretation of quantum mechanics and relativity.It is shown the possibility of superluminal motion of light pulces and wavepackets through the medium and photonic barriers.

CPP 10.11 Tue 17:00 P3

Superluminal motion in interacting system of electrons, positrons and photons. — •Tofig Gassym — Gehri Strasse 7, 6010 Kriens, Switzerland

By solving the coupled system of kinetic equations for interacting system of electrons, positrons and photons in high electric E, arbitrary magnetic H and at the propagation of strong electromagnetic waves nonstationary and non-equilibrium distribution function (DF) of photons and charge carriers with arbitrary heating and the mutual drag of carriers and photons is found.It is shown that DF has the stationary limit at $u\,q/(\hbar\omega_q) < 1$ and grows by time exponentially for $u\,q/(\hbar\omega_q) > 1$. At the point $u\,q = \hbar\omega_q$ (i.e. $u = c$) state is ground with $N(q) = N(q, T_i)$ =const. have not singularity. At this point $u = V_H = c$, $E = H$ and $E\,H\,V_H$ and electromagnetic field becomes transversal and free and emitted. From this point at $u > c$ begins the transition of carriers "dressed" by photons to the following energetic levels. It is the mechanism of inverse population of Lasers. Separating stationary DF $N(q) = N(q, T_i)\,(1 - u\,q/(\hbar\omega_q))^2$ to the isotropic and anisotropic parts at $u\,q$ as in theory of relativity we have: $N_s(q) = N(q, T_{co})\,(1 - u/c)^2$; $N_a(q) = (u\,q/(\hbar\omega_q))\,N_s(q) = (u/c)\,N_s(q)$. Relativistic factor enters to expressions as $(1-u/c)^2$, instead $(1-u/c)^{-1/2}$ in Einsteins theory, which considers the case of absence of external fields. Thus we liquidate the main problems of superluminality and show the possibility of superluminal motion of light through the medium, at $u > c$ in accordance with a lot of experiments.