DY 24: Pattern formation in colloidal and granular systems I

Time: Thursday 14:45–16:45 Location: ZEU 255

DY 24.1 Thu 14:45 ZEU 255

Reversibly tunable standing strain wave pattern and soliton dynamics in a two dimensional colloidal crystal with confinement — •David Yu-Hang Chui[1], Surajit Sengupta[2], Ian K Snook[3], and Kurt Binder[1] — [1]Institut für Physik, Johannes-Gutenberg-Universitüt, Staudingerweg 7, 55099 Mainz, Germany — [2]S. N. Bose National Centre for Basic Sciences, Block JD, Sector III, Salt Lake, Kolkata 700098, India — [3]Applied Physics, School of Applied Science, RMIT University, GPO Box 2476V, Melbourne 3001, VIC, Australia

We have shown that confinement can be used to impose a controllable mesoscopic superstructure of a predominantly mechanical elastic character on a crystal [1]. The two dimensional colloidal crystal of two different sizes interacting with an inverse power law potential was simulated using Monte Carlo simulations [2]. Two structured walls, which are created by choosing two rows of particles fixed in the positions of the triangular lattice, provide the confinement to the system. Due to an interplay of the particle density of the system and the width D of a confining channel, "soliton staircases" can be created along both parallel confining boundaries, that give rise to standing strain waves in the entire crystal. This strain wave superstructure in the crystal can be reversibly tuned by varying the physical conditions. The novel soliton dynamics and elasticity are also investigated using Molecular Dynamics simulations. References [1] Y. H. Chui, S. Sengupta and K. Binder, Europhysics Letter 83, 58004 (2008). [2] A. Ricci, P. Nielaba, S. Sengupta and K. Binder, Physical Review E 75, 011405 (2007).

DY 24.2 Thu 15:00 ZEU 255

How attractive is a barchan dune? — •Christopher Groh[1], Ingo Rehberg[1], and Christof Kruelle[1,2] — [1]Experimentalphysik V, Universität Bayreuth, Germany — [2]Maschinenbau und Mechatronik, Hochschule Karlsruhe - Technik und Wirtschaft, Germany

The spatio-temporal behaviour of barchan dunes is investigated experimentally with downsized longitudinal barchan dune slices generated in a narrow water flow tube. We observe a rapid transition to a steady-state solution with constant mass, shape, and velocity. The development towards this shape attractor is shown on the basis of four different starting configurations in qualitative observation and quantitative analysis.

[1]C. Groh, A.Wierschem, N. Aksel, I. Rehberg, and C. A. Kruelle (2008). Barchan dunes in two dimensions: Experimental tests for minimal models. Phys. Rev. E 78, 021304.

[2]C. Groh, I. Rehberg, and C. A. Kruelle (2008). How attractive is a barchan dune? New Journal of Physics, submitted.

[3]C. Groh, N. Aksel, I. Rehberg, and C. A. Kruelle (2008). Grain size dependence of barchan dune dynamics. http://arxiv.org/abs/0811.4729

DY 24.3 Thu 15:15 ZEU 255

electric-field induced chiral patterns and dynamical states of fd-virus suspensions — •kyongok kang and jan dhont — forschungszentrum juelich, weiche-materie, juelich, 52425, germany

For low frequency and a low ionic strength, suspensions of fd-virus particles respond to external electric fields due to the deformation of their thick electric double layer. We are interested in pattern formation and phase transitions that results from interactions between such deformed double-layers. Depending on the electric-field amplitude and frequency, dynamical states and various phases are observed. Below a critical frequency, a non-chiral nematic transforms to a chiral nematic with a pitch that is a strong function of the field amplitude and frequency. On increasing the amplitude below a critical frequency, dynamical states are observed where small nematic domains melt and form. These dynamical states are investigated by time-lapsed image correlation function analysis. At sufficiently high frequency, a uniformly aligned phase is stable, which is characterized by means of birefringence measurements. There is a *non-equilibrium critical point* where all transition lines meet, and above which the dynamical state directly transforms to the uniform aligned phase on increasing the frequency.

References: K. Kang, and J. K. G. Dhont, *Double-layer polarization induced transitions in suspensions of colloidal rods*, EPL, 84 (2008) 14005. K. Kang, and J. K. G. Dhont, *Electric-field induced transitions in suspensions of rods (fd-virus) due to double-layer polarization*, Submitted to PRE (2008).

DY 24.4 Thu 15:30 ZEU 255

Humidity determines granular transport hysteresis — •Tobias Lang[1], Christof Krülle[1,2], and Ingo Rehberg[1] — [1]Universtität Bayreuth, Universitätsstrasse 30, D-95447 Bayreuth — [2]Maschinenbau und Mechatronik, Hochschule Karlsruhe - Technik und Wirtschaft, D-76133 Karlsruhe

Since the pioneering works of R.A Bagnold, a grown interest in dune dynamics evolved. Incipient motion of a sand bed starts, when the wind speed over the bed surpasses a critical threshold. It is known that the sand flux depends sensitively on the humidity of the air. Using a small scale closed-circuit wind tunnel with active moisture control, we studied the dependency of the granular transport process on the humidity. Via the variation of humidity, electrostatic charging of the particles can also be influenced. In particular we measure the hysteretic dependence of the sand flux on the wind speed.

DY 24.5 Thu 15:45 ZEU 255

Network formation in liquid crystal-colloidal-suspensions — •Marcel Roth, Günter K. Auernhammer, and Doris Vollmer — Max-Planck-Institut für Polymerforschung, Mainz, Germany

When cooling a mixture of thermotropic liquid crystal (5CB) and micrometer-sized colloids (PMMA) from the isotropic to the nematic state a self-supporting network is formed. Within this network the pores are filled with colloid-free nematic liquid crystal while the colloids are concentrated in the walls leading to a low frequency elastic modulus of up to 10^5Pa.[1]

In this talk we present the results of measurements with a self-made piezo-rheometer in shear mode. Since the applied strain is in the order of only 10^{-4} the network formation is not affected by the measurement and results are well reproducible. Moreover, the intrinsic frequency range spans four orders of magnitude accessing even 1kHz. With a suitable temperature control we monitor the extended viscoelastic response in dependence on temperature. We show that the low frequency elastic plateau is followed by a strongly viscoelastic region at higher frequencies. In addition the whole spectrum shows a pronounced temperature dependence as cooling deeper into the nematic region.

The rheological data is combined with microscopic images. Here special emphasis will be laid to the transition from a 2D to a 3D-structure varying cooling rates and sample thicknesses.

[1] Vollmer et al., Langmuir 21, 4921-4930 (2005)

DY 24.6 Thu 16:00 ZEU 255

Phase diagram of wet granular material under vertical vibrations — •Kai Huang, Klaus Röller, and Stephan Herminghaus — Max Planck Institute for Dynamics and Self-organization, Bunsenstr.10, 37073 Göttingen, Germany

The phase diagram of vertically vibrated wet granular matter is investigated by both experiments and simulations. We find a critical point where the coexistence (C) regime of the fluid (F) and gas (G) phases terminates. The energy driven F-C transition is found to scale with the rupture energy of a liquid bridge if the corresponding vibration amplitude(A) is less than particle diameter(d). This is in good agreement with our simulations. Close to the F-G transition line, the variation of the size of the gas bubble with vibration amplitude shows a hysteretic behavior. Within the hysteresis loop, we observe temporary gas bubbles with strong fluctuations in size. The F-G boundary is shown to have an interfacial tension and non-trivial wetting behavior at container walls. Focusing on the solid (S)- F transition line, we find that the fluidization is a surface melting process. This is demonstrated by detecting the mobility of ruby tracers utilizing ruby fluorescence. This as well agrees with our simulation results.

DY 24.7 Thu 16:15 ZEU 255

Fractionation in random symmetric A-B block copolymers — •Alice von der Heydt and Annette Zippelius — Institut für Theoretische Physik, Göttingen, Germany

Starting from a mean-field free energy based on a microscopic model, we investigate the coexistence of homogeneous and structured phases of a triblock copolymer melt with an incompatibility $\chi \propto 1/T$ between

A- and B-blocks. The natural random block sequence distribution is generated by a Markov process with an overall A-probability $p = \frac{1}{2}$ and a correlation parameter λ. The latter determines the structure of the ordered phases which the initially disordered melt forms on increasing χ: lamellae with wave number $k(\lambda)$ appear for $\lambda < \lambda_c$, two homogeneous A- and B-rich phases for $\lambda > \lambda_c$ [1].

An explicit *fractionation* ansatz takes into account the exchange of individual sequences between coexisting lamellar and homogeneous phases: higher χ give rise to two additional homogenous phases for $\lambda < \lambda_c$, and to a third lamellar phase with an increased content of alternating sequences for $\lambda > \lambda_c$. The new phases emerge with zero volume fraction, but with a finite deviation from the natural sequence distribution, and, for the fractionated lamellae, with finite k. Reliable results can be obtained especially in the vicinity of the tricritical point (λ_c, χ_c), where other methods encounter difficulties.

[1] G. H. Fredrickson, S. T. Milner, and L. Leibler, *Multicritical Phenomena and Microphase Ordering in Random Block Copolymer Melts*, Macromol. **25** (1992), 6341

DY 24.8 Thu 16:30 ZEU 255

Air pressure influence on the sublimation of a granular gas in an annular conveyor — •Ralph Neubauer[1], Ingo Rehberg[1], and Christof Krülle[2] — [1]Universität Bayreuth - Experimentalphysik V, D-95440 Bayreuth — [2]Hochschule Karlsruhe - Technik und Wirtschaft, D-72133 Karlsruhe

Glass beads in a sinusoidally driven annular conveyor show the effect of solid to fluid transition. For a small range of driving frequencies the width of the gas phase is accompanied by a hysteresis. We observe this hysteresis, which is also affected by air pressure, with different amounts and sizes of the grains in the diameter range of 0.3 mm to 1.2 mm. In addition, the influence of the electrostatic charging is investigated by changing the grains from glass beads to conductive silver-coated glass beads.